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ANDERSON SECONDARY SCHOOL
Preliminary Examination 2016
Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: / INDEX NUMBER:

PHYSICS **5059/01**

Paper 1 Multiple Choice **29 August 2016**

1 hour

1300 – 1400h

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid/tape.
Write your name, class and index number on the Answer Sheet in the spaces provided.

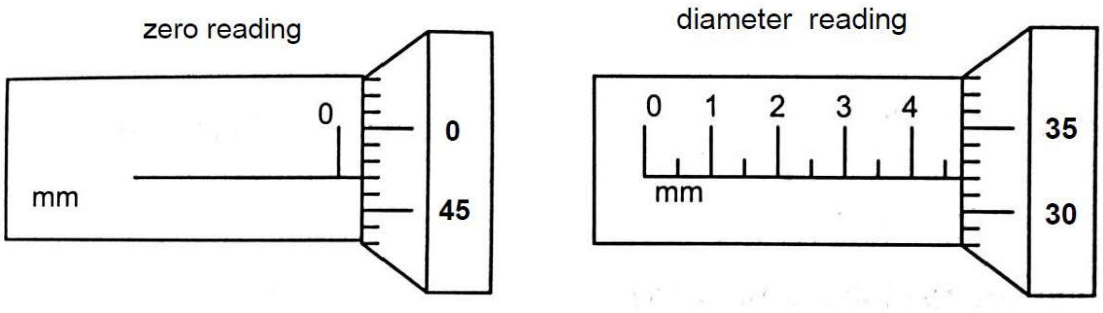
There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** or **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

1 The diameter of a steel ball is measured using a micrometer screw gauge. A student takes an initial zero error reading and then a reading of the diameter as shown.

Setter: Mr Ng Wei Da



What is the actual diameter of the steel ball?

A 4.35 mm **B** 4.75 mm **C** 4.85 mm **D** 5.29 mm

2 At t = 0 s, a stone is thrown vertically up into the air at 20 m/s.

Which of the following best describes the motion of the stone in the air at t = 2.0 s?

	speed / m/s	acceleration / m/s^2
A	10	0
B	10	10
C	0	0
D	0	10

3 A girl takes 90 s to walk 80 m towards the north. She then runs 60 m towards the east for 10 s.

What is her average speed and average velocity?

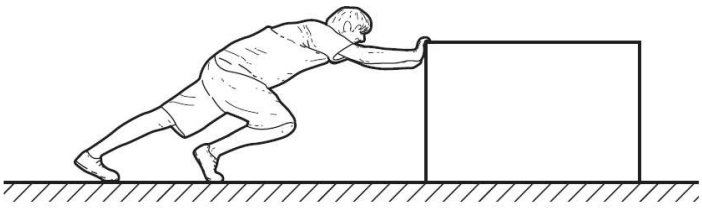
	average speed / m/s	average velocity / m/s
A	1.4	1.0
B	1.4	6.1
C	2.0	1.0
D	3.4	6.9

4 When a horizontal force of 5.0 N is applied to a wooden block of mass 3.0 kg on a horizontal surface, the block moves with a constant velocity.

If the force is increased to 12 N, what is the acceleration of the block?

A 1.7 m/s^2 **B** 2.3 m/s^2 **C** 4.0 m/s^2 **D** 5.7 m/s^2

5 A man pushes a heavy box along the ground.



A force acts between the man's hands and the box. Another force acts between the man's feet and the floor.

In which directions do these forces act on the man?

	force on man's hands	force on man's feet
A	towards the left	towards the left
B	towards the left	towards the right
C	towards the right	towards the left
D	towards the right	towards the right

6 The diagram below shows a wine bottle placed in a wooden holder. The bottle and the holder are in equilibrium.



Which of the following statements is true about the set-up?

A The centre of gravity of the bottle is directly above the base of the wooden holder.

B The centre of gravity of the bottle and that of the wooden holder are at the same point.

C The centre of gravity of the wooden holder is directly above the base of the wooden holder.

D The centre of gravity of the bottle and the wooden holder is directly above the base of the wooden holder.

7 200 cm^3 of liquid A with density 1.0 g/cm^3 is mixed with 300 cm^3 of liquid B with density 0.80 g/cm^3.

Assuming there is no change in total volume after mixing, what is the density of the mixture?

A 0.88 g/cm^3 **B** 0.90 g/cm^3 **C** 1.1 g/cm^3 **D** 1.8 g/cm^3

8 Two mercury barometers X and Y are placed next to each other in a room. The height of the mercury column in X is slightly lower than that in Y.

What is a possible reason for the difference in height?

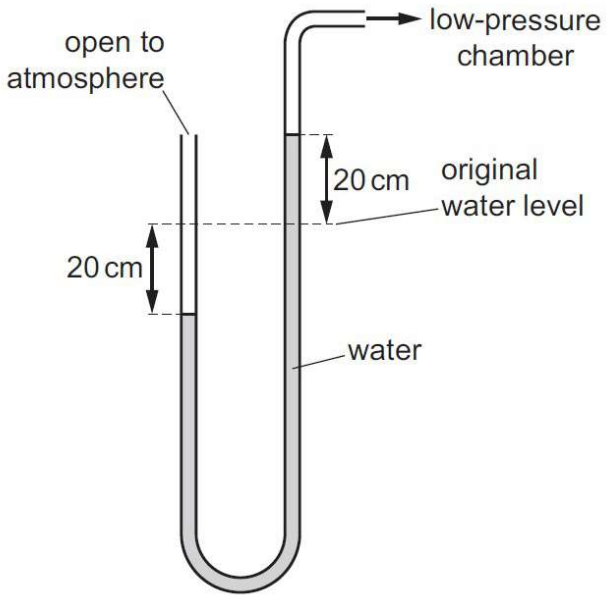
A The atmospheric pressure is different.

B There is air in the space above liquid X.

C The diameter of the tube of X is larger than of Y.

D Barometer X is slightly tilted while barometer Y is standing upright.

9 A U-tube containing water is used as a manometer. When one end of the manometer is connected to a low-pressure chamber, both water levels in the manometer change by 20 cm as shown.

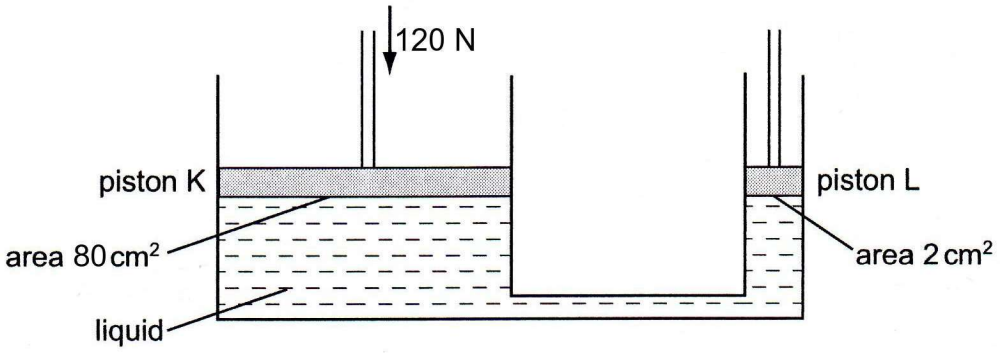


The density of water is 1000 kg/m^3.

How far below atmospheric pressure is the pressure in this chamber?

A 2000 Pa **B** 4000 Pa **C** 200 000 Pa **D** 400 000 Pa

10 The diagram below shows a hydraulic press.



A downward force of 120 N is exerted on piston K.

What is the force exerted on piston L?

A 0.75 N **B** 3.0 N **C** 120 N **D** 4800 N

11 A rocket of total mass M is travelling at a speed v. The engine of the rocket is fired and fuel is used up. The mass of the rocket decreases to $M/2$ and its speed increases to $2v$.

What happens to the kinetic energy of the rocket?

A The kinetic energy doubles.

B The kinetic energy halves.

C The kinetic energy increases by a factor of four.

D The kinetic energy remains the same.

12 A toy boat was propelled steadily from rest to reach a speed of 2.0 m/s in 10 seconds. During this time, there is an average water resistance of 3.0 N acting between the base of the boat and the water.

What is the rate of work done against water resistance?

A 3.0 W **B** 6.0 W **C** 30 W **D** 60 W

13 In a Brownian motion experiment involving smoke particles in air, large smoke particles settle quickly but very small smoke particles remain suspended for long periods of time.

Which of the following explains why small smoke particles do not settle quickly?

A The Earth's gravitational field does not act on small smoke particles.

B The small smoke particles have the same density as air.

C Random bombardments by air molecules keep the small smoke particles suspended.

D Air pressure has a greater effect on smaller particles.

14 Blowing across the surface of a bowl of hot soup will cause the soup to cool faster.

Which of the following statements is the correct explanation?

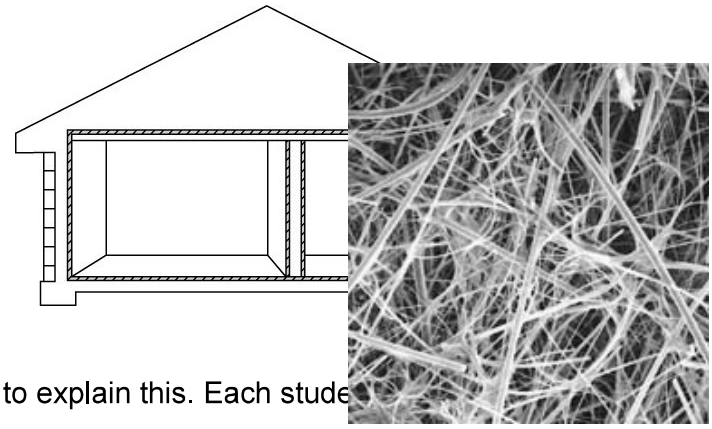
A Moving air is a better conductor of heat than still air.

B Convection currents cannot be set up without blowing.

C Blowing across the surface of the soup increases the rate of evaporation, hence more thermal energy will be lost from the soup.

D Blowing across the surface of the soup increases the surface area of the soup, hence more thermal energy will be lost through radiation.

15 Fibre-glass consists of a large amount of fine glass fibres. Fibre-glass coverings laid on the floor, walls and ceiling of a house can greatly reduce heat lost to the surroundings.



Three students attempt to explain this. Each stude

Student 1: Glass fibres have a low specific heat capacity.
Student 2: The glass fibres with trapped air are very poor conductors of heat.
Student 3: Fibre-glass coverings are good absorbers of infra-red radiation.

Which of the students is/are correct?

A 1 only **B** 2 only **C** 1 and 2 only **D** 2 and 3 only

16 A thermometer uses an electrical resistance of a piece of metal that varies with temperature. It is calibrated from resistance value of 20 Ω to 2000 Ω.

When the resistance is at 20 Ω, the temperature shows -10 °C. For resistance of 450 Ω, it shows 60 °C.

What is the highest temperature at which the thermometer can measure?

A 200 °C **B** 230 °C **C** 310 °C **D** 330 °C

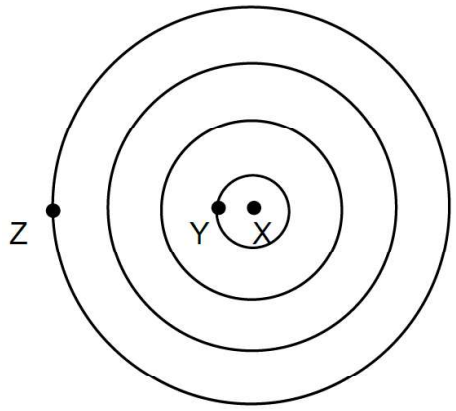
17 An ice machine removes heat at a rate of 3000 W.

The specific heat capacity of water is 4.2×10^3 J / kg °C and the specific latent heat of fusion of ice is 3.4×10^5 J / kg.

What is the time needed to freeze 2.5 kg of water at 30 °C?

A 280 s **B** 300 s **C** 390 s **D** 8600 s

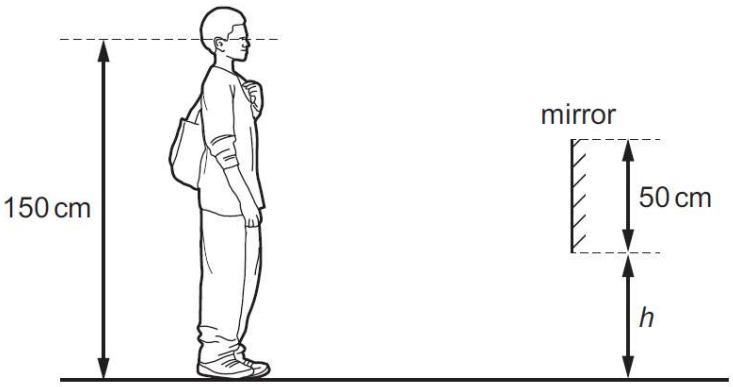
18 A spherical dipper of frequency 15 Hz is placed at X, and circular wavefronts radiate from X to Z as shown.



Give that the distance between Y and Z is 1.2 m, what is the speed of the wave?

A 4.5 m/s **B** 6.0 m/s **C** 13 m/s **D** 18 m/s

19 A shoe shop puts a mirror on the wall so that customers can look at their shoes.

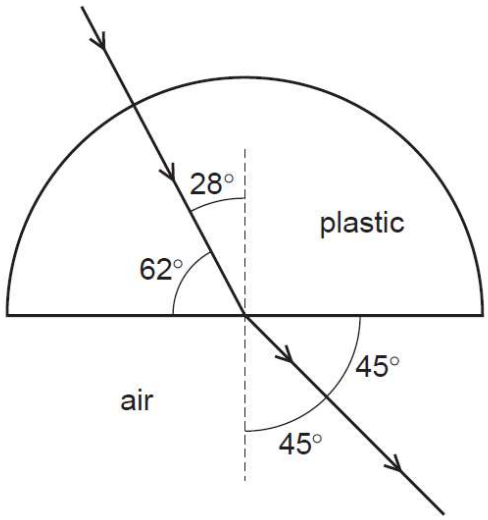


The length of the mirror is 50 cm. A customer has eyes 150 cm above ground level. The bottom of the mirror is at height *h* above the ground.

What is the smallest value of *h* that allows the customer to see an image of his shoes in the mirror?

A 10 cm **B** 25 cm **C** 50 cm **D** 75 cm

20 A semi-circular block is made from a plastic. A ray of light passes through it at the angles shown.



What is the refractive index of the plastic?

A 0.70 **B** 1.3 **C** 1.4 **D** 1.6

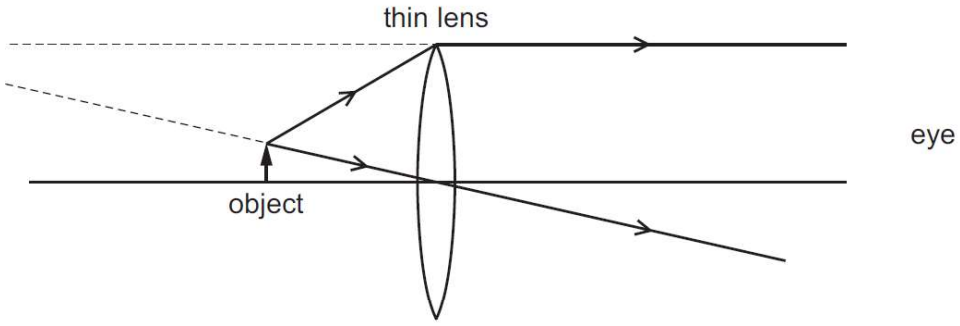
21 An X-ray travels from vacuum into a medium of refractive index 2.1.

What is the speed of the X-ray in the medium?

A 0.7×10^8 m/s **B** 1.4×10^8 m/s **C** 3.0×10^8 m/s **D** 6.3×10^8 m/s

22 An object is viewed through a converging lens.

The diagram shows the paths of two rays from the top of the object to an eye.



How does the image compare with the object?

A It is larger and inverted.

B It is larger and upright.

C It is smaller and inverted.

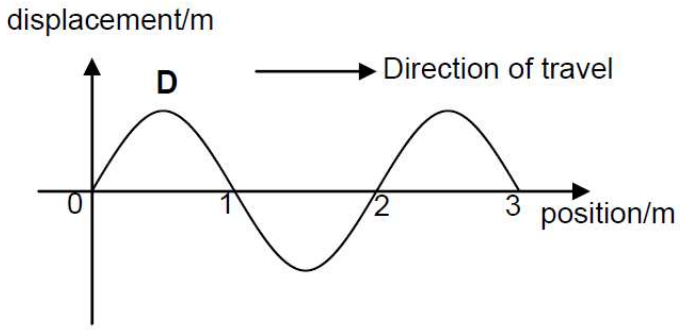
D It is smaller and upright.

23 When an object is placed 50 cm from a convex lens, a real image of the same size as the object is formed. The object is then moved 15 cm towards the lens.

Which of the following correctly describes the new image formed?

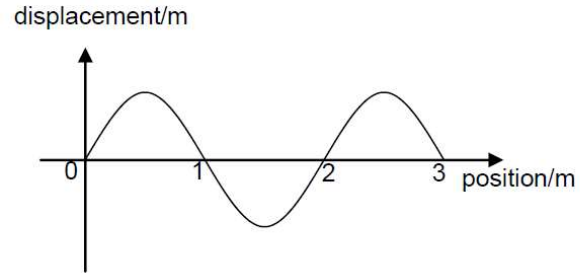
	image	image distance
A	diminished	less than 50 cm from the lens
B	magnified	less than 50 cm from the lens
C	diminished	more than 50 cm from the lens
D	magnified	more than 50 cm from the lens

24 The diagram shows the displacement-position graph of a transverse wave at t = 0 s as it travels from left to right. The wave has a period *T*.

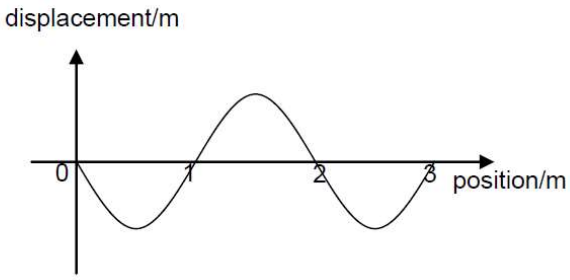


Which of the following graphs correctly shows how the transverse wave would look like at t = 0.25*T*?

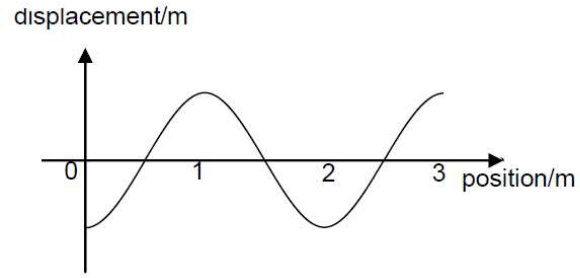
A



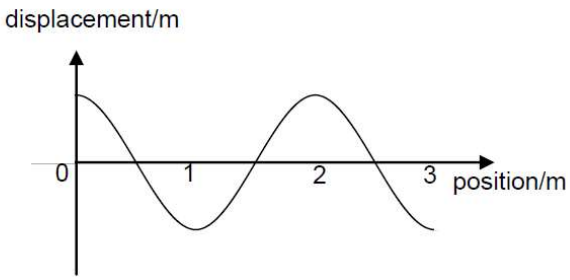
C



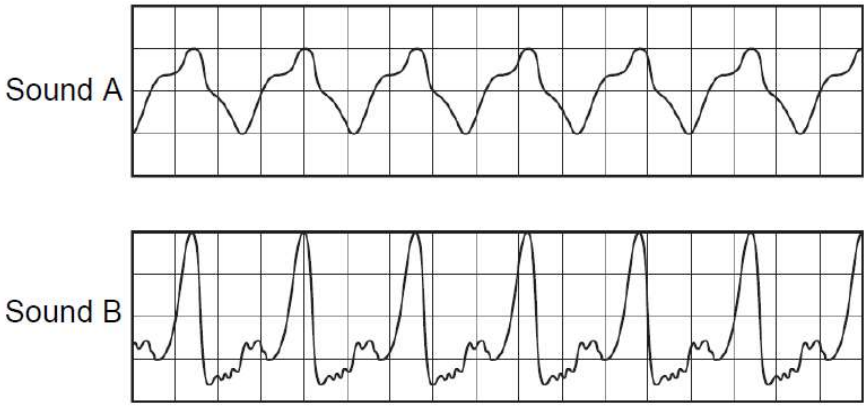
B



D



25 The sounds produced by two musical instruments are directed towards a microphone connected to a cathode ray oscilloscope (c.r.o.). The waveforms produced on the screen are shown. For both waveforms, the settings of the c.r.o. remain the same.



Which statement about the two sounds is correct?

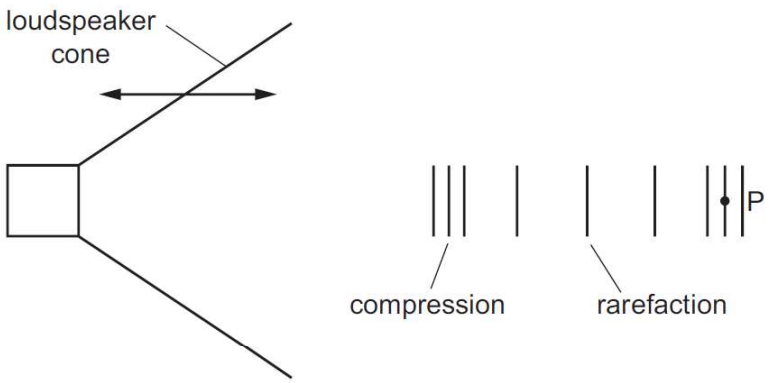
A Sound A travels slower than sound B.

B Sound B has a lower pitch than sound A.

C Sound B is louder than sound A.

D Sound B has a higher pitch and greater loudness than sound A.

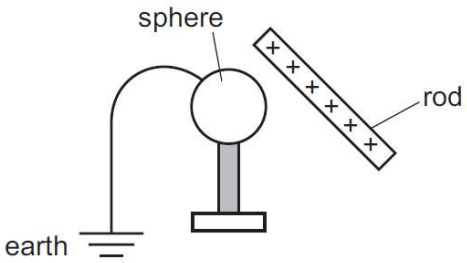
26 Compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forwards. The frequency of vibration is 50 Hz.



A compression is at point P. How much time elapses before the next rarefaction arrives at P?

A 0.010 s **B** 0.020 s **C** 25 s **D** 50 s

27 A positively charged rod is held close to an earthed metal sphere.



Which of the following describes the charge on the metal sphere?

A It is negative because electrons are attracted towards the rod.

B It is neutral because electrons are attracted towards the rod and protons are repelled.

C It is neutral because it is earthed.

D It is positive because protons are repelled by the rod.

28 Which of the following is equivalent to one coulomb?

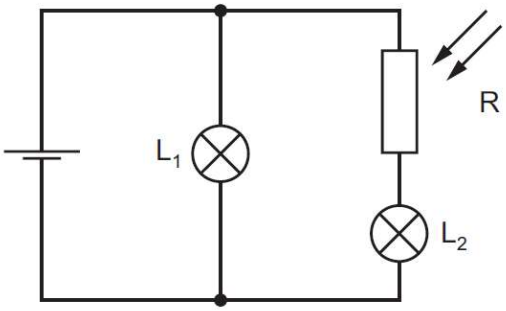
A one ampere per volt

B one ampere second

C one volt ampere

D one volt per ampere

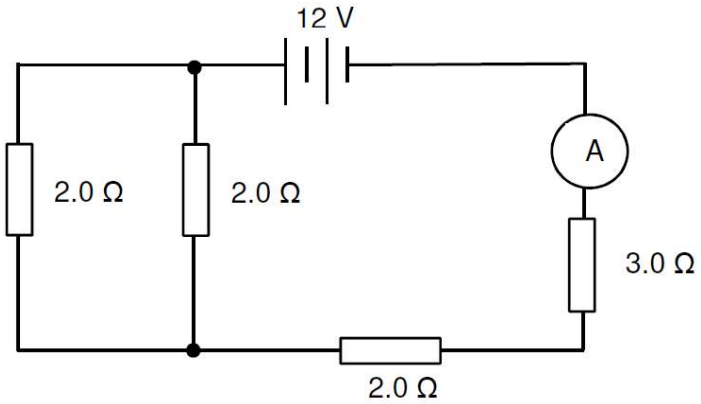
29 In the circuit shown, R is a light-dependent resistor.



The light intensity on R increases. What happens to the brightness of the two lamps L_1 and L_2?

	L_1	L_2
A	decreases	decreases
B	decreases	increases
C	stays the same	decreases
D	stays the same	increases

30 A circuit is set up in the diagram below.



What is the ammeter reading in the circuit?

A 0.50 A **B** 0.67 A **C** 1.5 A **D** 2.0 A

31 The diagram shows the label on an electric iron.

ELECTRIC IRON	
Operating Voltage	240 V
Power	2.8 kW
Fuse Rating	13 A

This iron is used for 12 hours every month.

The cost of 1 kWh of electrical energy is 25 cents.

Which of these statements is true about the electric iron?

A The fuse will blow because the fuse rating is too low.

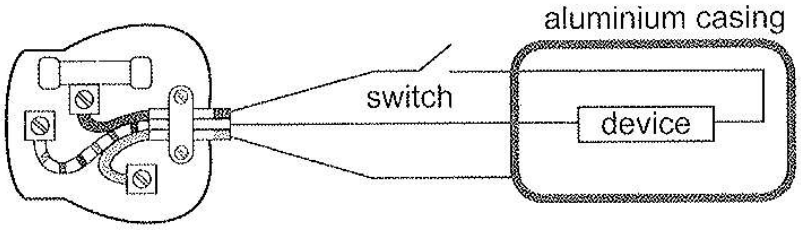
B The energy dissipated in the iron every month is 120 kJ.

C The iron is 90% efficient.

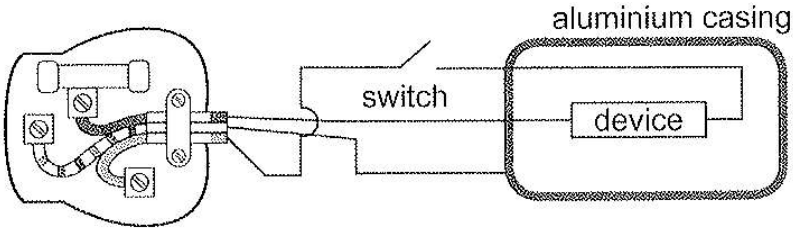
D It costs $8.40 every month to use the iron.

32 Which one of the following electrical appliances is correctly wired to a three-pin plug?

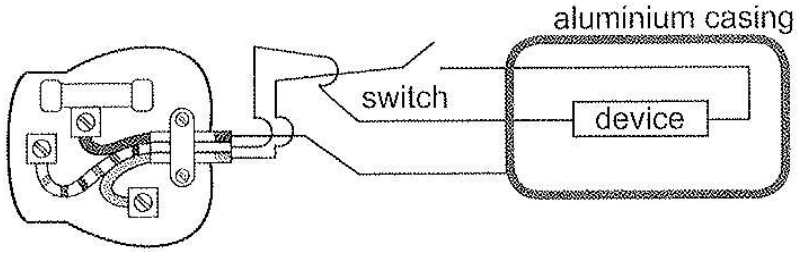
A



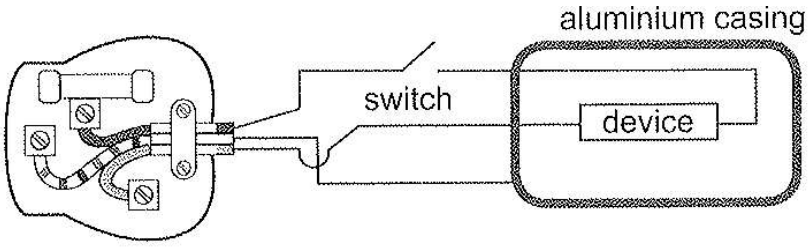
B



C



D



33 The bulb in a lamp is rated 2 V, 1 W, while the bulb in an oven is rated 220 V, 10 W.

What will happen when both the lamp and oven are connected in series across a 220 V operating supply?

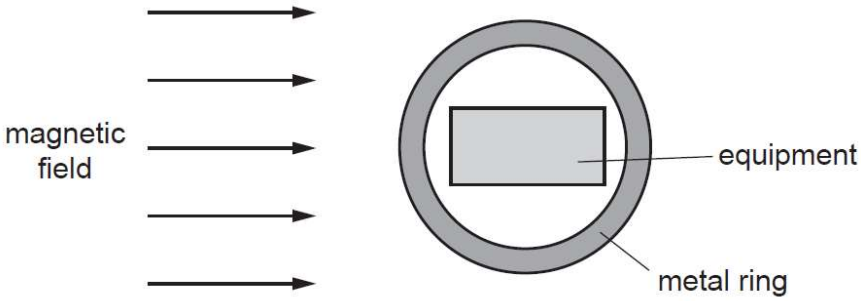
A The bulb in the lamp will blow immediately, and no current will flow in the circuit.

B The bulb in the lamp will appear to operate normally, while the bulb in the oven will emit a weak light.

C The bulb in the lamp will emit very little light, while the bulb in the oven will appear to operate normally.

D Both bulbs will operate at normal brightness.

34 A metal ring screens a piece of equipment from a magnetic field.

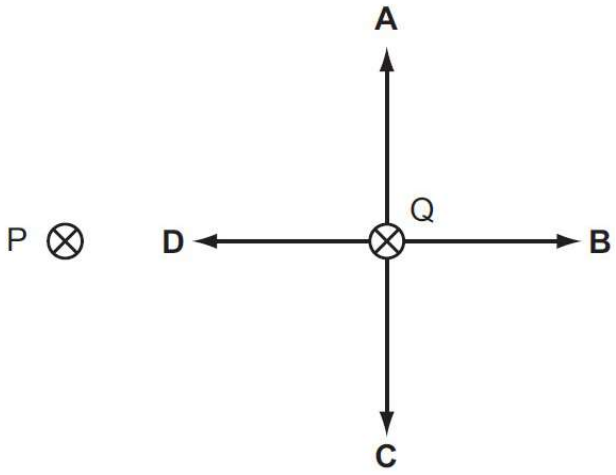


Which metal should be used for the ring, and why?

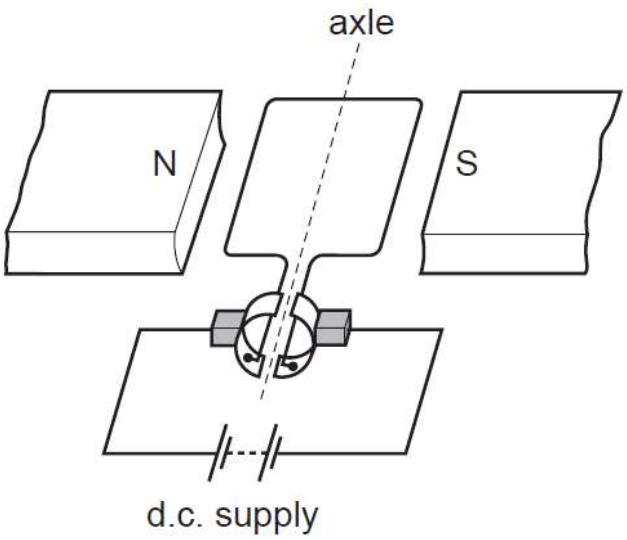
	metal	explanation
A	copper	the metal carries the field lines around the equipment
B	copper	the metal is non-magnetic
C	iron	the metal carries the field lines around the equipment
D	iron	the metal is non-magnetic

35 P and Q represent two, parallel, straight wires carrying currents into the plane of the paper. P and Q exert a force on each other.

Which arrow shows the force on Q?



36 The diagram below shows a simple d.c. motor.

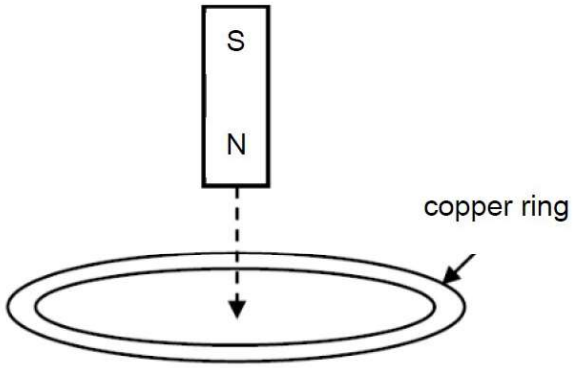


When the switch is closed, which of the following statements is/are correct?

I A current will flow round the coil in the direction **WXYZ**.
II The coil will rotate in a clockwise direction about the axle.
III The split-ring commutator will reverse the direction of the current every 360°.

A I only **B** I and II only **C** I and III only **D** I, II and III

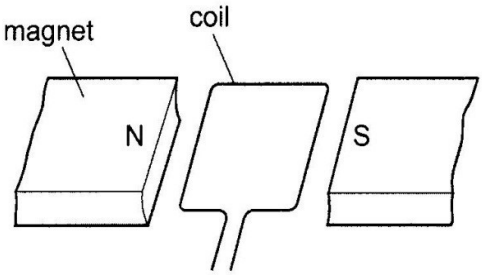
37 A magnet is dropped vertically through a copper ring.



Which of the following statements is **incorrect**?

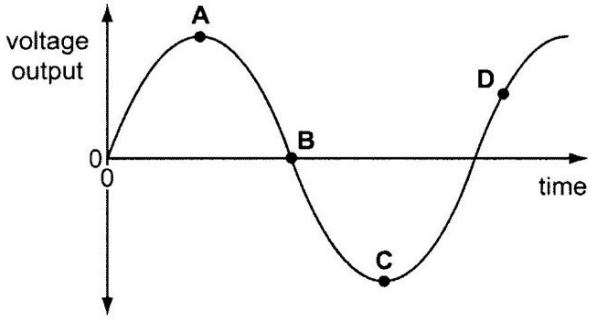
A A current flows in the ring just before the magnet passes through the ring.
B A current flows in the ring just after the magnet passes through the ring.
C The magnet slows down just before it passes through the ring.
D The magnet accelerates just after it passes through the ring.

38 The diagram shows part of an a.c. generator when its coil is in a horizontal position.

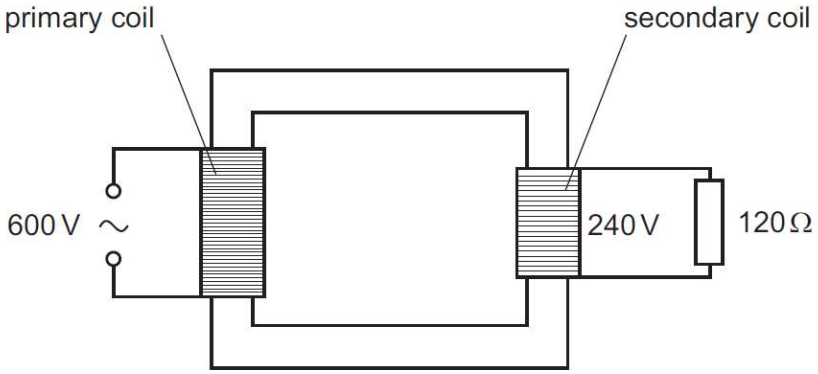


The graph below shows the voltage output plotted against time.

Which point on the graph shows the coil in a vertical position?



39 An ideal transformer has a primary voltage of 600 V and a secondary voltage of 240 V. The secondary coil is attached to a resistor of resistance 120 Ω.



What is the power dissipated in the resistor and the current in the primary coil?

	power / W	current / A
A	120	0.20
B	120	5.0
C	480	0.80

D	480	1.3

40 An oscilloscope is used to display the waveforms of 2 alternating current (a.c.) input.

Diagram 1 shows the oscilloscope trace produced by the first input of voltage 2.0 V and frequency 50 Hz.

Diagram 2 shows the trace produced by the second input. The controls on the oscilloscope are set at the same values.

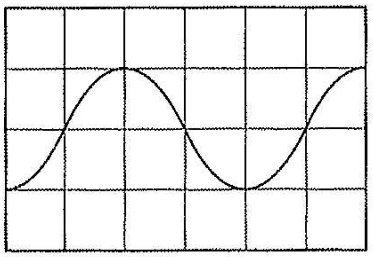


Diagram 1

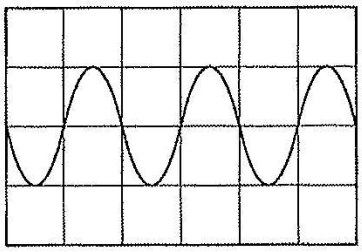


Diagram 2

What is the voltage and frequency of the second input?

	voltage / V	frequency / Hz
A	1.0	50
B	2.0	25
C	2.0	100
D	4.0	50

END OF PAPER

O

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2016
Secondary Four Express & Five Normal

CANDIDATE NAME:

CLASS: / INDEX NUMBER:

PHYSICS **5059/02**

Paper 2 Theory

29 August 2016

1 hour 45 minutes

1045 – 1230h

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Section A	
Section B	
Total	

Section A

Answer **all** the questions in this section.
This document consists of **18** printed pages.

Setter: Mr Ng Wei Da

1 Fig. 1.1 shows a student doing a push-up. A total force *F* acts upwards on his hands. There is also a force *R* upwards on his toes.

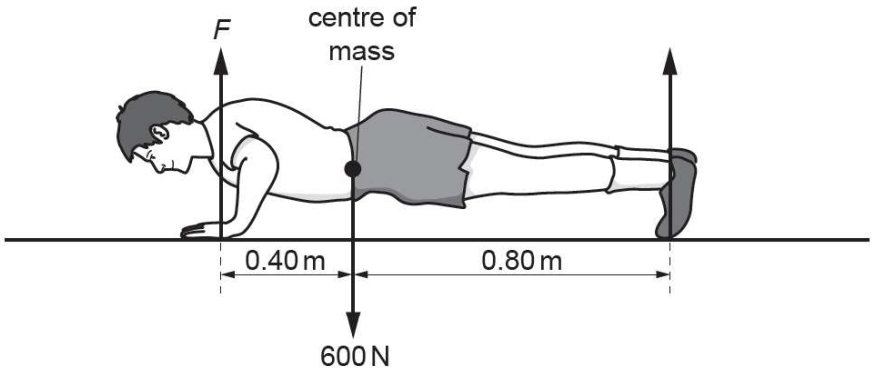


Fig. 1.1

The weight of the student is 600 N and this force acts downwards from his centre of gravity.

(a) **(i)** Describe how the student does work as his body rises from the ground.

_____

_____ [1]

(ii) State the form of energy that the student uses to do this work.

_____ [1]

(b) At the position shown in Fig. 1.1, the student is stationary. The weight of the student causes a moment about his toes.

(i) Calculate the moment of the weight of the student about his toes.

moment = _____ [1]

(ii) Calculate the value of the forces *F* and *R*.

F = _____

R = _____ [2]

(c) Describe the other force that forms a Newton's Third Law action-reaction pair with *F*, and state the body on which it acts.

[2]

2 In Fig. 2.1, a balloon is filled with air and is attached to a puck. Air is continuously released from the balloon through a hole at the bottom of the puck. The puck is given an initial push. It then moves on a horizontal table along a straight path formed by a pair of tracks.

Fig. 2.2 shows the speed-time graph of the puck.

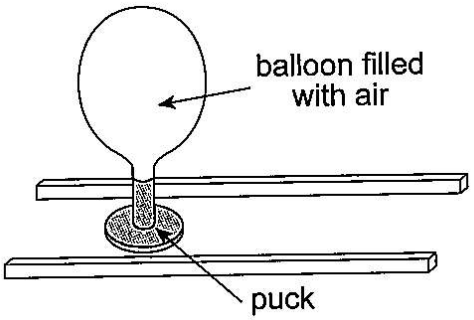


Fig. 2.1

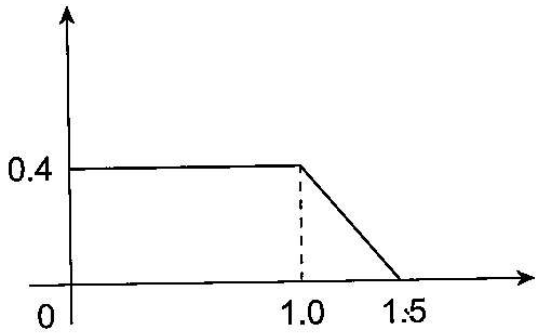


Fig. 2.2

(a) **(i)** Describe the motion of the puck from $t = 0$ to $t = 1.5$ s.

[2]

(ii) Explain the change in motion of the puck at $t = 1.0$ s.

[2]

(b) The experiment is repeated with less air in the balloon. The initial speed of the balloon remains at 0.4 m/s.

On Fig. 2.2, sketch the new speed-time graph of the puck. [1]

3 An experiment is carried out to find how the pressure of a fixed mass of air at room temperature varies with volume. Fig. 3.1 shows the apparatus used.

The syringe is sealed at one end and the piston is free to move up and down as different metal weights are used. The piston has a cross-sectional area of 30 cm^2.

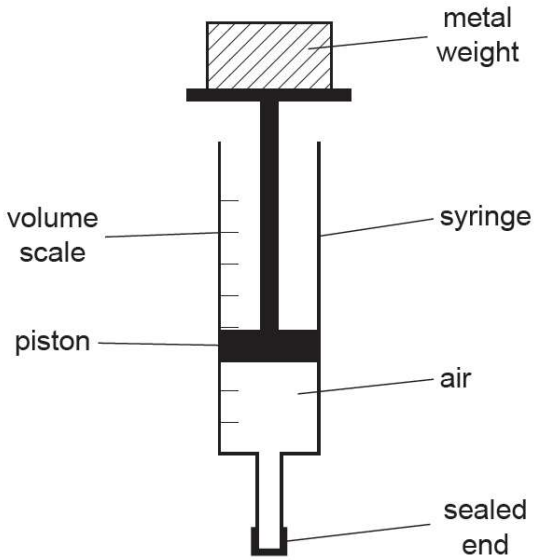


Fig. 3.1

(a) The metal weight in Fig. 3.1 has a mass of 400 g.
Calculate the pressure, in Pa, exerted on the air due to this metal weight.

pressure exerted = _____ [2]

(b) More metal weights are placed on top of the syringe.

Describe how the air molecules inside the syringe are able to support the additional metal weights.

_____

_____

_____

_____

_____ [3]

(c) Fig. 3.2 shows the axes for a graph of pressure against volume for the air in the syringe. One point is plotted on the graph at pressure of P_0 and volume V_0. The temperature of the air is kept constant.

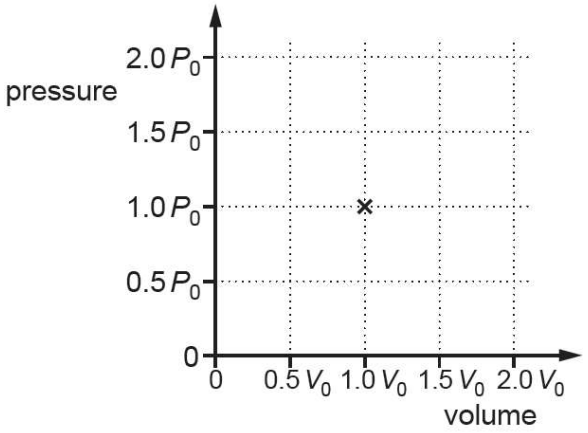


Fig. 3.2

By plotting appropriate points at volumes of 0.5 V_0 and 2.0 V_0, complete the graph on Fig. 3.2. [2]

4 Ultrasound is used in quality control to detect cracks in metal. Pulses of ultrasound are sent into the metal from a transmitter placed on the front surface of the metal. A detector placed next to the transmitter picks up the pulses reflected from the back surface of the metal.

Fig. 4.1 shows the oscilloscope trace of the ultrasound pulses produced for a piece of metal that contains no cracks. One division along the x-axis represents 1.0×10^{-6} s.

Pulses labelled **S** are the ones sent out from the transmitter. Each pulse labelled **R** is the reflection of **S** from the back surface of the metal.

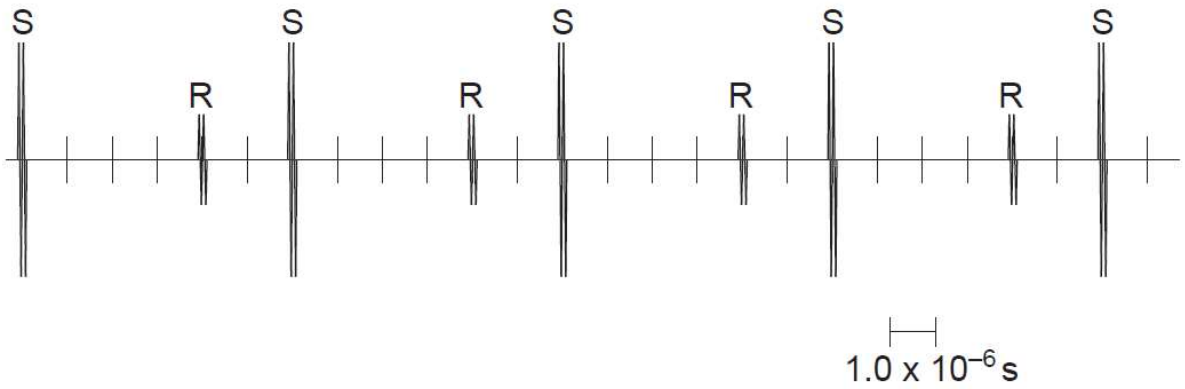


Fig. 4.1

(a) State what is meant by *ultrasound*.

[1]

(b) Suggest one reason why the amplitude of **R** is less than the amplitude of **S**.

[1]

(c) Use Fig. 4.1 to calculate the number of pulses sent out by the source in one second.

number of pulses = _____ [1]

(d) The speed of ultrasound in the piece of metal in Fig. 4.1 is 5000 m/s.
Calculate the thickness of the piece of metal.

thickness = _____ [2]

(e) A while later, the piece of metal is tested again. It now has a small crack half-way between the front surface and the back surface.

On Fig. 4.1, draw the position of the pulses produced by this crack. Label each of these pulses **C**. [1]

5 In a company that manufactures frying pans, a researcher wishes to select a new material that can be used for the base of the pan. Fig. 5.1 shows 4 possible materials and their

properties.

Material	Melting point / °C	Specific heat capacity / J kg^{-1} °C^{-1}	Colour
A	2350	900	silver
B	950	480	silver
C	1600	480	black
D	7800	130	black

Fig. 5.1

(a) **(i)** Material A has a specific heat capacity of 900 J kg^{-1} °C^{-1}. State what is meant by this statement.

[1]

(ii) The researcher carries out a series of experiments on the materials.

In one of the experiments, 2.0 kg of a sample of material A is heated by an electrical heater of power 450 W. The initial temperature of the sample is 25 °C.

Calculate the time taken for the temperature of the sample to rise to 100 °C.

time taken = [2]

(b) Based on the data in Fig. 5.1, discuss which material is the most suitable to be used for the base of the frying pan. Give reasons to support your choice.

[3]

6 Fig. 6.1 shows how fuel is pumped through a pipe from a tanker to an aeroplane at an

airport.

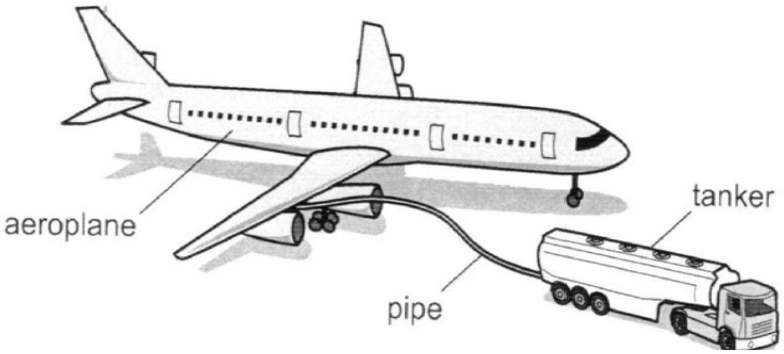


Fig. 6.1

As the fuel rubs against the pipe, it becomes negatively charged and this in turn charges the aeroplane.

(a) Explain, in terms of charges, how the fuel becomes negatively charged.

_____

_____

_____ [2]

(b) **(i)** The aeroplane gains 2.4 nC of charge in 5.0 s.

Calculate the average current during this time.

average current = _____ [1]

(ii) Describe a hazard that can arise when the aeroplane becomes charged.

_____

_____ [1]

(iii) Suggest and explain how the aeroplane can be prevented from being charged.

_____

_____

_____ [2]

7 Fig. 7.1 shows a workman using a cordless electric drill.

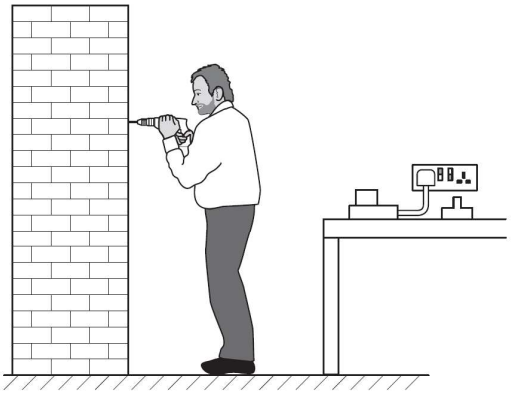


Fig. 7.1

The motor of the drill is powered by a rechargeable battery with an electromotive force (e.m.f.) of 18 V. When the drill is used, the current supplied to the motor is 25 A.

(a) **(i)** Explain what is meant by an *e.m.f. of 18 V*.

[1]

(ii) Calculate the power supplied to the motor.

power = [1]

(b) After 90 minutes of use, the battery is flat. It is connected to a charger and is recharged.
The charger includes a transformer that produces a 23 V alternating current (a.c.) output from a 230 V a.c. mains supply.

(i) Draw a labelled diagram to show the structure of the transformer used in the charger.

[2]

(ii) State how the transformer ensures that the a.c. output has a value of 23 V when the input is the 230 V a.c. mains supply.

[1]

(iii) State and explain **one** advantage of using an alternating current for long-

distance transmission of electrical power.

[2]

8 Fig. 8.1 shows a wind-up torch which does not contain batteries.

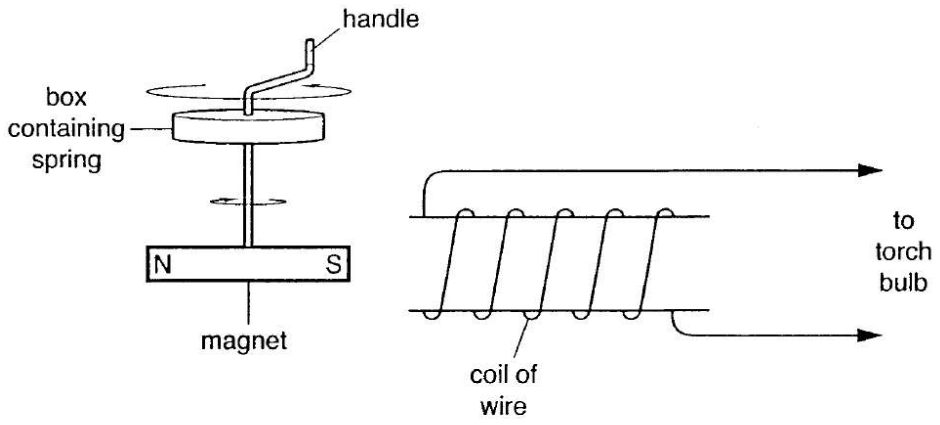


Fig. 8.1

To use the torch, the handle is first rotated to wind a spiral spring in a box. When the switch of the torch is turned on, the spring unwinds and a current is produced in the coil.

(a) Explain why there is a current in the coil.

[2]

(b) As the spring unwinds, the force in the spring decreases. Explain the effect on the intensity of the light produced.

[2]

(c) Suggest **two** modifications to the design of the torch in order to produce a larger current.

[2]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

9 **(a)** An application of total internal reflection is the cutting of diamond to achieve a brilliant sparkle. A well-cut diamond has facets that reflect light instead of allowing light to refract out from its bottom.

Fig. 9.1a, 9.1b and 9.1c are **scaled diagrams** showing three diamonds in which light that is incident at the top of the diamond refracts out from the bottom of the diamond.

(i) Define *critical angle*.

_____

_____ [1]

(ii) Using information from Fig. 9.1a to 9.1c, determine the critical angle of diamond. Hence, calculate the refractive index of diamond.

critical angle = _____ [1]

refractive index = _____ [1]

(iii) State and explain which diamond in Fig. 9.1 produces the brightest sparkle.

_____

_____

_____ [2]

(b) Another application of total internal reflection is the use of optical fibres to transmit information over long distances.

A typical optical fibre comprises of a core encased in a cladding material as shown in Fig. 9.2.

Fig. 9.2

Light rays are transmitted along the core. Rays incident on the core-cladding boundary at angles greater than the critical angle of core-cladding boundary will be reflected. The critical angle of this boundary can be determined using the formula

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

where
n_1 = refractive index of core;
n_2 = refractive index of cladding;

θ_1 = angle of incidence in core; and
θ_2 = angle of refraction in cladding.

In a particular optical fibre, materials with refractive indices of 1.2 and 1.5 are used.

(i) Explain which material, **X** or **Y**, has a refractive index of 1.5.

_____

_____

_____ [2]

(ii) Calculate the critical angle of the core-cladding boundary.

critical angle = _____ [2]

(iii) The critical angle of the core-air boundary is 41°, lower than the critical angle of core-cladding boundary. Although the higher critical angle of the core-cladding boundary decreases the likelihood of total internal reflection, a cladded optic fibre is still preferred to one that is not cladded.

Suggest a reason why this is so.

_____

_____ [1]

10 Fig. 10.1 shows the properties of 3 rods, **X**, **Y** and **Z**, which are made of different materials. These rods have an identical length of 0.40 m and a diameter of 1.0 cm.

Rod	Material	Density (kg/m^3)	Resistivity (Ω m)
X	copper	8960	1.7×10^{-8}
Y	lead	11 340	2.2×10^{-7}
Z	plastic	1200	1.6×10^{16}

Fig. 10.1

(a) Calculate the resistance of the copper rod.

resistance = _____ [2]

(b) An experiment is carried out for each of these rods.
Fig. 10.2 shows the setup of the experiment where the copper rod **X** is used. **X** hangs from a spring balance and is connected to a circuit containing a battery supply.

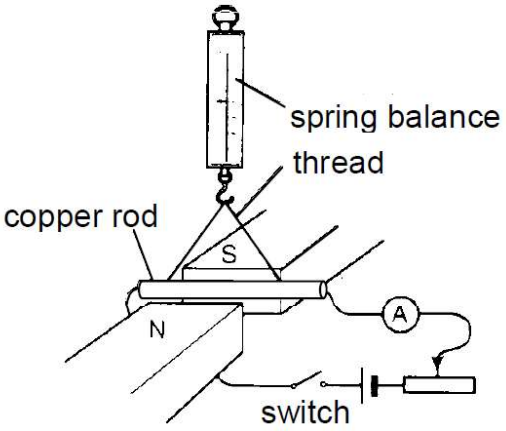


Fig. 10.2

The initial spring balance reading is recorded as N_1. The switch is then closed, and the new reading is recorded as N_2. The ammeter reading is recorded as I.

(i) Compare the value of N_1 and N_2 in Fig. 10.2. Explain your answer.

[2]

(ii) Rod **X** is replaced with **Y** and **Z**, and the experiment is repeated in each case.

For each of the following cases, identify the rod (**X**, **Y** or **Z**) that produces the observation and explain your answer.

1. Largest value of N_1 recorded,

[2]

2. No change in value of N_1 and N_2,

[2]

3. Largest ammeter reading I.

[2]

11 EITHER

Fig. 11.1a shows a relay connected to a cell and a switch.

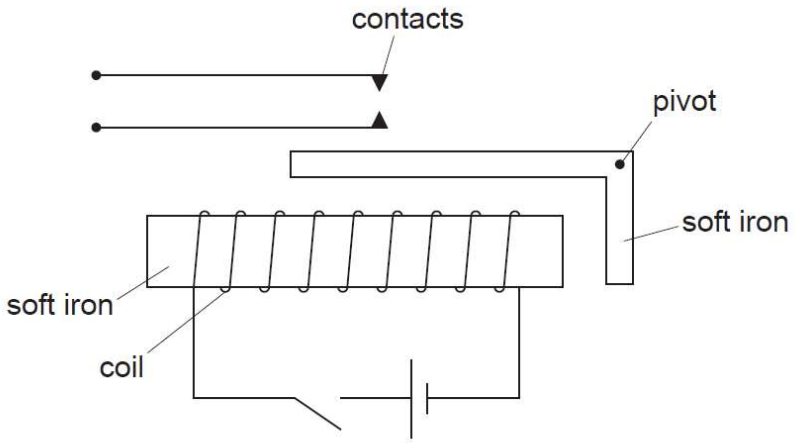


Fig. 11.1a

(a) When the switch is closed, the iron core is magnetised.

(i) Explain how this causes the contacts to close.

[2]

(ii) On Fig. 11.1a, mark

1. the S-pole of the iron core,

2. the N-pole and the S-pole of the iron armature. [2]

(b) Fig. 11.1b shows the relay connected in a circuit to a 12 V battery and a thermistor. The bell is initially not ringing.

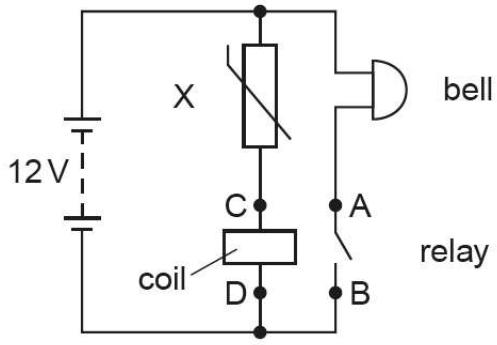


Fig. 11.1b

(i) Explain why the bell rings when the temperature of the thermistor rises.

_____

_____

_____

_____ [2]

(ii) When the resistance of the thermistor is 2000 Ω, the current in the coil is 1.5 mA. This causes the contacts in the relay to close.
The resistance of the bell is 200 Ω.

Calculate

1. the current passing through the bell,

current = _____ [1]

2. the potential difference (p.d.) across the coil.

p.d. across coil = _____ [2]

(iii) Suggest an advantage of using a relay in this circuit.

_____

_____ [1]

11 OR

Fig. 11.2a shows part of the mains electrical circuit in a house. The mains supply is 240 V.

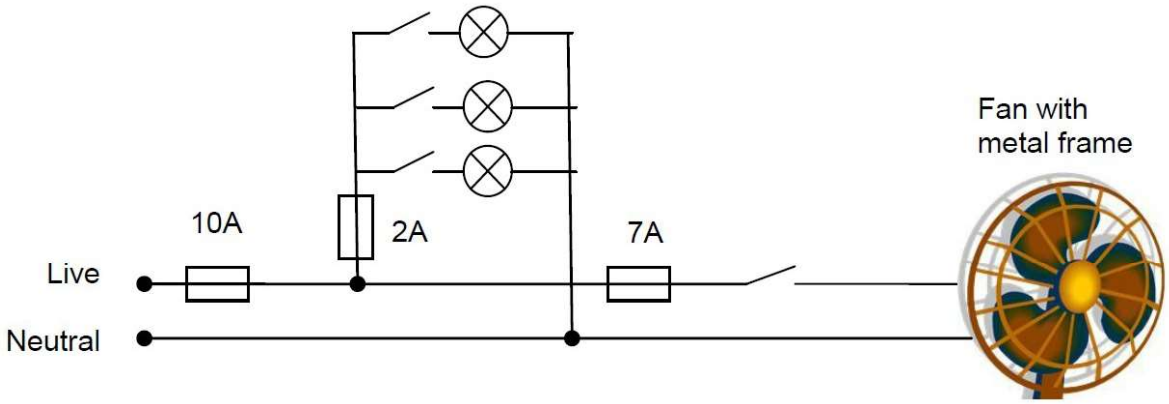


Fig. 11.2a

Three identical lamps are connected to the live wire through a fuse labelled **X**.

An electrical fan is connected to the live wire through a 7 A fuse.

There is a 10 A fuse to protect the whole circuit.

(a) Explain what is meant by

(i) *live wire*,

_____

_____ [1]

(ii) *neutral wire*.

[1]

(b) Each of the lamps is rated 100 W, 240 V.

(i) Calculate the amount of current drawn by each lamp.

current drawn = [1]

(ii) Suggest a suitable fuse rating for **X**. Support your answer with appropriate calculations.

fuse rating = [2]

(c) The electrical fan is not connected to an earth wire. Explain how this will affect the safety of the user.

[2]

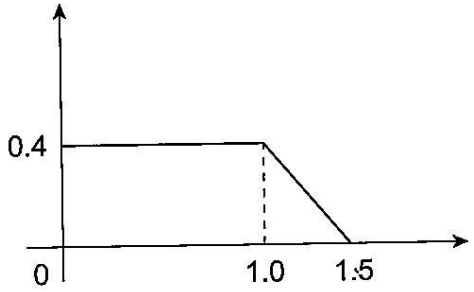
(d) If the live wire touches the neutral wire inside the fan, state and explain what will happen to the fan, the lamps and the fuses.

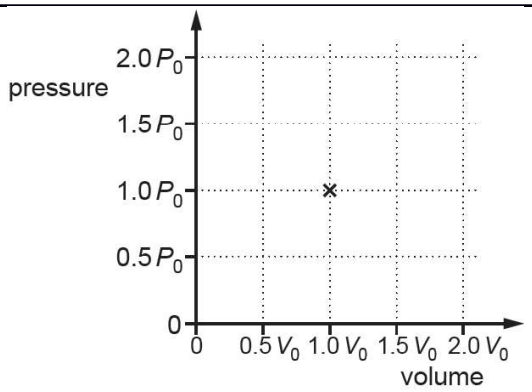
[3]

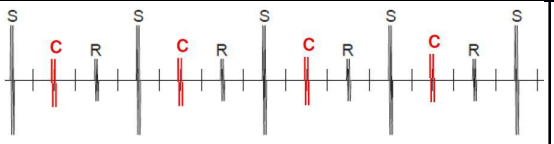
END OF PAPER

Anderson Secondary School
2016 Secondary 4 Express Preliminary Examination
Physics (5059/2) Mark Scheme

*Overall 1 mark penalty each for missing unit and sig fig **unless otherwise stated**.*

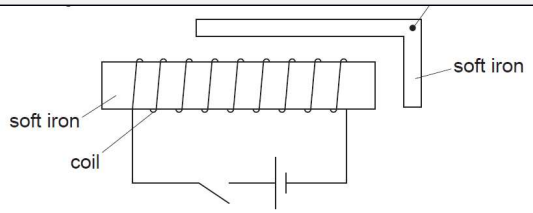
Question	Solution	Marks	Remarks
1 (a) (i)	When he pushes the floor, his body rises and moves through a distance in the same direction as the force, hence work is done.	[1]	
(ii)	Chemical (potential) energy	[1]	
1 (b) (i)	Moment = F x d = 600 x 0.80 = 480 Nm	[1]	**No credit for wrong/ missing unit.**
(ii)	By Principle of Moments, F x 1.2 = 480 F = 400 N ∑ upward forces = ∑ downward forces F + R = 600 R = 200 N	[1] [1]	Alternatively, Principle of Moments can be used to solve for R. Max [1] ecf if F is wrongly calculated.
1 (c)	The other force that forms an action-reaction pair with *F* is the force exerted by the boy on the floor. It has an equal magnitude but acting in the opposite direction to *F*.	[1] [1]	
2 (a) (i)	From t = 0 to 1.0 s, the puck moves at a constant speed of 0.4 m/s. From t = 1.0 to 1.5s, it moves with a constant deceleration / speed decreases constantly (uniformly / linearly) until it comes to rest.	[1] [1]	
(ii)	After t = 1.0 s, no more air can be released from the balloon, so the puck will come into contact with the table. It will experience friction which opposes the motion of the puck, hence the puck begins to decelerate.	[1] [1]	
2 (b)	Deceleration begins before 1.0 s Same value of deceleration  	[1]	

Question	Solution	Marks	Remarks
3 (a)	Pressure = F / A = (0.4 x 10) / (30 x 10^{-4}) = 1300 Pa	 [1] [1]	**Deduct [1] if pressure is not in Pa.**
3 (b)	When more metal weights are placed on top of the syringe, the piston is pushed downwards, and the air molecules will occupy a smaller volume / the number of air molecules per unit volume increases. This results in a higher frequency of collision by the air molecules on the inner walls of the piston, and a larger pressure is exerted. Since force = pressure x area, the force exerted by the air molecules increases, and this will balance the additional weights added.	[1] [1] [1]	Do not accept 'collide with more force'; *increase in frequency of collision* and *inner wall* must be mentioned. Accept alternative: pressure increases to be equal to the pressure exerted by the additional weights
3 (c)	 Correct points at 0.5 V_0 and 2.0 V_0 Smooth, decreasing curve through points	[1] [1]	
4 (a)	Ultrasound is sound that has a frequency of above 20 kHz / above human audible frequency range.	[1]	
4 (b)	Not all sound is reflected from back surface as some passes through the back surface. / Some energy/sound is absorbed by the metal. / Sound/energy spreads out/scattered/reflected in other directions. (any one)	[1]	Do not accept 'sound energy is lost' without any elaboration.
4 (c)	No of pulses = 1/ (6.0 x 10^{-6}) = 1.7 x 10^5	 [1]	
4 (d)	Thickness = ½ x v x t = ½ x 5000 x (4.0 x 10^{-6}) = 0.010 m	 [1] [1]	Max [1] awarded if factor of '1/2' is missing.

Question	Solution	Marks	Remarks
4 (e)		[1]	All four 'C' must be drawn and labelled.
5 (a) (i)	900 J of (thermal) energy is required to raise the temperature of 1 kg of material A by 1 °C.	[1]	
(ii)	Q = mcΔθ = 2.0 x 900 x (100 – 25) = 1.35 x 10^5 J Time taken = Energy / power = 1.35 x 10^5 / 450 = 300 s	[1] [1]	
5 (b)	Material D is the most suitable. (***Any two of the following***) • D has the highest melting point of 7800 °C which ensures that it remains a solid upon heating. • It has the lowest specific heat capacity of 130 J kg^{-1} $°C^{-1}$ and hence, it heats up the fastest / requires the least energy to heat up. • It is a good absorber of heat due to its black appearance.	[1] [2]	No credit awarded if: - material is chosen without any explanation; - candidate quotes data from the table without discussing the relevance of the data. **Deduct [1] if candidate did not quote any value in the explanation.**
6 (a)	When the fuel rubs against the pipe, friction causes electrons to move/ transfer from the pipe to the fuel. The fuel gains electrons and becomes negatively charged.	[1] [1]	
6 (b) (i)	Current = Q / t = 2.4 x 10^{-9} / 5.0 = 4.8 x 10^{-10} A	[1]	
(ii)	Discharge/Sparks in air may occur which can ignite the fuel (vapour) and cause a fire/explosion. / Workers may get an electric shock when they come into contact with the plane. (any one)	[1]	
(iii)	A metal cable can be connected from the aeroplane to the ground. Charges accumulated on the plane can flow along the cable to earth and the plane will be earthed.	[1] [1]	
7 (a) (i)	18 J of work is done to drive a unit charge around the circuit.	[1]	
(ii)	P = IV = 25 x 18 = 450 W	[1]	

Question	Solution	Marks	Remarks
7 (b) (i)	A transformer with the following labels: laminated (soft) iron core; primary coil connected to a 230 V a.c. supply and the secondary coil connected to a 23 V a.c. output. There should be more turns in the primary coil.	 [1] [1]	
(ii)	The ratio of the primary to secondary coil of the transformer is maintained at 10:1.	[1]	
(iii)	An alternating current allows voltage to be stepped up with the use of a transformer. This lowers the transmission current and hence reduces energy loss due to Joule heating.	[1] [1]	
8 (a)	When the spring unwinds, the magnet rotates and produces a changing magnetic field/flux linking the coil. This induces an emf and hence drives a current in the coil.	[1] [1]	
8 (b)	When the force in the spring decreases, the speed of rotation of the magnet decreases, causing the rate of change of magnetic field/flux linking the coil to decrease as well. A smaller current will be induced and this decreases the light intensity.	[1] [1]	
8 (c)	Increase the number of turns of the coil / Use a stronger magnet / Insert a soft iron core in the coil / Bring the magnet closer to the coil. (any two)	[2]	
9 (a) (i)	Critical angle is the incident angle in the **optically** denser medium which produces an angle of refraction of 90° in the **optically** less dense medium.	[1]	No credit awarded if "optically" is omitted.
(ii)	From Fig. 9.1c, Critical angle = 24° Refractive index = 1 / sin c = 1 / sin 24° = 2.5 (2 s.f.)	[1] [1]	Accept range 23° to 25°. No ecf for calculation of refractive index.
(iii)	The diamond in Fig. 9.1c produces the brightest sparkle. It is cut in such a way that most of the light rays are incident at angles greater than the critical angle of diamond, hence total internal reflection will occur easily/ more frequently.	[1] [1]	

Question	Solution	Marks	Remarks
9 (b) (i)	X has a refractive index of 1.5. Light should travel from an **optically** denser to an **optically** less dense medium in order for total internal reflection to occur. Hence the core must be made of a material with a higher refractive index.	[1] [1]	No credit awarded if "optically" is omitted.
(ii)	Using $n_1 \sin\theta_1 = n_2 \sin\theta_2$, $1.5 \sin c = 1.2 \sin 90°$ $c = 53°$ (2 s.f.)	 [1] [1]	Max [1] for application of formula if the wrong value of refractive index is identified in (i).
(iii)	The cladding protects the inner core from damage.	[1]	
10 (a)	$R = \rho l / A$ $= 1.7 \times 10^{-8} \times 0.40 / (\pi \times 0.005^2)$ $= 8.7 \times 10^{-5}\ \Omega$ (2 s.f.)	 [1] [1]	**Deduct [1] if wrong sig fig or unit.** Max [1] for application of formula if area is incorrectly calculated.
10 (b) (i)	N_2 has a lower value than N_1. When the switch is closed, a current flows in the copper rod. By Fleming's Left-Hand Rule, where the thumb, index finger and second finger represents the direction of the force, magnetic field and current respectively, an upward force will act on the rod. This decreases the spring balance reading.	[1] [1]	Accept: Interaction of the magnetic field of the current and that of the magnet produces an upward force.
(ii)	1. Rod Y. It has the highest density of 11340 kg/m^3 and hence the largest mass and weight.	[1] [1]	**No credit if each rod is identified without any explanation.** Accept: Plastic is a poor conductor of electricity if low resistivity is mentioned in 3. **Deduct [1] from whole of part (ii) if candidate did not quote any value from table in the explanation.**
	2. Rod Z. Plastic has the highest resistivity of $1.6 \times 10^{16}\ \Omega$m. When the switch is closed, no current flows through it and it will not experience any force.	[1] [1]	
	3. Rod X. Copper has the lowest resistivity of $1.7 \times 10^{-8}\ \Omega$m and hence the lowest resistance. It will produce the largest current.	[1] [1]	
EITHER			
11 (a) (i)	The magnetised iron core attracts the iron armature, which will rotate clockwise about the pivot. The horizontal arm of the armature will then close the contacts.	 [1] [1]	

Question	Solution	Marks	Remarks
11 (a) (ii)		[2]	Accept if the S-pole of the iron armature is drawn on the horizontal arm, either at the pivot or the far end of the armature.
11 (b) (i)	When the temperature of the thermistor rises, its resistance decreases. This will cause a larger current to flow through the coil. The soft iron will be magnetised and the relay switch will be closed, causing the bell to ring.	[1] [1]	
(ii)	1. I = V / R = 12 / 200 = 0.060 A	[1]	
	2. p.d. of thermistor = RI = 2000 x 1.5 x 10^{-3} = 3.0 V p.d. across coil = 12 – 3.0 = 9.0 V	[1] [1]	
(iii)	Only a small current of 1.5 mA is required to switch on the bell using the relay. Without the relay, the user needs to handle a higher and more dangerous current of 60 mA.	[1]	Candidate is required to relate to the context of the question.
OR			
11 (a) (i)	The live wire is connected to a high potential and delivers current to the appliance.	[1]	
(ii)	The neutral wire is connected to zero potential and provides a return path for the current back to the supply.	[1]	
11 (b) (i)	Current drawn = P / V = 100 / 240 = 0.42 A (2 s.f.)	[1]	
(ii)	Total current drawn by 3 lamps = 0.416 x 3 = 1.25 A Hence fuse rating = 2 A	[1] [1]	Max [1] ecf if current drawn in (i) is wrongly calculated.
11 (c)	If the live wire touches the metal frame of the fan, the fan will become live/be at a high voltage/potential. The user will get an electric shock if he touches the fan.	[1] [1]	

Question	Solution	Marks	Remarks
11 (d)	The fan will not work as it will be short-circuited. The 7 A and 10 A fuses will blow due to the large current. Fuse X (2A fuse) will not blow because it is in a parallel connection. The lamps will not light up because the 10 A fuse has blown, hence the circuit becomes an open circuit/electrical supply is cut off.	[1] [1] [1]	

Anderson Secondary School
2016 Secondary 4 Express Preliminary Examination
Physics (5059/1) Answers

1	2	3	4	5	6	7	8	9	10
A	**D**	**A**	**B**	**B**	**D**	**A**	**B**	**B**	**B**
11	12	13	14	15	16	17	18	19	20
A	**A**	**C**	**C**	**B**	**C**	**C**	**B**	**B**	**C**
21	22	23	24	25	26	27	28	29	30
B	**B**	**D**	**B**	**C**	**A**	**A**	**B**	**D**	**D**
31	32	33	34	35	36	37	38	39	40
D	**D**	**C**	**C**	**D**	**A**	**D**	**B**	**C**	**C**

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination Two 2016
Secondary Four

PHYSICS **5059/01**

Paper 1 **24 August 2016**

1 hour

Candidates answer on the OMR Form.

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Check the number of printed pages on both sides of the paper.

There are **forty** questions in this section. Answer **all** questions. For each question, there are 4 possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the Optical Mark Reader (OMR) Form.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Hand in OMR Form separately.

Additional Materials:

OMR Form

Information to Candidates

Take the weight of 1 kg to be 10 N.
Take speed of light to be 3×10^8 m/s in vacuum.

1 A vernier calipers is used to measure the length of a rod. Diagram 1 shows part of the vernier calipers scales when the jaws are fully closed. Diagram 2 shows the vernier calipers scales when the jaws are closed around the ends of the rod.

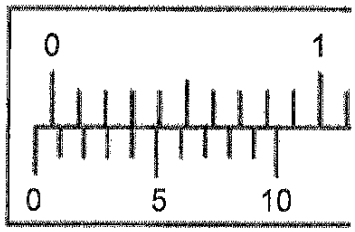


Diagram 1

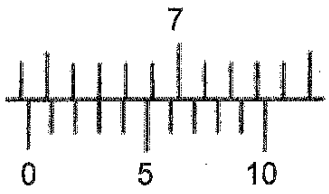


Diagram 2

What is the length of the rod?

A 6.39 cm **B** 6.40 cm **C** 6.43 cm **D** 6.49 cm

2 Which of the following statement(s) is/are a vector quantity?

(i) The rate of transferring heat to the pan.

(ii) The rate of change in displacement.

(iii) The rate of flow of electric charge.

(iv) The pull on a mass.

A (iv) only

B (i) and (iii) only

C (ii) and (iv) only

D (ii), (iii) and (iv) only

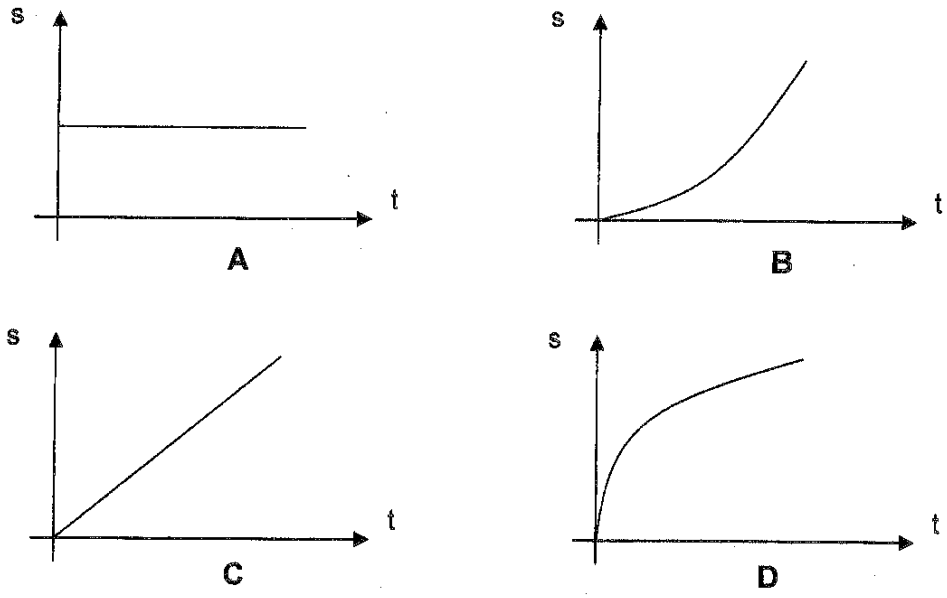
3 A mass of a liquid of density p is thoroughly mixed with an equal mass of another liquid of density 2 p. No change of the total volume occurs.

What is the density of the liquid mixture?

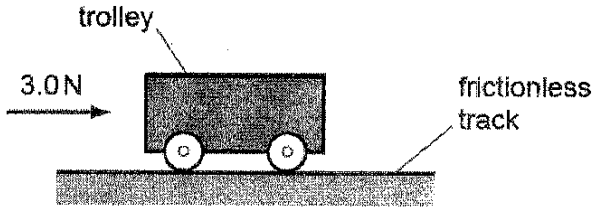
A 4/3 p **B** 3/2 p **C** 5/3 p **D** 3 p

4 A car moves with constant speed and decelerates later.

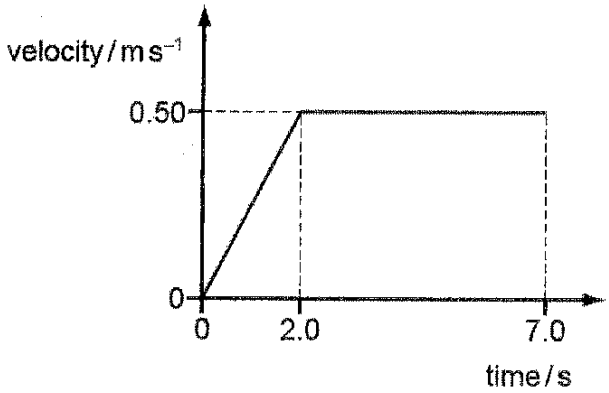
Which of the following graphs shows the distance-time graph for the car?



5 A trolley is pushed with a force of 3.0 N for 2.0 s along a frictionless track.



The graph shows the velocity of the trolley against time.



How much work is done by the force on the trolley?

A 1.5 J **B** 3.0 J **C** 6.0 J **D** 9.0 J

6 A body is initially at rest. Two forces are then applied to it; one is constant, the other acts in the opposite direction with a magnitude that is proportional to the velocity of the object.

Which statement best describes the motion of the object?

A The acceleration will increase from zero to a maximum.

B The acceleration will increase from zero to a maximum and then decrease.

C The velocity will increase from zero to a maximum.

D The velocity will increase from zero to a maximum and then decrease.

7 The list contains three energy resources P, Q and R.

P geothermal energy from hot rocks

Q nuclear fission in reactors

R sunlight on solar panels

Which of these resources are renewable?

A P and Q only

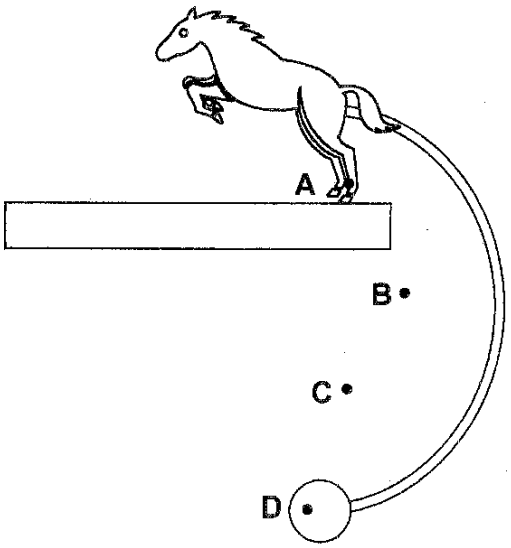
B P and R only

C Q and R only

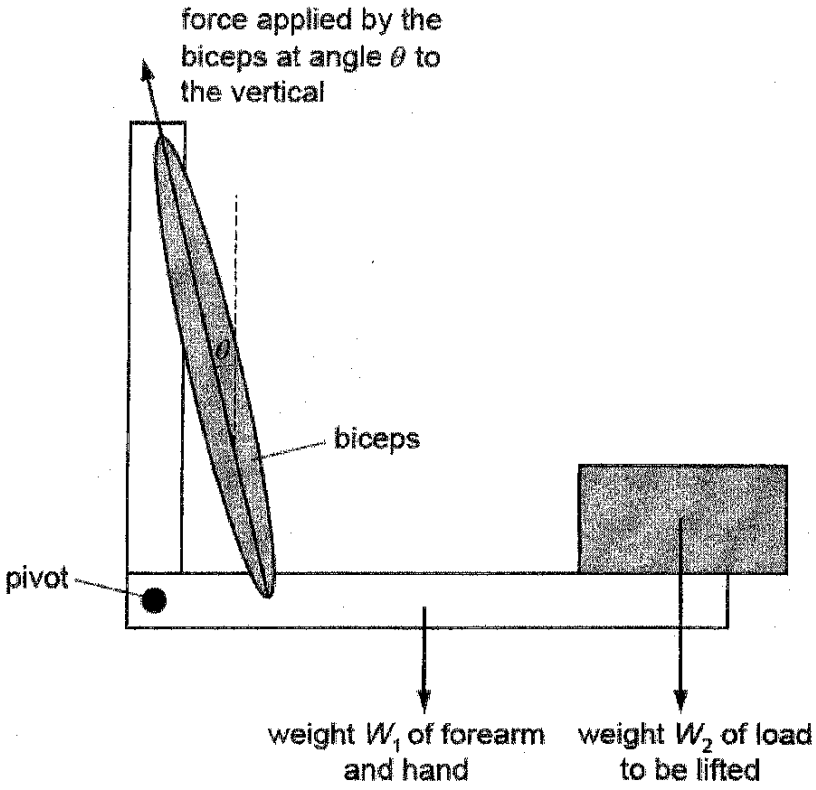
D P, Q and R

8 The diagram below shows the rest position of a balancing toy on the edge of a table.

Which position is most likely to be the centre of mass of the toy?



9 The diagram shows a model of an arm. A force applied by the biceps muscle can hold the arm in equilibrium while it supports a load.



Which statement is correct when the arm is in equilibrium in the position shown?

A The force at the pivot is zero.

B The force from the biceps is bigger when the load is moved nearer to the pivot.

C The force from the biceps is equal to $W_1 + W_2$.

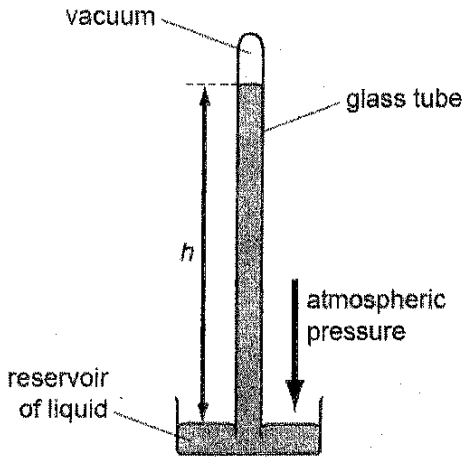
D The resultant force on the biceps is zero.

10 A vehicle is used to explore under the sea. The force due to the water on its horizontal rectangular window, which measures 50.0 cm by 40.0 cm, is 8.24×10^6 N.

At what depth is the window? (Density of sea water is 1.03×10^3 kg/m^3).

A 40.8 m **B** 163 m **C** 4.0×10^3 m **D** 4.0×10^4 m

11 A barometer can be used to measure atmospheric pressure as shown.



For a barometer containing water, the height h is 10.4 m. A second barometer, with a glass tube which has twice the cross-sectional area, contains alcohol.

density of water = 1.0×10^3 kg/m^3

density of alcohol = 0.8×10^3 kg/m^3

What is the height h of the alcohol?

A 4.2 m **B** 6.5 m **C** 8.3 m **D** 13.0 m

12 Which of the following physical properties is **not** used to measure temperature?

A volume of fixed mass of liquid

B electrical resistance of a platinum wire

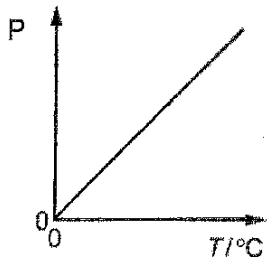
C electromotive force

D pressure and volume of a gas

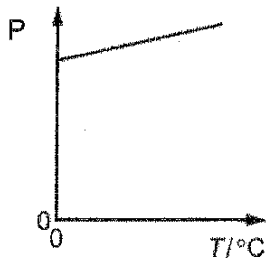
13 A fixed mass of gas in a syringe at 0 °C is heated at constant volume.

Which graph shows the variation of pressure P with temperature T, measured in °C?

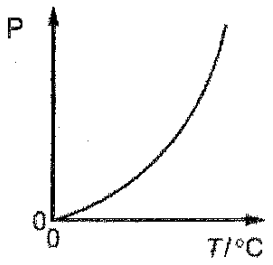
A



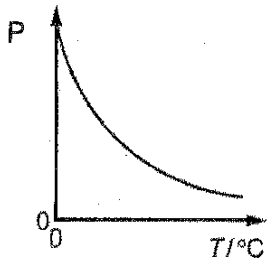
B



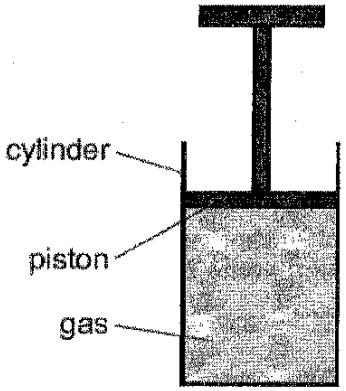
C



D



14 A piston is supported by gas trapped in a cylinder.



The piston moves upwards when the trapped gas in the cylinder is heated.

What happens to the molecules of the gas?

A They hit the piston more frequently.

B They hit the piston with a smaller force.

C They have a larger size.

D They have more kinetic energy.

15 A metal block X of mass m, specific heat capacity c and temperature 80°C is placed in good thermal contact with a second metal block Y of mass 2m, specific heat capacity 2c and temperature 30°C. Assume no energy losses to the surroundings.

What will be the final temperature of both blocks?

A 40°C **B** 50°C **C** 55°C **D** 110°C

16 Which statement concerning the evaporation and boiling of a liquid is true?

A Boiling always occurs at a higher temperature than evaporation.

B Evaporation and boiling are unaffected by changes in the surface area of the liquid.

C Evaporation occurs at any temperature whereas the boiling point depends on the atmospheric pressure.

D Evaporation results in the loss of the most energetic molecules from a liquid whereas in boiling, all molecules have the same energy.

17 A gas in the process of condensation will

A not give off or take in any heat because there is no change in temperature.

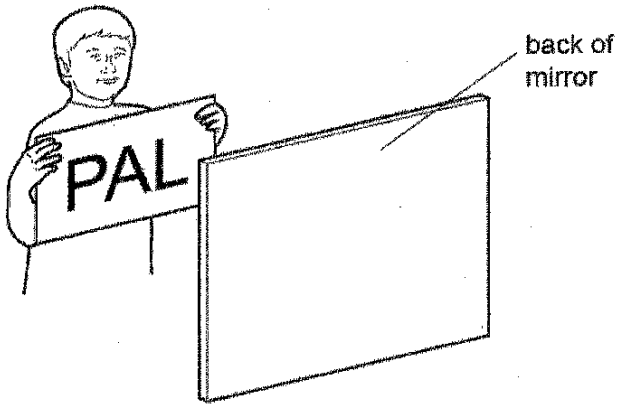
B give off heat because its molecules are losing kinetic energy.

C give off heat because intermolecular forces are forming.

D take in heat in order to break the intermolecular forces.

18 A piece of paper has 'PAL' written on it.

A student holds the paper in front of a plane mirror.



What does the student see?

A



B



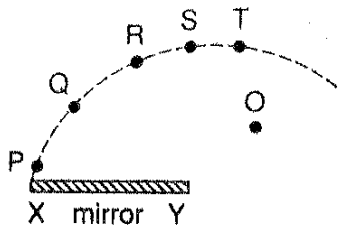
C



D



19 The diagram shows an object O is placed in front of a mirror XY.



An observer will be able to see the image if he stands between points

A P and Q.

B Q and R.

C R and S.

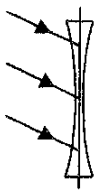
D S and T.

20 A ray of light from air is incident on the surface of a glass block with an angle of incidence of 65°. The refractive index of the glass is 1.45. The light ray changes direction when entering the glass.

How much the ray deviate as it enters the block?

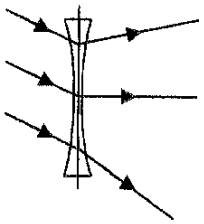
A 21.4°C **B** 26.3°C **C** 38.7°C **D** 51.3°C

21 Three rays of light fall on a thin lens as shown

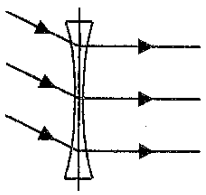


Which diagram shows the path of the rays after passing through the lens?

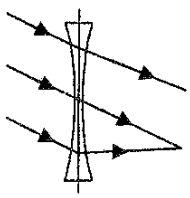
A



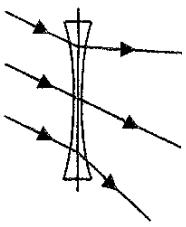
B



C



D



22 An object placed at 28 cm from a thin converging lens produces an image of the same size as the object.

When object is moved to 20 cm from the same lens, the image produced will be

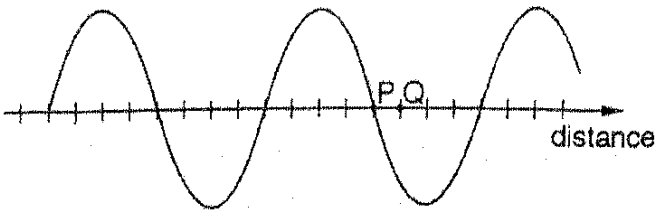
A real, inverted, diminished.

B real, inverted, magnified.

C virtual, upright, magnified.

D virtual, upright, diminished.

23 The diagram shows a transverse wave at a particular instant. The wave is travelling to the right. The frequency of the wave is 12.5 Hz.



At the instant shown the displacement is zero at the point **P**.

What is the shortest time to elapse before the displacement is zero at point **Q**?

A 0.01 s **B** 0.03 s **C** 0.08 s **D** 0.10 s

24 Studies show that black holes and neutron stars are capable of emitting high power X-rays in deep space.

Which of the following could be the frequency of X-rays in space?

A 3.0×10^{9} Hz

B 3.0×10^{12} Hz

C 3.0×10^{18} Hz

D 3.0×10^{20} Hz

25 What is the approximate range of audible wavelength for a young person?

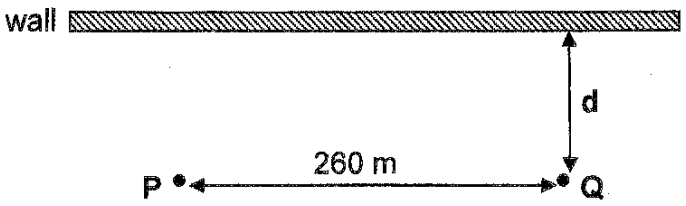
A 170 mm to 340 m

B 17 m to 59 m

C 17 mm to 17 m

D 17 μm to 340 μm

26 Two persons **P** and **Q** are positioned 260 m apart from each other.

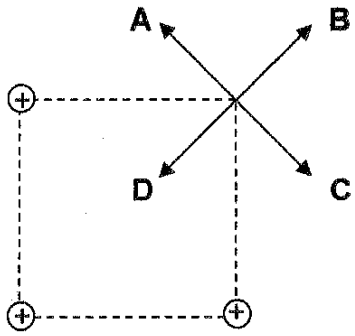


When **P** gives a clap, the time interval between the two sounds heard by **Q** is 0.20s. If the speed of sound is 340 m/s, what is the approximate distance, **d** from **Q** to the wall?

A 68 m **B** 100 m **C** 136 m **D** 260 m

27 The diagram shows point charges, each of equal magnitude of positive charge, placed at three corners of a square.

What is the direction of the resultant electric field at the fourth corner?



28 To charge an isolated metal sphere by induction, the following four processes are required.

P The sphere is earthed by touching it.

Q The earth connection is removed from the sphere.

R A charged rod is brought close to the sphere.

S The charged rod is removed.

In which order can these stages be carried out to charge the isolated metal sphere?

A P → Q → R → S

B P → R → S → Q

C R → P → Q → S

D R → P → S → Q

29 Four lamps have filaments made from the same material. The lamps are connected in parallel across a battery.

Which filament lamp transfers the most energy into heat and light per second?

	length of filament	cross-sectional area of filament
A	L	2A
B	2L	2A
C	L	A
D	2L	A

30 A torch is switched on and left until its battery is flat. During this time, the current in the lamp remains steady at 0.60 A for three hours and then decreases uniformly to zero in the next hour.

What is the total charge passing through the lamp?

A 1.2×10^2 C

B 4.3×10^3 C

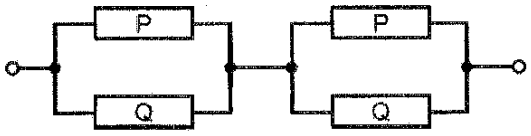
C 7.6×10^3 C

D 8.6×10^3 C

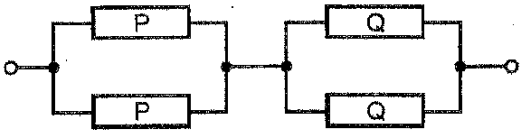
31 In the diagrams, resistor P has twice the resistance of resistor Q.

Which network has the lowest resistance?

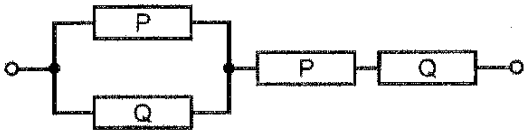
A



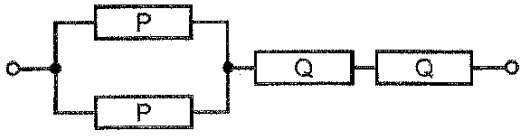
B



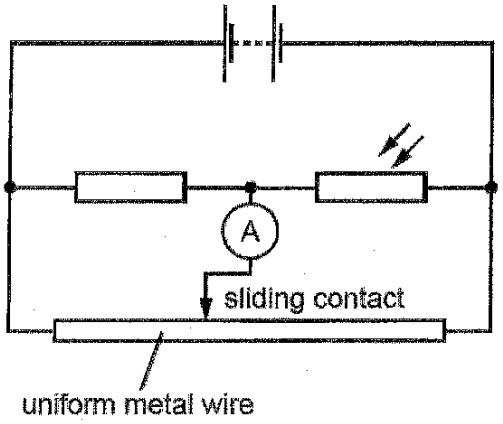
C



D



32 In the potentiometer circuit shown, the reading on the ammeter is zero.



The light-dependent resistor (LDR) is then covered up and the ammeter gives a non-zero reading.

Which change could return the ammeter reading to zero?

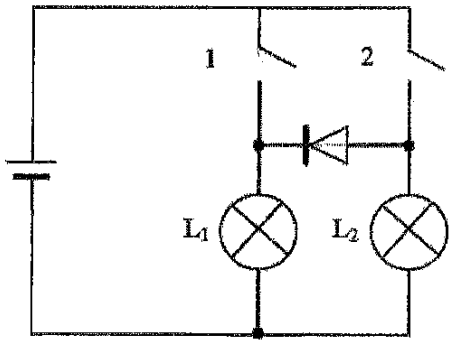
A Decrease the supply voltage.

B Increase the supply voltage.

C Move the sliding contact to the left.

D Move the sliding contact to the right.

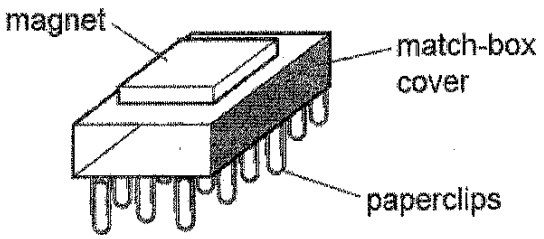
33 The circuit shows how two lamps L_1 and L_2 are connected to a battery through two switches 1 and 2 and a diode.



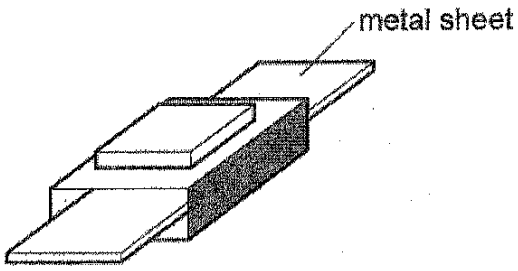
Which of the following best describes the operation of this circuit?

	switch 1 closed switch 2 open	switch 2 closed switch 1 open
A	both bulbs light up	L_2 light up
B	none	both bulbs light up
C	L_1 light up	both bulbs light up
D	both bulbs light up	L_1 light up

34 A teacher sticks a magnet to the top surface of a match-box cover. The bottom surface is placed in a small tray of iron paperclips. As the match-box cover is lifted up, a large number of paperclips are held on the bottom surface.



Sheets of metal are placed inside the match-box cover, between the magnet and the paperclips.

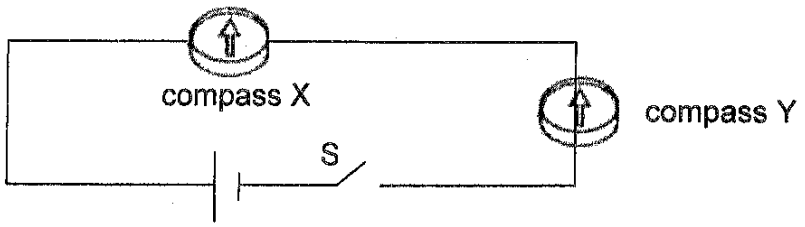


When sheet X is placed inside, the paperclips stay attached. When sheet Y is placed inside, all the paperclips fall off.

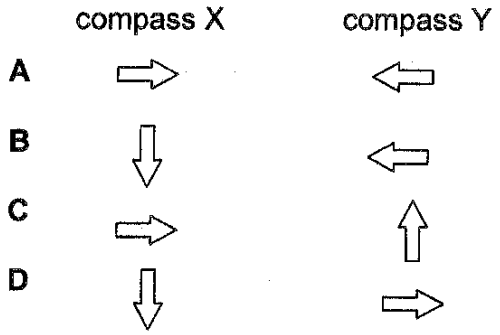
Which metals are the sheets made from?

	sheet X	sheet Y
A	aluminium	copper
B	copper	iron
C	iron	aluminium
D	iron	copper

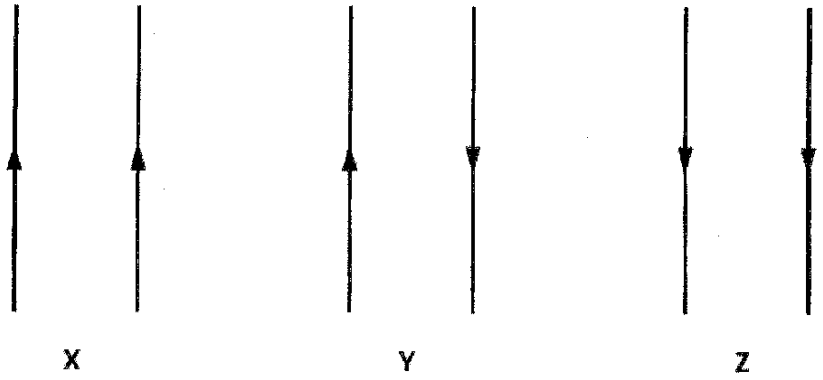
35 The diagram shows a circuit with a wire connected to a battery through the switch S. A compass X is placed above the wire and compass Y is placed below the wire.



When the switch is closed, which of the following diagrams correctly shows the orientation of the compass needles?



36 The diagram shows the direction of currents through three pairs of parallel wires.

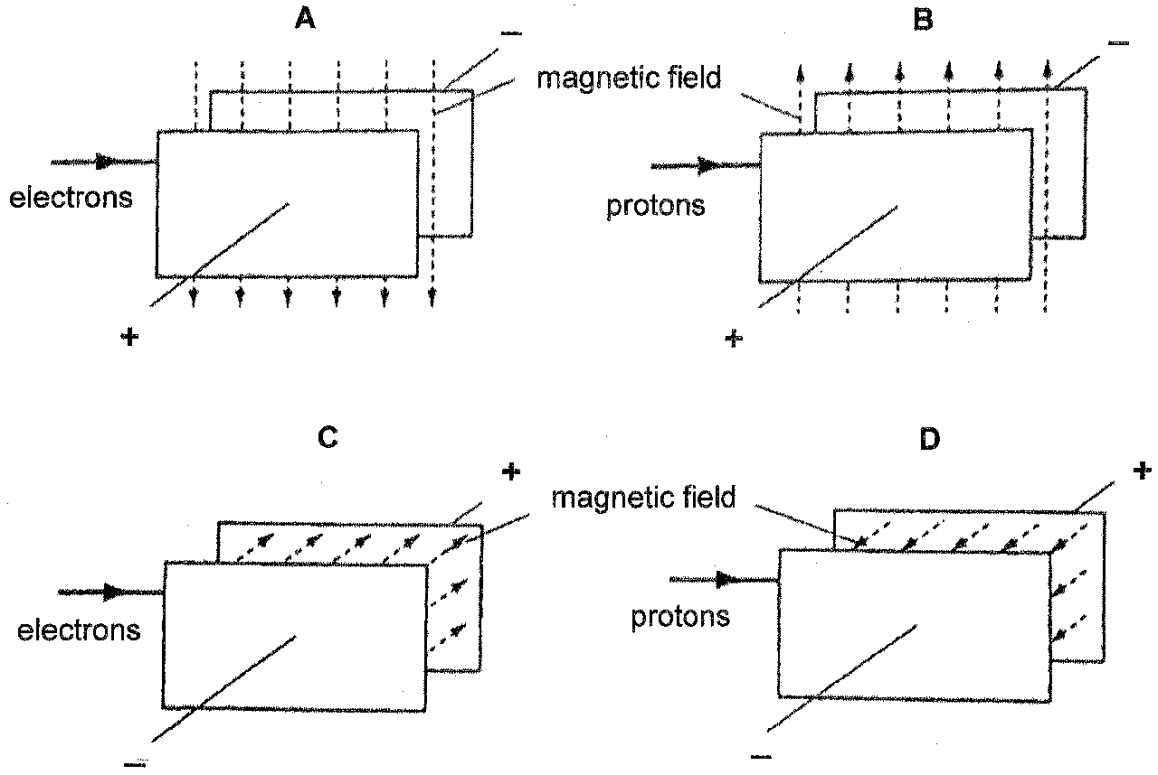


Which forces do the pairs of wires experience?

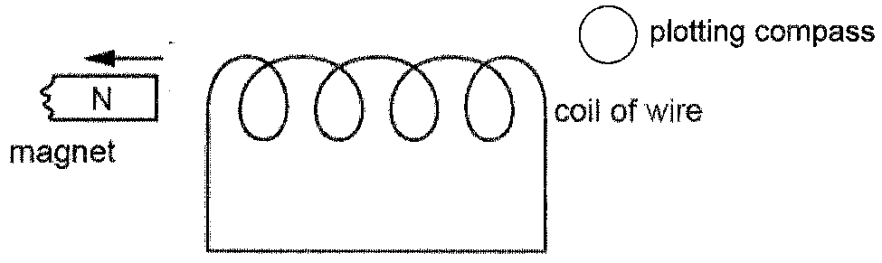
	X	Y	Z
A	attraction	repulsion	attraction
B	attraction	none	repulsion
C	none	attraction	none
D	repulsion	attraction	repulsion

37 The diagrams show different particle beams entering a region between two metal plates in which there are uniform electric and magnetic fields.

In which arrangement would it be possible for the beam to pass through undeflected?



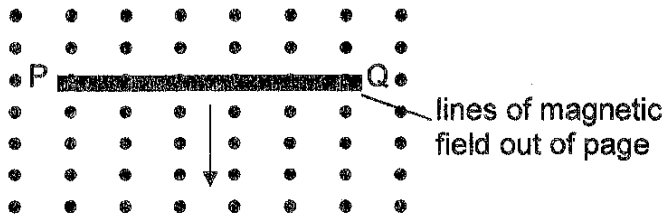
38 The diagram shows the north pole of a magnet moving out of a coil of wire. A small plotting compass is placed near the coil of wire.



In which direction does the plotting compass set momentarily when the magnet moved out?



39 A copper rod PQ is placed horizontally as shown below. It is released and then falls vertically, cutting across the lines of magnetic field pointing out of the page. Neglecting air resistance, which of the following statements is/are correct?



(i) A voltage is induced across PQ

(ii) A steady induced current is generated in the rod

(iii) The copper rod falls with an acceleration that is less than the acceleration due to gravity

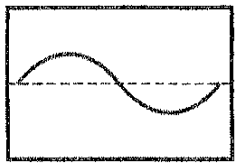
A (i) only

B (ii) only

C (i) and (ii) only

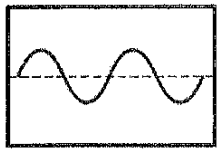
D (ii) and (iii) only

40 The coil of an a.c. generator is rotated and the output is displayed on the screen of a cathode-ray oscilloscope (c.r.o.). The diagram shows the trace on the screen.

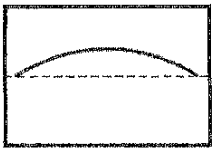


Assuming that the settings on the c.r.o. are unaltered, which trace appears on the screen when the number of turns in the coil is doubled and the speed of rotation of the coil is halved?

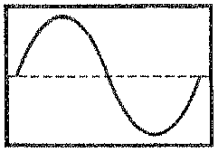
A



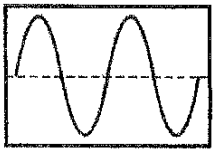
B



C



D



END OF PAPER

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination Two 2016
Secondary Four

CANDIDATE NAME

CLASS 4 ☐ INDEX NUMBER ☐☐

PHYSICS
Paper 2 Physics

5059/02
17 August 2016

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12 and Question 13.**
Write your answers in the spaces provided on the question paper.

For calculations, take speed of light in air to be 3×10^8 m/s.
1 kg of mass to have a weight of 10 N (unless otherwise indicated).

Submit **Section A** and **Section B** separately.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

For Examiner's Use
80

Section A (50 marks)

For Examiner's Use

1 A rocket blasts off vertically from rest on a launch pad on Earth with a constant upward acceleration of 2.50 m/s^2. At 20.0 s after taking off, the engines suddenly fail and the rocket begins free fall.

(a) At the instant the engine fails, calculate

(i) the velocity of the rocket

velocity : ..... [1]

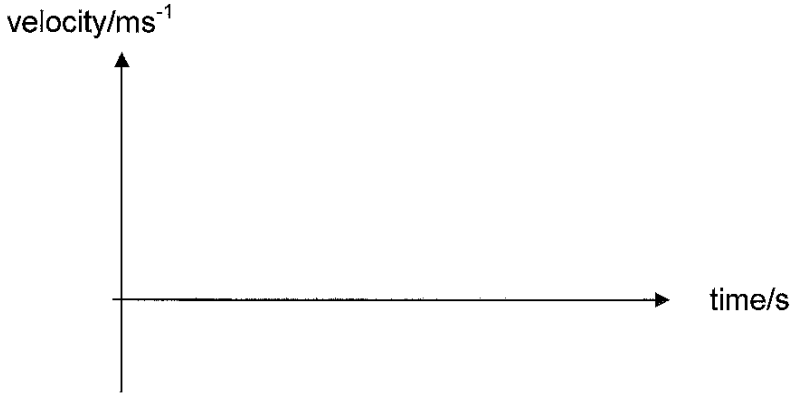
(ii) the height of the rocket

height : ..... [1]

(b) How long does it take for the rocket to reach the highest point after taking off?

time : ..... [2]

(c) On the following axes, sketch the velocity-time graph from the time the rocket launches till it reaches the highest point.



[2]

For Examiner's Use

2 Fig. 2.1 shows a balloon just before take-off. The balloon's basket is attached to the ground by two fixing ropes. The ropes make an angle of 50 ° with the ground and each has a tension of 400 N.

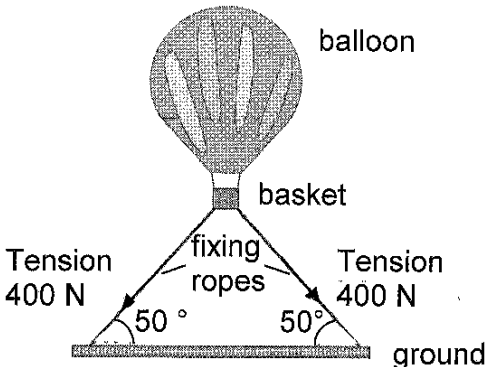


Fig. 2.1

(a) In the space provided, draw a scale diagram to determine the magnitude of the resultant of the two tensions in the ropes.

magnitude : ..... [3]

(b) If the total weight of the balloon and its basket is 2000 N, determine the upward lift exerted on the balloon. Ignore the weight of the ropes.

For Examiner's Use

upward lift : ..... [2]

(c) The balloon takes off when the two ropes are simultaneously released from the ground. Explain in terms of forces why the balloon will experience an upward acceleration.

.....

.....

.....

.....

..... [2]

3 Fig. 3.1 shows two workers **A** and **B** carrying a compressor unit on a 3.0 m long uniform plank. The plank has a mass of 2.0 kg. Worker **A** lifts at one end with a force of 480 N and the other lifts at the opposite end with a force of 640 N.

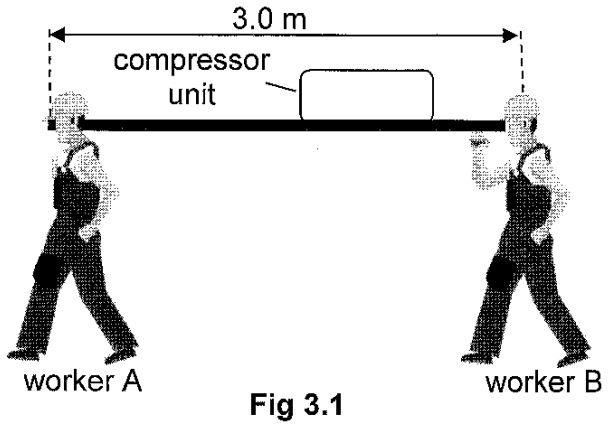


Fig 3.1

(a) What is the weight of the compressor unit?

weight : ..... [2]

(b) How far away is the center of gravity of the compressor unit from worker A?

For Examiner's Use

distance : ..... [2]

4 An old steam engine, such as the one shown in Fig. 4.1, heats water to its boiling point and then converts the water to steam.

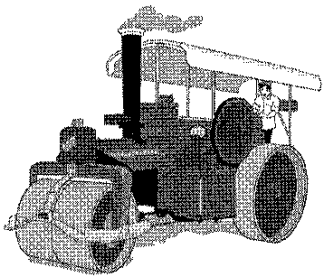


Fig. 4.1

(a) Every 20 minutes the engine converts 65 kg of water at a temperature of 23 °C to steam at 100 °C.

Specific heat capacity of water = 4200 J/(kgK).
Specific latent heat of vaporisation of water = 2.26×10^6 J/kg.

Calculate

(i) the total amount of heat energy required every 20 minutes,

heat energy : ..... [2]

(ii) the average power required for the heating and vaporising processes.

power : ..... [1]

For Examiner's Use

(b) The steam engine exerts a driving force of 4000 N when travelling at a constant speed of 5.0 m/s.

(i) Calculate the power output of the steam engine.

power output : ..... [1]

(ii) Calculate the percentage efficiency of the steam engine.

efficiency : ..... [1]

5 Ultraviolet radiation is commonly used in water filtration devices to kill microscopic organisms in the water. Fig. 5.1 shows an ultraviolet lamp emitting ultraviolet waves to sterilize the water. It takes 1.76×10^{-9} s to produce 1×10^{6} complete waves.

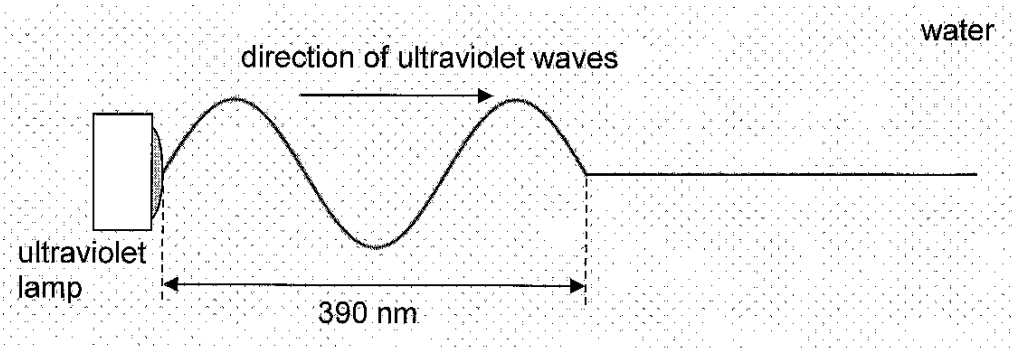


Fig. 5.1

(a) What is the frequency and speed of the ultraviolet radiation in water?

frequency : .....

wave speed : ..... [3]

For Examiner's Use

(b) State one harmful effect of prolonged human exposure to solar ultraviolet radiation.

..... [1]

6 **(a)** Sometimes, when people have been riding in a car, they get an electric shock from the door handle as they get out of the car. Suggest why this happens.

.....

.....

.....

..... [2]

(b) A plastic rod is rubbed with a cloth and becomes positively charged. After charging, the rod is held close to the suspended table-tennis ball shown in Fig. 6.1. The table-tennis ball is covered with metal paint and is initially uncharged.

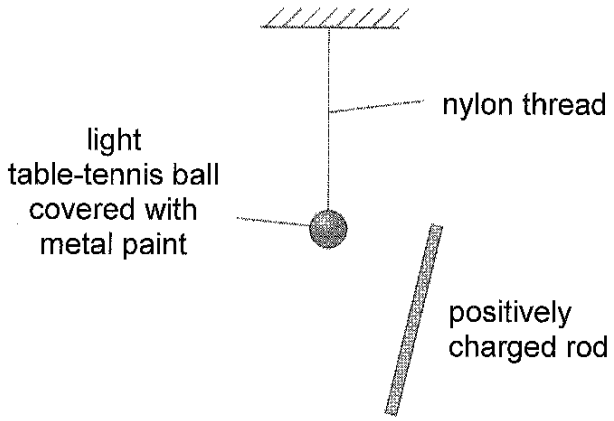


Fig. 6.1

Describe and explain what happens to the metal-painted ball as the rod is brought near it.

.....

.....

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.....

.....

..... [3]

For Examiner's Use

7 Fig. 7.1 shows the coil of a loudspeaker attached to a cardboard cone. One pole of a stationary cylindrical magnet lies near to the coil.

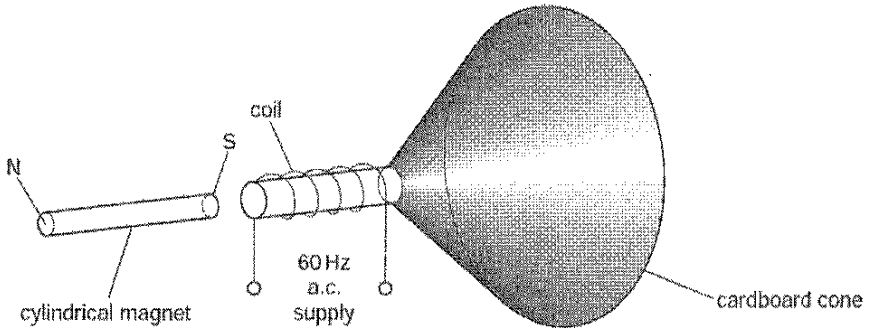


Fig. 7.1

There is an alternating current in the coil of the loudspeaker. A student hears the note produced.

(a) Explain why the cone of the loudspeaker vibrates.

.....

.....

.....

.....

..... [3]

(b) A stronger cylindrical magnet is now used. State the difference in the note heard. Explain why.

.....

..... [2]

8 Fig. 8.1 shows how an a.c. generator is driven by lowering a 5 kg weight. A 12 W lamp is connected to the output of the generator and will glow at normal brightness when the 5kg weight is lowered at a steady speed of 1.2 m/s.

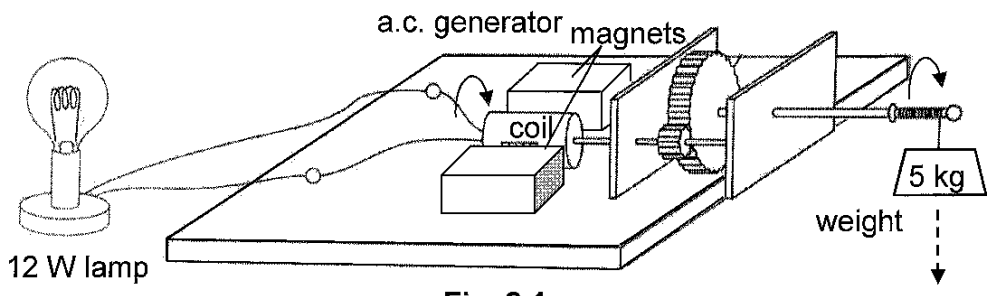


Fig. 8.1

For Examiner's Use

(a) Explain why the lamp will light up when the coil of the generator rotates.

.....

.....

.....

.....

..... [3]

(b) What is the loss in gravitational potential energy of the 5 kg weight in 2.0 s?

loss in gravitational potential energy : ..... [2]

(c) What is the power supplied to the generator by the weight?

power : ..... [1]

(d) Suggest two reasons why the power delivered in the lamp is less than the value obtained in **(c)**.

1. .....

2. ..... [2]

9 Fig. 9.1 shows a transformer.

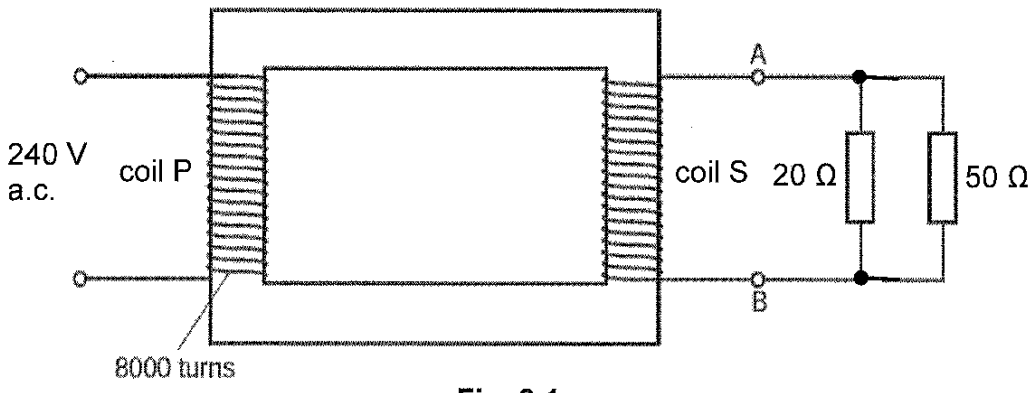


Fig. 9.1

For Examiner's Use

(a) Assume the transformer is 100% efficient and the input to the primary coil P is 240 V. This coil has 8000 turns of wire. The voltage obtained between terminals A and B is 12 V.

(i) Calculate the number of turns of wire in the secondary coil S.

number of turns : ..... [2]

(ii) Two resistors, 20 Ω and 50 Ω are connected parallel across the terminals A and B.

Calculate

1. the current in coil S,

current : ..... [1]

2. the current in coil P.

current : ..... [1]

(b) **(i)** Describe how two transformers are used to transmit electrical energy from the main power station to a distant sub power station.

.....

.....

..... [1]

(ii) Explain why this is necessary.

.....

.....

..... [1]

For Examiner's Use

Name: ..... Class: ..... Index no.: .....

Section B (30 Marks)

10 During a practice jump, an airborne jumper of total mass 105 kg exits from the side of a helicopter which is stationary at a high altitude. When the jumper leaves the aircraft, he is high enough in altitude that the air resistance can be considered negligible and he falls as a freely falling body for 11.5 s until he pulls the parachute cord. When the parachute cord is pulled, we assume that the parachute deploys immediately and exerts a total air resistance force of magnitude $F_D = dv^2$, where d = 20 N m^{-2} s^2 is the drag coefficient due to air resistance, and v is the velocity of the jumper. The jumper achieves terminal velocity 5.0 s after the opening of the parachute. The jumper lands on the ground 20.0 s after achieving terminal velocity.

The jumper landed straight on hard concrete and felt a strain in his knees and limped off after practice. He was later advised by his instructor to look out for soft grass patches to land for the next jump.

(a) Draw a free-body diagram of the jumper when the parachute is opened. [2]

(b) Calculate the terminal velocity of the jumper after the parachute is opened.

Terminal Velocity = ... [2]

(c) Sketch the velocity – time graph of the jumper from the instance that he jumps off the plane until he reaches the ground. [3]

(d) Explain how landing on a soft grass patch decreases the amount of force that the jumper will experience upon impact.

.....

.....

.....

[2]

.....

(e) Suggest another way that the jumper can act during the landing to reduce the force he experiences upon impact.

.....

.....

[1]

.....

11 A current carrying wire is held between the poles of the horseshoe magnet that is placed on an electronic balance as shown in Fig. 11.1. The reading on the balance is 340 g when there is a current flowing through the wire.

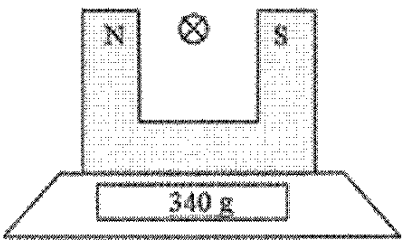


Fig. 11.1

(a) (i) On Fig. 11.1, draw the magnetic fields due to the horseshoe magnet. [1]

(ii) On Fig. 11.1, draw an arrow on the wire to indicate the direction of the force acting on the wire. [1]

(iii) State and explain how the reading displayed on the balance will change if the current in the wire is switched off.

.....

.....

.....

[2]

.....

(b) Fig 11.2 shows a simple D.C motor.

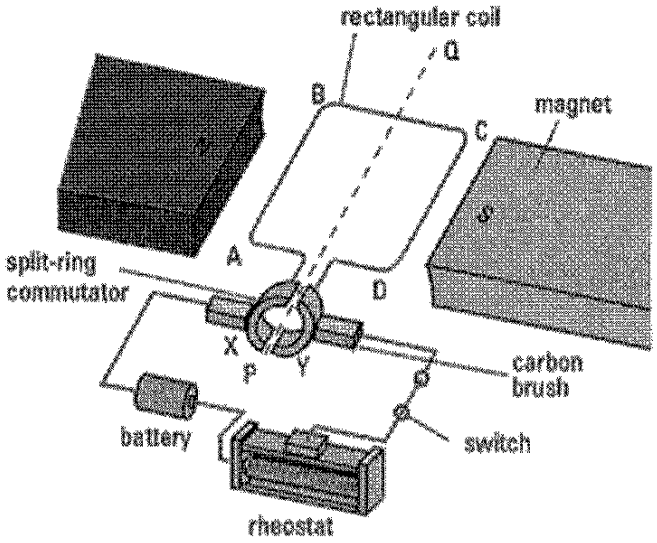


Fig. 11.2

(i) Describe and explain how the rectangular coil completes one revolution when a current passes through the coil.

.....

.....

.....

.....

[4]

.....

(ii) State two things that could be done to increase the turning effect of the coil.

.....

.....

[2]

.....

EITHER

12 (a) The voltage supplied in one particular household is 240 V. There is an earthed ring main house power circuit containing four electrical sockets. The circuit includes a 20 A fuse as shown in Fig. 12.1.

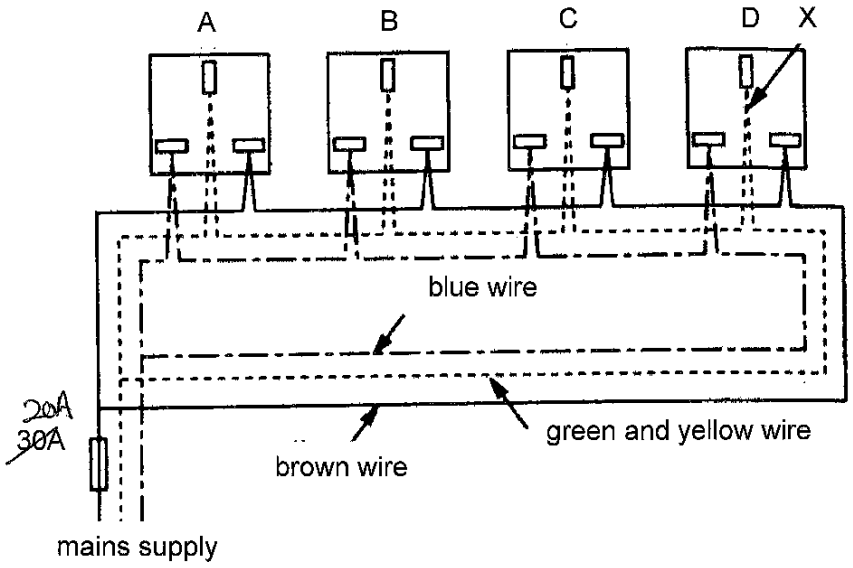


Fig 12.1

(i) Is it advisable to run four 1.5 kW electrical appliances with the four different sockets at the same time? Explain.

.....

.....

.....

[2]

.....

(ii) A break develops in the two earth wires at X. A device is plugged into socket D and is found to work normally. Is it safe to use socket D with the break in the wires at X? Explain.

.....

.....

.....

[2]

.....

(b) Fig. 12.2 below shows the power - time graph for an electric ~~lamp~~ heater running off a 240 V supply.
The electric heater is rated 350 W, 240 V.

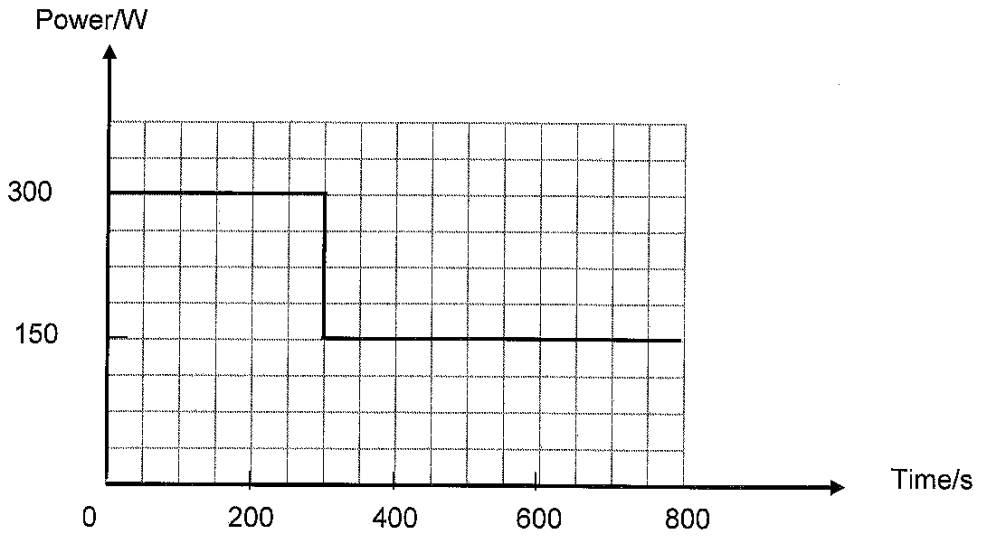


Fig 12.2

(i) With reference to Fig. 12.2, calculate the cost of operating the electrical heater for 8000 s if Singapore Power charges $0.24 for each kilowatt-hour of electrical energy.

Energy = _____[2]

For Examiner's Use

(ii) What is the effective resistance of the heater when its power output is 300 W?

Resistance = _____[2]

(c) Fig. 12.3 shows the V-I characterisitics of a light bulb in the electric lamp.

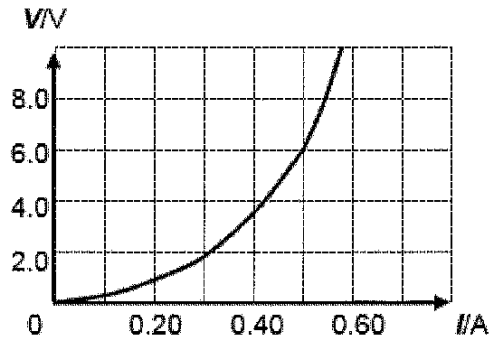


Fig. 12.3

Does the light bulb obey Ohm's law? Justify your answer.

.....

.....

.....

[2]

.....

OR

13 Fig. 13.1 shows a solar water heating system. The heater is made from a glass-covered wooden box and the copper pipe inside is painted black. The heater is put on an inclined surface. Oil circulates between the heater and the water storage tank via the copper pipe.

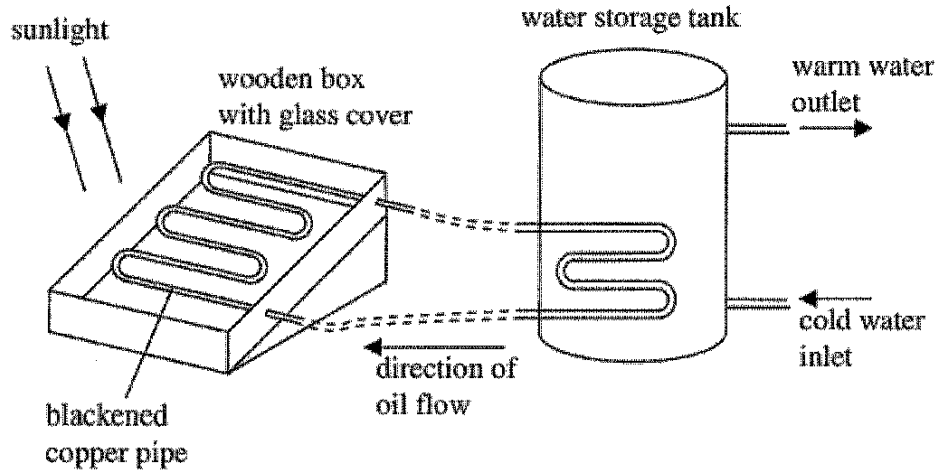


Fig. 13.1

(a) Explain why the copper pipe inside the box is painted black.

.....

.....

[1]

.....

(b) Suggest 2 reasons why the wooden box is covered by a sheet of glass.

.....

.....

.....

[2]

.....

(c) Explain why the oil circulates in the system in the direction as indicated in Fig. 13.1.

.....

.....

.....

[2]

.....

(d) If the wooden box is sealed and made air-tight, how would the air pressure inside change when temperature increases? Explain briefly in terms of kinetic theory.

.....

.....

.....

.....

.....

[3]

.....

(e) State and explain the process(es) by which water is heated in the storage tank.

.....

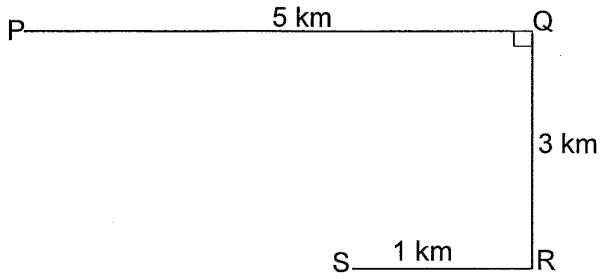
.....

.....

[2]

.....

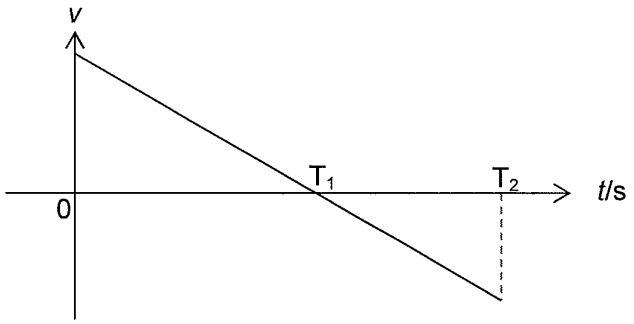
1 The diagram shows the path travelled by a car from P to S.



What is the displacement of the car?

A 5.0 km **B** 6.8 km **C** 8.2 km **D** 9.0 km

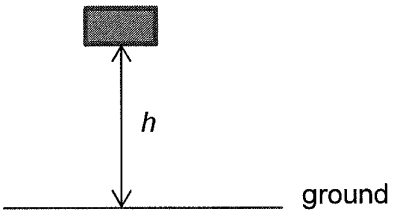
2 The velocity-time graph shown represents the motion of an object from $t = 0$ to $t = T_2$ s



Which of the following describes the motion of the object?

	From 0 to T_1	From T_1 to T_2
A	increasing acceleration	decreasing acceleration
B	uniform acceleration	decreasing acceleration
C	uniform deceleration	uniform deceleration
D	uniform deceleration	uniform acceleration

3 A brick, initially at rest, falls from a height of h and took 2.0 s to reach the ground.



The acceleration of free fall, $g = 10\ m/s^2$.

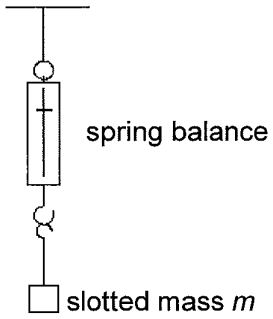
What is the height h of the brick?

A 10 m
B 20 m
C 30 m
D 40 m

4 Which statement about the net force acting on an object is correct?

A A net force is needed to keep an object moving with uniform velocity.
B A net force is needed to keep an object moving with increasing velocity.
C A net force is needed to keep an object moving with constant speed in a straight line
D Net force is zero if the object is slowing down.

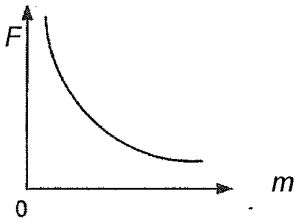
5 Different slotted masses *m* were hung on the end of a spring balance.



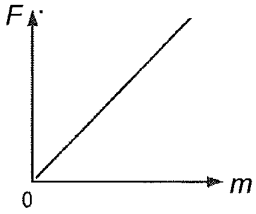
The gravitational force *F* acting on each of the mass was measured using the balance.

Which graph shows the relationship between the gravitational force, *F* and the mass *m*?

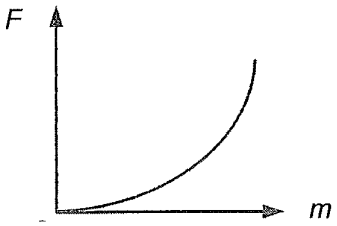
A



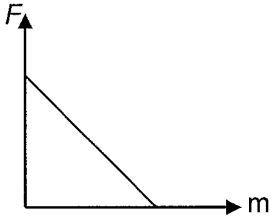
B



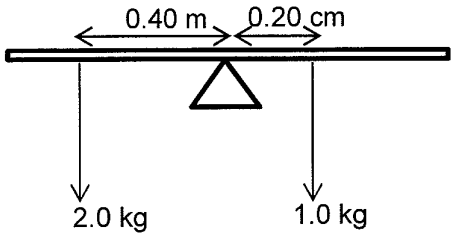
C



D



6 The diagram shows a uniform beam pivoted at the centre.



Two loads 2.0 kg and 1.0 kg are suspended as shown.

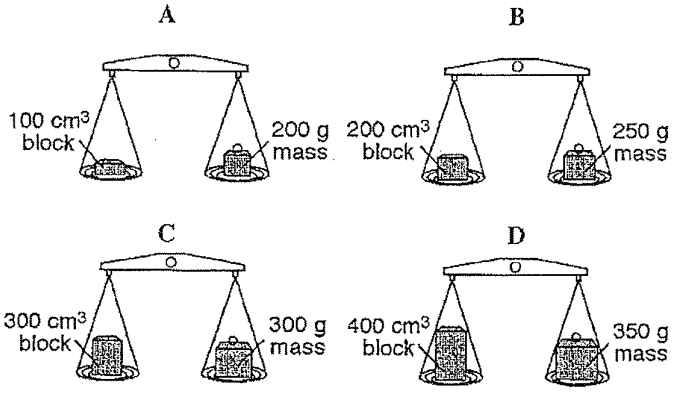
In order to balance the beam, a third load is added to the right of the pivot.

What is the mass of the load and how far from the pivot must it be attached?

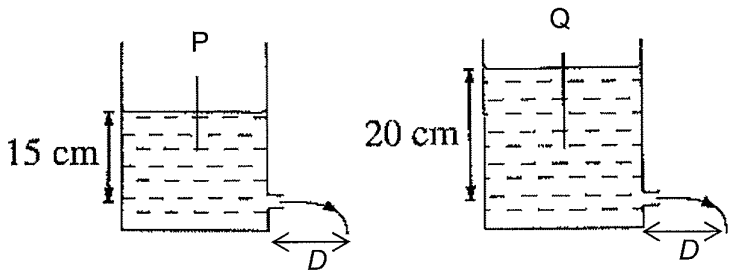
	Load/kg	Distance from pivot /m
A	1	0.40
B	2	0.10
C	2	0.30
D	3	0.10

7 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams.

In which diagram does the block have the greatest density?



8 The diagram shows two identical containers containing liquid P and liquid Q.



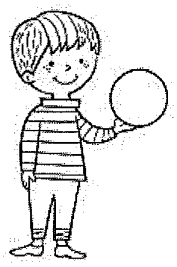
Water spurts out the same horizontal distance *D* when the depth of liquid P is 15 cm and the depth of liquid Q is 20 cm,

The density of liquid P is 2.00 g/cm^3.

What is the density of liquid Q in g/cm^3 ?

A 0.67 **B** 1.30 **C** 1.50 **D** 2.70

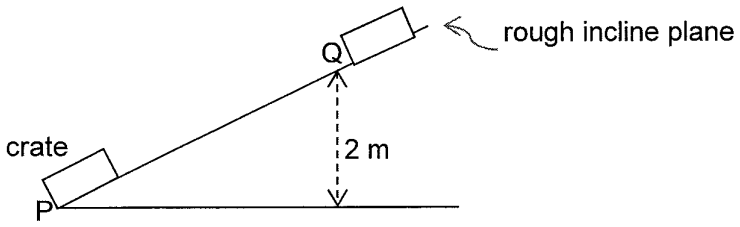
9 Mark holds a bowling ball in a fixed position.



Which statement regarding the work done on the ball is correct?

A The work done depends on the weight of the ball.
B The work done depends on mass of the ball.
C The work done is zero.
D The work done depends on the way he holds the ball.

10 A crate of mass 25 kg is pushed up a rough inclined plane.



The total work done on the crate from P to Q is 1500 J.

The gravitational field strength, g = 10 N/kg.

How much work is done against friction?

A 250 J
B 500 J
C 1000 J
D 2000 J

11 Sam of mass 75kg runs up to the top of a building in 5 minutes.
There are 260 steps, each 0.18 m high.

The gravitational field strength, g = 10 N/kg.

What is Sam's mechanical power?

A 11.7 W
B 65.0 W
C 117 W
D 7020 W

12 Two marbles, A and B are dropped to the ground from the roof of the school.

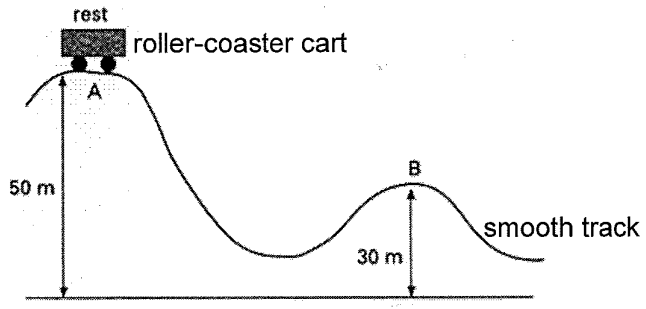
The mass of marble A is 2 times the mass of marble B.

Air resistance can be neglected.

What is the kinetic energy of marble A just before hitting the ground?

A the same kinetic energy as marble B.
B 2 times the kinetic energy of B.
C ½ the kinetic energy of B.
D 4 times the kinetic energy of B.

13 The diagram shows a roller-coaster cart starting from rest at point A and moving down a smooth track to past point B.



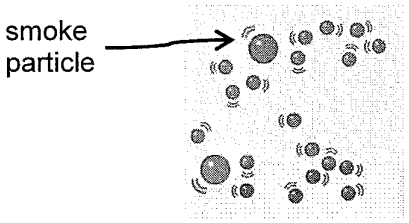
The gravitational field strength, g = 10 N/kg.

What is its speed at point B?

A 10 m/s
B 20 m/s
C 20 m/s
D 40 m/s

14 Illuminated smoke particles, suspended in air, are viewed with a microscope.

They are seen to move randomly.



What does the motion of smoke particles tell us about the molecular movement of air molecules?

A Air molecules are in continuous motion.
B Air molecules moves in clusters.
C Air molecules move just as fast as smoke particles
D Air molecules have the same amount of average kinetic energy at different temperature.

15 Which of the following about internal energy is correct?

A The temperature of a body is a measure of the total internal energy of the body.

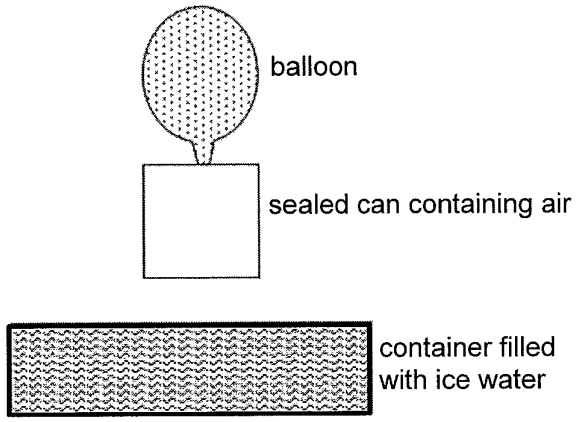
B The internal energy is a measure of the total kinetic and potential energy of the molecules in the body.

C Two bodies at the same temperature always have the same amount of internal energy.

D The internal energy of a body will increase if the temperature decreases.

16 Air was pumped into a balloon. The balloon is then connected to a sealed can.

The can is then placed in a container of ice water as shown in the diagram.



What will happen to the balloon when placed inside the container of ice water?

A The balloon will increase in size because the pressure inside the balloon decreases.

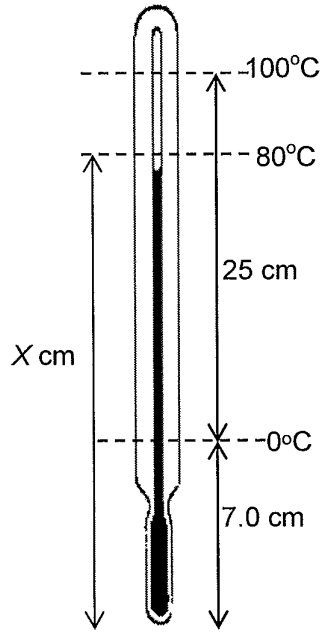
B The balloon will increase in size because the pressure outside the balloon decreases.

C The balloon will decrease in size because the pressure inside the balloon decreases.

D The balloon will decrease in size because the pressure outside the balloon increases.

17 When a thermometer was placed in pure melting ice the mercury thread has a length of 7.0 cm measured from the end of the thermometer bulb,as shown in the diagram.

When placed in steam from water boiling at 100°C the mercury thread increases by a length of 25.0 cm.

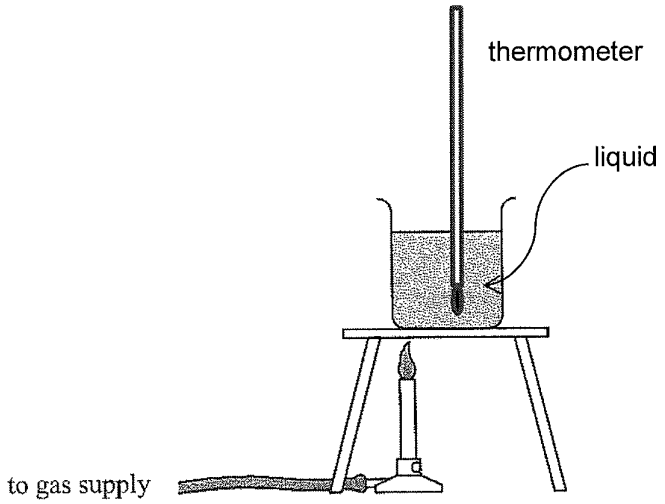


What is the length of the thread X in cm if the thermometer measures 80°C ?

A 20
B 21
C 27
D 28

18 The experimental setup shown is used to determine the specific heat capacities of four different liquids W, X, Y, and Z.

The bunsen burner is switched on for the same period of time for each substance of the same mass.



Neglecting energy loss to the surroundings, which of the following substances has the largest specific heat capacity?

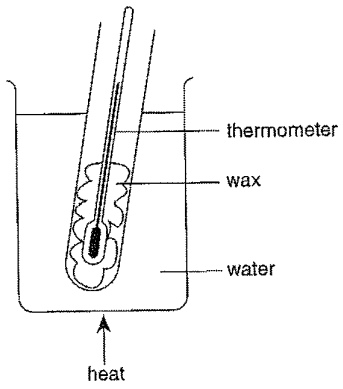
	Liquid	Rise in temperature /°C
A	W	8
B	X	7
C	Y	6
D	Z	5

19 A piece of iron feels colder than a piece of wood when touched.

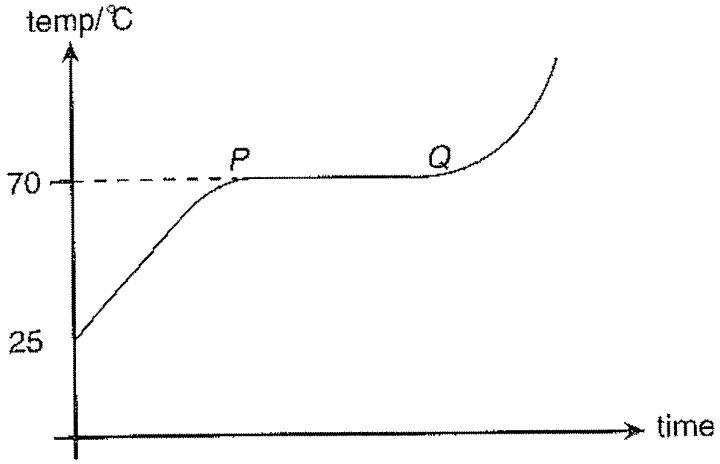
Which of the following statements explains why?

A Iron is a better thermal conductor than wood.
B Iron surface is smoother than wood.
C The temperature of the piece of iron is lower than the wood.
D Wood is a better thermal conductor than iron.

20 A piece of solid wax in a test-tube is heated in a water bath.



A graph of temperature-time graph is plotted.



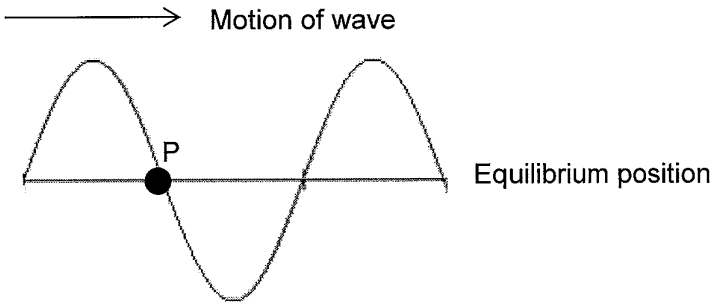
Which of the following statements is correct?

A The boiling point of wax is 70°C.
B Only liquid wax is present between P and Q.
C No thermal energy is absorbed by the wax between in the horizontal section PQ.
D There is an increase in internal energy of the wax in the horizontal section PQ.

21 Which of the following statements about wave motion is **incorrect**?

A Longitudinal waves are characterized by rarefactions and compressions.
B Longitudinal waves can be represented by displacement-distance graphs.
C Transverse wave transmit energy by transferring matter.
D Transverse waves are characterized by crests and troughs.

22 A transverse wave is travelling to the right as shown.

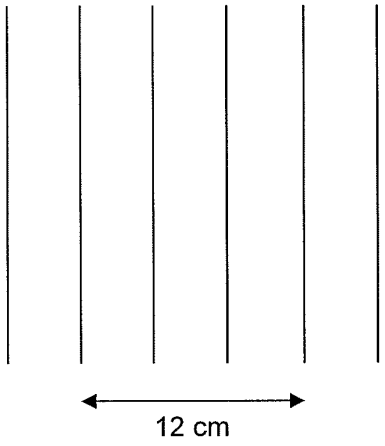


What is the direction of motion of P at this instant?

A momentarily at rest.
B moving downwards.
C moving to the right.
D moving upwards.

23 A ripple tank filled with water is used to study waves.

The diagram shows some wavefronts when viewed from the top.



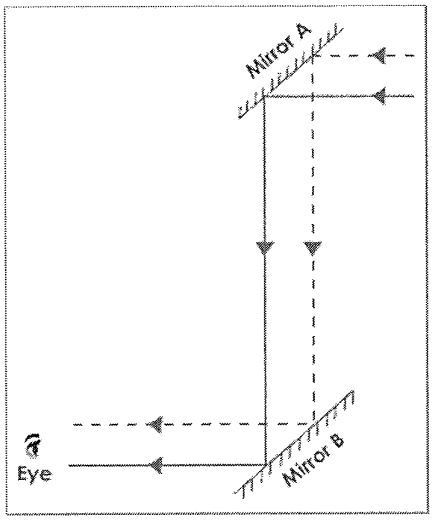
The frequency of the water waves is 20 Hz.

What is the wave speed in m/s?

A 0.20
B 0.40
C 0.80
D 1.20

24 A boy sees an object is through a periscope.

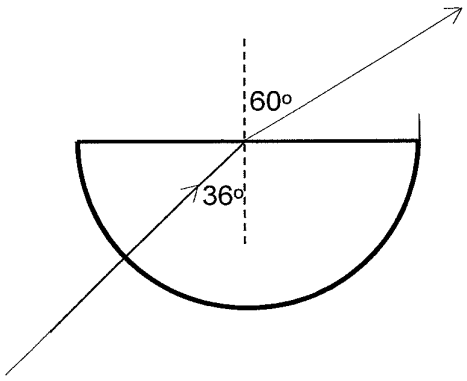
The periscope is made from 2 mirrors as shown in the diagram.



Which of the following statements is correct?

A The image is magnified.
B The image is laterally inverted.
C The image is virtual.
D The image is inverted.

25 A ray of light travelling in air enters a semi-circular glass block.



A student measures the angle of incidence 36° and the corresponding angle of refraction as 60°.

What is the refractive index of the glass block?

A 0.60
B 0.69
C 1.47
D 1.67

26 An object is placed at a distance between one focal length and two focal lengths from the centre of a converging lens.

Where is the image formed?

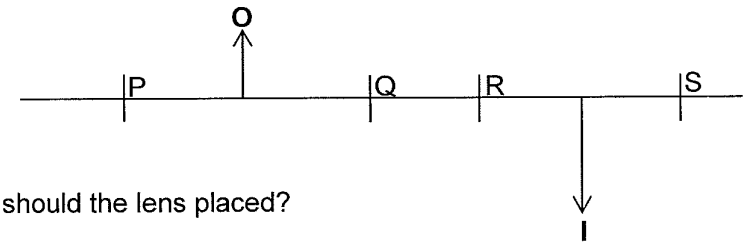
A on the opposite side of the object and formed more than two focal length from the lens.

B on the opposite side of the object and formed very close to the lens.

C on the same side as the object and formed more than two focal lengths from the lens.

D on the same side as the object and formed very close to the lens.

27 In the diagram **I** is the image of an object **O** formed by the lens.



Where should the lens placed?

Position of lens

A P

B Q

C R

D S

28 Which of the following electromagnetic waves has the longest wavelength?

A infra-red radiation

B red light

C ultra-violet radiation

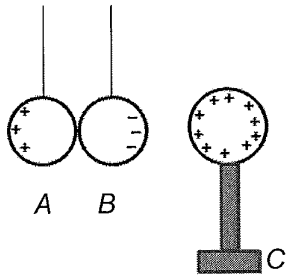
D violet light

29 *A* and *B* are two insulated uncharged metal spheres touching each other and hung on threads.

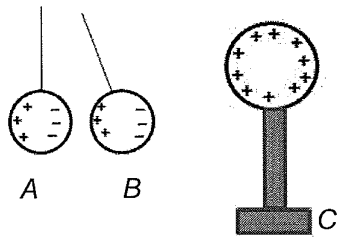
A positively-charged sphere C mounted on a plastic stand is brought near to *B*.

Which of the following diagrams shows the correct distribution of the charges on the spheres?

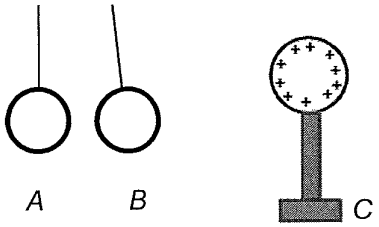
A



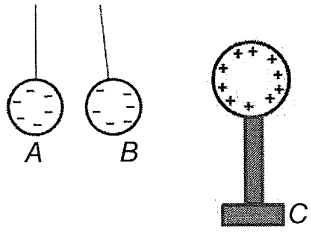
B



C



D

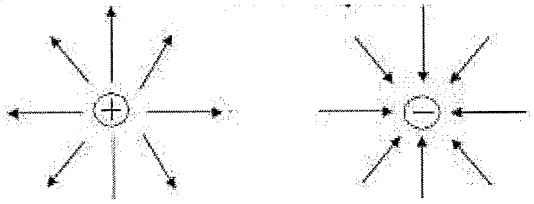


30 Two opposite charged spheres are shown in the diagram.

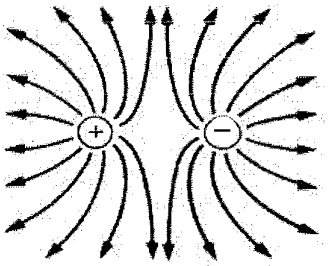


Which of the following diagrams best represent the resultant electric field between the 2 charged spheres?

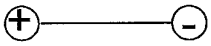
A



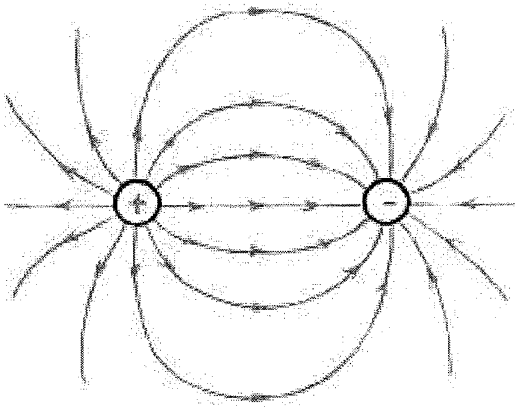
B



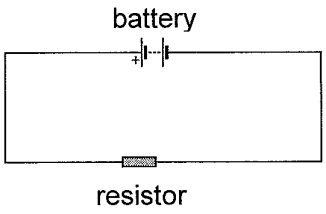
C



D



31 In the circuit 9 J of energy is supplied by a battery when 3 C of charges passes through it.



Which of the following statements is true?

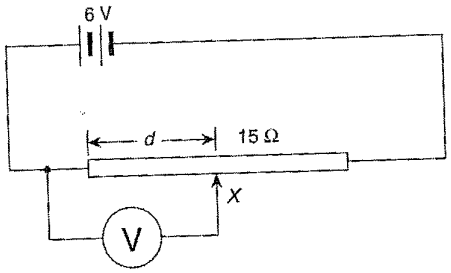
A The electromotive force of the battery is 3 V.
B The electromotive force of the battery is 27 V.
C The current flowing in the circuit is 1 A.
D The resistance in the circuit is 3 Ω.

32 A lamp is rated 100 W, 200 V.

What is the resistance of the lamp and the current drawn during normal operation?

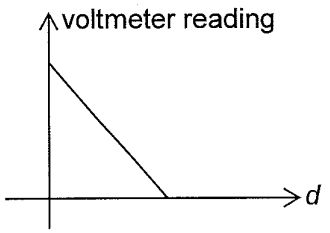
	Resistance / Ω	Current / A
A	2.0	2.0
B	200	0.5
C	200	2.0
D	400	0.5

33 A 6 V battery is connected across a 15 Ω uniform resistance wire as shown in the diagram.

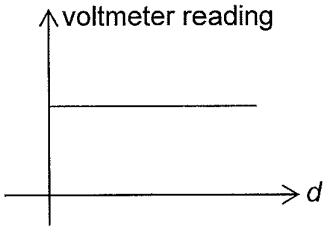


Which of the following graphs best represents the variation of the voltmeter reading with the distance *d*?

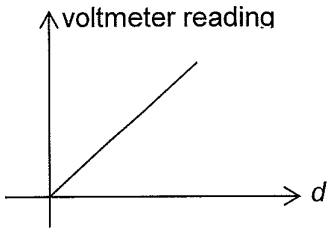
A



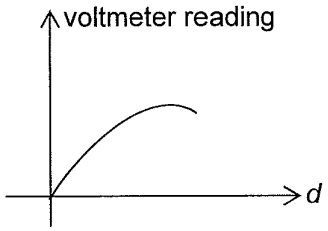
B



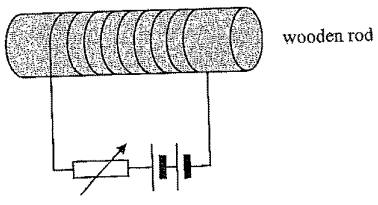
C



D



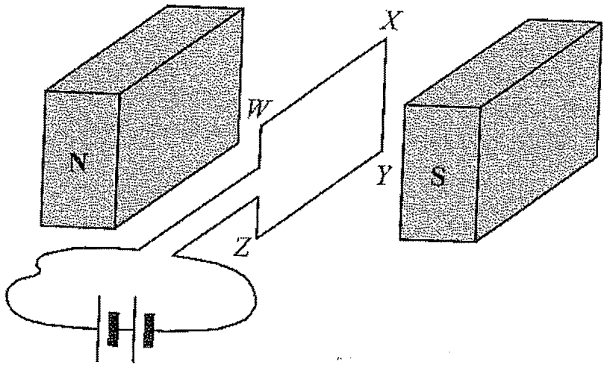
34 The figure shows a circuit with a solenoid wound on a wooden rod.



How can the magnetic field around the solenoid be increased?

A increase the resistance of the rheostat.
B increase the length of the wooden rod.
C increase the voltage of the battery.
D decrease the current in the circuit.

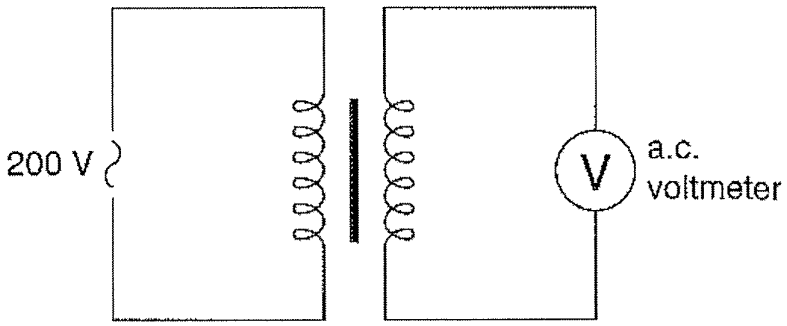
35 The diagram shows the position of the coil after it has rotated through 90° in a magnetic field.



Which of the following statements is true about the coil in this position?

A The part of the wire WX has no force acting on it.
B The part of the wire ZY has no force acting on it.
C There is no moment produced by both the parts of the wire WX and YZ.
D There is no current through the coil.

36 The diagram shows a transformer.

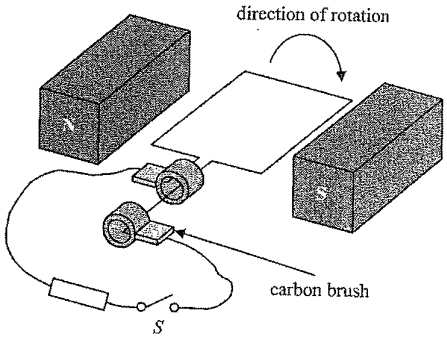


The number of turns in the secondary coil is 100, the primary voltage is 200 V and the voltmeter reads 10 V.

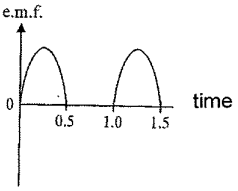
What is the number of turns in the primary coil?

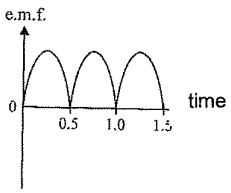
A 2000
B 1000
C 200
D 50

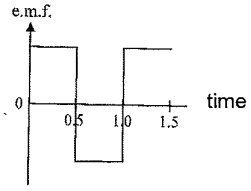
37 The diagram shows a simple generator.

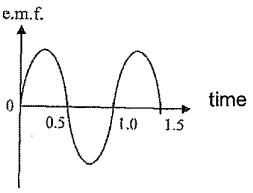


Which of the following shows the variation of the electromotive force (emf) generated with time?

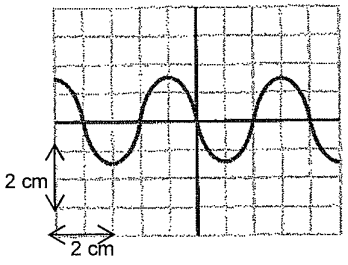
A.


B.


C.


D.


38 An electrical signal is fed into a cathode ray oscilloscope. The diagram shows the waveform displayed on the screen at a particular instant.



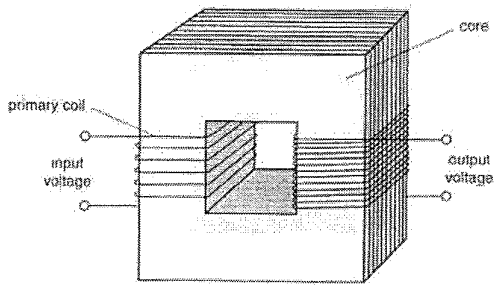
Y-gain control: 4 V cm^{-1}

Time base: 10 ms cm^{-1}

What is the peak voltage and the frequency of the signal?

	peak voltage / V	frequency / Hz
A	1.5	25
B	1.5	40
C	6.0	25
D	6.0	40

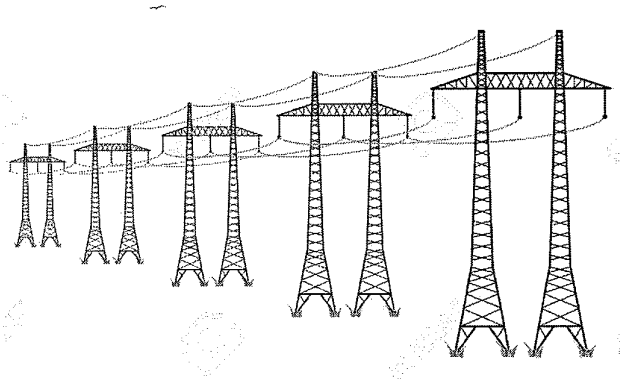
39 The core of a transformer is usually laminated.



What is the purpose of this design?

A improves the circulation of air in the core.
B increases the flux linkage in the coil.
C reduces heat loss in the core.
D reduces heat loss in the coil.

40 Electricity is transmitted at very high voltage over long distance.

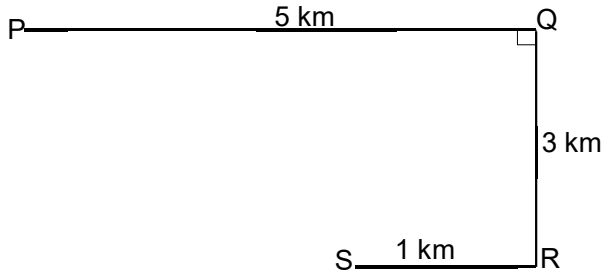


What is the reason for doing this?

A Electricity is transmitted faster along the cables when the voltage is high.
B Less energy is lost in the cables.
C It is safer to transmit electricity when the voltage is high.
D The cables do not require insulation.

End of Paper

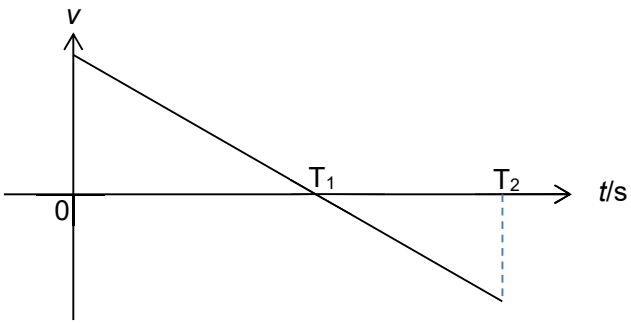
1 The diagram shows the path travelled by a car from P to S.



What is the displacement of the car?

A 5.0 km **B** 6.8 km **C** 8.2 km **D** 9.0 km

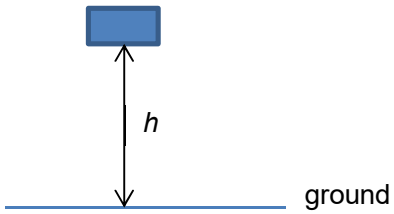
2 The velocity-time graph shown represents the motion of an object from $t = 0$ to $t = T_2$ s



Which of the following describes the motion of the object?

	From 0 to T_1	From T_1 to T_2
A	increasing acceleration	decreasing acceleration
B	uniform acceleration	decreasing acceleration
C	uniform deceleration	uniform deceleration
D	uniform deceleration	uniform acceleration

3 A brick, initially at rest, falls from a height of h and took 2.0 s to reach the ground.



The acceleration of free fall, g = 10 m/s^2.

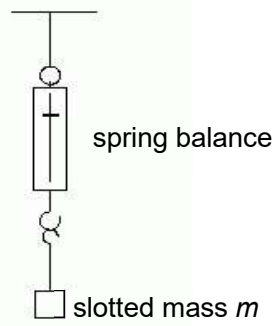
What is the height h of the brick?

A 10 m
B 20 m
C 30 m
D 40 m

4 Which statement about the net force acting on an object is correct?

A A net force is needed to keep an object moving with uniform velocity.
B A net force is needed to keep an object moving with increasing velocity.
C A net force is needed to keep an object moving with constant speed in a straight line
D Net force is zero if the object is slowing down.

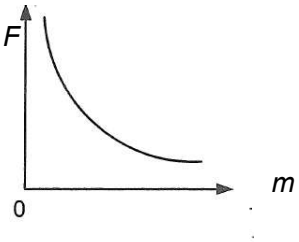
5 Different slotted masses *m* were hung on the end of a spring balance.



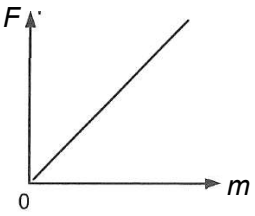
The gravitational force *F* acting on each of the mass was measured using the balance.

Which graph shows the relationship between the gravitational force, *F* and the mass *m*?

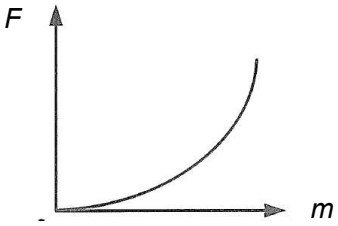
A



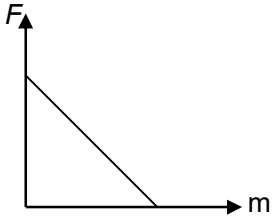
B



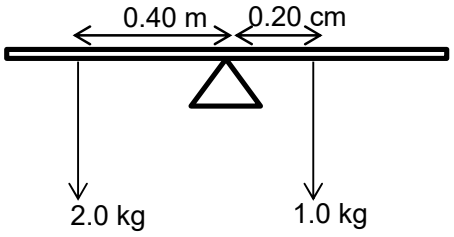
C



D



6 The diagram shows a uniform beam pivoted at the centre.



Two loads 2.0 kg and 1.0 kg are suspended as shown.

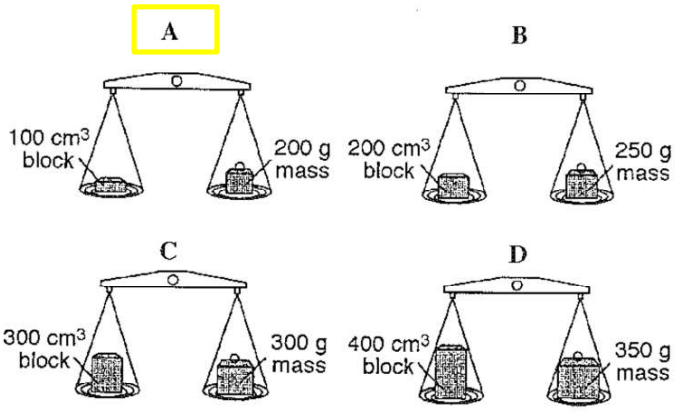
In order to balance the beam, a third load is added to the right of the pivot.

What is the mass of the load and how far from the pivot must it be attached?

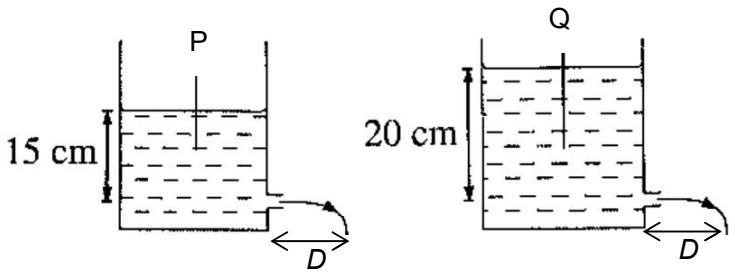
	Load/kg	Distance from pivot /m
A	1	0.40
B	2	0.10
C	2	0.30
D	3	0.10

7 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams.

In which diagram does the block have the greatest density?



8 The diagram shows two identical containers containing liquid P and liquid Q.



Water spurts out the same horizontal distance *D* when the depth of liquid P is 15 cm and the depth of liquid Q is 20 cm,

The density of liquid P is 2.00 g/cm^3.

What is the density of liquid Q in g/cm^3 ?

A 0.67 **B** 1.30 **C** 1.50 **D** 2.70

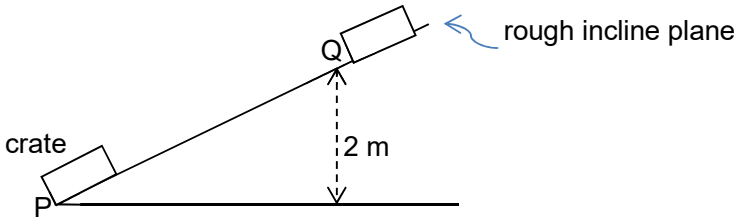
9 Mark holds a bowling ball in a fixed position.



Which statement regarding the work done on the ball is correct?

A The work done depends on the weight of the ball.
B The work done depends on mass of the ball.
C The work done is zero.
D The work done depends on the way he holds the ball.

10 A crate of mass 25 kg is pushed up a rough inclined plane.



The total work done on the crate from P to Q is 1500 J.

The gravitational field strength, g = 10 N/kg.

How much work is done against friction?

A 250 J
B 500 J
C 1000 J
D 2000 J

11 Sam of mass 75kg runs up to the top of a building in 5 minutes.
There are 260 steps, each 0.18 m high.

The gravitational field strength, g = 10 N/kg.

What is Sam's mechanical power?

A 11.7 W
B 65.0 W
C 117 W
D 7020 W

12 Two marbles, A and B are dropped to the ground from the roof of the school.

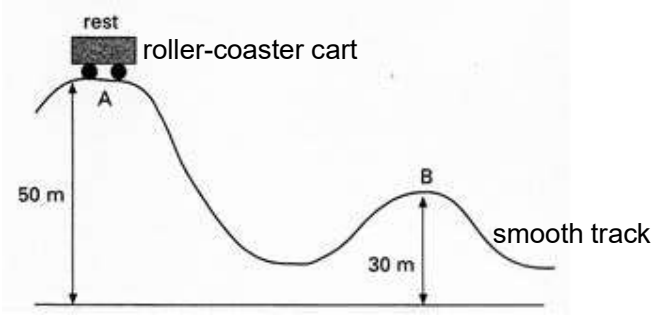
The mass of marble A is 2 times the mass of marble B.

Air resistance can be neglected.

What is the kinetic energy of marble A just before hitting the ground?

A the same kinetic energy as marble B.
B 2 times the kinetic energy of B.
C ½ the kinetic energy of B.
D 4 times the kinetic energy of B.

13 The diagram shows a roller-coaster cart starting from rest at point A and moving down a smooth track to past point B.



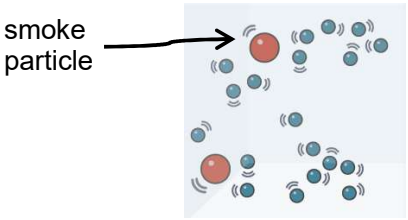
The gravitational field strength, g = 10 N/kg.

What is its speed at point B?

A 10 m/s
B 20 m/s
C 30 m/s
D 40 m/s

14 Illuminated smoke particles, suspended in air, are viewed with a microscope.

They are seen to move randomly.



What does the motion of smoke particles tell us about the molecular movement of air molecules?

A Air molecules are in continuous motion.
B Air molecules moves in clusters.
C Air molecules move just as fast as smoke particles
D Air molecules have the same amount of average kinetic energy at different temperature.

15 Which of the following about internal energy is correct?

A The temperature of a body is a measure of the total internal energy of the body.

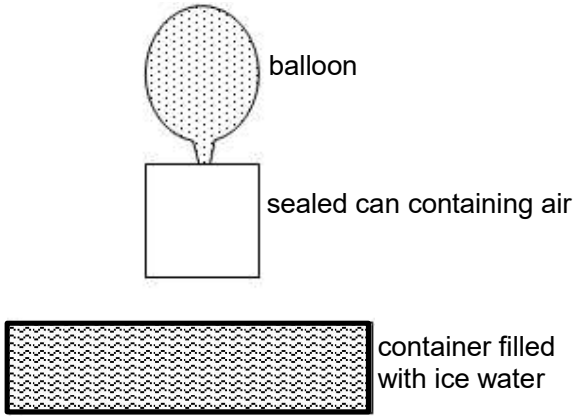
B The internal energy is a measure of the total kinetic and potential energy of the molecules in the body.

C Two bodies at the same temperature always have the same amount of internal energy.

D The internal energy of a body will increase if the temperature decreases.

16 Air was pumped into a balloon. The balloon is then connected to a sealed can.

The can is then placed in a container of ice water as shown in the diagram.



What will happen to the balloon when placed inside the container of ice water?

A The balloon will increase in size because the pressure inside the balloon decreases.

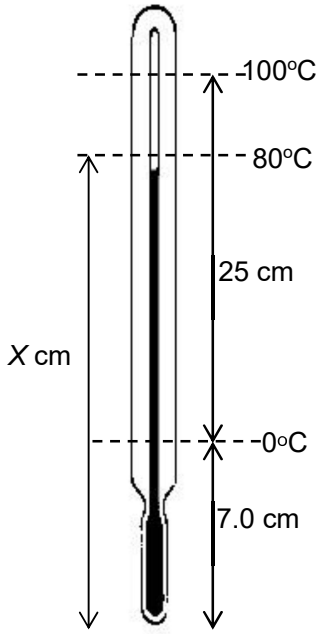
B The balloon will increase in size because the pressure outside the balloon decreases.

C The balloon will decrease in size because the pressure inside the balloon decreases.

D The balloon will decrease in size because the pressure outside the balloon increases.

17 When a thermometer was placed in pure melting ice the mercury thread has a length of 7.0 cm measured from the end of the thermometer bulb,as shown in the diagram.

When placed in steam from water boiling at 100°C the mercury thread increases by a length of 25.0 cm.

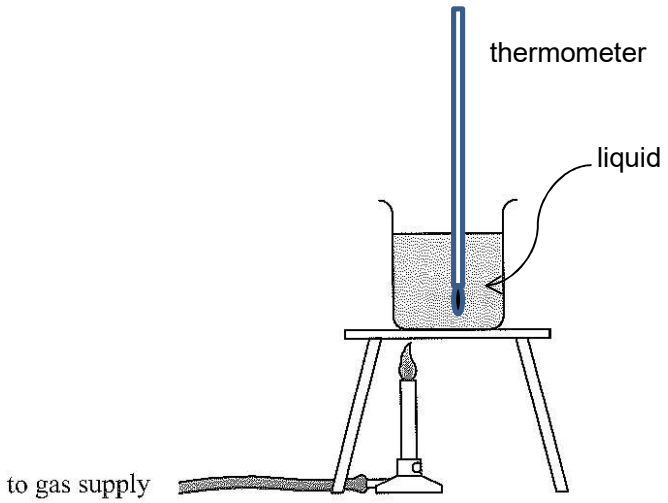


What is the length of the thread X in cm if the thermometer measures 80°C ?

A 20
B 21
C 27
D 28

18 The experimental setup shown is used to determine the specific heat capacities of four different liquids W, X, Y, and Z.

The bunsen burner is switched on for the same period of time for each substance of the same mass.



Neglecting energy loss to the surroundings, which of the following substances has the largest specific heat capacity?

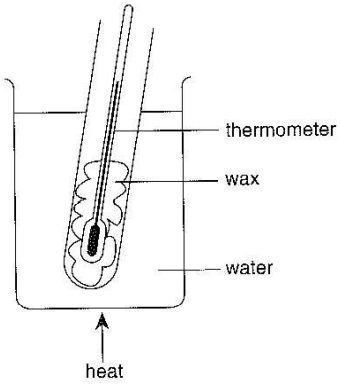
	Liquid	Rise in temperature /^{o}C
A	W	8
B	X	7
C	Y	6
D	Z	5

19 A piece of iron feels colder than a piece of wood when touched.

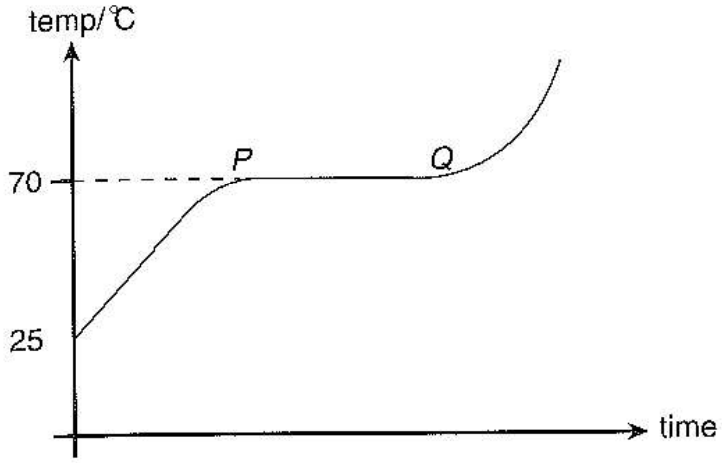
Which of the following statements explains why?

A Iron is a better thermal conductor than wood.
B Iron surface is smoother than wood.
C The temperature of the piece of iron is lower than the wood.
D Wood is a better thermal conductor than iron.

20 A piece of solid wax in a test-tube is heated in a water bath.



A graph of temperature-time graph is plotted.



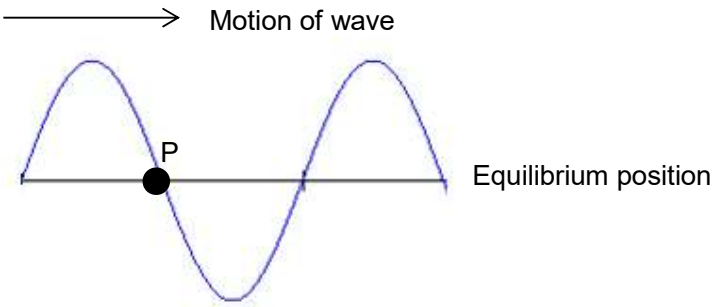
Which of the following statements is correct?

A The boiling point of wax is 70°C.
B Only liquid wax is present between P and Q.
C No thermal energy is absorbed by the wax between in the horizontal section PQ.
D There is an increase in internal energy of the wax in the horizontal section PQ.

21 Which of the following statements about wave motion is **incorrect**?

A Longitudinal waves are characterized by rarefactions and compressions.
B Longitudinal waves can be represented by displacement-distance graphs.
C Transverse wave transmit energy by transferring matter.
D Transverse waves are characterized by crests and troughs.

22 A transverse wave is travelling to the right as shown.

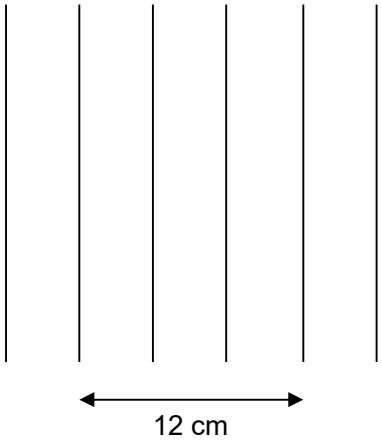


What is the direction of motion of P at this instant?

A momentarily at rest.
B moving downwards.
C moving to the right.
D moving upwards.

23 A ripple tank filled with water is used to study waves.

The diagram shows some wavefronts when viewed from the top.



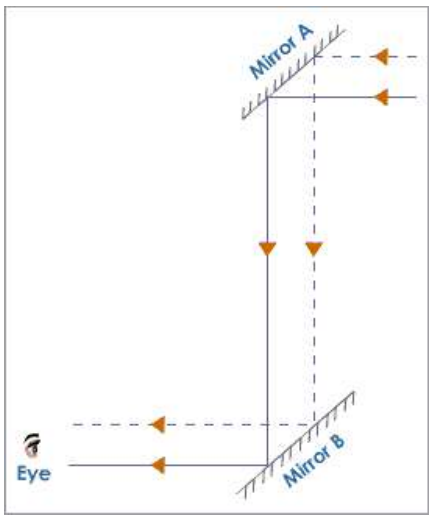
The frequency of the water waves is 20 Hz.

What is the wave speed in m/s?

A 0.20
B 0.40
C 0.80
D 1.20

24 A boy sees an object is through a periscope.

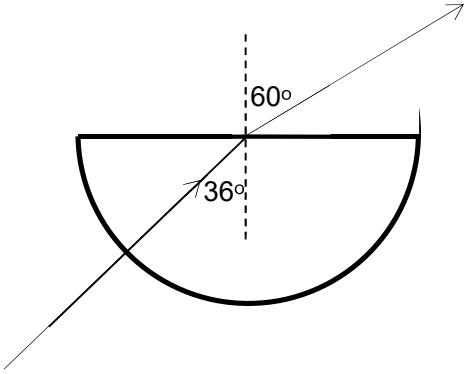
The periscope is made from 2 mirrors as shown in the diagram.



Which of the following statements is correct?

A The image is magnified.
B The image is laterally inverted.
C The image is virtual.
D The image is inverted.

25 A ray of light travelling in air enters a semi-circular glass block.



A student measures the angle of incidence 36° and the corresponding angle of refraction as 60°.

What is the refractive index of the glass block?

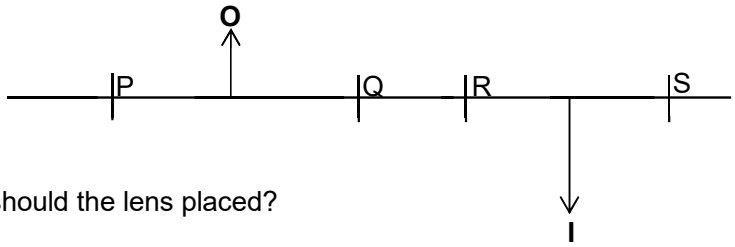
A 0.60
B 0.69
C 1.47
D 1.67

26 An object is placed at a distance between one focal length and two focal lengths from the centre of a converging lens.

Where is the image formed?

A on the opposite side of the object and formed more than two focal length from the lens.
B on the opposite side of the object and formed very close to the lens.
C on the same side as the object and formed more than two focal lengths from the lens.
D on the same side as the object and formed very close to the lens.

27 In the diagram **I** is the image of an object **O** formed by the lens.



Where should the lens placed?

Position of lens
A P
B Q
C R
D S

28 Which of the following electromagnetic waves has the longest wavelength?

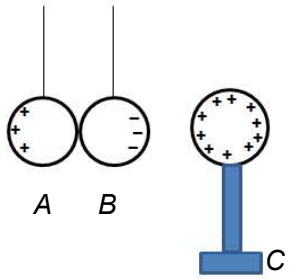
A infra-red radiation
B red light
C ultra-violet radiation
D violet light

29 *A* and *B* are two insulated uncharged metal spheres touching each other and hung on threads.

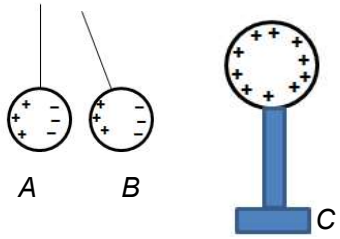
A positively-charged sphere C mounted on a plastic stand is brought near to *B*.

Which of the following diagrams shows the correct distribution of the charges on the spheres?

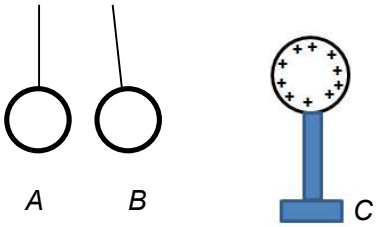
A



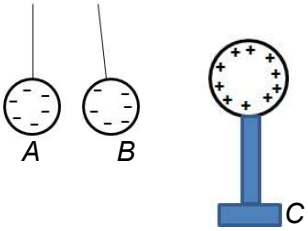
B



C



D

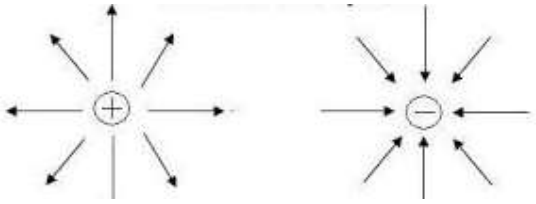


30 Two opposite charged spheres are shown in the diagram.

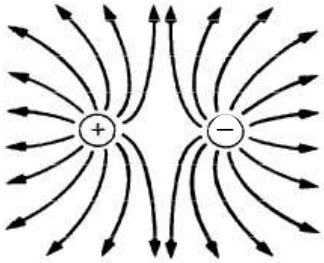


Which of the following diagrams best represent the resultant electric field between the 2 charged spheres?

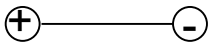
A



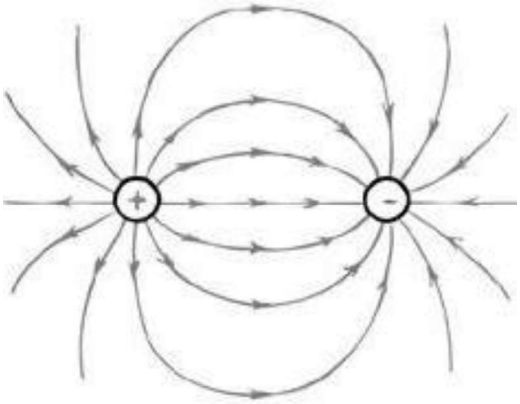
B



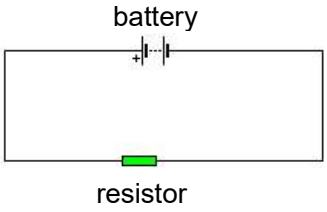
C



D



31 In the circuit 9 J of energy is supplied by a battery when 3 C of charges passes through it.



Which of the following statements is true?

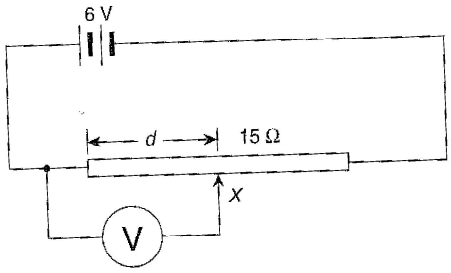
A The electromotive force of the battery is 3 V.
B The electromotive force of the battery is 27 V.
C The current flowing in the circuit is 1 A.
D The resistance in the circuit is 3 Ω.

32 A lamp is rated 100 W, 200 V.

What is the resistance of the lamp and the current drawn during normal operation?

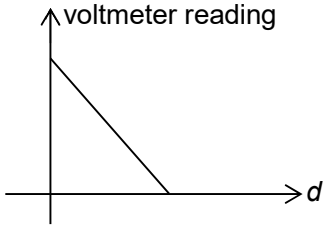
	Resistance / Ω	Current / A
A	2.0	2.0
B	200	0.5
C	200	2.0
D	400	0.5

33 A 6 V battery is connected across a 15 Ω uniform resistance wire as shown in the diagram.

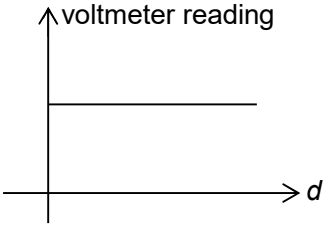


Which of the following graphs best represents the variation of the voltmeter reading with the distance *d*?

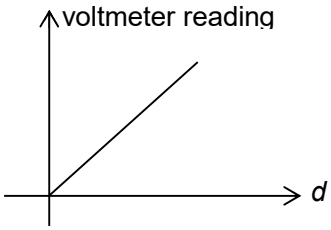
A



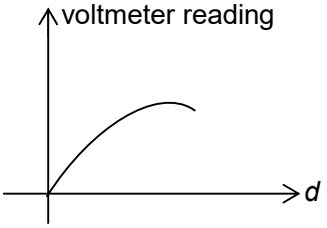
B



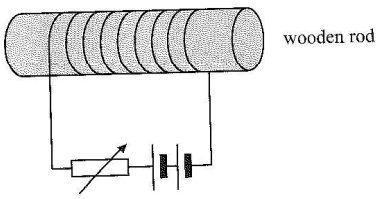
C



D



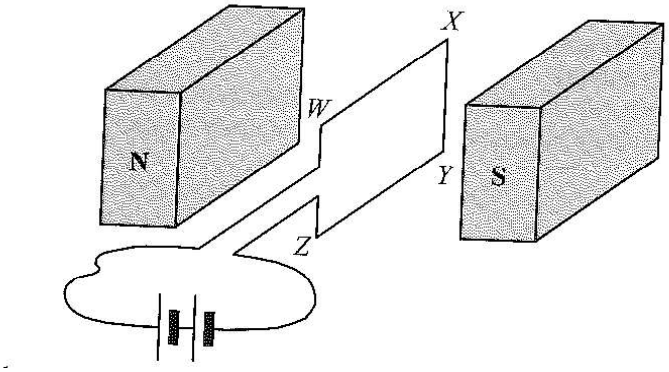
34 The figure shows a circuit with a solenoid wound on a wooden rod.



How can the magnetic field around the solenoid be increased?

A increase the resistance of the rheostat.
B increase the length of the wooden rod.
C increase the voltage of the battery.
D decrease the current in the circuit.

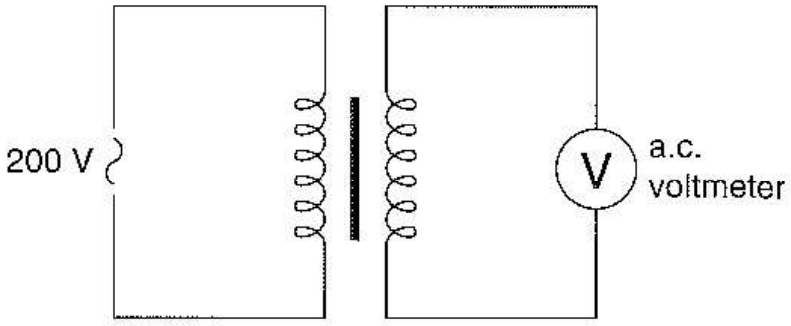
35 The diagram shows the position of the coil after it has rotated through 90° in a magnetic field.



Which of the following statements is true about the coil in this position?

A The part of the wire WX has no force acting on it.
B The part of the wire ZY has no force acting on it.
C There is no moment produced by both the parts of the wire WX and YZ.
D There is no current through the coil.

36 The diagram shows a transformer.

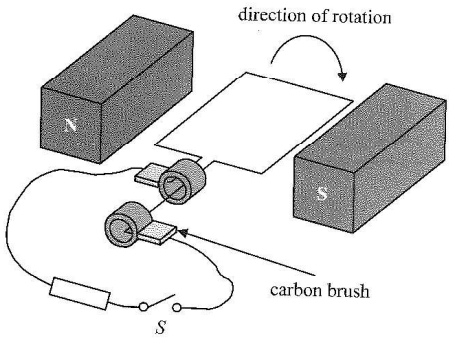


The number of turns in the secondary coil is 100, the primary voltage is 200 V and the voltmeter reads 10 V.

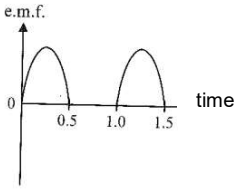
What is the number of turns in the primary coil?

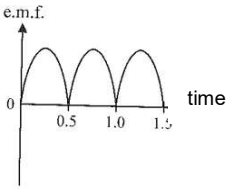
A 2000
B 1000
C 200
D 50

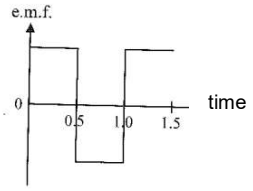
37 The diagram shows a simple generator.

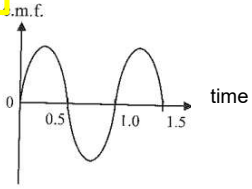


Which of the following shows the variation of the electromotive force (emf) generated with time?

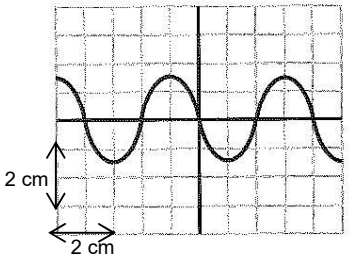
A.


B.


C.


D.


38 An electrical signal is fed into a cathode ray oscilloscope. The diagram shows the waveform displayed on the screen at a particular instant.



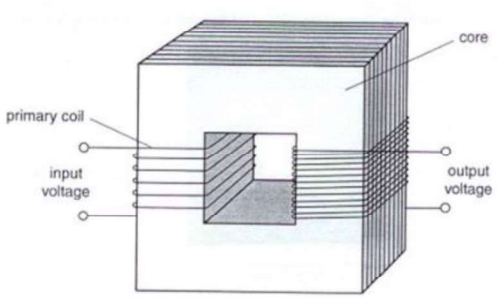
Y-gain control: 4 V cm^{-1}

Time base: 10 ms cm^{-1}

What is the peak voltage and the frequency of the signal?

	peak voltage / V	frequency / Hz
A	1.5	25
B	1.5	40
C	6.0	25
D	6.0	40

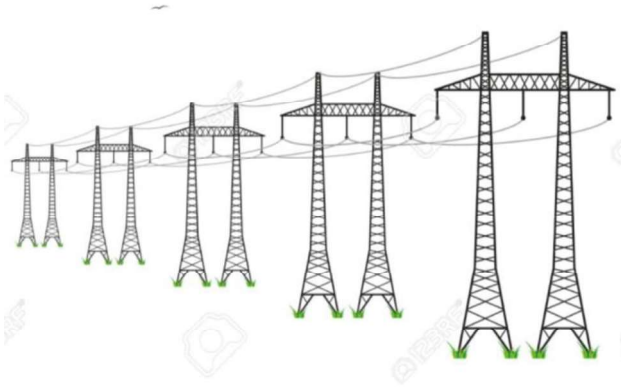
39 The core of a transformer is usually laminated.



What is the purpose of this design?

A improves the circulation of air in the core.
B increases the flux linkage in the coil.
C reduces heat loss in the core.
D reduces heat loss in the coil.

40 Electricity is transmitted at very high voltage over long distance.



What is the reason for doing this?

A Electricity is transmitted faster along the cables when the voltage is high.
B Less energy is lost in the cables.
C It is safer to transmit electricity when the voltage is high.
D The cables do not require insulation.

End of Paper

Section A [50 marks]

Answer **all** the questions in this section in the spaces provided.

1 It was a rainy day and Joanna looks out of her bedroom window. She noticed that drops of water were falling from a crack in the gutter as shown in Fig. 1.1.

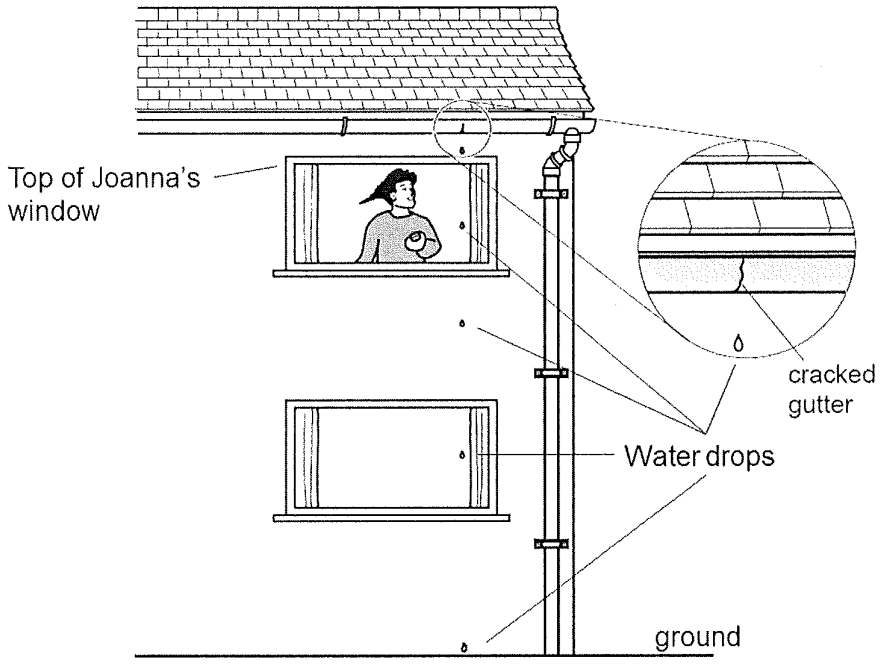


Fig. 1.1

Being a conscientious Physics student, she decided to find the time between one drop and the next.

She started her stopwatch when a drop came into view at the top of her window and count it as "zero". She stopped her stopwatch when the 20th drop came into view.

The reading on the stopwatch was 6.8 s.

(a) **(i)** Calculate the time interval between one drop and the next.

time = ... s [2]

(ii) Explain how timing 20 intervals instead of 1 interval will improve the accuracy of (a)(i).

.....

.....

.....

.....[1]

(b) Using Fig. 1.1, estimate the time for a drop to fall from the top of Joanna's window to the ground.

time = ... s [2]

(c) Fig. 1.1 shows that the drops get further apart as they fall closer to the ground.

Explain why this happens.

.....

.....

.....

.....[1]

2 A car is travelling on a straight level road. Fig. 2.1 shows two horizontal forces that act on the car. Force *P* is caused by air resistance and friction.

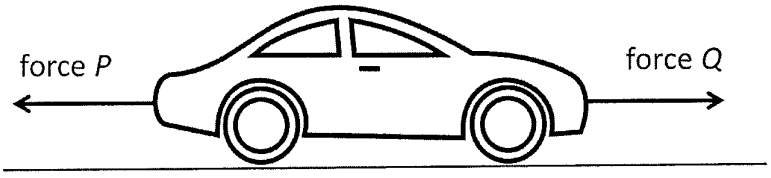


Fig. 2.1

(a) The forward force *Q* and the backward force *P* are equal.

Describe the motion of the car.

.....

.....

.....[1]

(b) The mass of the car is 1000 kg.

Force *Q* increases to 6000 N. This causes the car to accelerate initially at 1.5 m/s^2.

Determine the size of force *P*.

force P = ... [3]

(c) Force *Q* remains constant at 6000 N.

Explain why the acceleration of the car decreases as the car continues along the level road.

.....

.....

.....[2]

3 Fig. 3.1 shows a crane loading containers onto a ship.

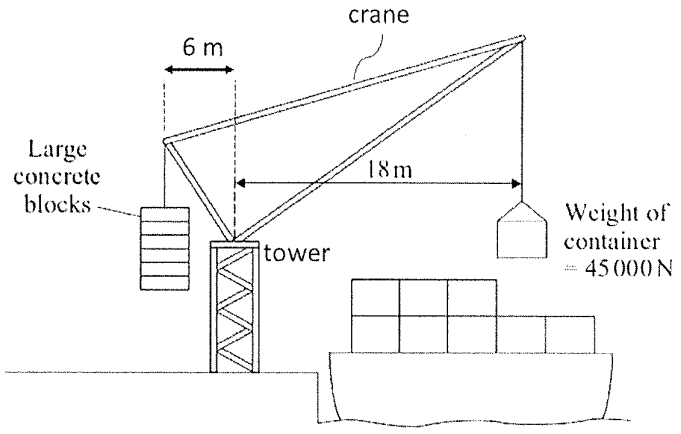


Fig. 3.1

(a) State the meaning of the term "*moment*" of a force. [1]

.....

.....

(b) Calculate the moment of the container about the tower shown in Fig. 3.1.

moment of container = ... [1]

(c) The large concrete blocks are meant to counterbalance the effect of the container.
Determine the weight of the concrete blocks.

weight of concrete blocks = ... [2]

(d) The weight of the crane is 10500 N and it sits on the tower.
Calculate the normal force exerted by the tower on the crane.

normal force = ... [2]

4 (a) Fig. 4.1 shows a paper cup in which hot tea is served at a fast-food outlet. The paper cup is constructed from two layers of cardboard as shown in Fig. 4.2.

Paper cup

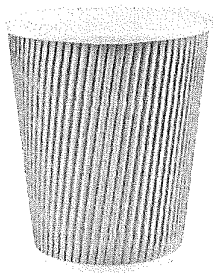
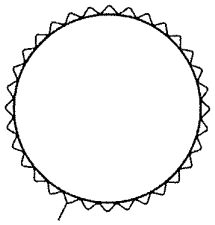


Fig. 4.1

Cross-section view of paper cup



Layer of corrugated cardboard glued onto a layer of cardboard, with air trapped between them

Fig. 4.2

It is covered with a thin plastic lid.

(i) State two ways in which thermal energy loss may be reduced by the lid.

1. .....

2. ..... [2]

(ii) State two reasons why the layer of corrugated cardboard enables a person to hold the cup with her fingers even though the tea inside the cup is at a high temperature.

1. .....

.....

2. .....

..... [2]

(b) (i) State the meaning of the term *heat capacity.*

.....

.....

.....[1]

(ii) At another fast-food outlet, tea may be served in 2 types of clay mugs. The 2 types of mugs have the same dimensions but have different heat capacities as they are made from different types of clay.

When hot tea is poured into either one of the 2 types of mugs, the temperature of the tea always drop due to absorption of some thermal energy by the mugs.

If type A mug has a higher heat capacity than type B, state and explain which mug causes the least drop in temperature of the hot tea.

mug: .....

explanation: .....

..... [2]

5 A stretched string is vibrating between two fixed ends. Fig. 5.1 shows how the string is vibrating.

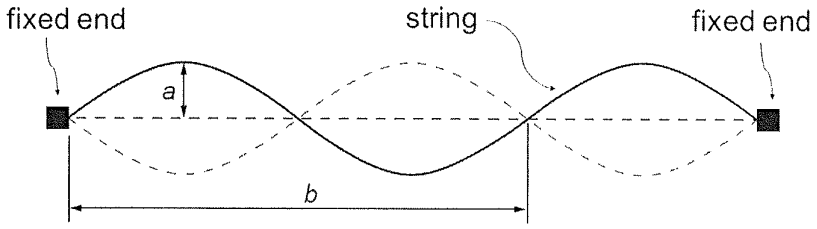


Fig. 5.1

(a) State the name of the quantity *a* and *b* labelled in Fig. 5.1.

a: ..... [1]

b: ..... [1]

(b) The string causes sound to be transmitted through the air.

(i) Describe how the string causes the sound.

.....

.....

.....

.....[2]

(ii) State what happens to the sound as the quantity, *a* decreases.

.....

.....[1]

(i) Describe and explain:

the movement of charges (if any) between the conducting sphere and the aluminium ball.

.....

.....

.....

.....[2]

(ii) Draw on Fig. 7.3 the final position of the aluminium ball and label it as d(ii). [1]

8 Fig. 8.1 shows a type of electric door lock.

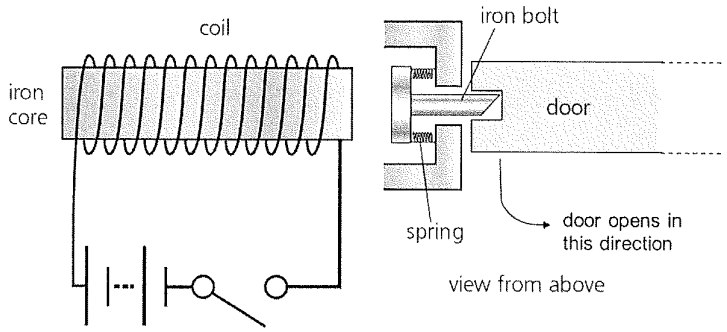


Fig. 8.1

The lock is closed when the position of the iron bolt is as shown in Fig. 8.1.

(a) Explain how closing the switch in the circuit allows the door to be opened.

.....

.....

.....[2]

(b) The door's iron bolt is changed, and a thicker, stronger piece of iron is used. When the switch is closed, the lock remains closed.

Without changing the bolt, suggest and explain two changes that could be made, each of which would open the lock.

Change number 1 and explanation:

.....

.....

..... [2]

Change number 2 and explanation:

.....

.....

..... [2]

6 Fig. 6.1 shows components in the electromagnetic spectrum.

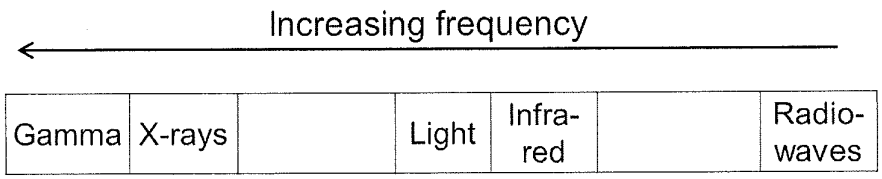


Fig. 6.1

Two components are missing from Fig. 6.1.

(a) Complete Fig. 6.1 by adding the names of these missing components. [1]

(b) State one property, other than speed, that all electromagnetic waves have in common.

.....

.....[1]

7 Fig. 7.1 shows a conducting sphere that has been given excess positive charges. The sphere is mounted on an insulating stand.

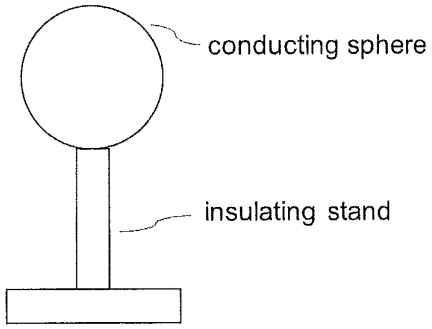


Fig. 7.1

(a) Draw in Fig. 7.1 the distribution of the excess charges on the conducting sphere. [1]

(b) Draw in Fig. 7.1 the electric lines of force produced by these excess charges. [1]

(c) An electrically neutral aluminium ball suspended from a nylon string is brought near to the conducting sphere. It is attracted towards the conducting sphere but NOT touching the sphere as shown in Fig. 7.2.

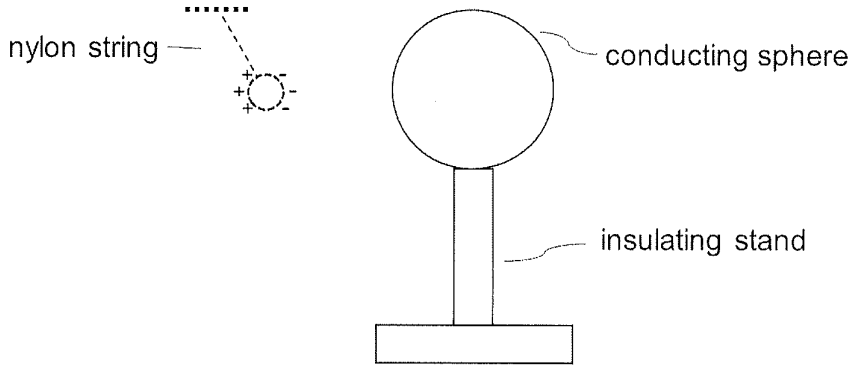


Fig. 7.2

Charges are induced on the aluminium ball as shown in Fig.7.2.

Explain, in terms of electric forces, why the aluminium ball is attracted towards the positively charged conducting sphere.

.....

.....

.....

.....

.....[2]

(d) The aluminium ball is moved to the right such that it is allowed to touch the conducting sphere as shown in Fig. 7.3.

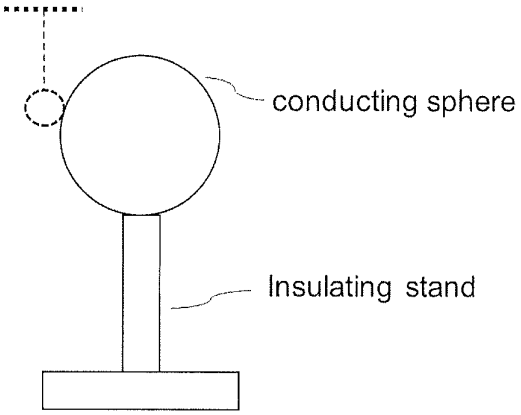


Fig. 7.3

9 Fig.9.1 shows a bar magnet on a wooden turntable which is rotated by an electric motor at a constant speed so that the ends of the magnet rotates pass the end, *P*, of a solenoid which is connected to a centre-zero galvanometer.

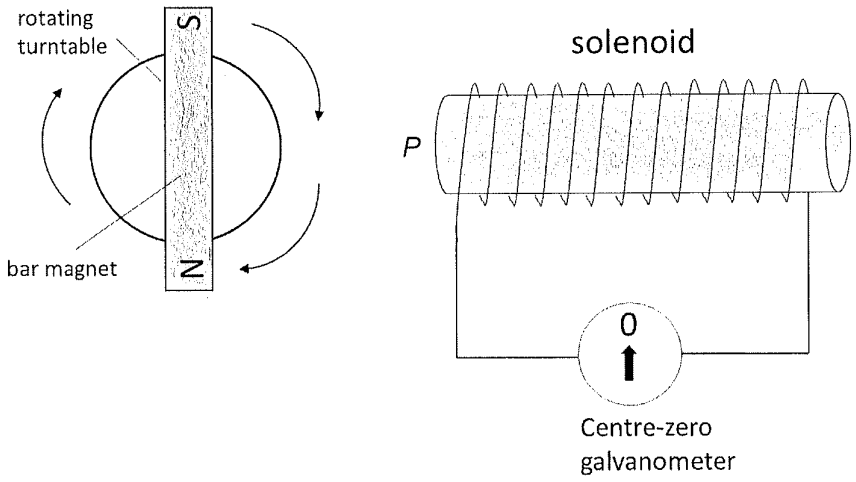


Fig. 9.1

(a) Describe the movement of the pointer of the galvanometer when the S-pole of the magnet rotates pass *P* of the solenoid.

.....

.....

..... [2]

(b) Describe the movement of the pointer of the galvanometer when the N-pole of the magnet rotates pass *P* of the solenoid.

.....

.....

..... [1]

(c) On the axes shown in Fig. 9.2, sketch the graph to show how the voltage reading shown on the galvanometer varies with time for a *complete rotation* of the turntable. [2]

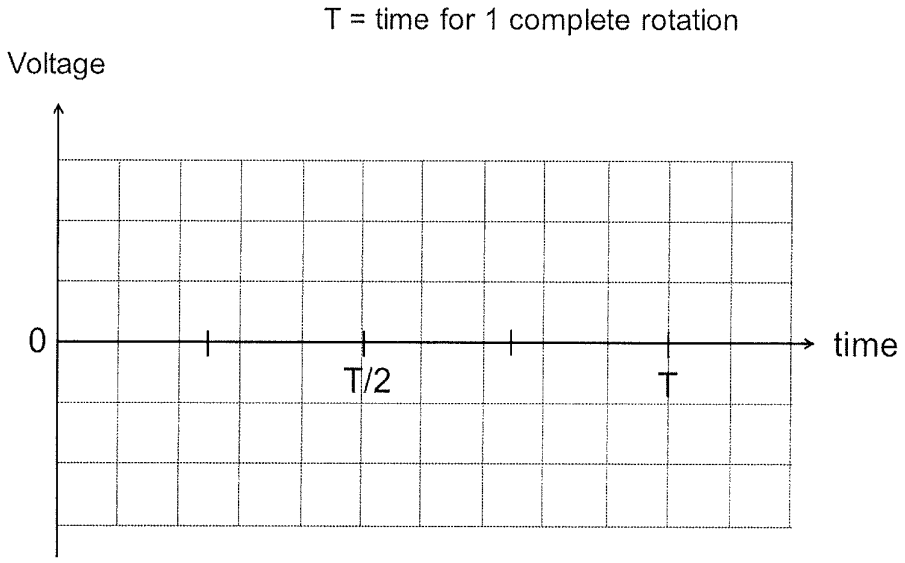


Fig. 9.2

Class | Index Number

Name : _____

Section B (30 marks)

Answer **all** the questions in this section in the spaces provided. Answer only one of the two alternative questions in Question 12.

10 Ultrasound waves are high frequency sound waves that can pass through the human body to produce medical images.

When ultrasound waves are directed at human skin, most of the waves are reflected. In fact, ultrasound waves are reflected at the boundaries of organs.

When a material known as 'coupling agent' is placed on the skin, most of the ultrasound waves is able to pass through the skin and into the body. The coupling agent used is usually a gel. Water is a good coupling agent. However, water is not used as it will run off the surface of the skin.

(a) A scientist tests different coupling agents in an experiment.

Fig 10.1 shows a coupling agent being tested.

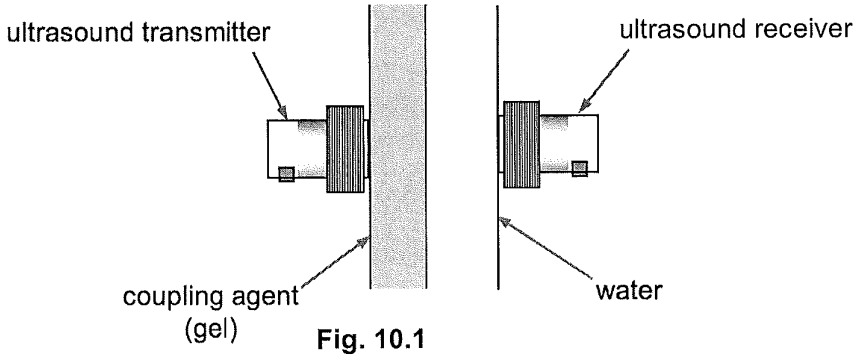


Fig. 10.1

The width of the coupling agent and the layer of water is kept constant by the scientist during the experiment.

The table in Fig. 10.2 shows the results for coupling agents A, B, C, D, E, F and G. They were tested using ultrasound of two different frequencies, 1.1 MHz and 3.0 MHz. The results show how well the waves pass through the coupling agent compared with how they pass through water.

The results are shown as a percentage. 100% means that the coupling agent behaves the same as water.

coupling agent	coupling agent percentage using 1.1 MHz / %	coupling agent percentage using 3.0 MHz / %
A	108	100
B	105	100
C	104	98
D	100	98
E	98	90
F	89	89
G	88	92

Fig. 10.2

(i) State which coupling agent allows the most ultrasound to pass through at both frequencies.

[1]

.....

(ii) State which coupling agent perform the poorest in allowing ultrasound to pass through.

.....

[1]

.....

Fig. 10.3 shows an ultrasound device sending ultrasound waves into a patient's body.

The waves enter the skin and body tissue and move towards a kidney. The body tissue is mainly made of water.

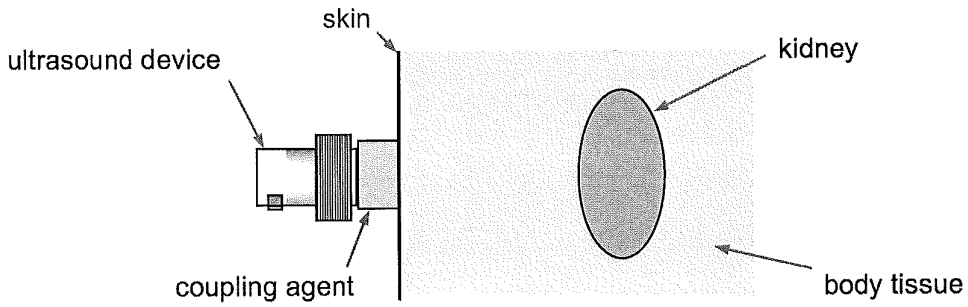


Fig. 10.3

The ultrasound device also detects ultrasound waves and is connected to an oscilloscope.

Fig. 10.4 shows the trace on the screen of the oscilloscope. The intensity of the ultrasound waves is measured in terms of voltage, μV.

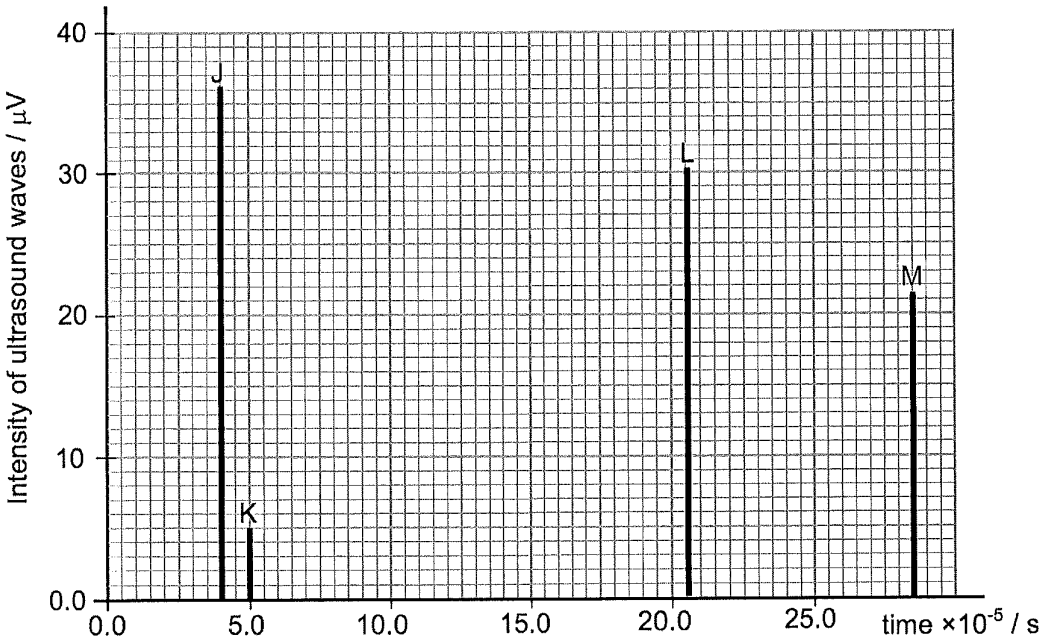


Fig. 10.4

J represents the intensity of the waves emitted by the ultrasound device.

(b) From Fig. 10.3 and the information in Fig. 10.4, explain the presence and intensity of

(i) K

.....

.....

[2]

(ii) L

.....

.....

[1]

(iii) M

.....

.....

[2]

(c) The speed of ultrasound waves in the body is 1500 m/s.

Use the information from Fig. 10.4 to calculate the maximum width of the kidney.

maximum width = ... [3]

11 (a) Fig 11.1 shows a piston supported by some gas trapped in a cylinder.

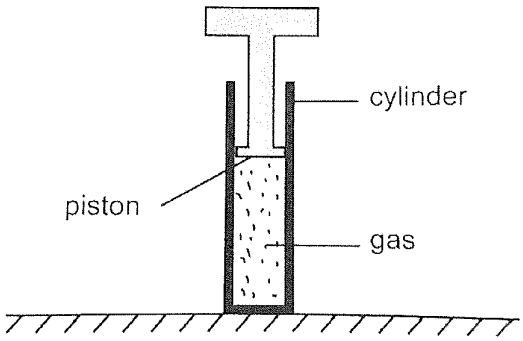


Fig 11.1

(i) Define pressure.

.....

.....[1]

(ii) The cross sectional area of the piston is 4.0×10^{-4} m^2. The pressure of the gas inside the cylinder is 1.5×10^5 Pa. Atmospheric pressure is 1.0×10^5 Pa. The gravitational field strength g is 10 N/kg.

Determine the mass of the piston.

mass = ...[3]

(b) Fig 11.2 shows air in another cylinder at room temperature. The piston is free to move in and out of the cylinder.

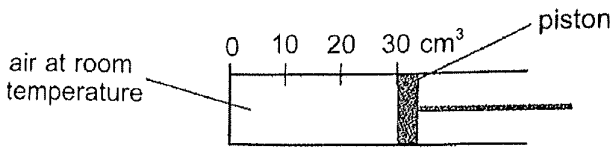


Fig 11.2

The cylinder is placed in a very cold freezer. The piston is observed to move inwards and comes to rest as shown in Fig 11.3.

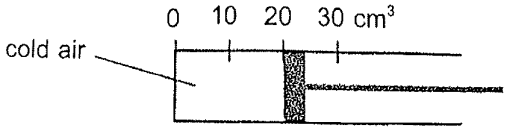


Fig 11.3

(i) The pressure of air in the cylinder in Fig 11.2 is the same as the pressure of the air in the cylinder in Fig 11.3.

I. Explain in terms of the movement of particles, how the air in the cylinder exerts a pressure.

.....

.....

.....

..... [2]

II. Explain why the pressure of the air in the cylinder remains unchanged in both instances in Fig 11.2 and Fig 11.3.

.....

.....

.....

..... [2]

(ii) Explain what causes the piston to move inwards as the cylinder is cooled when placed in a freezer.

.....

.....

.....[2]

EITHER

12 (a) Fig. 12.1 shows a circuit with an ammeter reading of 0.50 A.

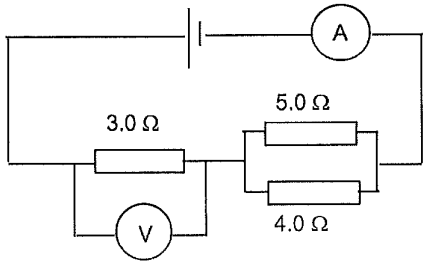


Fig 12.1

(i) Calculate the total resistance of the circuit.

total resistance = ... [3]

(ii) Determine the reading of the voltmeter.

voltmeter reading = ... [2]

(b) Fig 12.2 shows a graph of potential difference against current of two resistance wires A and B.

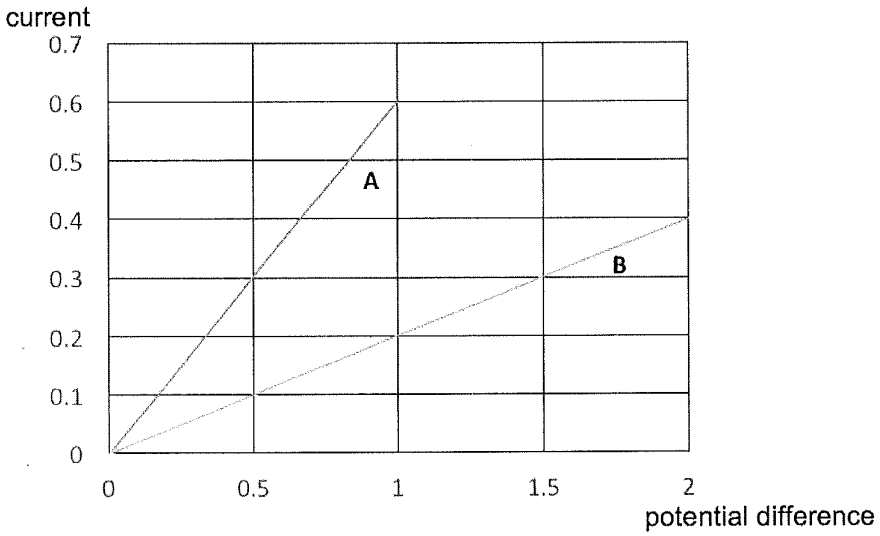


Fig 12.2

(i) Define the term "electrical resistance" of a resistance wire.

.....

.....[1]

(ii) From the graph in Fig 12.2, state and explain which resistance wire has a higher electrical resistance.

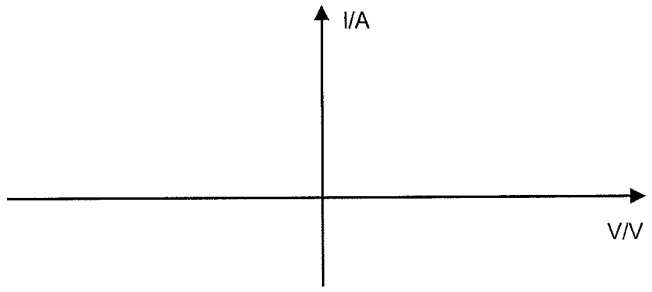
.....

.....

.....[2]

(c) A semi-conductor diode is a non-ohmic conductor that allows current to flow in one direction only.

In Fig 12.3, sketch the graph of a semi-conductor diode.



[2]

Fig 12.3

OR

(a) Fig 12.3 shows a typical marking for electrical appliances, usually located on the casing.

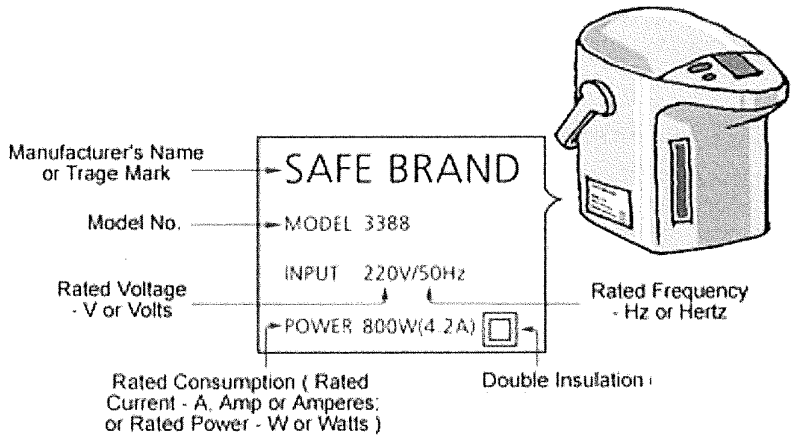


Fig 12.3

(i) State and explain why it is safer to use a 3-pin plug instead of a 2-pin plug.

.....

.....[2]

(ii) An electrical appliance using a 2-pin plug is usually double insulated. State the meaning of the term "double insulated" and explain its purpose in terms of electrical safety.

.....

.....[2]

(iii) "An electrical appliance of rated voltage less than 200 V must not be connected directly to the 230 V a.c. household power supply."

Explain the warning in terms of power.

.....

.....[1]

(b) A lamp with a rating of "230 V, 500 W" is plugged into a socket of a household unit. The voltage of the mains supply is 230 V. The cost of electrical energy is $0.90 per kWh.

(i) Determine and explain the most suitable fuse rating for this lamp from the following list: 1 A, 5 A & 13 A.

.....

.....

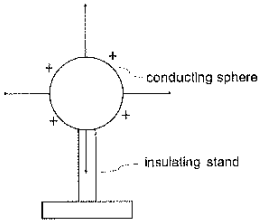
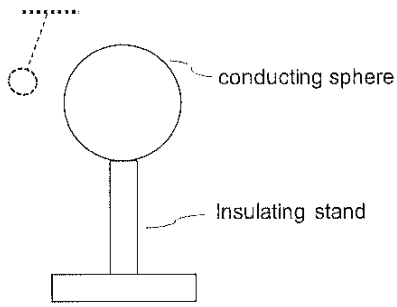
.....[3]

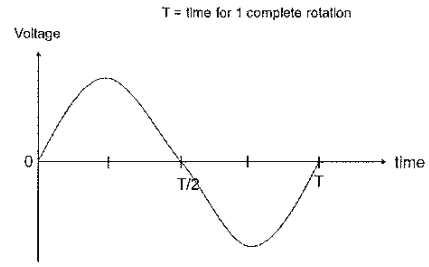
(ii) Calculate the cost of using this lamp for 3 hours.

cost = ...[2]

End of Paper

		Physics Answers – Paper 2A Prelims 2016	
1	a(i)	6.8s/20	C1
		0.34 s	A1
	(ii)	Reduce error due to human reaction time. [more accurate not accepted as it is already stated in the question]	B1
	b	4 × (a) OR (4 and a bit) × (a) OR 5 × (a) ecf 1.36s 1.36 s < any value < 1.70 s 1.70s	C1
		1.36 – 1.70 (s)	A1
	c	drops accelerate/fall faster / increase speed / distance increase per unit time	B1
		due to gravitational force acting on drop	
2	a	Moves with constant / uniform velocity / speed	B1
	b	Resultant force, F = ma	C1
		= 1000 x 1.5	
		= 1500 N	
		F = Q - P	B1
		1500 (ecf) = 6000 - P	
		P = 6000 – 1500	
		= 4500 N	A1
	c	Air resistance increases as the car's velocity increases.	B1
		Resultant force decreases.	B1
3	a	Moment = turning effect of force about a fixed point/pivot OR Formula: F x perpendicular distance	B1
	b	Moment = 45000 x 18 = 8.1×10^5 Nm (81000 Nm)	B1
	c	Taking moments about the tower: Anticlockwise moments = clockwise moments W x 6 = 81000 where W = weight of concrete blocks W = 1.35×10^5 N (13500 N)	B1 A1
	d	normal force exerted by tower on crane = downward force on tower normal force = 45000 + 13500 + 10500 = 6.90×10^4 N	B1 A1
4	a (i)	Radiation, convection, evaporation - any 2	B1, B1
	(ii)	Cardboard is a poor conductor or good insulator Air is a poor conductor or good insulator Reduced surface area in contact with fingers ANY 2	B1 B1
	b(i)	Heat or thermal energy to raise or lower or change temperature of a **body** OR heat or energy to heat up a **body** by 1 C or by 1K or by unit temperature. **Substance** not accepted	B1
	(ii)	Mug with low thermal / heat capacity. less heat needed to raise temperature OR absorbs less heat	B1 B1
5	a(i)	amplitude	B1
	(ii)	Wavelength	B1

	b(i)	String moves air / vibrates air Backwards and forwards OR Up & down OR Compressions & rarefactions	M1 A1
	(ii)	Gets quieter OR softer OR less loud.	B1
6	(a)	Ultraviolet, microwaves	B1
	(b)	Do not need medium to transmit.	B1
7	(a) (b)	 At least 4 charges and 4 lines of electric force (originate from centre of sphere)	B1, B1
	c	Negative charges nearer to sphere - B1 Attractive force stronger than repulsive force - B1	B1 B1
	d(i)	some negative charges / electrons move from aluminium ball to conducting sphere due to attraction of net positive charges on sphere. [unlike charges attract without referring to net positive charge on sphere NOT accepted.]	B1 B1
	d(ii)		B1
8	a	Current flows through coil, coil becomes electromagnet (energised), attracts iron bolt. iron bolt moves to the left, allowing door to be opened.	B1 B1
	(b)	ANY 2 increase current (by increasing voltage of supply) – stronger electromagnet, stronger attraction on bolt. increase number of turns on coil – increase strength of electromagnet, stronger attraction on bolt. move electromagnet / solenoid / iron core nearer to bolt – stronger magnet field near to bolt, attraction on bolt.	B2 B2

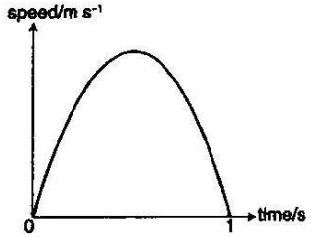
9	a	The pointer deflects momentarily <u>to one side</u> and then <u>back to zero</u>.	B1 B1
	b	Pointer shows the same deflection as in (a) but in the opposite directions.	B1
	c	 Shape (sine curve or any curve that is "sine" like – B1 Curve peak at T/4 (either up or down) and at 3T/4 (opposite to T/4) - B1	B1 B1

Answer Scheme (Sec 4 Prelim Exam 2016)
Section (B)

10	**(a)**	**(i)**	A	B1
		(ii)	performs the same for both frequency but poorer/worse off then water	B1
	(b)	**(i)**	reflection from skin	B1
			very little reflection, so small intensity/peak	B1
		(ii)	large reflection from front of kidney	B1
		(iii)	reflection from back of kidney	B1
			smaller intensity/peak due to absorption of ultrasound in kidney OR further from source OR front of kidney already reflected a lot, so there is now less to be reflected	B1
	(c)	Δt	$= 28.5 \times 10^{-5}$ s $- 20.5 \times 10^{-5}$ s	
			$= 8.0 \times 10^{-5}$ s (e.c.f.)	B1
		width	$= ½ \times 1500$ m/s $\times 8.0 \times 10^{-5}$ s	M1
			= 0.060 m OR 6.0 cm	A1
11	**(a)**	**(i)**	Pressure is the ratio of force per unit area	B1
		(ii)	Wt of piston/Area + Patm= P gas	
			Mg/A + Patm = P	C1
			$M = (1.5 \times 10^5 - 1.0 \times 10^5) \times 4 \times 10^{-4}/10$	C1
			= 2.0 kg	A1
11	**(b)**	**(i)**		
	A		Molecules collide with walls of cylinder and exert force on the wall.	B1
			The average force exert by air is the pressure	B1
	B		As temp decreases, vol of air decreases. The number of collisions hitting wall per unit time increases correspondingly.	B1 B1
		(ii)	The pressure difference between cold air and atmospheric pressure pushes piston in.	B1
12	**(a)**			
	(i)		$Rt = (1/5 + 1/4)^{-1}$	C1
			+ 3	C1
			= 5.2 Ω	A1
	(ii)		V=IR = 3 x 0.5	C1
			=2.1 V	A1

	(b)		
	(i)	Ratio of PD across component to I flowing thru it	B1
	(ii)	From the graph, wire B has the lower gradient and hence higher R.	B1
		1/R is the gradient of I V graph.	B1
	(c)	Correct shape of graph	B1
		Forward bias on positive side of x axis	B1
OR	**(a)**		
	(i)	3 pin plug has earth wire	B1
		that channels current to earth in event of appliance fault.	B1
	(ii)		
		Casing is made of insulator	B1
		Hence stray wire will not be able to conduct current out of casing to user.	B1
	(iii)		
		Large current will be drawn into appliance, overheating it.	B1
	(b)		
	(i)	Indicates the voltage that appliance is designed to work with at certain current.	B1
	(ii)	I=P/V	
		=500/230	M1
		=2.17 A	
		Therefore 5 A fuse.	A1
		Exceed 1A hence will blow. 13 A fuse is too high a rating to prevent any current surge.	B1
	(c)	Cost = 0.5kW x 3 x 0.9	C1
		= $1.35	A1

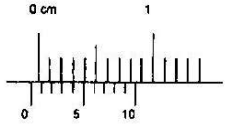
1 The graph shows the speed-time graph of a pendulum bob oscillating from a point.



What is the period of the oscillation of the pendulum bob?

A 5 s **B** 1.0 s **C** 1.5 s **D** 2.0 s

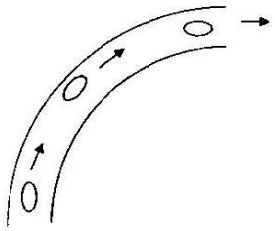
2 The diagram below shows part of a vernier scale when the jaws of the vernier calipers are closed.



What is the zero error of the vernier calipers shown?

A +0.04 cm **B** -0.04 cm **C** +0.06 cm **D** -0.06 cm

3 A car travels at *constant speed* round a bend.

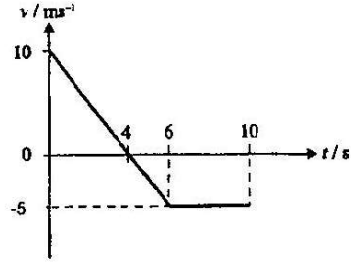


Which of the following statements about the motion of the car is **not** correct?

A The car is accelerating.
B The velocity of the car is uniform.
C The displacement of the car increases.
D The distance covered per unit time by the car is constant.

CWSS16

4 The velocity-time graph below shows the motion of an object moving in a straight line.



Which of the following statements is/are true?

1. The object is stationary at 4 s.
2. The object is 5 m behind the starting point at t = 6 s.
3. The object is furthest away from its starting point at t = 10 s.

A 1 only
B 1 and 2 only
C 1 and 3 only
D All of the above

5 The engine of an 800 kg sports car exerts a constant forward force of 500 N on the car.

When the parachute is opened, the car decelerates at 2.5 ms^{-2} while the engine continues to provide the forward force of 500 N.

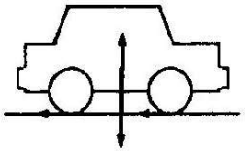


What is the tension in the cord at this instant? (Assuming that there is no other resistive force.)

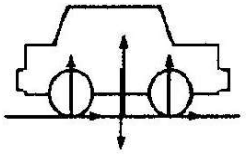
A 500 N
B 1500 N
C 2000 N
D 2500 N

6 A car starting from rest accelerates towards the right without skidding along a horizontal road. Which diagram below illustrates the forces acting on the car?

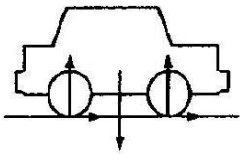
A



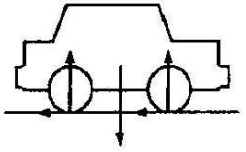
B



C



D

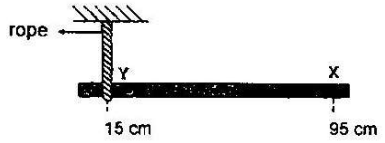


7 The gravitational field strength of a particular planet is 5 N/kg. On earth, the gravitational field strength is 10 N/kg. A rock weighs 80 N on that planet.

What would be its weight on earth?

A 10 N B 16 N C 80 N D 160 N

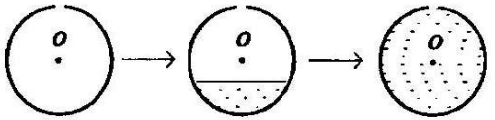
8 In the diagram below, the uniform metre rule is pivoted at **X** and held up at the point **Y** by a rope.



Given that the weight of the metre rule is 4.0 N, calculate the tension in the rope that is needed to ensure that the ruler stays horizontal.

A 1.8 N B 2.3 N C 3.1 N D 5.1 N

9

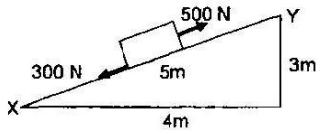


The above diagram shows a uniform hollow metal sphere with a small opening on top. *O* is the position of the centre of gravity of the hollow sphere.

What will happen to the position of the centre of gravity of the system as the sphere is being slowly filled with oil from the opening?

A It will remain unchanged throughout the process.
B It will fall gradually, and its final position will be below *O*.
C It will rise gradually and its final position will be above *O*.
D It will fall gradually at first and then rise to its original position.

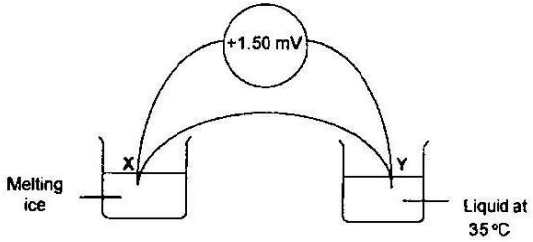
10 A force of 500 N is applied to a box to move it up the ramp as shown. The friction acting on the box is 300 N.



How much work is done against friction?

A 300 J B 1 200 J C 1 500 J D 3 000 J

11 The diagram shows a thermocouple thermometer when junctions X and Y are placed in melting ice and in a liquid at 35°C respectively.



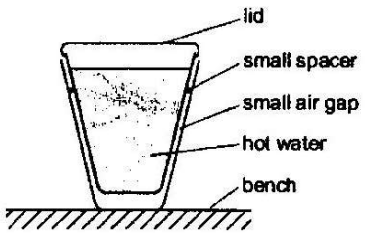
What is the voltmeter reading when junction X is removed and placed in boiling water instead?

A -2.79 mV
B -1.92 mV
C +1.50 mV
D +2.79 mV

12 Which of the following best explains steam point?

A The temperature of pure water when it boils at a pressure of 1 atm.
B The temperature of pure water just after it boils at a pressure of 1 atm.
C The temperature of steam from pure boiling water at a pressure of 1 atm.
D The temperature of the air above pure boiling water at a pressure of 1 atm.

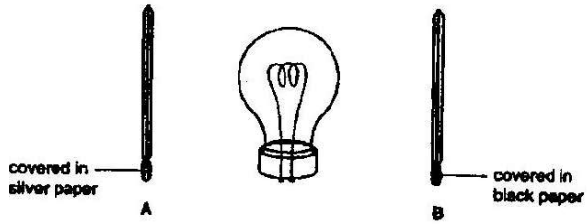
13 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top, as shown.



Which statement is correct?

A No heat passes through the sides of either cup.
B The lid is used to reduce heat loss by convection.
C Heat loss by radiation is prevented by the small air gap.
D The bench is heated by convection from the bottom of the outer cup.

14 The experiment is set up using a light bulb and two thermometers, **A** and **B**. The light bulb is switched on. After two minutes the thermometers show an increase in temperature. Thermometer **B** shows a greater increase in temperature.



Which of the following is/are **true** statements about this experiment?

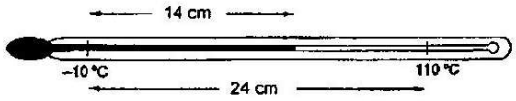
1. The silver paper is a better reflector of radiation.
2. The black paper is a better absorber of radiation
3. Heat is transferred to the thermometers mainly by radiation.

A 2 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

15 What happens when a liquid is being heated at its boiling point?

A An increase in molecular size
B An increase in molecular spacing
C An increase in the total number of molecules
D An increase in the average kinetic energy of the molecules

16 The figure below shows a mercury thermometer. The distance between the -10°C and 110°C markings is 24 cm.



What temperature does the thermometer read?

A 48 °C
B 58 °C
C 60 °C
D 70 °C

17 Which statement is true about water molecules at 70 °C?

A There are forces between the molecules and no molecules have enough energy to escape the liquid.
B There are forces between the molecules and some molecules have enough energy to escape the liquid.
C There are no forces between the molecules and no molecules have enough energy to escape the liquid.
D There are no forces between the molecules and some molecules have enough energy to escape the liquid.

18 The diagram below shows a frying pan.



The table shows three solid materials with their respective specific heat capacities.

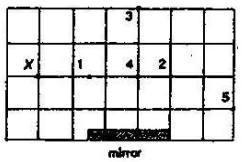
Solid Material	*Specific Heat Capacity (J/kg°C)*
K	440
L	920
M	4250

Assuming all these materials have reasonably high melting points, which materials are best suited to make the base and handle?

	Base	Handle
A	K	M
B	L	M
C	M	K
D	M	L

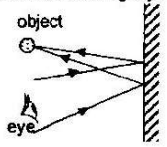
19 A person stands at point *X* as shown in the diagram.

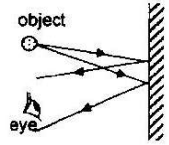
Which of the pins (1, 2, 3, 4 and 5) will the person be able to see in the mirror?

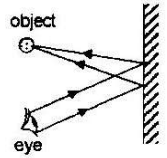


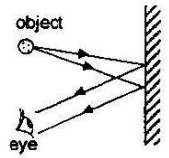
A 1, 3
B 2, 3 and 4
C 2, 4
D 2, 4 and 5

20 Which of the following ray diagrams is correct?

A


B


C


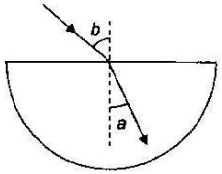
D


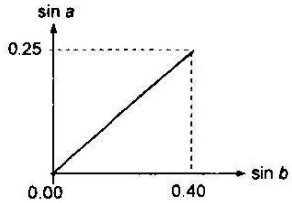
21 A ray of light travels with speed v_1 through medium 1 and then passes into another medium 2, where it travels at speed v_2. The refractive index for medium 1 and medium 2 are n_1 and n_2 respectively.

Which row in the following table correctly compares the speeds and refractive indices for each medium?

	Speed of light	Refractive index
A	v_2 is less than v_1	n_1 is less than n_2
B	v_2 is less than v_1	n_2 is same as n_1
C	v_2 is greater than v_1	n_2 is same as n_1
D	v_2 is greater than v_1	n_1 is less than n_2

22 A light beam is incident into a semi-circular glass block and refracted out as shown. A graph of sin *a* against sin *b* is plotted as shown.



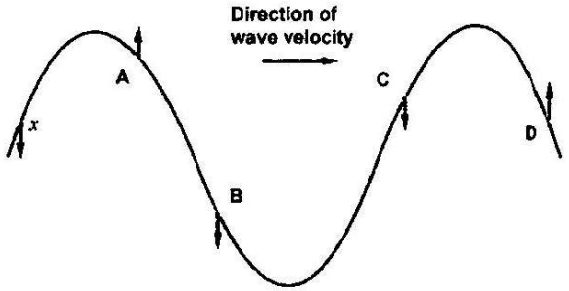


What is the critical angle of the glass?

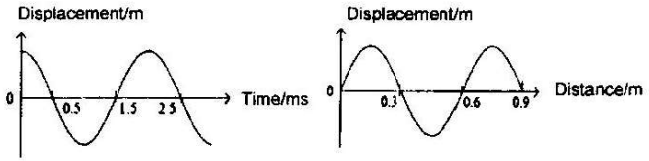
A 36.9°
B 38.7°
C 51.3°
D 53.1°

23 The diagram shows a section of a wave motion. The particle at position x moves in the direction of the arrow shown.

Which of the following particles at the labelled positions, A, B, C and D is incorrect?



24 The two graphs shown below refer to the same wave.

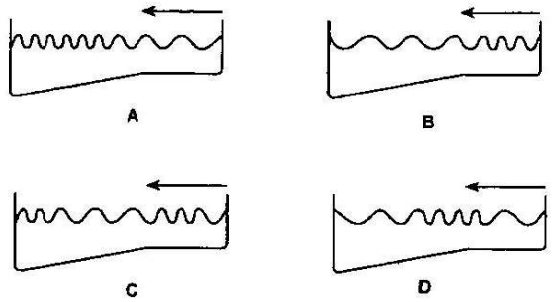


What is the speed of the wave?

A 0.3 ms^{-1}
B 1.2 ms^{-1}
C 150 ms^{-1}
D 300 ms^{-1}

25 A ripple tank contains water of varying depths.

Which diagram correctly represents the water waves as they travel from the shallow to the deep region?



26 Below are three statements about electromagnetic radiation.

- Microwaves may cause the ionisation of cells.
- Radio waves are use in cancer radiotherapy.
- Ultraviolet radiation is used in remote controls for television sets.

How many of the statements is/are correct?

A 0
B 1
C 2
D 3

27 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.

What is the correct order of increasing wavelength?

	shortest ⟶ longest		
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

28 The speed of a sound wave is reduced by half when it passes from medium A to medium B.

Which statement below describes the change in the sound wave correctly?

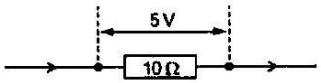
A The frequency is reduced by half.
B The wavelength is reduced by half.
C The frequency becomes twice its initial value.
D The wavelength becomes twice its initial value.

29 Sam plays a note on the guitar. He then plays a louder sound of the same pitch.

Which of the following correctly compares the speed and wavelength of the second note with the first note?

	Speed of second sound	Wavelength of second sound
A	Same	Same
B	Same	Different
C	Different	Same
D	Different	Different

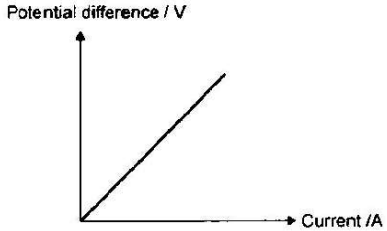
30 The potential difference across a 10 Ω resistor is 5 V.



How much charge passes through the 10 Ω resistor in 30 seconds?

A 2 C B 15 C C 60 C D 1500 C

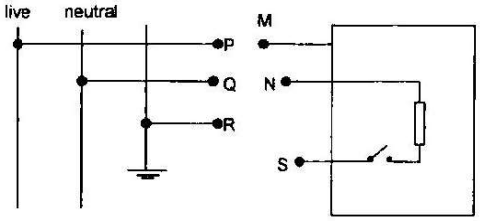
31 The graph below shows the variation of potential difference across a uniform resistance wire against the current in the wire.



Which of the following changes will make this graph steeper?

A A thinner wire is used.
B A shorter wire is used.
C The wire is made of a material of lower resistivity.
D A similar wire is connected in parallel to this wire.

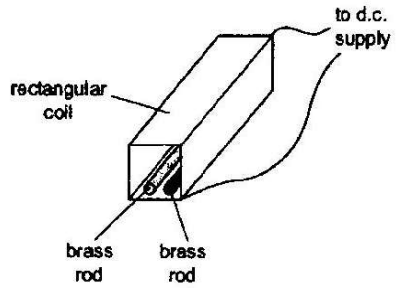
32 An electrical appliance with a metal case is to be connected to the mains supply as shown below.



Which of the following shows the correct connection of the wires from P, Q and R respectively?

	P	Q	R
A	S	M	N
B	S	N	M
C	N	M	S
D	N	S	M

33 The diagram shows two brass rods, side by side, at the bottom of a rectangular coil. The wires of the rectangular coil are insulated.

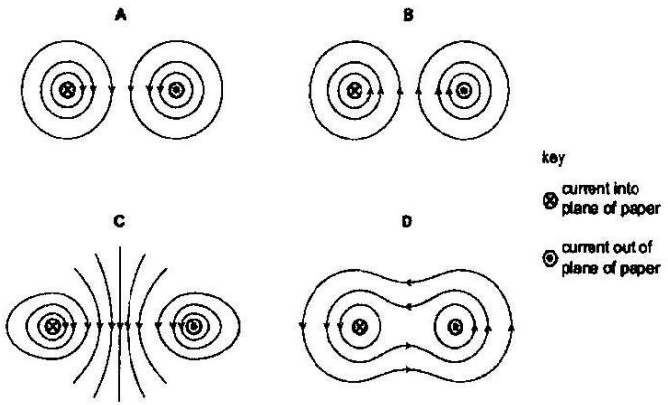


What happens when a direct current passes through the coil?

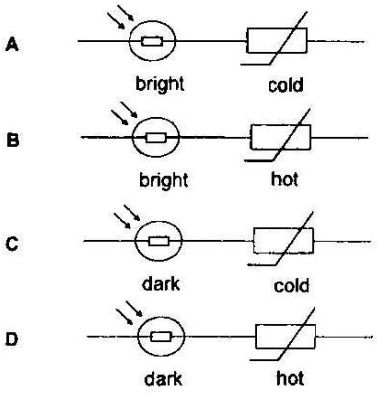
A Nothing happens.
B The two rods move towards each other.
C The two rods move away from each other.
D The two rods will move towards and then away from each other.

34 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

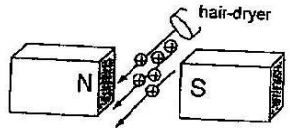
Which diagram shows the magnetic field around the two wires?



35 Given that the resistance of a thermistor decreases with increasing temperature, which of the following conditions will create the largest combined resistance in the circuit?



36 Hot air from a hair-dryer contains many positively charged ions.

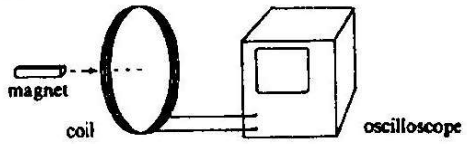


The hot air is directed between the poles of a strong magnet, as shown in the diagram above.

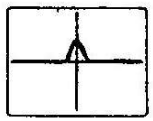
Which direction would the ions be defected?

A upwards.
B downwards.
C towards the north pole.
D towards the south pole.

37 A bar magnet is moved slowly into a coil of wire which is connected to an oscilloscope.

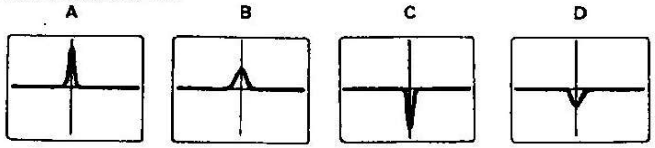


The trace on the oscilloscope is shown below:

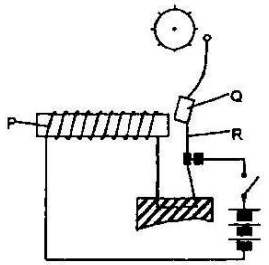


The magnet is then moved back from the coil at a greater speed.

Which trace shows this?

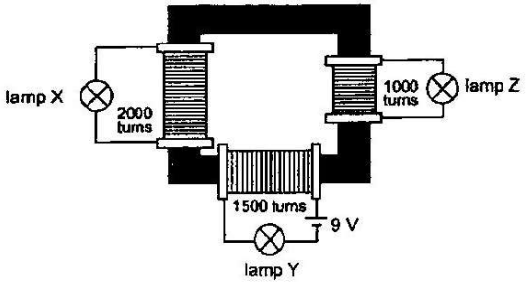


38 In an electric bell, what are parts P, Q and R made of?



	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

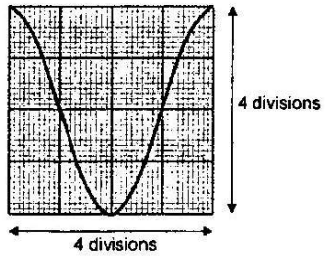
39 Three identical filament lamps, X, Y and Z, are connected to a transformer with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	Lamp X	Lamp Y	Lamp Z
A	Dimmer than normal	Normal brightness	Brighter than normal
B	Brighter than normal	Normal brightness	Dimmer than normal
C	Not lit	Normal brightness	Not lit
D	Not lit	Not lit	Not lit

40 The diagram illustrates the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.



The time-base is set to 2.0 ms/div and the voltage sensitivity is 2.0 V/div.

Which of the following correctly represents the peak voltage and frequency of the signal?

	Peak voltage	Frequency
A	4.0 V	83.3 Hz
B	4.0 V	125 Hz
C	8.0 V	83.3 Hz
D	8.0 V	125 Hz

Paper 1

1	D	11	A	21	A	31	A
2	D	12	C	22	B	32	B
3	B	13	B	23	B	33	A
4	A	14	D	24	D	34	C
5	D	15	B	25	B	35	C
6	C	16	C	26	A	36	A
7	D	17	B	27	D	37	C
8	B	18	A	28	B	38	A
9	D	19	D	29	A	39	C
10	C	20	B	30	B	40	B

CWSS16.

SECTION A (50 marks)

Answer **all** questions. Write your answers in the spaces on the question paper.

1 Fig. 1.1 shows the velocity-time graph of a moving object.

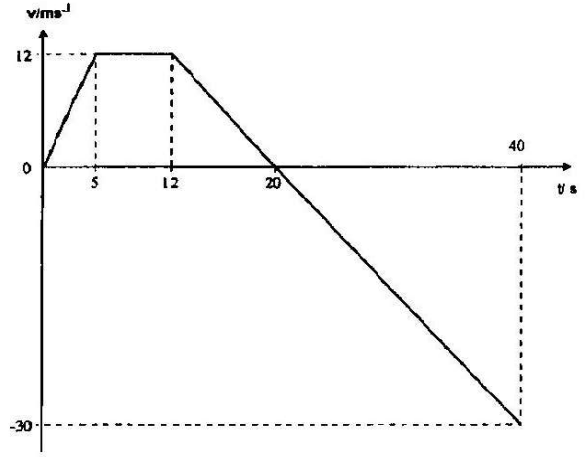


Fig. 1.1

(i) Calculate the acceleration of the object from t = 12 s to t = 20 s. [2]

Acceleration = ...

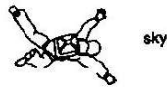
(ii) Describe the motion of the object from t = 12 s to t = 40 s. Indicate the direction of motion clearly throughout the entire duration. [2]

.....

.....

.....

2 A sky-diver jumps from a high-altitude helicopter as shown in Fig. 2.1.



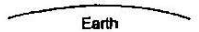


Fig. 2.1

(a) Explain why the acceleration of the sky-diver

(i) is 10.0 ms^{-2} at the start of the jump. [1]

.....

.....

(ii) decreases with time, [2]

.....

.....

.....

(b) At one point during the dive, the acceleration of the sky-diver was 7.5 ms^{-2}. The sky-diver and his equipment have a total mass of 90 kg.

Determine the total resistive force acting on the sky-diver at that point. [2]

total resistive force = ...

3 Two identical barometers **P** and **Q** containing mercury are set up at sea level as shown in Fig. 3.1.

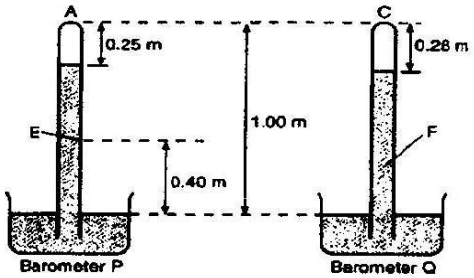


Fig. 3.1

The column of space A in barometer **P** is a perfect vacuum. The density of mercury is 13 600 kgm^{-3}

(a) State the atmospheric pressure as measured by barometer **P**. [1]

.....

(b) Calculate the pressure at point E, giving your answer in Pascal. [2]

pressure = ...

(c) Suggest a possible reason why the column of space **C** is more than **A**. [1]

.....

(d) State the pressure within the space **C**. [1]

.....

4 The piston for the bicycle pump in Fig. 4.1 is pushed in slowly until the air pressure inside the pump in Fig.4.2 is three times greater. The air in the pump remains at a constant temperature of 20 °C.

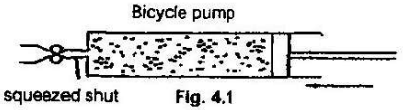


Fig. 4.1

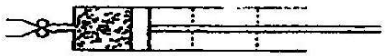


Fig. 4.2

(i) Explain in terms of molecular motion why the pressure in Fig. 4.2 should be three times greater than in Fig. 4.1. [2]

.....

.....

.....

(ii) If the piston had been pushed in quickly, the temperature of the air in the pump would have increased.

Explain in terms of molecular motion how this would affect the pressure in the pump. [3]

.....

.....

.....

.....

.....

5 Fig. 5.1 shows the path of a light ray through a converging lens.

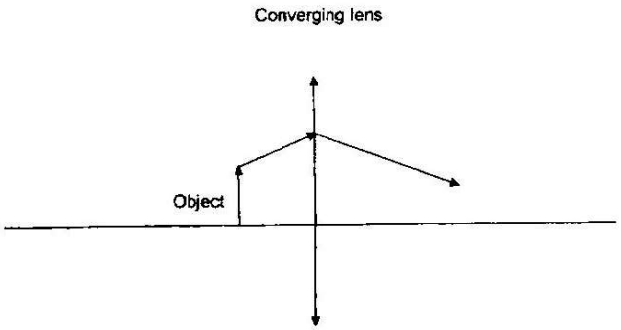


Fig. 5.1

(i) Complete the ray diagram in Fig. 5.1, locate and draw the image of the object [2]

(ii) Explain how your diagram shows that the image is virtual. [1]

.....

.....

(iii) Complete the ray diagram in Fig. 5.1, locate the Principal Focus of the converging lens and label the point F. [2]

6 Fig. 6.1 shows wavefronts of a water wave in a ripple tank.

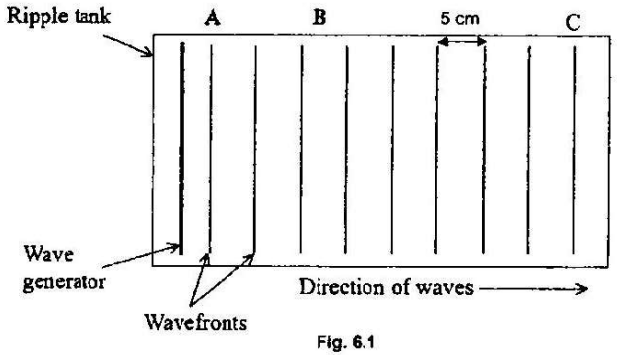


Fig. 6.1

(i) State the meaning of "*wavefront*". [1]

.....

.....

(ii) Determine the wavelength of the wave. [1]

Wavelength = ...

(iii) A wavefront takes 1 second to travel from **A** to **C**. Determine the frequency of the wave. [1]

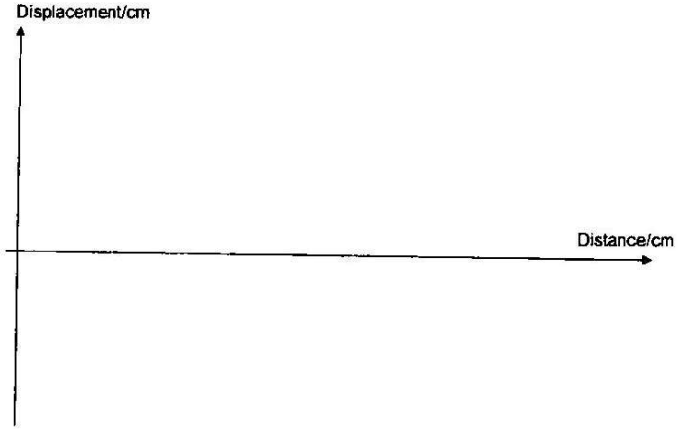
Frequency = ...

(iv) Calculate the speed of the wave. [2]

Speed = ...

(v) The wave generated has an amplitude 1.5 cm.

Sketch a displacement-distance graph. Indicate the position of **A** and **B** clearly in your graph. [2]



7 (a) The honey industry in Britain is under serious threat from a parasite that attacks bees. A company has developed a patented natural wax powder that keeps the parasites away from the bees. The formulated powder is added to a specially designed applicator placed in the doorway of the hive. Bees have specially modified hairs on their bodies that develop a static electricity charge.

Explain how the powder can adhere to the bodies the bees when they enter the hive. [2]

.....

.....

.....

(b) Large amounts of grains such as wheat can generate charges as they are poured from one storage bin to another. These organic materials are highly explosive when there is ample supply of oxygen.

State the method of charging of the grains during pouring and explain the main reason for the grains to be highly explosive. [3]

.....

.....

.....

.....

.....

8 Fig. 8.1 shows an electrical circuit with three identical lamps X, Y and Z, a switch, a 12 V battery, an ammeter, a voltmeter and a variable resistor.

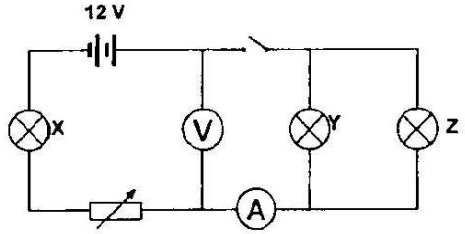


Fig. 8.1

(a) State the ammeter and voltmeter readings when the switch is opened. [2]

ammeter reading: .....

voltmeter reading: .....

(b) When the switch is closed, the ammeter reading is 1.50 A and the voltmeter reading is 3.00 V.

(i) Calculate the resistance of each lamp. [2]

resistance = ...

(ii) Calculate the power dissipated by Lamp X. [2]

power = ...

(iii) Calculate the potential difference across the variable resistor. [2]

potential difference = ...

(c) State what happens to the brightness of Lamp Y when the resistance of the variable resistor is increased. [1]

.....

9 Fossil fuels will eventually run out. This has led to scientists looking for alternative sources of energy. Tidal stream systems use the kinetic energy of seawater to generate electrical energy during the incoming and outgoing tides.

Fig. 9.1 below shows a twin-turbine system in which flowing seawater turns the turbine blades.

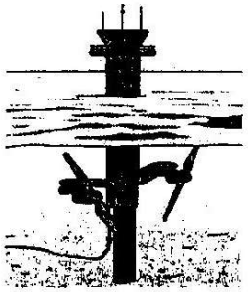


Fig. 9.1

When operating, 9.7×10^5 kg of seawater travelling at a speed of 3.0 ms^{-1} passes through each turbine every second. Each turbine generates 1.2×10^6 W of electrical energy.

(a) Define *power*. [1]

.....

(b) The input power to each turbine is the kinetic energy of the seawater that flows through each turbine in one second.

Calculate the input power of each turbine. [2]

Input power = ...

(c) Calculate the percentage efficiency of each turbine. [1]

Percentage efficiency = ...

(d) Suggest one advantage of tidal stream systems over conventional wind farms. [1]

.....

.....

SECTION B (30 marks)

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 Four transformers, **A**, **B**, **C** and **D** are being investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs in Fig. 10.1.

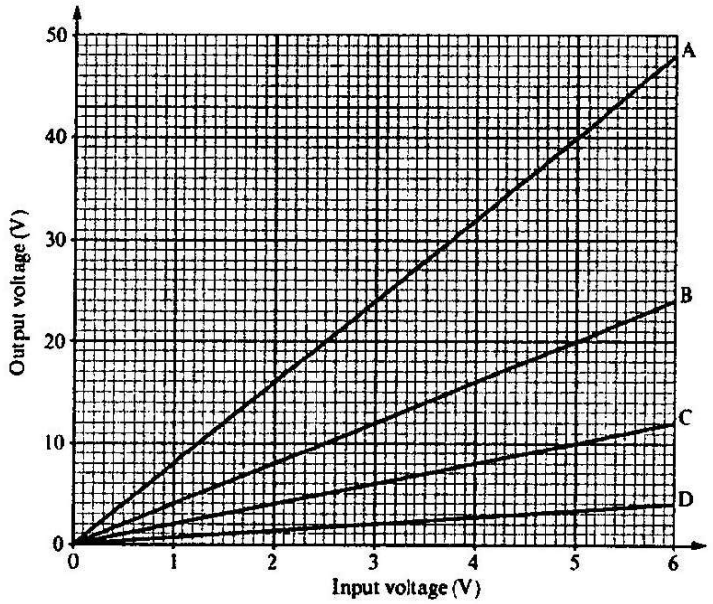


Fig. 10.1

One of the transformers is then used to light up a 12 V lamp from a 3 V power supply as shown in Fig. 10.2.

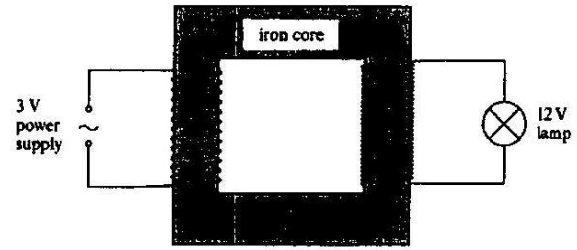


Fig. 10.2

(a) Explain how a current in the primary coil produces an output voltage in the secondary coil. [2]

.....

.....

.....

.....

(b) Describe the purpose of the iron core. [1]

.....

.....

(c) Using the data on the graphs in Fig. 10.1 to answer the following questions.

(i) State and explain which transformer, **A**, **B**, **C** or **D**, would be used to light the 12 V lamp to normal brightness, from a 3 V supply as shown in Fig. 10.2 [1]

.....

.....

(ii) Transformer **C** contains 50 turns on its primary coil. Calculate the number of turns on its secondary coil. [2]

Number of turns = ...

(iii) Transformer **A** has a current of 0.5 A in the primary coil. Calculate the current in the secondary coil. [2]

Current = ...

(iv) State and explain which transformer, **A**, **B**, **C** or **D**, is **not** suitable to be used for the transmission and distribution of energy from power stations to transmission cables. [2]

.....

.....

.....

11 A thermistor is placed in an environment where the surrounding temperature increases at constant rate of 1 °C/ minute. Fig. 11.1 shows how the resistance of a thermistor changes with its surrounding temperature.

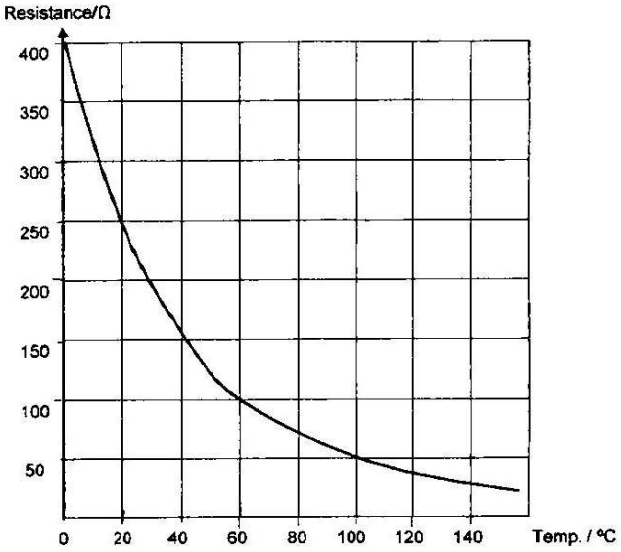


Fig. 11.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature. [1]

.....

.....

The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig. 11.2.

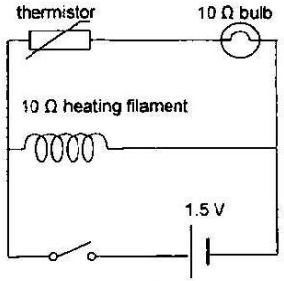


Fig. 11.2

Explain why the bulb

(i) fails to light up immediately when the switch is closed. [2]

.....

.....

.....

.....

(ii) lights up slowly after a while. [2]

.....

.....

.....

.....

(c) (i) Calculate the resistance of the thermistor when a current of 0.025 A flows through the light bulb [2]

Resistance = ...

(ii) Hence determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb [1]

Temperature = ...

(d) When the temperature of the thermistor is 100 °C, calculate the effective resistance of the whole circuit. [2]

Effective resistance = ...

12 EITHER

A pendulum consists of a metal sphere of mass 200 g attached to a thin thread as shown in Fig. 12.1. The length of the thread is 1.0 m.

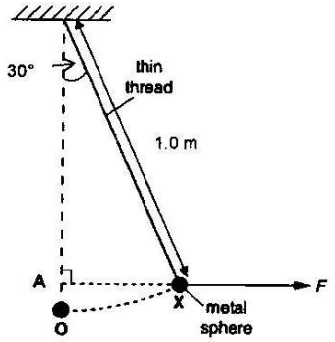


Fig. 12.1

When the thread is vertical, the metal sphere is at O. The metal sphere is moved from O to X and held in position by a horizontal force *F*. The angle between the thin thread and vertical is 30°.

(a) With an appropriate scale and drawing, determine *F* and the tension in the thread. [5]

Scale =.....

F = ...

Tension = ...

(b) Calculate the

(i) distance OA, which is the vertical displacement of the sphere from O to X. [1]

Distance OA =.....

(ii) work done to raise the sphere from O to X. [2]

Work done =.....

(iii) maximum speed of the sphere after it has been released. [2]

Maximum speed=.....

12 OR

A student poured 250 g of hot tea into a container. He placed a thermometer into the tea and started measuring the temperature with respect to time. After a while, he added ***m*** kg of ice cubes into the tea.

Fig. 12.2 below shows the temperature-time graph obtained.

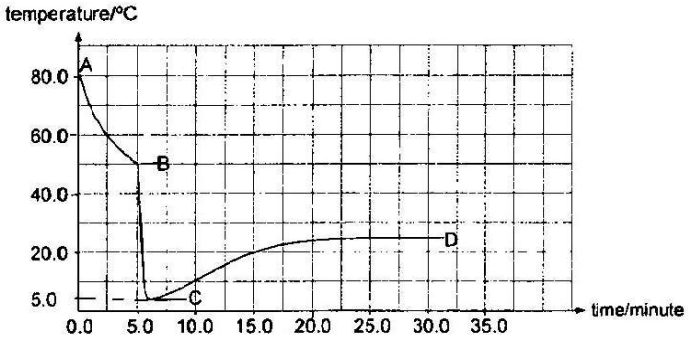


Fig. 12.2

The following information is provided :

specific heat capacity of ice = 2.10×10^3 J/kg°C
specific latent heat of fusion of ice = 3.36×10^5 J/kg
specific heat capacity of water or tea = 4.20×10^3 J/kg°C
specific latent heat of vaporisation of water or tea = 2.26×10^6 J/kg

The temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State and explain what time the student added the ice cubes into the tea. [1]

.....

.....

(b) Calculate the loss of thermal energy in the hot tea from B to C. [2]

loss of thermal energy = ...

(c) Calculate ***m***. You may assume that there is no loss of thermal energy to the surrounding. [3]

m = ...

(d) Explain why the temperature of the tea increases from C to D. [2]

.....

.....

.....

(e) Estimate the temperature of the surrounding. [1]

.....

(f) In another experiment, the student placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

On Fig.12.2, draw the temperature-time graph for the second experiment. [1]

CWSS 16

Section A (50 marks)

1 (i) Acceleration = (12 – 0)ms^{-1}/(12-20)s [1]
= -1.50 ms^{-2} [1]

(ii) Object travel with **constant negative acceleration** [1]

Or: Decreasing velocity at a constant rate from 12 s to 20 s and increasing velocity at a constant rate from 20 s to 40 s.

The object **changes direction at t = 20s.** [1]
Or: The object moves in the positive direction from t = 12-20 s and it moves in the negative direction from t = 20-40 s.

To accept answer as long as student shows understanding that **the direction of motion is reversed at t = 20s.**

Total mark for Q 1 [4]

2 (a) (i) air resistance is **zero/negligible** [1]
or: weight / gravitational force is **only force**
Or: resultant force is the weight

(ii) **air resistance increases** as speed increases [1]
resultant force decreases [1]

2 (b) Resultant force = ma
= 90 kg x 7.5 ms^{-2}
= **675 N** [1]

Total resistive force = Weight – resultant force
= 900 N – 675 N
= **225 N** [1]

Total mark for Q 2 [5]

3 (a) Atmospheric Pressure: **0.75 mHg** or 75 cmHg or 750 mmHg [1]
Accept: 1.02 x 10^5 Pa

(b) identify h as **0.35 m** [1]

Pressure at E = 0.35 m x 13600 kg/m^3 x 10N/kg
= **47600 Pa** [1]

(c) There is **air** in C or C is not a perfect vacuum [1]

(d) P in C = **0.03 mHg** or 3 cmHg or 30 mmHg [1]
To accept answer in SI unit: 4080 Pa

Total mark for Q 3 [5]

Version 4 updated on 22 August 2016

4 (i) **The number of air molecules per unit volume is three times greater in Fig. 4.2.** [1]

Accept: Less space or distance deceases

As a result, the **frequency of collisions of the air molecules with the walls of the pump is three times greater.** [1]

Accept: 'three times' is mentioned once either in the first or second point.

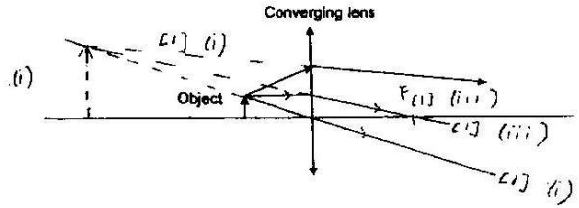
(ii) **Kinetic Energy** or **speed of air molecules increases** due to increase in temperature. [1]

The air molecules **collide more frequently and violently/forcefully with the walls** of the pump. [1]

Pressure increases [1]
Or: pressure is more than the previous se-up

Total mark for Q4 [5]

5



(i) A straight line passing through the tip of the object and Optical Centre and with extension. [1]

Extension of the given ray to intersect with the previous extension to form an upright image. Labelling of image is not required. Do not penalize if image is not dotted. [1]

(ii) The real rays do not intersect. [1]

(iii) A ray drawn parallel to Principal Axis, extended to tip of the image and passed through Principal Axis [1]

F correctly marked and labeled. [1]

To deduct a maximum of one mark for the following:
- missing arrows
- extension not in dotted lines
- arrows on extension
- arrows in wrong direction

Total mark for Q5 [5]

6 (i) A wavefront is an imaginary line **joining all the adjacent points in the same phase/adjacent crests/adjacent troughs.** [1]

(ii) Wavelength = **5 cm** [1]
Accept: 5.0 cm, 5.00 cm

(iii) Frequency = **8 Hz** [1]
Accept: 8.0 Hz, 8.00 Hz

(iv) Speed = frequency x wavelength
= **8 Hz x 5.0 cm** [1]
= **40 cms^{-1}** [1]
ecf from (ii) and (iii)

Accept: 0.4 ms^{-1}

(v) A sinusoidal wave with an amplitude of 1.5 cm [1]
B at the trough at 2.5 wavelength from **A.** [1]

Total mark for Q6 [7]

7 (a) By method of **induction** [1]
Or: a description of the induction process

The **charge of powder** nearer to the body of bee will be **opposite** to the **charge on the bee. Force of attraction is greater than the force of repulsion.** [1]

(b) Charging by **friction** or rubbing [1]

Large surface area of the grains and **charges accumulate fast** [1]
Or: large surface area of the grains and **large amount of charges accumulate** on the surface of the grains

Spark or **sudden discharge** might occur [1]
Or: high reaction/combustion rate

Total mark for Q7 [5]

Version 4 updated on 22 August 2016

8 (a) Ammeter reading = **0 A** [1]
voltmeter reading = **12 V** [1]

(b) (i) Since Y and Z are identical, current flowing through them = 1.50 A/2
= **0.75 A** [1]
R_Y = 3.00 V/0.75 A = **4.0 Ω** [1]
Hence resistance of each lamp = 4.0 Ω

(ii) P = I^2R = **(1.50 A)^2 x 4.0 Ω** [1]
= **9.0 W** [1]

(iii) p.d. across lamp X, V = IR = 1.50 A x 4.0 Ω
= **6.00 V** [1]

p.d. across the variable resistor = 12 V – 6.00 V– 3.00 V
= **3.00 V** [1]

(c) The brightness **decreases** [1]
Or: Lamp Y becomes dimmer.

Total mark for Q8 [9]

9 (a) **Rate of work done** [1]
Or: **Rate of energy conversion**
Accept: Formula expressed in words (work done divided by time taken)
Accept: Rate of energy generated/consumed

(b) **½ (9.7 X 10^5 kgs^{-1}) (3.0 ms^{-1})^2** [1]
= **4.37 X 10^6 J/s or W** [1]

(c) (1.2 x 10^6 / 4.37 x 10^6) x 100%
= **27.5%** [1]
e.c.f. from (b)

(d) Any of the following: [1]

- Tidal energy has **more** consistent **efficiency** as it is not dependent on climatic condition/wind condition and direction.
- **No noise pollution** for tidal energy.
- **Do not require large clearance of land space.**
- A tidal stream turbine system of identical size to a wind turbine system will **produce greater power** for the same water or wind speed
- Does not obstruct the flight path of birds

Total mark for Q9 [5]

10 (a) The **current** in the primary coil is **alternating**/changing [1]
Or: The magnetic field is changing

hence the **magnetic flux in the secondary coil is changing** conlinuously, hence induces an emf in the secondary coil. [1]
Or: The magnetic field linked to the secondary coil is changing

(b) To **concentrate the magnetic field lines** [1]
Or: to **link magnetic field to the secondary coil**

(c) (i) **B** because the **the output voltage is 12 V when the input voltage is 3V.** (as shown on the graph) [1]
Or: **the turns ratio is 4**
or **the output voltage is four times the input voltage**

(ii) **N_s/50 = 12V/6V** [1]
Or: The turns ratio is 2

N_s = 100 [1]

(iii) **48 V/ 6V = 0.5 A/I_s** [1]

I_s = 0.0625 A [1]

(iv) **D** [1]

because it is a **step-down** transformer/current is stepped up hence the **power loss** in the cable is **higer** [1]

Total mark for Q10 [10]

11 (a) The resistance **decreases** as temperature **increases.** [1]

(b) (i) **Temperature is low** or the resistance of thermistor is high. [1]
Accept: Heating element has not been heated up
or the heating element takes time to get heated up

The p.d. across the thermistor is high hence the **p.d. across the bulb is low.** [1]
Or: No/low current through the bulb due to the high resistance in this path.

(ii) **Temperature of thermistor increases** due to the heat being transferred from the heating filament to the thermistor. [1]

The resistance and p.d of the thermistor decreases resulting in a **larger p.d. across the bulb.** [1]
Or: Current through the bulb increases due to the decrease in resistance in this path.

(c) (i) V = IR
1.5 V = 0.025 A (R_{th} + 10 Ω) [1]
Rth = 50 Ω [1]

Or:
P.d. across bulb = I x R = 0.025 x 10 = 0.25 V
P.d. across thermistor = 1.5 – 0.25 = **1.25 V** [1]
Resistance across thermistor = 1.25/0.025 = **50 Ω** [1]

(ii) Temperature = **100 °C** [1]
e.c.f. from (c) (i)
Accept: 80 °C to 100 °C for 60 Ω from (c) (i)

(d) R in series = 50 + 10 = 60 Ω
1/R = 1/60 + 1/10 [1]
R = 60/7 = 8.57 Ω [1]

Total mark for Q11 [10]

12 EITHER

(a) Accept either parallelogram or tip-to-tail method

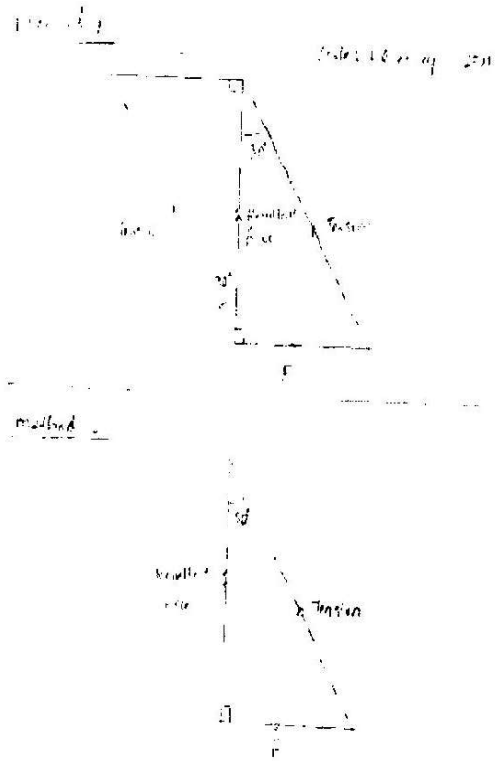
Vector diagram correctly constructed with **correct lengths for the 2.00 N vertical force** [1]

With an **enclosed angle of 30°** between vertical force and the tension **[1]**

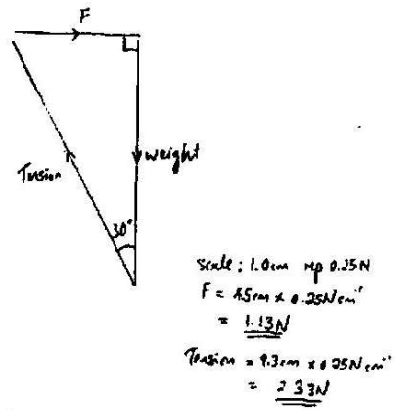
With **correct direction** of arrows for Tension, *F* and the 2.0 N vertical force. [1]

Values of *F* in the range from **1.02 N** to **1.25 N** [1]

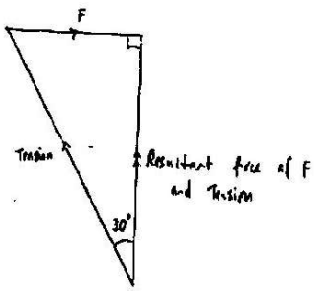
Values of Tension in the range from **2.10 N** to **2.56 N** [1]



Method 3



Method 4



Method 5:
Similar to method 2 but with weight drawn with a single downward arrow

(b) **(i)** Distance **OA** = 1.0 m – (1.0 m cos 30°)
= **0.134 m** [1]

(ii) Work done = Gain in GPE
= mgh
= **0.200 kg x 10 Nkg^{-1} x 0.134 m** [1]
= **0.268 J** [1]
e.c.f. from (b) (i)

(iii) KE at O = GPE at X = 0.268 J
½ mv^2 = 0.268 J [1]
v = **1.64 ms^{-1}** [1]
e.c.f. from (b) (ii)

Total mark for Q12 EITHER [10]

12 OR

(a) The student added the ice cubes at **5.0 minutes** (or at B). This is because there was a **sudden drop/decrease/change in temperature** from 5.0 minutes onwards. [1]

(b) Loss in thermal energy = $mc\theta$
= **0.250 kg x 4200 J /kg°C x (50.0 °C – 5.0°C)** [1]
= 47 250 J
= **47 300 J** (or 47 000 J) [1]

(c) Heat loss from tea = heat gained by ice cubes
47 300 = (m x 3.36 x 10^5) + (m x 4200 x 5.0)
= 336 000 m + 21 000 m
m = 47 250 / 357 000
= **0.132**

e.c.f. from (b)

Adding heat gained by ice in melting to heat gained by the melted ice in warming up: **(m x 3.36 x 10^5) + (m x 4200 x 5.0)** [1]
Equating heat gained by ice to answer in (b) [1]
Correct answer of 0.132 kg or 132 g [1]

(d) Since there is a **temperature difference** between the tea and the surrounding [1]
Or: the tea is at a lower temperature than the surrounding
Or: So to achieve equal temperature/equilibrium

thermal energy is transferred/gained/absorbed from the surrounding to the tea [1]
Or: heat flow from the surrounding to the tea

(e) **25.0 °C** (or 25 °C) [1]

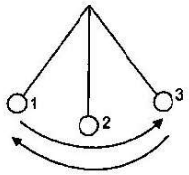
(f) **Cooling curve** from 80°C to 25°C.
Final temperature of **25°C**
Takes a **longer time than 22.5 minutes** to reach 25°C

All three correct [1]

Total mark for Q12 OR [10]

SCGS 16 P1

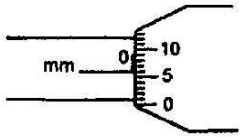
1 The diagram below shows a simple pendulum that swings between positions 1 and 3.



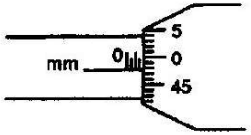
What is the period of the pendulum if it takes T s to swing from positions 2 to 3?

A $\frac{T}{2}$ s B T s C $2T$ s D $4T$ s

2 The diameter of a ball bearing is measured using a micrometer screw gauge. A student takes an initial zero error reading and then a reading of the diameter. The diagrams show an enlargement of the micrometer screw gauge readings.



zero reading

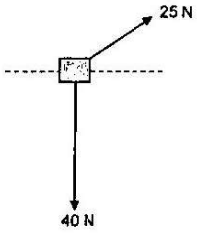


diameter reading

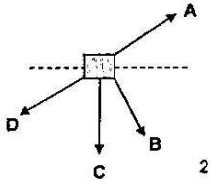
What is the volume of the ball bearing?

A 1.50 mm^3 B 3.71 mm^3 C 4.06 mm^3 D 4.45 mm^3

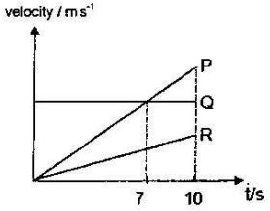
3 Forces of 40 N and 25 N act on an object in the directions shown.



Which arrow shows the direction of the resultant force on the object?



4 Three objects P, Q and R start from the same point and move in the same direction. The diagram shows the v-t graph of the objects in the first 10 s of their motion.



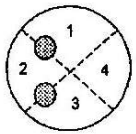
Which of the following statements is correct?

A P has the greatest displacement in the 10 s.
B Q has the greatest average velocity in the 10 s.
C R has the smallest acceleration.
D P overtakes Q at the 7th second.

5 A car is initially travelling along a straight path at 5.0 $m s^{-1}$. It then accelerates at 2.0 $m s^{-2}$ for 10 s. What is the final speed of the car?

A 5.0 $m s^{-1}$
B 10.0 $m s^{-1}$
C 20.0 $m s^{-1}$
D 25.0 $m s^{-1}$

6 The figure below represents a uniform lamina with the two shaded portions cut out.



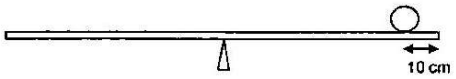
The centre of gravity of the remaining portion is in quadrant .....

A 1 B 2 C 3 D 4

7 Which property of an object resists changes in the state of motion of the object?

A acceleration
B density
C mass
D velocity

8 A uniform metre rule is pivoted at its mid-point. An object of weight 30 N is placed on the metre rule as shown.



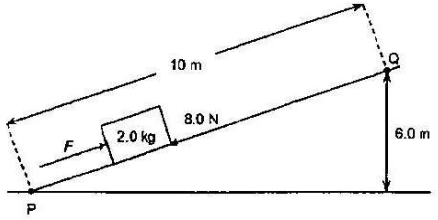
Which of the following forces will rebalance the metre rule?

A 30 N upwards, 10 cm to the left of the pivot.
B 30 N downwards, 40 cm to the left of the pivot.
C 40 N downwards, 10 cm to the right of the pivot.
D 40 N upwards, 40 cm to the right of the pivot.

9 A toy car was pushed steadily from rest to reach a speed of 5.0 $m\,s^{-1}$ in 10 s. During this time, there was an average air resistance of 3.0 N acting on the car. Calculate the rate of work done against air resistance.

A 7.5 W
B 15 W
C 75 W
D 150 W

10 A box of mass 2.0 kg is pushed upwards with an applied force F along a 10 m ramp from point P to point Q. The average frictional force acting on the box is 8.0 N throughout the motion. The box reaches a vertical height of 6.0 m above ground when it is at point Q.



If the increase in kinetic energy of the box is 45 J as it moves from point P to point Q, what is the work done by the applied force F?

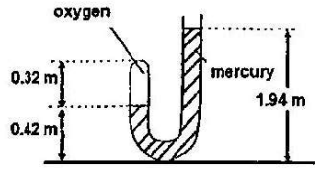
A 80 J B 85 J C 165 J D 245 J

11 A crane lifts a weight of 600 N through a vertical height of 30 m in 25 s. The efficiency of the crane is 40%.

What is the average power of the crane?

A 0.29 kW B 0.72 kW C 1.8 kW D 1800 kW

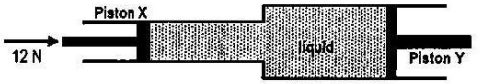
12 Oxygen is compressed in the sealed end of a long J-tube by means of a column of mercury open to the atmosphere as shown.



Given that the atmospheric pressure is 76 cm Hg, what is the approximate ratio of the pressure of the compressed oxygen to that of the atmosphere?

A 1.5 B 2.0 C 2.5 D 3.0

13 A cylinder fitted with two pistons X and Y of diameters 5.0 cm and 10.0 cm respectively. The piston X is pushed by a force of 12 N.

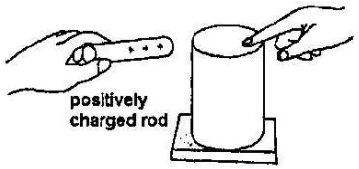


What is the force exerted on piston Y?

A 3.0 N
B 6.0 N
C 24 N
D 48 N

14 A student tries to charge a metal cylinder negatively using a series of steps (not in order):

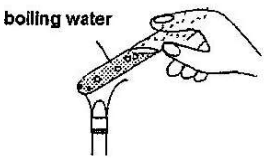
I. touch the cylinder with a finger;
II. bring a positively charged rod near the cylinder;
III. remove the finger;
IV. remove the rod



Which is the correct order to charge the metal cylinder negatively?

A II, I, III, IV
B I, II, IV, III
C I, III, IV, II
D II, I, IV, III

15



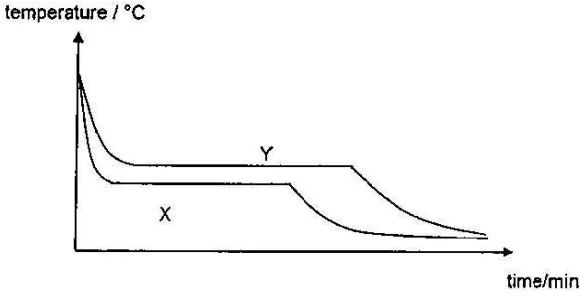
You can still hold a test tube while the water in it is boiling as shown in the diagram because

A glass is a poor conductor of heat
B glass is a poor radiator of heat
C water is a poor conductor of heat
D water is a poor radiator of heat

16 A resistance thermometer has a resistance of 20 Ω when the temperature is 30°C and 60 Ω when the temperature is 100°C. What is the temperature when the resistance is 50 Ω?

A 47.1°C
B 52.5°C
C 82.5°C
D 105°C

17 John performed an experiment to compare the physical properties of two liquids X and Y. He poured equal mass of the liquids, initially at the same temperature, into two identical test tubes and placed them at room temperature. The cooling curves are shown in the graph below.



Which of the following statements is/are correct?

(I) Liquid X has a higher specific latent heat of fusion than liquid Y.
(II) Liquid X has a lower freezing point than liquid Y.
(III) Liquid X has a lower specific heat capacity than liquid Y.

A (I) and (II) only
B (I) and (III) only
C (II) and (III) only
D (I), (II) and (III)

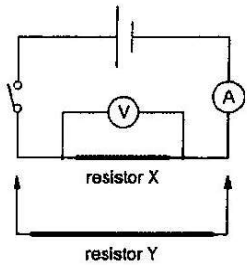
18 The internal energy of a body consists of the

A sum of kinetic energy and potential energy of the body
B sum of kinetic energy and potential energy of atoms in the body
C energy released when the body is completely burnt
D energy released when its body is partially burnt

19 A current of 3.0 A flows through a resistor. What is the total amount of charges passing through it in 2.0 minutes?

A 0.025 C
B 1.5 C
C 6.0 C
D 360 C

20 A resistor X with resistance R is made from a length L of resistance wire with a cross-sectional area A. It is connected to a simple electrical circuit and the voltmeter and the ammeter readings are recorded.



A second resistor Y made from wire of the same material has length $2L$ and cross-sectional A, connected in parallel with wire X.

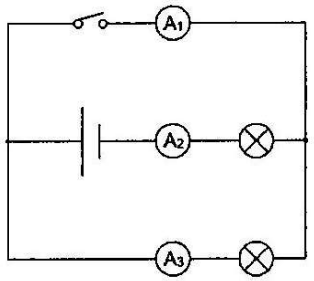
Which of the following correctly describes the readings observed from the voltmeter and ammeter?

	voltmeter reading	*ammeter reading*
A	decrease	decrease
B	decrease	increase
C	no change	decrease
D	no change	increase

21 Which of the following statements about the resistance of a pure metallic conductor is true when its temperature increases? The resistance of the pure metallic conductor

A decreases because the metallic conductor will expand and its particles are less likely to obstruct the flow of charges.
B decreases because the particles in the metallic conductor gain energy and flow around at higher speeds.
C increases because the particles in the metallic conductor will expand and obstruct the flow of charges.
D increases because the particles in the metallic conductor will vibrate more vigorously and obstruct the flow of charges.

22 An electrical circuit with two lamps and three ammeters with negligible resistance is set up as shown below. The switch is initially open.



When the switch is closed, which of the following is correct?

A $A_1 = A_2$
B $A_1 > A_2$
C $A_2 = A_3$
D $A_1 + A_3 = A_2$

23 An electrical fault occurs in a kettle such that the live wire is in touch with the metal casing which is earthed. Under normal condition, a current of 6 A is delivered to the kettle, which has a plug that contains a 7 A fuse.

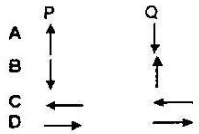
Which of the following occurs after the fault kicks in?

A Current continues to flow along the live wire and earth wire.
B The fuse will melt and cut off the electricity supply.
C The fuse becomes hot but does not blow.
D The metal case will become live and dangerous.

24 Two small plotting compasses P and Q are placed near the ends of a bar magnet as shown in the diagram.



The needles of the compasses point in the directions shown in

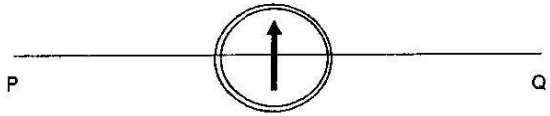


25 An electric kettle has a power rating of 2 kW while a bread toaster has a power rating of 1.5kW. On a typical day, both the electric kettle and the toaster are switched on for 30 minutes.

If the cost of electricity is 20 cents per kWh, what is the cost of using the two appliances for 30 days?

A $10.50
B $11.00
C $12.00
D $12.50

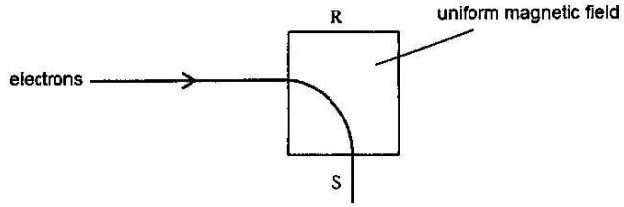
26 The diagram shows a magnetic compass placed below a wire PQ when there is no current flowing through it.



Ignoring the effect of the earth's magnetic field, which of the following correctly states the motion of the compass needle when a strong current flows from Q to P?

A The needle remains at the same position.
B The needle points in the opposite direction.
C The needle points to the left.
D The needle points to the right.

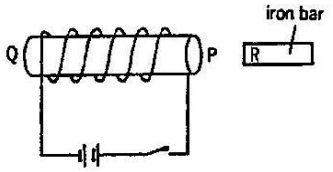
27 A beam of electrons enters a uniform magnetic field, causing the beam to change direction.



What is the direction of the magnetic field?

A perpendicularly out of the page
B perpendicularly into the page
C towards the bottom of the page
D towards the top of the page

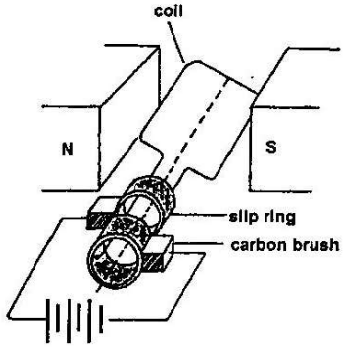
28 The diagram shows an iron bar placed next to a coil of wire connected to a battery and a switch.



Which of the following correctly describes the polarities of P and R when the switch is closed?

	P	R
A	North	South
B	South	North
C	North	North
D	South	South

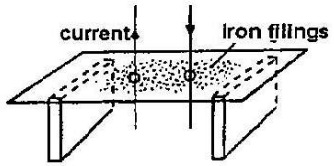
29 The diagram below shows a simple d.c. motor connected to a pair of slip rings instead of split ring.



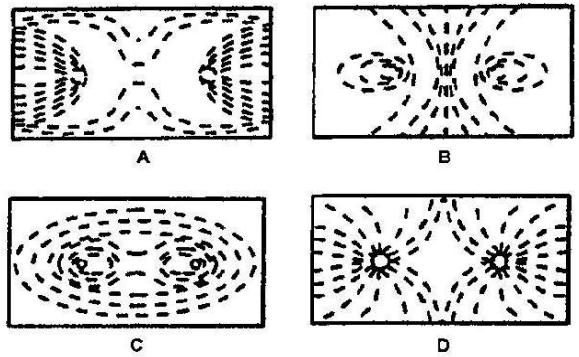
Which of the following is true?

A The coil will rotate continuously back and forth.
B The coil will rotate continuously at a slower rate.
C The coil will rotate in the clockwise direction continuously.
D The coil will rotate in the anti-clockwise direction continuously.

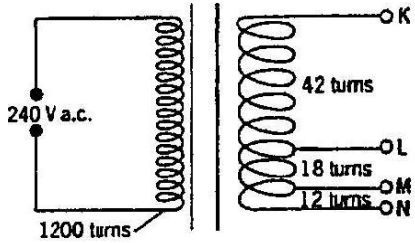
30 The diagram shows two straight and parallel current-carrying wires passing through a horizontal plane. Some iron filings are placed on the horizontal plane.



Which of the following shows the pattern of the magnetic field produced by the current-carrying wires?



31 The diagram shows a multi-tap transformer where different output voltages can be obtained. The primary coil has 1200 turns and the number of turns in the secondary coil between KL, LM and MN are 42, 18 and 12 turns respectively.



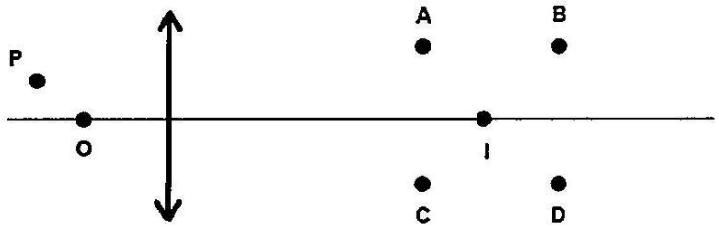
Between which two terminals would the output voltage be 12 V?

A K and L
B L and M
C M and N
D K and M

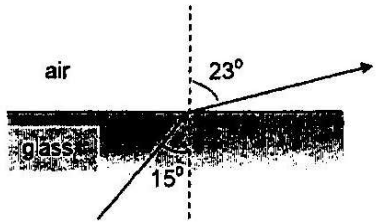
32 An electric current can produce a heating effect and a magnetic effect.
Which option shows the effect used by a relay and its corresponding application?

	effect used by a relay	one application of a relay
A	heating effect	allowing a small current to switch on a large current
B	heating effect	changing the voltage of an alternating current
C	magnetic effect	allowing a small current to switch on a large current
D	magnetic effect	changing the voltage of an alternating current

33 An object is placed in front of a converging lens. The lens forms an image at I. If the object is placed at P, where will the image be formed?



34 The diagram shows the path of light ray as it travels from glass to air.

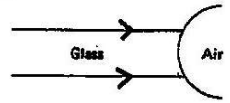


What is the critical angle of glass?

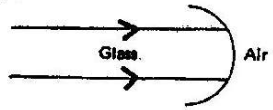
A 40.8°
B 41.5°
C 63.3°
D 72.2°

35 The diagrams show parallel beams of light entering from one medium into another.

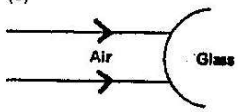
(1)



(2)



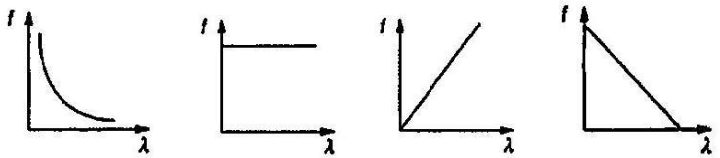
(3)



Which beam will emerge as diverging rays?

A (1) only
B (2) only
C (3) only
D (1) and (2) only

36 Which of the following graphs shows the correct relationship between the frequency *f* of an electromagnetic wave and its wavelength λ?

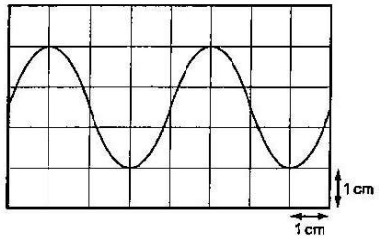


A B C D

37 A crest of a water wave travels 40 cm in 5 s. If the distance between two successive crests is 5 mm, what is the frequency of the wave?

A 0.2 Hz
B 1.6 Hz
C 8.0 Hz
D 16 Hz

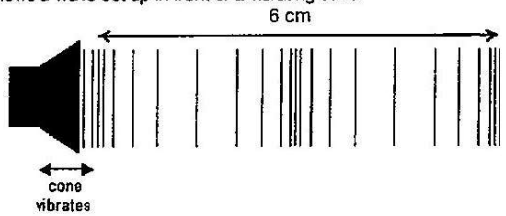
38 The diagram shows a trace of a wave on a cathode-ray oscilloscope.
The vertical and horizontal gridlines have a spacing of 1.0 cm.
The Y-gain is 4 V cm^{-1} and the timebase is 5 ms cm^{-1}.



What is the amplitude and the period of the wave?

	Amplitude/V	Period/ ms
A	3.0	10
B	6.0	10
C	6.0	20
D	12.0	20

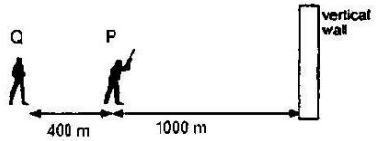
39 The diagram shows a wave set up in front of a vibrating cone.



Which of the statements about the wave is/are true?
(1) It is a travelling wave.
(2) It is a longitudinal wave.
(3) Its wavelength is 3 cm

A (2) only
B (3) only
C (2) and (3) only
D (1), (2) and (3)

40 A man P stands 1000 m from a vertical wall. A second man Q is located 400 m from P and 1400 m from the wall, as shown below.



When P fires a gun into the sky, Q hears two bangs. The first bang is heard when P fired the gun, and the second bang is the echo from the gun. What is the time interval between the two bangs if the velocity of sound in air is 330 ms^{-1}?

A 1.21 s
B 1.81 s
C 6.06 s
D 7.27 s

- END OF PAPER -

SCGS P2 16.

SECTION A

Answers **all** the questions in this section.

1 On a skydiving trip, two parachutists, A and B, jumped out of a plane at the same time. A has a mass of 45.0 kg and B has a mass of 80.0 kg.

After free falling for 2 seconds, both of them stretched out their arms and legs. A then reached a constant speed 56 m s^{-1}, while B continued to accelerate downwards before reaching a constant speed of 78 m s^{-1} several seconds later.

Fig. 1.1 shows the speed-time graph of both A and B for the first 2 s.

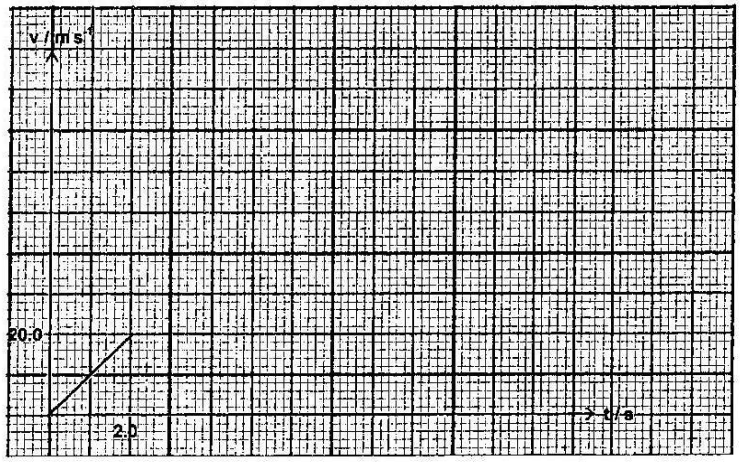


Fig. 1.1

(a) State the acceleration of the parachutist at t = 1.0 s.

Acceleration = ...[1]

(b) On Fig. 1.1, complete the graphs for A and B until they reach constant speed. Label the graphs clearly. [2]

(c) Explain in terms of forces acting on each of them, why B continued to accelerate for a while even though A had started to fall with constant speed.

.....

.....

.....

.....

..... [3]

2 In Fig. 2, the axle A is fixed into the wheel W, so that they rotate together.

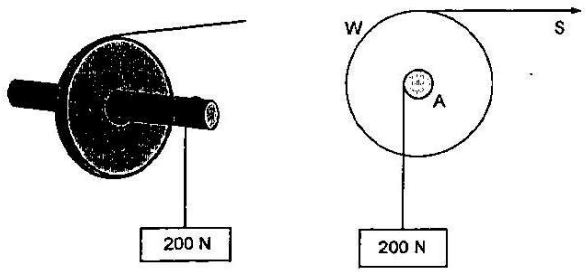


Fig. 2

A load of 200 N hangs on a rope wound around the axle which has a radius of 14 cm. A string S is wound around the wheel of radius 70 cm.

The string is pulled with a 50 N force and the load rises through a vertical distance of 6.0 m at a slow and steady speed.

Calculate

(a) the work done on the load, [2]

(b) the number of rotations of the 'wheel and axle' system when the load rises 6.0 m,

number of rotations = ... [1]

(c) the work done by the force pulling the string.

Work done = ... [2]

(d) Account for the difference in your answers to (a) and (c).

.....

.....

.....[1]

(e) Calculate the efficiency of the wheel and axel system.

Efficiency = ... [1]

3 A uniform rod AB of length 4.0 m weighs 10.0 N. It is suspended by two identical strings at points X and Y as shown in Fig. 3 below.

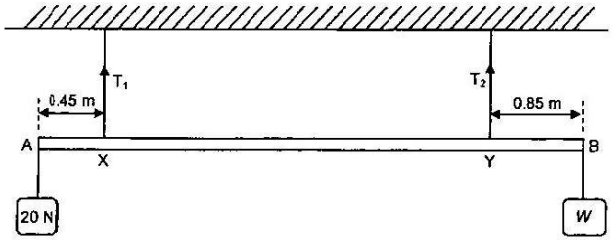


Fig. 3

Two weights 20 N and *W* are hung from the rod at point A and point B respectively.

(a) State the conditions of equilibrium of a body.

.....

.....

.....[2]

(b) When weight *W* is 35 N, calculate the tensions of the strings T_1 and T_2.

T_1 = ... N T_2 = ... N [3]

(c) If the breaking tension of each string is 60 N, what is the maximum weight *W* that can be hung such that one of the strings breaks?

maximum *W* = ... N [2]

4 (a) A copper rod is heated at one end X by a Bunsen flame as shown in Fig. 4.1. An iron nail initially stuck on the other end Y by a piece of wax that falls off after t minutes.

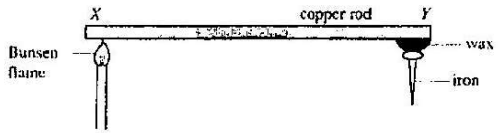


Fig. 4.1

(i) Describe, in terms of the motion of particles, how the temperature of end Y rises.

.....

.....

.....

.....

.....

.....

.....[3]

(ii) If the copper rod is replaced by a metal rod whose heat capacity is larger, state and explain any change in the value of t.

.....

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.....

.....[2]

(b) Fig. 4.2 shows a heater used in homes during winter to keep the room warm.

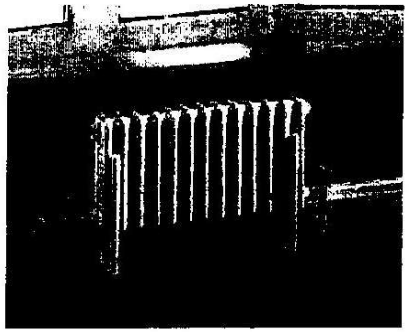


Fig. 4.2

(i) State the main processes of heat transfer by the heater to warm up the whole room.

.....[1]

(ii) The heater is usually placed at the bottom of the bedroom. Explain why the heater is placed at the bottom in terms of density changes.

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.....[2]

5 At an airport, fuel is pumped through a pipe from a tanker to an aeroplane, as shown in Fig. 5.

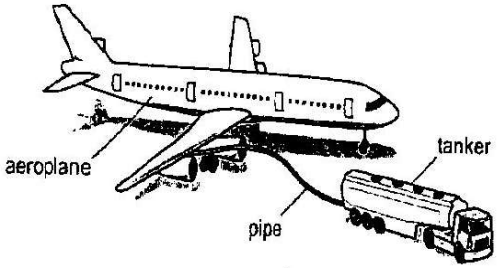


Fig. 5

As the fuel rubs against the pipe, the fuel becomes positively charged and this charges up the aeroplane.

(a) Explain, in terms of the particles involved, how the fuel becomes positively charged.

.....

.....

.....[1]

(b) Explain how the positively charged fuel can charge up the aeroplane.

.....

.....

.....[1]

(c) To prevent an aeroplane from becoming charged, a metal cable connects the aeroplane to the ground.

i) Explain why the cable is made of metal.

.....

.....

.....[1]

ii) Explain how the cable prevents the aeroplane from becoming charged.

.....

.....

.....[1]

(d) Calculate the current that flows through the cable if 2.0 μC of charge on aeroplane flows in a time of 1.2 ms.

Current = ...[2]

6 Fig. 6 shows a step-up transformer. The ends AB of the primary coil are connected to a 1.5 V cell and a switch. The switch is initially closed and the lamp is not lit. The switch is suddenly opened and the lamp illuminates for a short time.

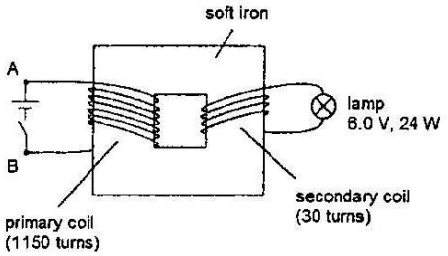


Fig. 6

(a) Explain why the lamp is initially not lit when the switch is closed, but illuminates only for a short period when the switch is opened.

.....

.....

.....

.....

.....

.....

.....[3]

(b) The 1.5 V cell is replaced by an a.c. supply of 230 V. The transformer is 80% efficient. Calculate the power loss in the transformer.

Power loss = ...[2]

(c) Suggest and explain one method to minimize power loss in the transformer.

.....

.....

.....

.....

.....[1]

7. Fig. 7 shows the passage of light beam A through an optical fibre.



Fig. 7

(a) State and explain the process that takes place as the light beam **A** travels through the optical fibre.

.....

.....

.....

.....

.....[2]

(b) Complete the diagram to show the passage of the light beam **B** through the same optical fibre. [1]



(c) Suggest why beam **B** will take slightly longer to travel through the fibre than beam **A**.

.....

.....

.....

.....

.....[1]

(d) The speed of light in the fibre was found to be 1.2×10^8 m/s. Calculate the maximum angle that Beam B makes with the boundary so that it can travel through the optical fibre.

Maximum angle = ...[2]

8 **(a)** Fig. 8.1 shows a fishing boat far out at sea.

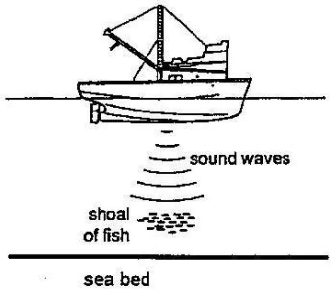


Fig. 8.1

(i) The fishermen on the boat are using ultrasound technology to detect fish.

Suggest why the fishermen cannot hear the ultrasound.

.....

.....

.....[1]

(ii) The fishermen sent a pulse into the sea and they recorded the reflected pulse on a microphone after 0.5 seconds. Calculate the depth of the sea. The speed of sound in water is 1500 m/s.

Depth of sea = ...[2]

(b) Fig. 8.2 is a diagram drawn to scale. It shows a device that the fisherman used to measure the waves in the sea. The waves on the surface of the sea caused a wooden ring to slide up and down a fixed vertical rod as the waves pass. At time t = 0 s, the ring was below P. The wooden ring reaches **P** every 20 seconds.

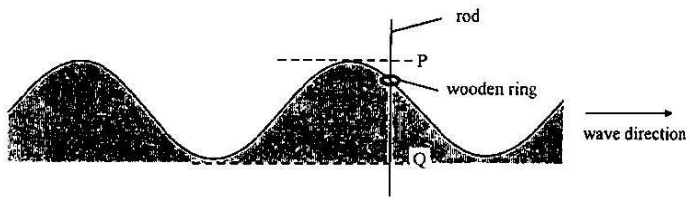


Fig. 8.2

(i) On Fig. 8.2, draw the direction that the ring is moving at t = 0 s.

(ii) How does the motion of the ring show that the waves are transverse?

.....

.....

.....

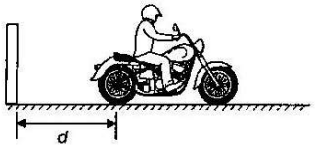
.....

.....[1]

SECTION B

Answer all the questions in this section.
Answer only one of the two alternative questions in **Question 11.**

9 A student is investigating the stopping distance for a motorcycle with high-performance brakes. In an experiment using electronic apparatus, a speeding motorcycle's distance d from a reference point is measured at different times t.



A mass is then added on the motorcycle and the experiment repeated.
Fig. 9.1 shows the results obtained for both experiments.

	without added mass	with added mass
t / s	d / m	d / m
0.0	0.0	0.0
0.2	12.0	12.0
0.4	23.0	24.0
0.6	31.2	34.8
0.8	35.8	44.4
1.0	37.6	52.4
1.2	38.0	58.8
1.4	38.0	63.5
1.6	38.0	66.5
1.8	38.0	68.0
2.0	38.0	68.4
2.2	38.0	68.4

Fig. 9.1

(a) Explain how the data in Fig. 9.1 for the motorcycle with the added mass suggests that the speed is constant at t = 0.2 s.

.....

..... [1]

(b) (i) On Fig. 9.2, draw a graph of d against t for the heavier motorcycle. [2]

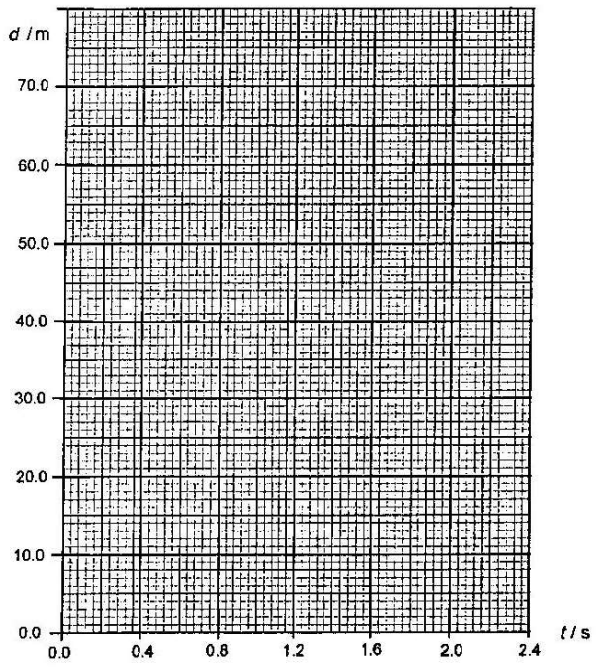


Fig. 9.2

(ii) At what time t does this motorcycle start to decelerate?

time = ... [1]

(iii) Explain how the graph shows that this motorcycle is decelerating at the time indicated in b(ii).

.....

..... [1]

(iv) Using the data in Fig. 9.1, determine the speed of the motorcycle with added mass at t =1.0 s.

speed = ... [1]

(v) Hence determine the average deceleration of the motorcycle with added mass between t = 0.2 s and t =1.0 s.

average deceleration = ... [2]

(c) Compare the motion of the original motorcycle with that of the heavier one.

.....

.....

..... [2]

10 (a) A light dependent resistor and a 2 kΩ resistor are connected in series across a 3.0 V d.c. supply as shown in Fig. 10.1.

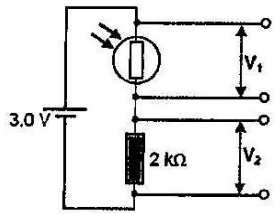


Fig. 10.1

In an experiment the light intensity incident on the LDR is varied during a 60 s period. The voltage V_1/V across the LDR is measured over the 60 s period and a graph was obtained as shown in Fig. 10.2.

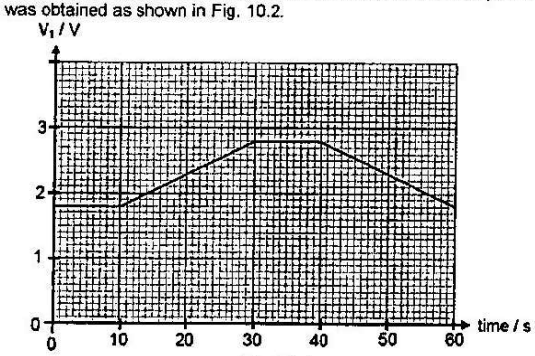
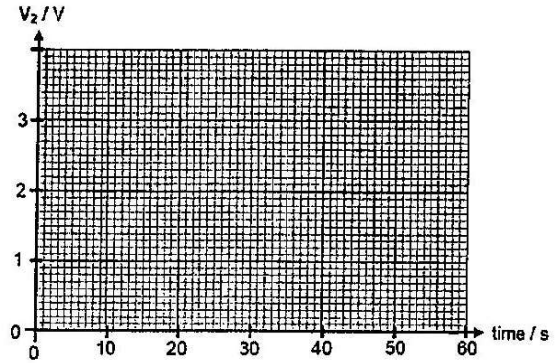


Fig. 10.2

(i) Sketch, in the grid below, the graph of V_2/V against time/s, across the 2 kΩ resistor over the same 60 s period. [2]



(ii) Calculate the resistance of the light dependent resistor at the start of the 60 s period.

Resistance = ...[2]

(iii) Is the light intensity incident on the LDR increasing or decreasing during the time interval between 10 s and 30 s? Explain your answer.

.....

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..... [2]

(b) A student was trying out a circuit he assembled using an A.C. source, diodes, switches and light bulbs (12V, 24 W). He wanted to measure the voltage of the input, so he connected a CRO across the supply as shown in Fig 10.3.

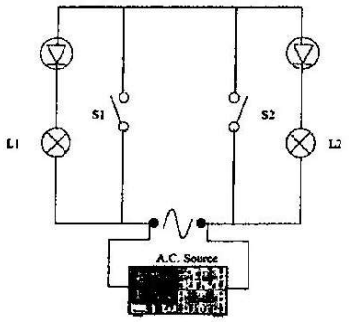
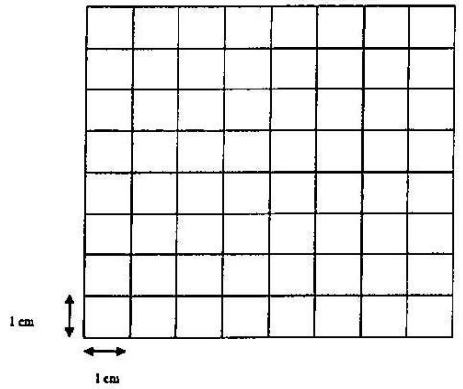


Fig. 10.3

(i) If the supply is a 12 V, 50 Hz A.C, how would the display look like if the gain is set at 3V/cm and the timebase is 5 ms/cm? Draw the probable waveform in the grid provided. [2]



(ii) The CRO is now connected across L2 (Fig 10.4). S1 is closed and S2 is open with the gain set at 4V/cm and the time base setting is 10 ms/cm. Assuming that the bulbs are working normally. The CRO now shows a display as shown in Fig 10.5.

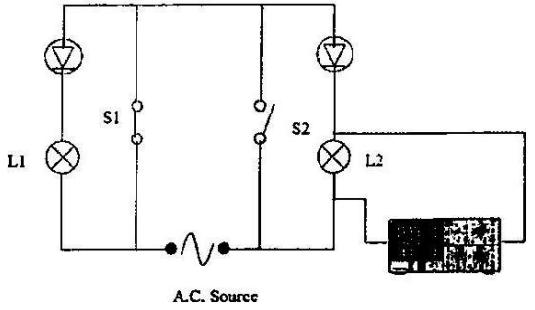


Fig. 10.4

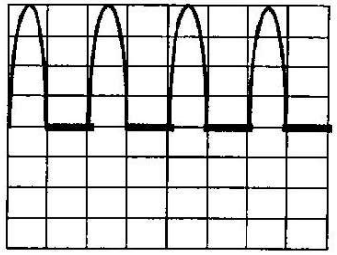


Fig. 10.5

Explain clearly how the graph shown in Fig 10.5 is obtained.

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..... [2]

11 Either

(a) Desktop computers store data on discs coated with a magnetic medium which records the data in a digital form. As a disc spins at very high speeds the magnetic field at each place on the disc can be detected in order to 'read' the data.

Fig. 11.1 shows a school laboratory model set up to demonstrate how such systems work.

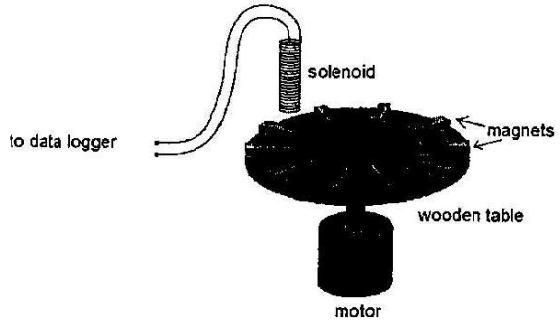


Fig. 11.1

The ten flat magnets on this model disc can be arranged with either the North Pole or South Pole facing upwards. These are detected by the solenoid linked to the datalogger as the wooden table spins.

(i) Fig. 11.2 shows the view of one of the magnets from the side. Sketch its magnetic field. [2]

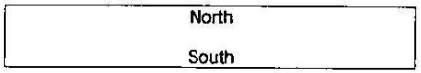


Fig. 11.2

(ii) Fig. 11.3 shows how the magnetic flux varies as an upward-facing north pole moves beneath the coil. Fig. 11.4 shows the corresponding induced emf from the solenoid.

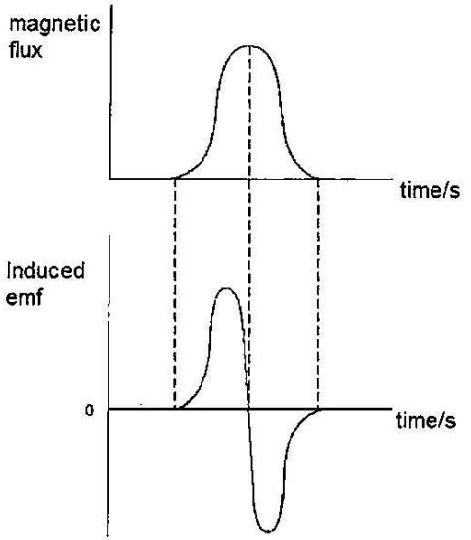


Fig. 11.3

Fig. 11.4

Explain how the output is generated and why it has this shape.

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..... [4]

(b) Fig. 11.5 shows an electric toothbrush that contains rechargeable batteries. The electric toothbrush charges its batteries despite there being no metal contacts between the toothbrush and the base.

The base, which is connected to an a.c. supply, contains a coil around a metal bar (coil X). The toothbrush contains a second coil (coil Y). When the toothbrush is placed on to the base, coil Y goes around the bar and coil X. The two coils do not make physical contact.

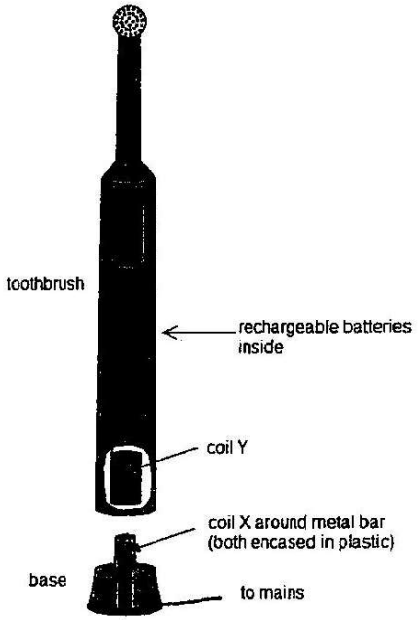


Fig. 11.5

(i) State a reason for the design of the electric toothbrush not having metal contacts between the toothbrush and the base.

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..... [1]

(ii) Explain how, without the two coils making contact, this arrangement is able to charge the battery in the toothbrush.

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..... [3]

11 Or

(a) In Fig. 11.6, the device inside the plastic box can be used to measure current. T_1 and T_2 are the terminals to which the external circuit is connected.

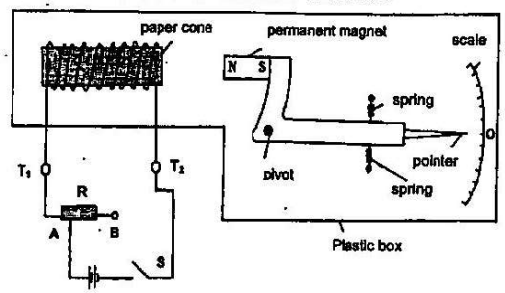


Fig. 11.6

(i) State and explain which direction the pointer would deflect when the switch S is closed.

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..... [2]

(ii) State the effect on the deflection of the pointer if the slide contact of the rheostat R is moved from A to B.

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..... [1]

(iii) The polarities of the cells are reversed. Briefly explain how the device can be used to show the direction of current.

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..... [2]

(iv) The permanent magnet is replaced by a piece of soft iron. Explain whether the device can be used to detect the direction of current.

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..... [1]

(v) Suggest one modification to the above device to produce a greater deflection for the same magnitude of current.

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..... [1]

(b) Fig. 11.7 shows a current-carrying wire, **AB**, placed between two magnets.

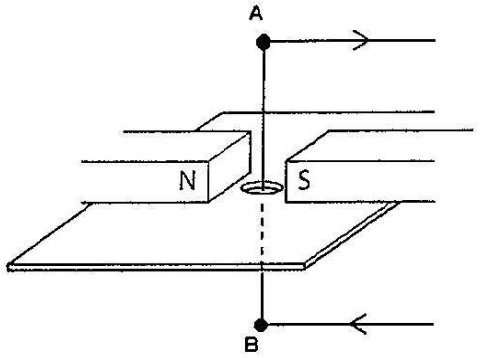


Fig. 11.7

(i) Indicate in Fig. 11.7, the direction of the force acting on the current-carrying wire **AB**. [1]

(ii) Explain why the wire in (i) moved in the direction you have indicated.

.....

.....

.....

.....

.....

..... [2]

End of Paper

Answers for SCGS 2016 Prelim Physics Paper 1				
1	D		21	D
2	B		22	A
3	B		23	B
4	B		24	C
5	D		25	A
6	D		26	B
7	C		27	B
8	B		28	A
9	A		29	A
10	D		30	B
11	C		31	D
12	D		32	C
13	D		33	C
14	A		34	B
15	A		35	A
16	C		36	A
17	C		37	D
18	B		38	C
19	D		39	D
20	D		40	C

SCGS 2016 Prelim Physics Paper 2 Mark Scheme

1 (a) State the acceleration of the parachutist at t = 1.0 s. [1]

taking gradient , a = 10.0 m s^{-2}

(b) On fig. 1.1, complete the graph for A and B until they reach constant speed. [2]

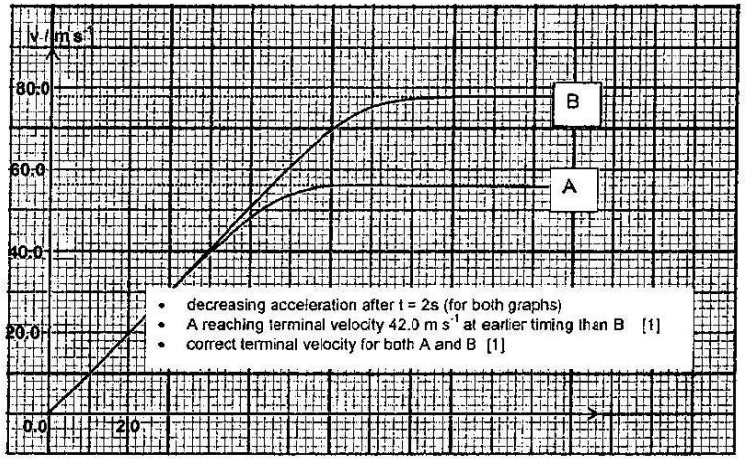


Fig. 1.1

(c) Explain in terms of forces acting on each of them, why B continues tc accelerate for a while even though A has started to fall with constant speed.

- As weight of A < weight of B
- A will reach terminal velocity earlier than B
- A will have a smaller magnitude of air resistance when terminal velocity is reached [1]
- Amount of air resistance depends on the speed of falling, so A will have a lower falling speed (terminal velocity). [1]
- Conversely, B must continue to accelerate to a higher speed until the air resistance is as large as its weight [1]

2 Find

(a) the work done on the load, [2]

Work done on load = force applied against gravity x vertical distance moved [1]
= 200 x 6.0 = 1200 J [1]

(b) the number of rotation of the 'wheel and axle' system when the load rises 6.0 m

circumference of axle = 2π r = 0.8796 m
number of wheel & axle rotation = 6.0 / 0.8796 = 6.82 [1]

(c) the work done by the force pulling the string. [2]

distance pulled by 50 N force = 6.82 x circumference of wheel = 6.82 x 4.40 = 30.0 m [1]
Work done by 50 N force = 50 N x distance pulled = 50 x 30.0
= 1500 J [1]

(d) Account for the difference in your answers to (a) and (b). [1]

Energy is loss as work done against frictional forces [1]

(e) the efficiency of the wheel and axel system. [1]

efficiency = useful energy output / total energy input x 100%
= 1200 / 1500 x 100% = 80 % [1]

3 a) State the conditions of equilibrium of a body.

No resultant force [1] and No resultant moment acting on a body [1]

b) When weight W is 35 N, calculate the tensions of the strings T_1 and T_2. [3]

taking moment about point X. At equilibrium,
clockwise moment about X = anticlockwise moment about X
(10 N x 1.55 m) + (35 N x 3.55 m) = (T_2 x 2.70 m) + (20 N x 0.45 m) ----- [1]
T_2 = 48.4 N ---------- [1]

$T_1 + T_2$ = 20 N + 10 N + 35 N
T_1 = 16.6 N ---------- [1]

c) If the breaking tension of each string is 60 N, what is the maximum weight W that can be hung such that one of the strings just breaks?

Since T_2 is greater, it will break first. Let T_2 = 60 N when it breaks.
taking moment about point X.

At equilibrium,
clockwise moment about X = anticlockwise moment about X
(10 N x 1.55 m) + (W x 3.55 m) = (T_2 x 2.70 m) + (20 N x 0.45 m) ----- [1]
15.5 + 3.55 W = 162 + 9.0
W = 43.6 N ---------- [1]

4 (a)

(i) Describe, in terms of the motion of particles, how the temperature of end Y rises. [2]

The particles at X gain thermal energy from the Bunsen Burner flame. Their average kinetic energy increases. The thermal energy is transferred to the neighbouring particles through molecular vibration and also through free electron diffusion.[1] Hence the particles at Y are driven into more vigorous vibration. Since temperature is directly proportional to the average kinetic energy of the particles, the temperature increases. [1]

(ii) If the copper rod is replaced by a metal rod whose heat capacity is larger, describe and explain any change in the value of t. [2]

The value of t will increase. [1]
A longer time is required for the Bunsen flame to supply a larger amount of energy so as to result in the same increase in temperature of the metal rod. [1]

(b)

(i) State the main processes of heat transfer by the heater to warm up the whole room. [1]

Radiation and convection [1]

(ii) The heater is usually placed at the bottom of the bedroom. Explain why the heater is placed at the bottom in terms of density changes. [2]

When the fan is placed at the bottom of the bedroom, it will heat up the air there. When temperature of the air increases, its volume expands and its density decreases. [1]
This causes it to rise and the cooler air at the top of the room, being denser will sink. [1] Convection currents are set up to effectively heat up the room.

5

(a) Explain, in terms of the particles involved, how the fuel becomes positively charged. [1]

Electrons move from fuel to the pipe. The fuel loses electrons and becomes positively charged and pipe gains electron and becomes negatively charged. [1]

(b) Suggest and explain how the positively charged fuel can charge up the aeroplane. [1]

Electrostatic induction occurs. Positively charged fuel induces positive charges on the plane. [1]

(c) To prevent an aeroplane from becoming charged, a metal cable connects the aeroplane to the ground.

i) Explain why the cable is made of metal, [1]

Metal is an electrical conductor that allows electrons to flow through it [1]

ii) Explain how the cable prevents the aeroplane from becoming charged. [1]

Electrons flow from plane along the cable to earth and plane is neutralised/earthed. [1]

(d) Calculate the current that flows through the cable if 2.0 μC of charge on aeroplane flows in a time of 1.2 ms. [2]

$I = Q/t = (2.0 \times 10^{-6}) / (1.2 \times 10^{-3})$ [1]
$= 1.7 \times 10^{-3}$ A [1]

6

a) Explain why the lamp illuminates only for a short period. [3]

There is a current in the primary coil when the switch is closed. This current creates a magnetic flux in the primary coil. Due to the soft iron ring, the magnetic flux created by the primary coil also links the secondary coil. With the switch closed, there is no change in the magnetic flux linkage at the secondary and hence the lamp is not lit. [1]

When the switch is opened, the magnetic flux decreases to zero in a short period. The rapid change in magnetic flux at the secondary coil creates an e.m.f. and the lamp illuminates for a short period.[1]

Eventually there is no magnetic flux at either the primary or the secondary coil and hence there is no e.m.f. induced – the lamp stays off. [1]

b) The 1.5 V cell is replaced by an a.c. supply of 230 V. The transformer is 80% efficient. Calculate the power loss in the transformer.

Power in primary coil = [24/80%] = 30W [1] **$(P_s/P_p) \times 100\%$ = Efficiency**
Power loss = 30 – 24 = 6W [1]

c) Suggest and explain one method to minimize power loss in the transformer. [1]

Laminate the soft iron core to prevent eddy current [1]

7. (a) State and explain the process that takes place as the light **A** beam travels down the optical fibre. [2]

total internal reflection[1]; when the incident angle of the ray of light that travels from the optical fibre into the external exceeds the critical angle, light is internally reflected. [1]

(b) Complete the diagram to show the passage of the light beam **B** down the same optical fibre. [1]



should show more reflections; [1]

(c) Suggest why beam **B** will take slightly longer to travel down the fibre than beam **A**. [1]

There are more reflections/hits side more often: A. so greater distance to travel [1]

(d) The speed of light in the fibre was found to be 1.2×10^8 m/s. Calculate

critical angle = $\sin^{-1}$ [1.2/ 3.0] = 23.6^0
Max angle B can make with boundary = $90^0 - 23.6^0 = 66.4^0$

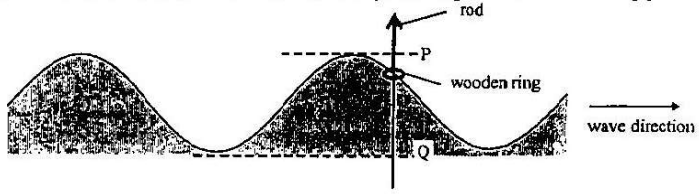
8 (a)(i) Suggest why the fishermen cannot hear the ultrasound. [1]

frequency/ pitch; OR above normal hearing /too high;

(ii) The fisher men sent a pulse into the sea and they recorded the reflected pulse on a microphone after 0.5 seconds. Calculate the depth of the sea. The speed of sound in water is 1500 m/s. [2]

distance = [1500 x 0.5] / 2 [1] = 375 m [1]

8 (b)(i) On Fig. 8.2, draw the direction that the ring is moving at t = 0 s. [1]



(ii) How does the motion of the ring show that the waves are transverse? [1]

ripples are at 90 degrees / vertical displacement (up / down) perpendicular to wave travel

[not forward and back]

Data Question (10 marks)

9 (a) Explain how the data in Fig. 9.1 for the motorcycle suggests that the speed is constant at t = 0.2 s.

the motorcycle moves equal distance of 12.0 m for both intervals from t = 0 to t =0.2 s and t= 0.2 s to t=0.4 s.

(b) (i) On Fig. 10.2, draw a graph of d against t for the heavier motorcycle. [2]

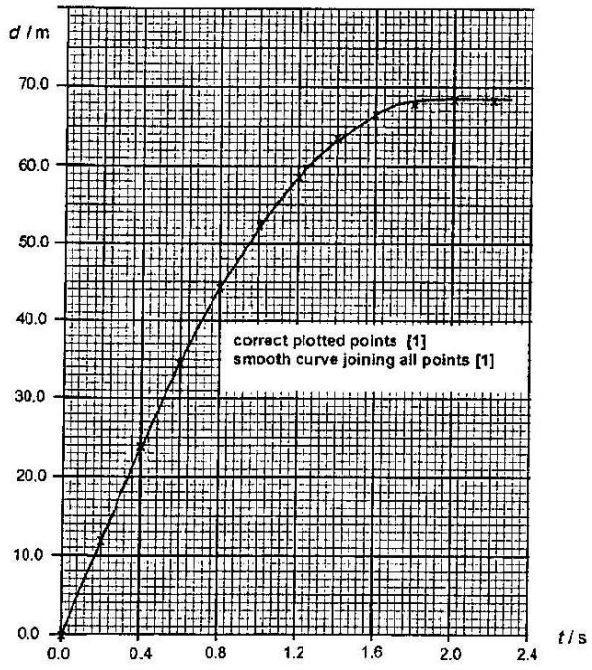


Fig. 10.2

(ii) At what time does this motorcycle starts to decelerate?

t = 0.6 s – 0.8 s [1]

(iii) Explain how the graph shows that this motorcycle is decelerating at the time indicated in b(ii).

the gradient of the graph represents speed and it starts to decrease from t = 0.6 s/ 0.8 s [1]

(iv) Using the data in Fig. 9.1, determine the speed of the heavier motorcycle at t =1.0 s.

the gradient (at t = 1.0 s) = (58.8 – 44.4) / (1.2 – 0.8) = 36 m/s [1]

(v) Hence determine the average deceleration of the heavier motorcycle between t = 0.2 s and t =1.0 s.

deceleration = change in speed / time (between t = 1.0 s and t = 0.2 s)
speed at t = 0.2 s is 60 m s^{-1} [1]

ave deceleration = (60 – 36) / 0.8 = 30 m s^{-2} [1]

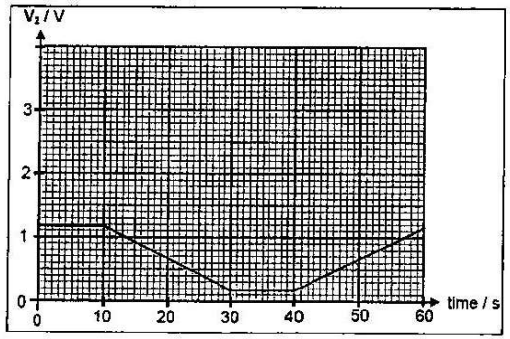
(c) Compare the motion of the original motorcycle with that of the heavier one.

the heavier motorcycle has a larger braking distance [1]

the lighter motorcycle has a greater deceleration
the lighter motorcycle took a shorter amount of time to come to a stop } [1]
same point

10 (a)

(I) Sketch in the graph of V_2/V against time/s below, the voltage across the 2 kΩ resistor over the same 60 s period. [2]



(II) Calculate the resistance of the light dependent resistor at the start of the 60 s period. [2]

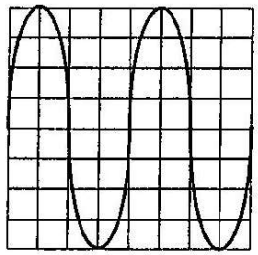
2000 Ω /R = 1.2 V/ 1.8 V [1]
R = 3000 Ω [1]

(iii) Is the light intensity incident on the LDR increasing or decreasing during the ti [2]
Interval between 10 s and 30 s? Explain your answer.

Light intensity is decreasing. [1]
V_1 is increasing. Resistance of LDR is increasing. [1]

(b)

(i) If the supply is a 12 V, 50 Hz A.C, how would the display look like if the gain is [2]
set at 3V/cm and the timebase is 5 ms/cm? Draw the probable waveform in
the grids provided.



(ii) Explain clearly how the graph shown in Fig 10.5. is obtained. [2]

When S2 is opened, the current will flow through the CRO when it flows out of the a.c. source from the left hand side.[1] This is will be captured on the CRO. When the a.c. source changes direction, no current flows.[1]

11 Either

(a) (i) Fig. 11.2 shows one of the magnets on this model. Sketch its magnetic field. [2]

Shape [lines not crossing] [1] arrow(s) [1]

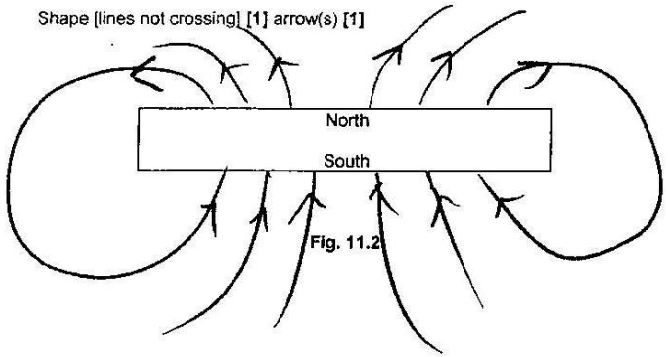


Fig. 11.2

(ii) Explain how the output is generated and why it has this shape. [4]

- There is a changing magnetic flux(linkage) and hence induces emf or current [1]
- emf is proportional to rate of change / Faraday's law stated [1]
- output is gradient of flux graph, max emf for max rate of change of magnetic flux / steepest gradient , Emf = 0 when gradient = 0 [1]
- signal +ve while the rate of change of magnetic flux increases / –ve while rate of change of magnetic flux decreases [1]

(b) (i) State a reason for avoiding metal contacts between the toothbrush and the base.

Advantage of avoiding metal contacts
Any one from:
- makes possible a sealed unit to prevent water from entering
- avoids electrocution
- prevents corrosion (by water)
- so that water cannot enter and cause short circuit

(ii) Explain how, without the two coils making contact, this arrangement is able to charge the battery in the toothbrush.

The a.c. in X produces a changing magnetic field and this produces a magnetic flux linkage between X and Y. [1]
This induced an emf and a current in Y which charges the batteries. [1]

11 Or

(a) (i) State and explain which direction would the pointer deflect when the switch S is closed.

Up [1]. The current flowing into the solenoid will **magnetize** the solenoid with a N pole on the left and a S pole on the right of the solenoid. This **attracts** the magnet and cause the pointer to move anticlockwise.[1]

(ii) State the effect on the deflection of the pointer if the slide contact of the rheostat R is moved from A to B. [1]

Resistance increase and smaller current flows and thus produces weaker magnetic force to attract the magnet. This produces a **smaller deflection**.

(iii) The polarities of the cells are reversed. Briefly explain how the device can be used to show the direction of current.
This produces a S pole on the left and a N pole on the right.[1] Like poles repel so the magnet will move to the right, producing an unbalanced clockwise moment which turns the pointer down/clockwise.[1]

(iv) The permanent magnet is replaced by a piece of soft iron. Explain whether the device can be used to detect the direction of current.

No. The soft iron will always have an induced magnetic pole that is opposite to the magnetic pole at the right end of the solenoid (as iron magnetises and demagnetises easily). Hence there will **always be an attraction** regardless of the direction of current flow.[1]

(v) Suggest one modification to the above device to produce a greater deflection for the same magnitude of current. [1]

Reduce the distance between the solenoid and permanent magnet / use a stronger permanent magnet / more turns[1]

(b) (i) Indicate in Fig. 11.7, the direction of the force acting on the current-carrying wire AB. [1]

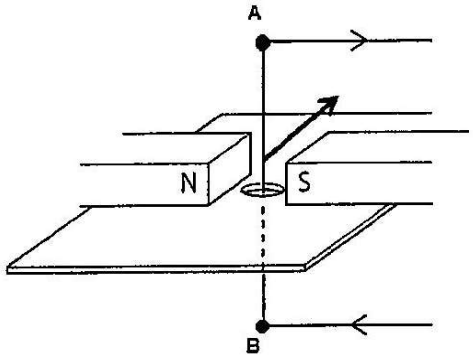


Fig. 11.7

(ii) Explain why the wire in (i) moved in the direction you have indicated.

When current flows through AB, there is a magnetic field produced around AB. [1] This magnetic field interacts with the external magnetic field and thus a force is exerted. According to Fleming's Left Hand Rule[1], the direction of the force is as shown.

End of Paper

1 What is the correct order of magnitude for the diameter of an atom and for the diameter of the Earth?

	diameter of atom	diameter of Earth
A	0.1 nm	10 Mm
B	0.1 nm	10 Gm
C	0.1 μm	10 Mm
D	0.1 μm	10 Gm

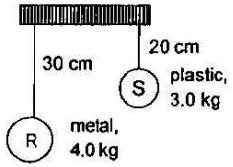
2 A student measures the diameter of a cylindrical wooden pencil with a ruler. How could he increase the precision of the measurement?

A	take the average value of several measurements of the diameter along different parts of the pencil using the ruler
B	take the average value of several measurements of the diameter along different parts of the pencil using vernier calipers with zero error
C	take the average value of several measurements of the diameter along different parts of the pencil using vernier calipers without zero error
D	use a micrometer with zero error and take one value of the diameter

3 The diagram shows two different pendulums R and S hung from a horizontal rod.

Which of the following statements is **true**?

A R will swing faster as it has a greater density.
B R will swing faster as it is larger in size.
C S will swing faster as it has a smaller mass.
D S will swing faster as it is shorter.



4 Two forces act at a point.

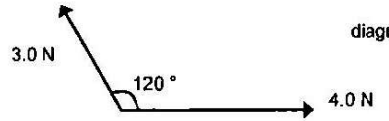


diagram not drawn to scale

What is the resultant of the two forces?

A 1.0 N **B** 3.6 N **C** 5.0 N **D** 7.0 N

5



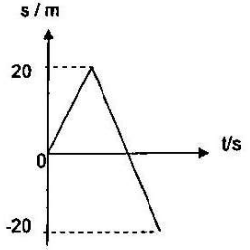
Once upon a time (300 B.C.) there was a very wealthy king, Hiero of Syracuse (Sicily) suspected that the goldsmith has cheated him by using a gold and silver mix instead of pure gold to make a crown. King Hiero asked Archimedes to determine the truth without destroying the crown. (In modern terms, he was to perform nondestructive testing).

Given that the mass of crown = 1000 g, volume of crown = 64.8 cm^3 and density of gold, silver and water are:19.3g/cm^3;10.49 g/cm^3 and 1g/cm^3 respectively, find the percentage of gold and silver.

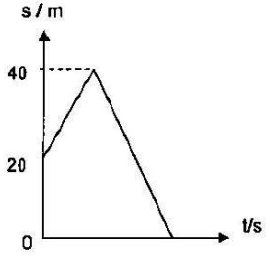
	% of Gold	% of Silver
A	29.8	70.2
B	35.2	64.8
C	64.8	35.2
D	70.2	29.8

6 A ball is thrown vertically up from the top of a building 20 m high with an initial velocity of 20 m s^{-1}. If the displacement of the balls is measured from the point of projection of the ball, which of the following graphs best represents the displacement of the ball with time t?

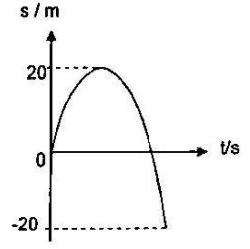
A



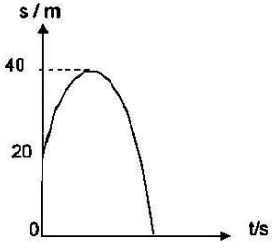
C



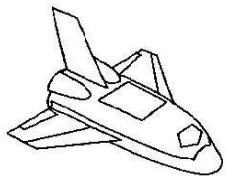
B



D



7 If the engine of a space craft travelling in empty space is turned off, the space craft will



A continue to move with constant acceleration.
B continue to move with constant deceleration.
C continue to move with constant velocity.
D stop moving.

8 A non-uniform object is placed on an inclined plane as shown in **Fig 8.1**. If the object is just about to topple, which position will be its centre of gravity?

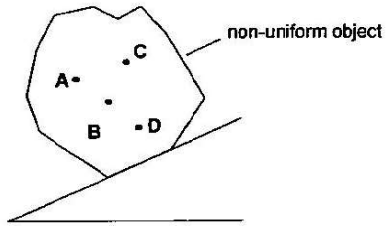
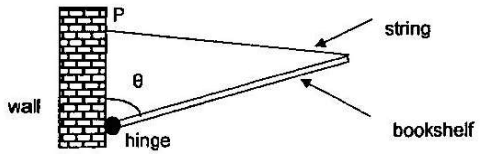


Fig 8.1

9 A string is tied to the wall at a fixed point P to help to secure a bookshelf.

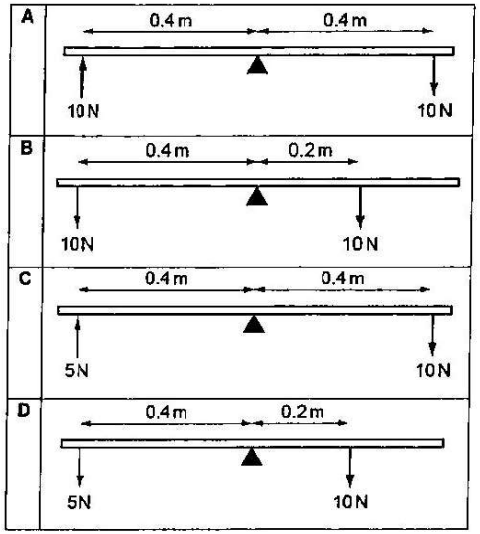


Which of the following will help to minimize the tension in the string in order to help it last longer?

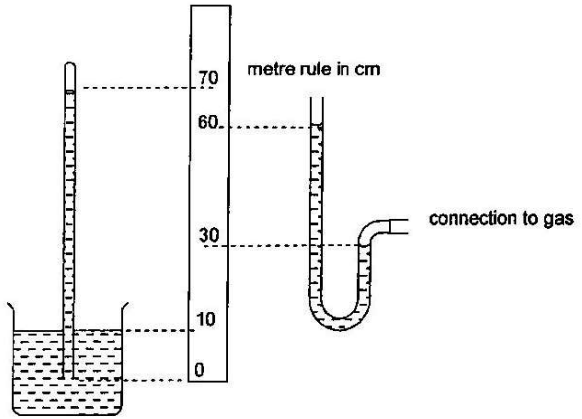
A a smaller θ
B have a longer bookshelf
C less friction at hinge
D use steel bookshelf instead of light wooden one

10 Forces are applied to a uniform beam pivoted at its centre.

Which beam is balanced?



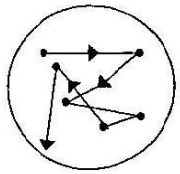
11 A mercury barometer and a mercury manometer are placed in the same room which is on a hill top. The manometer is connected to a gas container.



What is the pressure of the gas?

A 15 cm Hg B 40 cm Hg C 75 cm Hg D 90 cm Hg

12 Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



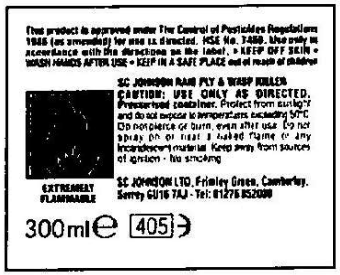
What does this experiment demonstrate about air molecules?

A They are in continuous random motion.
B They can be seen through a microscope.
C They move because of collisions with smoke particles.
D They move more slowly when they are heated.

13 When a solid is melting how do the potential energy and kinetic energy of the particles in the solid change?

	Potential Energy	Kinetic Energy
A	decreases	increases
B	increases	increases
C	increases	no change
D	no change	increases

14 On the spray containers of insecticide, there is a warning label stating that it is dangerous to dispose of the container, even when empty, in fire.



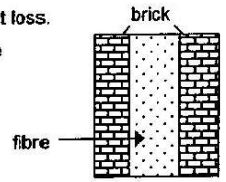
Why is it dangerous to throw empty insecticide containers into fire?

A	The can is not fire-proof and will catch fire easily.
B	When the can is heated, the gas molecules within the can will absorb the heat quickly from the fire and catch fire.
C	When the can is heated, the gas molecules inside the empty can will expand and the pressure within the container will build up until the can explodes.
D	When the can is heated, the gas molecules inside the empty can will move faster and the pressure within the container will build up until the can explodes.

15 The resistance of a piece of platinum wire in melting ice and boiling water are 800 Ω and 910 Ω respectively. What is the temperature reading in Kelvin when the resistance has a value of 1000 Ω?

A 328 K B 383 K C 455 K D 495 K

16 A brick wall in a cold country is filled with fibre to prevent heat loss.



Heat cannot easily escape through the wall because the fibre

A heats up the wall.
B is tightly packed.
C is warm.
D traps air.

17 A liquid placed inside an insulated container is kept boiling by a heater immersed in it. When the power supplied to the coil is 84 W, the liquid boils away at a rate of 10^{-3} kg/min.

Calculate the specific latent heat of vaporization of the liquid in J/kg.

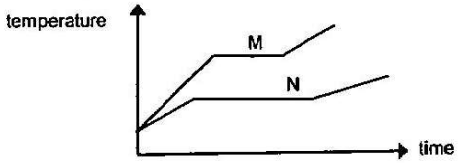
A 8.4×10^2 B 5.05×10^4 C 8.4×10^4 D 5.04×10^6

18 Two cars, one painted dull black and the other a shiny white, were left in the sun. When the two cars had reached the same temperature they were driven into the shade.

Which car will be heated up faster and which car will cool down faster?

	In the Sun	*In the shade*
A	Black car heats up faster	Black car cools down faster
B	Black car heats up faster	White car cools down faster
C	White car heats up faster	Black car cools down faster
D	White car heats up faster	White car cools down faster

19 Two solids M and N are heated separately by identical heaters under identical conditions. The changes in temperature with time for the two solids are shown below.



If M and N are of the same mass, which of these statements is/are correct?

1 Freezing point of N is lower than that of M.
2 Solid N has a higher specific heat capacity than solid M.
3 The specific latent heat of fusion of N is higher than that of M.

A 1 only B 1 and 2 only C 1 and 3 only D 1, 2 and 3

20 It is observed that the crest of a water wave takes 10 s to travel 20 cm. Given that the frequency of the wave is 5 Hz, calculate the wavelength of the water wave.

A 0.040 cm **B** 0.40 cm **C** 4.0 cm **D** 40 cm

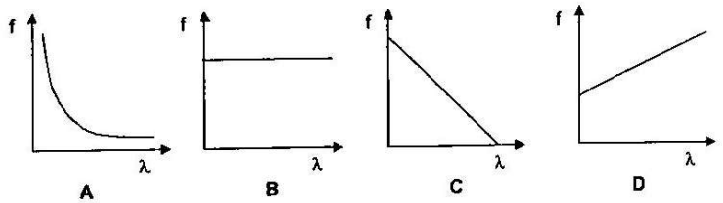
21 Which one of the following values can possibly be the wavelength of X-rays given that the wavelength of red light is 700 nm?

A 5×10^{-2} m **B** 5×10^{-5} m **C** 5×10^{-7} m **D** 5×10^{-10} m

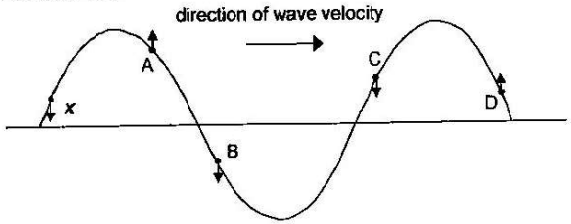
22 Which one of the following statements is **NOT** correct?

A	Gamma rays have wavelengths shorter than visible light and may be used to find faults in metal casting.
B	Infrared rays are given off by hot objects, and can pass through fog and glass.
C	Radiowaves have wavelengths longer than visible light and can be reflected by layers in the upper atmospheres.
D	Ultraviolet rays may produce sunburn, are absorbed by glass and can produce fluorescence.

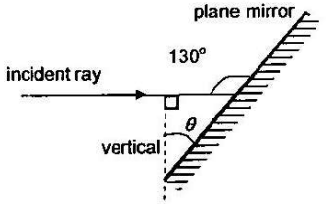
23 Which one of the following graphs shows the correct relationship between the frequency, **f** of an electromagnetic wave and its wavelength, λ?



24 The diagram shows a section of a wave motion. The particle at position *x* moves in the direction of the arrow shown. Which of the following particles at the labelled positions, **A**, **B**, **C** and **D** is ***incorrect***?



25 A plane mirror is tilted at an angle of θ to the vertical. When an incident ray of light strikes the mirror it makes an angle of 130° to the surface of the mirror as shown below.



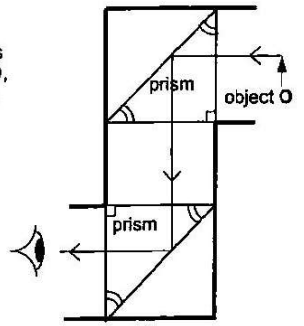
Find the angle of reflection and the angle θ.

	angle of reflection / °	angle θ / °
A	40	40
B	40	50
C	50	40
D	65	50

26 A periscope is used to look over the top of obstacles. One type consists of two triangular prisms that are fitted at end of a tube as shown. Each prism has angles of 90° and 45°. A ray of light from the top of an object **O**, passes through the periscope. The image of the object is viewed by an eye **E**.

What type of image is formed is seen by the eye **E**?

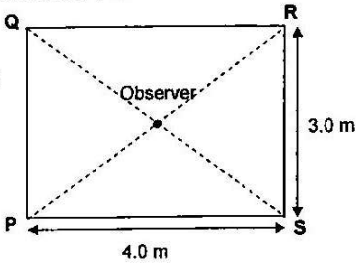
A	inverted and same size as object
B	inverted and smaller size than the object
C	upright and same size as object
D	upright and smaller size than the object



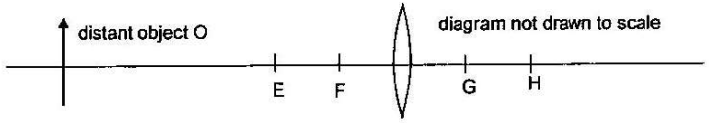
27 The diagram represents, the top view of a room **PQRS** which measures 3.0 m by 4.0 m. An observer stands at the centre of the room with his back to **PS**.

In order for the observer to see the full width of the wall **PS**, what is the minimum length of a plane mirror placed at eye level on the wall **QR**?

A	1.0 m
B	1.3 m
C	2.0 m
D	2.5 m



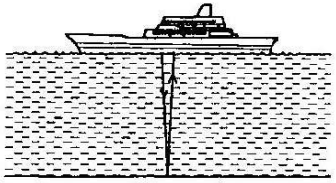
28 In the diagram below, a self-luminous object is located at O and is assumed to be faraway from the converging lens. Point E, F, G and H are points equally spaced along the axis of the lens. A real, inverted image of the object O is found at point G.



When the object is moved between E and F, what will happen to the image?

A It moves away from point G towards a point between G and H.
B It moves away from point G towards a point beyond H.
C It remains inverted at point G but becomes bigger.
D It remains inverted at point G but becomes smaller.

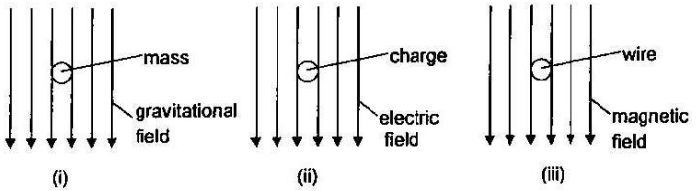
29 The diagram below shows a ship measuring the depth of the sea. The ship sends down an ultrasonic pulse and receives an echo from the sea bed 0.6 s later.



Calculate the depth of the sea if the speed of sound in water is 1400 m/s.

A 210 m **B** 420 m **C** 630 m **D** 840 m

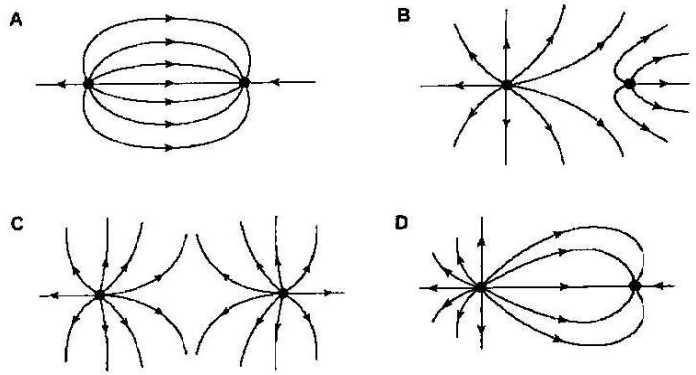
30 The diagrams show (i) a mass in a gravitational field, (ii) an unknown charge in an electric field and (iii) a current-carrying wire at right angles to a magnetic field.



Which are the possible direction(s) the forces act on the mass, unknown charge and the current-carrying conductor?

	Gravitational field	Electric field	Magnetic field
A	Force down	Force down	Force down
B	Force down	Force up or down	Force left or right
C	Force down	Force up or down	Force right
D	Force up or down	Force up or down	Force up or down

31 Which of the following shows two opposite electric charges of different magnitude?

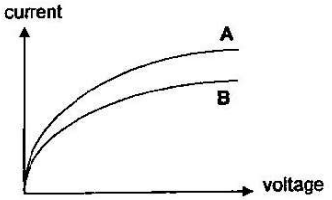


32 A battery moves a charge of 20 C round a circuit in a time of 5.0 s.

What is the current in the circuit?

A 0.25 A **B** 4.0 A **C** 80 A **D** 100 A

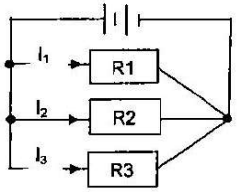
33 The graph shows the current and voltage relationship of two filament lamps made of the same type of metal.



Which of the following statements is **true**?

A Both filament A and filament B obey Ohm's law.
B Filament A is longer and thinner than filament B.
C The resistance of A is smaller than the resistance of B.
D The resistance of both filaments decreases with temperature rise.

34 The circuit below shows three resistors, R1, R2 and R3, connected to batteries and their resistances of the three resistors is $R_1<R_2<R_3$.



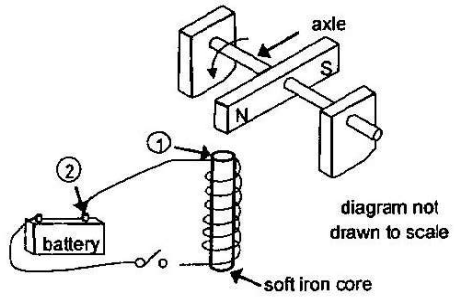
Which of the following shows correctly, in increasing order, the currents I_1, I_2 and I_3?

A $I_1 < I_2 < I_3$ **B** $I_1 < I_3 < I_2$ **C** $I_2 < I_3 < I_1$ **D** $I_3 < I_2 < I_1$

35 Which of the following is correct for domestic lighting circuits?

	Circuits connected in	Fuse placed in	Switch placed in
A	parallel	live lead	live lead
B	parallel	neutral lead	Neutral lead
C	series	live lead	live lead
D	series	neutral lead	Neutral lead

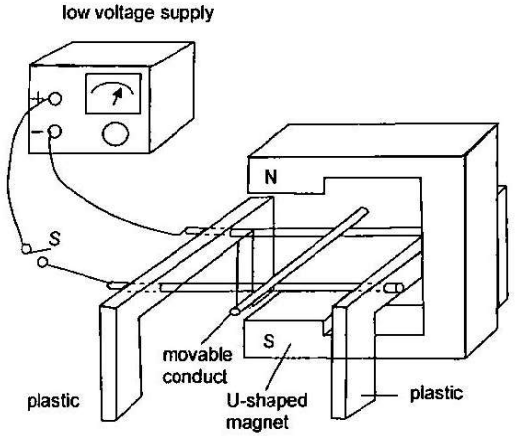
36 A magnet is free to spin. When the switch is closed, the magnet spins in the direction shown.



What is the magnetic polarity of the end of the soft iron core marked as (1) and the polarity of the battery terminal marked as (2)?

	Polarity of Magnet (1)	Polarity of Battery (2)
A	North	Negative
B	North	Positive
C	South	Negative
D	South	Positive

37 A movable conductor is placed on two parallel conductors and in the magnetic field of a U-shaped magnet. The two parallel connectors are connected to a low voltage supply.

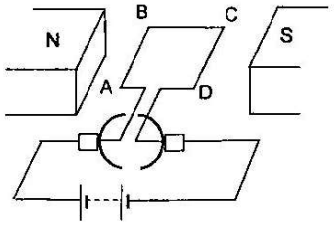


Which of the following can increase the magnetic force acting on the movable conductor when the switch is closed?

(1) Increasing the current
(2) Increasing the strength of the magnetic field
(3) Increasing the length of the movable conductor

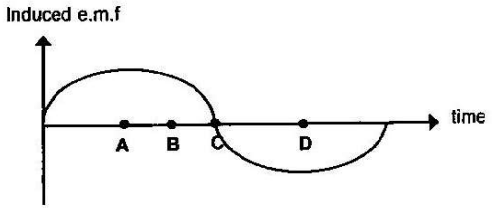
A (1) and (2) **B** (1) and (3) **C** (2) and (3) **D** (1), (2) and (3)

38 Why is a commutator used in a d.c. motor?



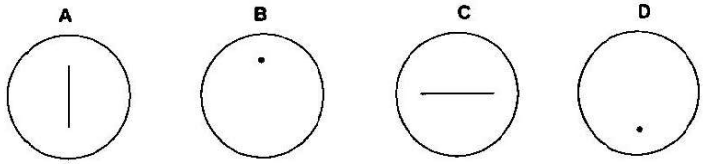
A	It allows the coil to rotate by allowing the wires to be entangled.
B	It allows the coil to rotate by reversing the current through the coil every half-turn.
C	It produces a greater turning effect by becoming magnetically induced.
D	It produces a greater turning effect by increasing the current through the coil

39 When an a.c. generator is rotating in a magnetic field, the induced e.m.f changes due to position of the coil.



Which point of the following graph shows that the area of the coil is at an oblique angle to the magnetic field?

40 Which of the following would be observed on the screen of the CRO if an alternating voltage supply is applied to the Y-input and the time-base is turned off?



The END

Section A (50 marks)
Answer **all** the questions in the section.

1 A student carries out an experiment to measure the power he produces. He runs up from floor of a hall to the top of the raised platform as shown in Fig. 1.1

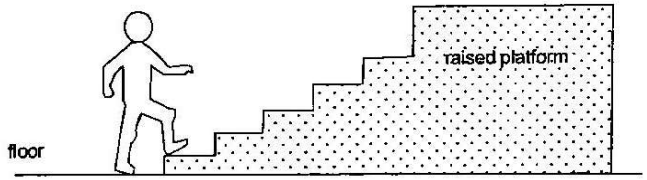


Fig. 1.1

(a) The student takes readings to calculate his power.

(i) List all the readings he must take. [2]

(ii) State one step he should take to make sure one of his readings is accurate. [1]

(iii) State one limitation in the way he determines his power. [1]

(b) Write down all of the equations he must use to calculate his power from the readings. You may use SI symbols or words in your equations. [1]

2 **Fig. 2.1** shows a 500 kg hovercraft accelerating from right to left while maintaining a constant height above the land. The four forces acting on it are Drag, Lift, Weight and Thrust.

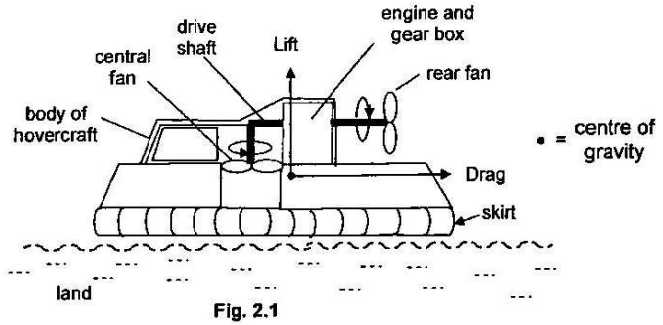


Fig. 2.1

(a) Draw and label the other two forces. [1]

(b) The hovercraft is travelling at constant acceleration.

State and explain the relationship between the four forces. In the relationship state whether the forces is less or equal or more than each other. [2]

(c) Calculate the Thrust needed if the acceleration of the hovercraft is 2.4 m/s^2 and the Drag is 200 N. [2]

(d) From **Fig. 2.1**, suggest how the Lift force is produced. [1]

3 **Fig. 3.1** shows a type of weighing machine. The two sliding weights can be moved independently along the rod. With no load on the hook and the sliding weights at the zero mark on the metal rod, the metal rod is horizontal. The hook is 4.8 cm from the pivot.

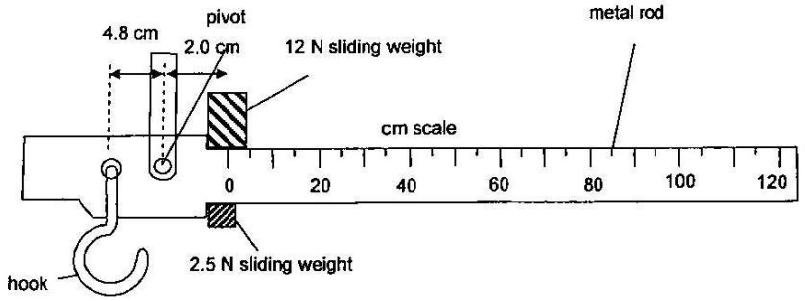


Fig. 3.1

(a) Explain what is meant by the moment of a force. [1]

(b) A sack of flour is suspended from the hook. In order to return the metal rod to the horizontal position, the 12 N sliding weight is moved 84 cm along the rod and the 2.5 N weight is moved 72 cm.

(i) Calculate the weight of the sack of flour. [2]

(ii) Suggest why this weighing machine would be imprecise when weighing objects with a weight of about 2.5 N and how would you overcome this limitation. [2]

4 **Fig. 4.1** shows a narrow beam of light, **AB** from a ray box directed towards the surface **ST** of an irregular shaped glass block **PQRSTU**. The glass block is fixed to a table.

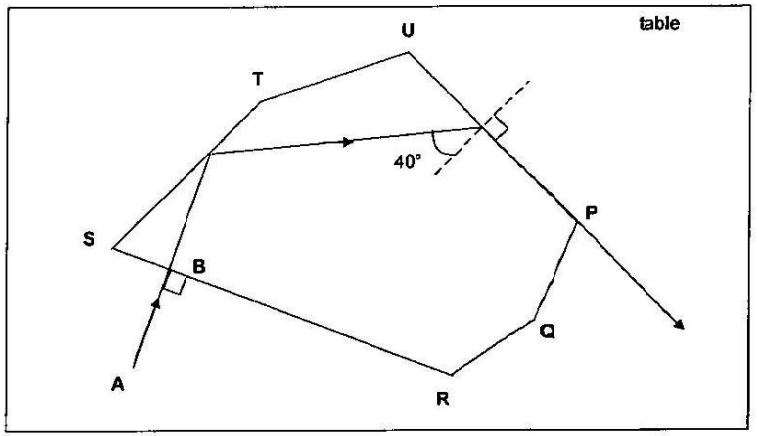


Fig. 4.1

(a) Calculate the refractive index of the glass. [2]

(b) Explain why the beam of light **AB** does not refract when it enters the glass block. [1]

(c) The ray from A is rotated in anti-clockwise direction while maintaining the **same** point of incidence B. At a new direction, it is found that the ray emerges along the surface **ST** of the glass block.

(i) On **Fig. 4.1**, sketch the new path and label the essential angles for this new emergent ray. [1]

(ii) Calculate the new angle of incidence if the angle at corner S is 65°. [2]

5 **Fig. 5.1** shows a diver working below the surface of a lake. The density of the water in the lake is 1000 kg/m^3, the atmospheric pressure at the surface is 1.0 x 10^5 Pa and the gravitational field strength is 10 N / kg. The diver inflates a balloon with air at a depth of 15 m and attaches the balloon to a tray of object.

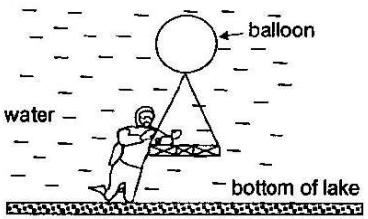


Fig. 5.1

(a) Calculate

(i) the pressure due to 15 m of water in Pa, [2]

(ii) the total pressure at 15 m below the surface of the lake. [1]

(b) The pressure of the air inside the balloon is less at the surface of the lake than at a depth of 15 m. Explain, in terms of the air molecules inside the balloon, why the pressure is less. State any assumption(s) made. [2]

(c) State one difference between the arrangement of the molecules of water in the lake and the molecules of air in the balloon. [1]

6 A collector views a postage stamp of height 1.5 cm through a lens. The lens is 2.0 cm from the stamp and the ratio of height of image to height of object is 3.0.

(a) In **Fig. 6.1**, complete the full scale ray diagram to determine the image of the stamp. [3]

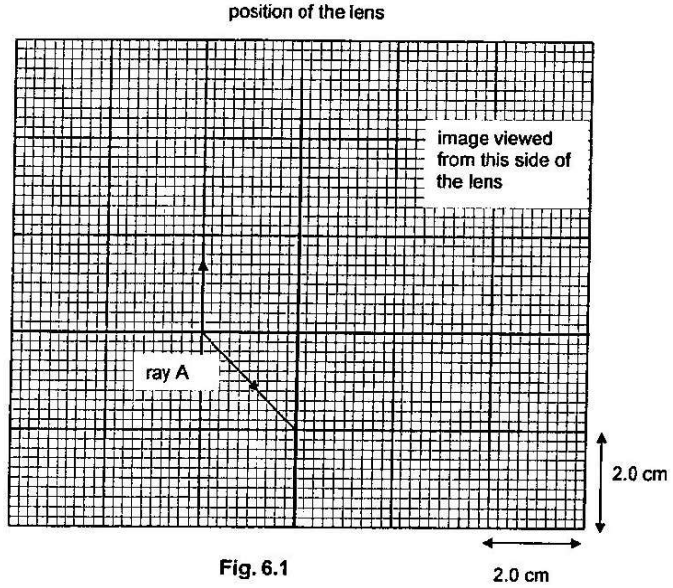


Fig. 6.1

(b) State what is meant by a virtual image. [1]

(c) Use your drawing to determine the focal length of the lens. [1]

(d) On **Fig. 6.1**, complete the path of ray A after passing through the lens. [1]

7 **Fig. 7.1** shows the position after a negatively charged sphere **C** on an insulating stand is brought close to a small, uncharged metal sphere **U** which is suspended from an insulating thread.

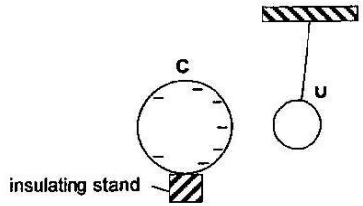


Fig. 7.1

(a) On **Fig. 7.1**, draw the induced charges on sphere **U**. [1]

(b) Sphere **C** is moved towards sphere **U** until the spheres touched. Sphere **U** is then repelled by sphere **C**, as shown in **Fig. 7.2**. The charges on **C** and **U** are not shown.

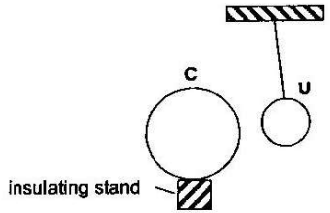


Fig. 7.2

(i) On **Fig. 7.2**, draw the resultant charges on spheres C and U after the spheres made contact. [2]

(ii) Explain what happens to the charges on the two spheres **C** and **U** as they touch. [2]

8 **Fig. 8.1** shows a circuit containing a variable resistor and two identical lamps each of resistance 10.0 Ω.

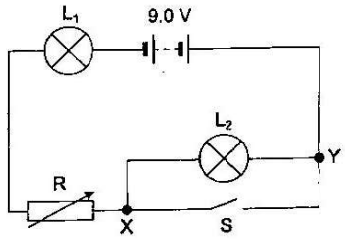


Fig. 8.1

(a) The switch S is open and the resistance of the variable resistor is gradually reduced to the minimum setting.

State and explain what happens to the brightness of both lamps. [2]

(b) Switch S is now closed with the variable resistor at its minimum setting.

(i) State the value of the potential difference across XY. [1]

(ii) State what happens to the brightness of lamp L_1. [1]

(c) Explain what happen to the brightness of L_1 at night when the rheostat is replaced by a light dependent resistor and the switch is open. [1]

9 **Fig. 9.1** shows a long flexible copper wire coil suspended vertically from a fixed clamp at A so that its lower end just dips into mercury in a container at B.

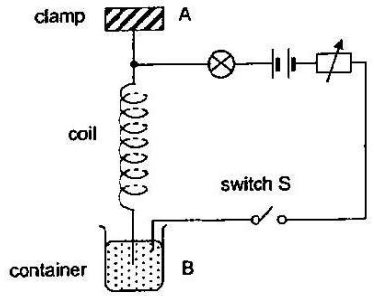


Fig. 9.1

Switch S is closed and when the current in the coil is gradually increased until the coil contracts such that the lower end loses contact with the mercury and the lamp goes out.

(a) Explain the above observation why the current need to be adjusted to a certain value for the lamp to be not lit. [2]

(b) State and explain what will take place after breaking contact with the mercury when switch S is still closed. [2]

(c) If the current in the coil is further increased, describe and explain what will happen to the lamp. [2]

Section B [30 marks]

Answer **all** questions in this sections.

Answer only one of the alternative questions in **Question 12.**

10 **Fig. 10.1** shows a graph of pressure against distance of a travelling wave at time $t = 0$ s. The speed of sound in air can be taken as 340 m/s.

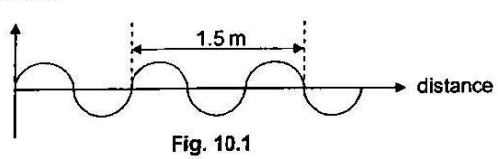


Fig. 10.1

(a) Determine the following characteristics by completing the table below. [4]

(i) Wavelength	
(ii) Frequency	
(iii) periodic time	

(b) As the wave travels to the right, sketch on **Fig. 10.1**, the pressure variation at half a period later. [2]

(c) An oscillator is used to set up water waves in a ripple tank which is slightly inclined. **Fig. 10.2** shows the top view and the wavelength in region X and wavelength in region Y is 2.5 cm and 3.5 cm respectively.

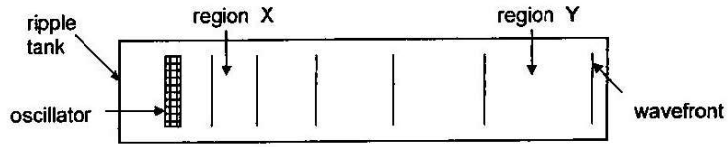


Fig. 10.2

(i) Which region X or Y is the shallower region? Explain your answer. [2]

(ii) State what is meant by a wavefront. [1]

(iii) Explain the formation of the above pattern of wavefront. [1]

11 In an experiment using a datalogger, a ball M is released from rest at a certain height h above the ground and the speed v is measured at a frequency of 10 Hz.

Some air is then released from the ball M and the altered ball is renamed ball L.
The same setting for the data logger is then repeated when ball L is released from rest and the height h.

Fig. 11.1 shows the results obtained with the ball M (with more air) and ball L (with less air).

time t / s	0.0	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
Ball 1 v / m/s	0.0	1.0	2.0	3.0	4.0	0.0	-1.5	-0.5	0.0
Ball 2 v / m/s	0.0	1.0	2.0	3.0	4.0	2.0	0.0	-0.5	0.0

Fig. 11.1

(a) Plot the above data for balls 1 and 2 and label correctly the two graphs as ball M and ball L in **Fig. 11.2**. [3]

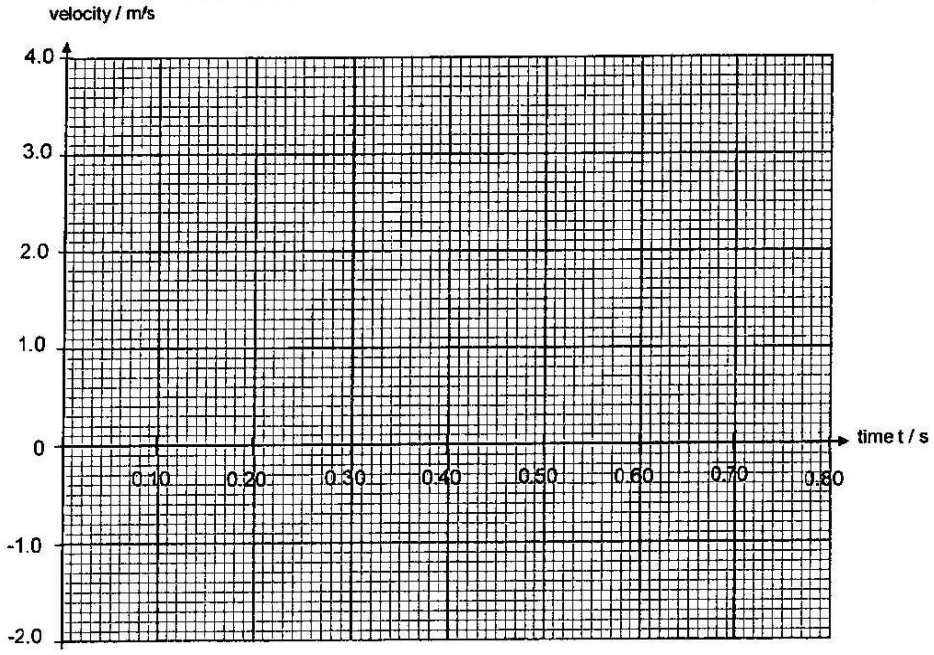


Fig. 11.2

(b) Explain your labelling of the graph as ball M. [1]

(c) Determine from the graph, h, the height from the ground at which the ball was initially released. [2]

(d) Explain how the graph shows that the ball in both instances was released from the same height. [1]

(e) From the data or graph, state the velocity of ball L when it first rebound from the ground. [1]

(f) Using the answer to (e) and the *Principle of Conservation of Energy*, explain why "more energy was lost to the ground" for the ball (with less air). [2]

12 **EITHER**

Fig. 12.1 shows the circuit diagram of a hairdryer. A motor-driven fan and a heating element are used to generate warm air. The hairdryer is connected to a 240 V a.c. supply. Switch S can be connected to either contact X or Y.

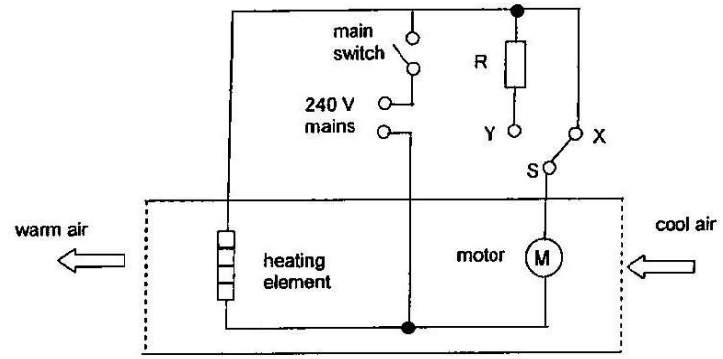


Fig. 12.1

(a) The hairdryer is used to dry wet hair.

Explain, using kinetic theory of particles, how the hairdryer can increase the rate of evaporation of water from the wet hair. [3]

(b) During quality control tests of the hairdryer in the factory, switch S is first connected to contact X. Some measurements are made to obtain the data shown in **Fig. 12.2**.

resistance of the heating element	30 Ω
resistance of resistor R	20 Ω
temperature of air entering the hairdryer	25 °C
rate of air flow through the hairdryer	0.055 kg/s
specific heat capacity of air	1 000 J/kg.°C

Fig. 12.2

(i) Estimate the temperature of the air flowing out of the hairdryer. [2]

(ii) State one assumption in your calculation. [1]

(c) Switch S is then connected to contact Y. State and explain whether there is any change in the temperature of the air flowing out of the hairdryer, as compared to when switch S is connected to contact X. [2]

(d) Calculate the cost of using the hair dryer for 10 minutes if the hair dryer is set to the lower heating setting and the cost of electricity is 20 cents per kWh. [2]

12 **OR**

Two coils, A and B, are placed one on top of the other, as shown in **Fig. 12.3**. Coil A is connected in series with a battery and a switch. A millivoltmeter is connected across the terminals of coil B

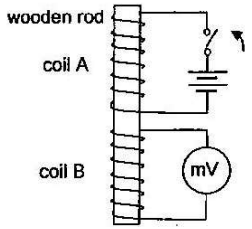


Fig. 12.3

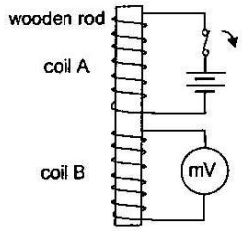


Fig. 12.4

(a) Explain why, when the current in coil A is switched on, the millivoltmeter indicates an induced e.m.f. for a short period of time and then reduces to zero rapidly in **Fig. 12.3**. [2]

(b) **(i)** On **Fig. 12.4**, draw an arrow on coil B to show the direction of the induced current in coil B when the switch was just opened. [1]

(ii) Explain the direction drawn in **(b)(i)**. [2]

Fig. 12.5 shows two coils of insulated wire wound on an iron core to make a transformer. One coil is connected to a 16 V a.c. supply. The other coil is connected to a lamp, which is rated 12 V, 24 W.

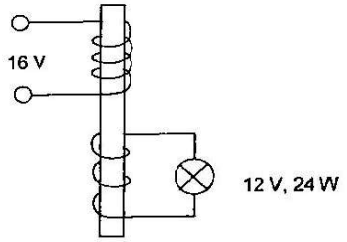


Fig. 12.5

(c) The lamp is operating at its correct rating.

Calculate the minimum current drawn from the 16 V supply. [2]

(d) However the current drawn from the supply is found to be 1.7 A.

(i) Calculate the input power to the transformer. [1]

(ii) How much electrical energy is lost by the transformer each second? [1]

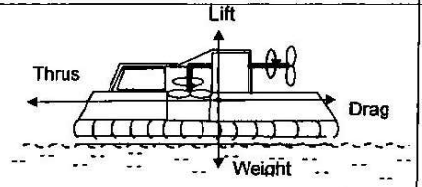
(iii) State one reason why a transformer is not 100% efficient. [1]

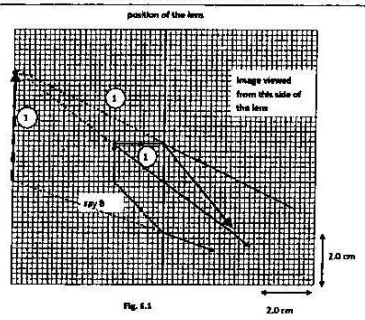
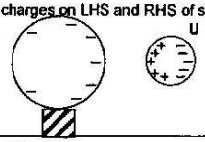
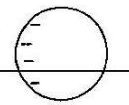
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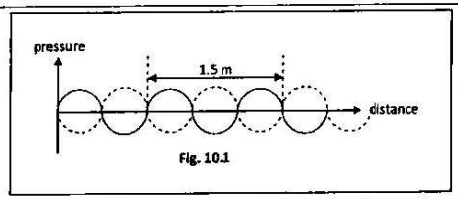
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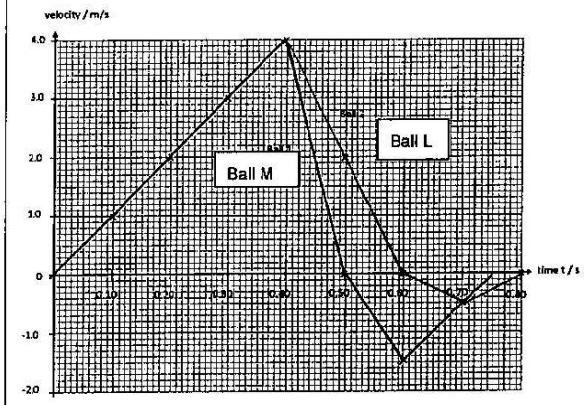
Paper 1 (40 marks)

1	2	3	4	5	6	7	8	9	10
A	C	D	B	D	B	C	B	A	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	A	C	D	C	D	D	A	D	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	A	A	B	A	C	B	B	B	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	B	C	D	A	D	A	B	B	A

Paper 2 Section A (50 marks)			
1	(ai)	>m, mass and g=10m/s^2 or W, weight >t, time he takes to reach the top and h, height of platform	[A1] [A1]
	(aii)	>Repeat or take several readings to find the average of h or t	[A1]
	(aiii)	>% error in timing t is significant in comparison for the time taken to complete his run. Or reaction time is not negligible in comparison to time of run.	[A1]
	(b)	P= mgh / t where P is Power or Wh/t	[A1]
2	(a)	>Horizontal line drawn longer than Drag line and opposite direction to Drag and Weight line drawn equal to Lift line but opposite direction 	[A1]
	(b)	>Thrust > Drag >Lift = Weight	[A1] [A1
	(c)	>F=ma, or Thrust – 200 = 500 (2.4) >Thrust = 1,400 N	[B1] [A1]
	(d)	>Lift force is produced when the force of air from the central fan or boat hits the land and the lands reacts by exerting an upward force back to the hovercraft	[A1]
3	(a)	>Moment is the turning effect and the magnitude is given by Force x perpendicular distance between line of action of force and pivot	[B1]
	(bi)	> sum of clockwise moments = sum of anti-clockwise moments W × 4.8 = (12 × (84) + (2.5 × (72) > W = 247.5 N = 248 N (3sf) or 250 N (2sf)	[M1] [A1]
	(bii)	> Imprecise due to either friction at the pivot or pivot is not a sharp point or small movement of weights The 2.5 N sliding weight has to move 4.8 cm away which is not measurable on the existing scale. >Improve by using smaller weights less than 2.5 N eg 0.50 N or oiling the pivot.	[M1] [A1]
4	(a)	>n = 1 / sin c = 1 / sin 40 >n = 1.5557 = 1.6 (2sf) or 1.56 (3sf)	[B1] [A1]
	(b)	>The angle of incidence is 0° and from sin i / sin r = n, r = 0° No mark if restate question or mention that beam is striking the surface at right angle or	[A1]

		angle i = 0° as answer is incomplete.	
	(ci)	>Correct drawing for new ray with double arrow head	
	(cii)	>sin i / sin 25 = 1.5557 > i = 41.1° (3sf) OR i = 41° (2sf)	
5	(ai)	>P=hρg = 15 x 1000 x 10 >P = 150,000 Pa or 1.5 x 10^5 Pa	[B1] [A1]
	(aii)	>Total P = 100,000 + 150,000 = 250,000 Pa or 2.5 x 10^5 Pa	[A1]
	(b)	>Assume temperature remains the same when it is near the surface or at depth of 15 m. >At depth of 15 m, the volume is smaller so the air molecules are moving a shorter distance before it impacts on the balloon or the **frequency of collisions is higher although its speed of impact and KE remains unchanged.**	[A1] [B1]
	(c)	>The molecules of air are arranged in a random manner whereas the water molecules are loosely packed formation. The difference is no fixed arrangement for air versus regular arrangement for water or air molecules are further space apart than water molecules.	[A1]
6	(a)	>correct position (6 cm) or height for image (4.5cm) >drawing of ray passing through centre of lens and extending backwards to meet image. >correct drawing of second ray 	[A1] [A1] [A1]
	(b)	>A virtual image is an image that cannot be formed on a screen.	[B1]
	(c)	>f = 3.0 cm	[B1]
	(d)	>correct drawing using concept ray from of bottom of object originate from bottom of image	[B1]
7	(a)	>equal number of positive and negative charges on LHS and RHS of sphere U 	[B1]
	(b)(i)	>Unequal number of negative charges on C and U Note the total number of negative charges must be Equal to above diagram (Eg 5 and 2 neg charges for C and U) 	[B1] [B1]

		>Both negative charges	
	(bii)	>During contact electrons from RHS of sphere C flow to neutralise the positive charges on LHS of sphere U due to the potential difference or unlike charges attract. >Redistribution of electron charges occur and since like charges repel, the movable sphere U moves away.	[B1] [A1]
8	(a)	>The brightness of both lamps increases >because the potential of each lamp increases due to the drop in potential across R as V_{L1} + V_{L2} + $V_{rheostat}$ = 9.0 V	[B1] [A1]
	(bi)	>0 V	[B1]
	(bii)	>Increase in brightness	[B1]
	(c)	>The brightness of L_1 in the night is not lit because the resistance of LDR is very large compared to resistance of L_1.	[B1]
9	(a)	> The adjacent coils have current flowing in the same direction. This results in the adjacent coils attracting each other as combined magnetic field of all the various concentric fields produces an attractive forces in the upwards direction. > When the current reaches a certain value, this upwards force is greater than the weight of the coil which is acting downwards.	[B1] [B1]
	(b)	>On losing contact, the compressed coil extends itself and touches the mercury again[1]. > It will oscillate up and down and the lamp blinks at regular intervals[1].	[A1] [A1]
	(c)	>The coil will compress more/becomes shorter and the lamp will blink at a slower rate [1]. >The coil will rise higher and fall through a bigger distance. This results in a bigger time interval between the lamp switching off and lighting up [1].	[A1] [A1]
Section B			
10	(ai)	>wavelength = 1.0 m	[B1]
	(aii)	>f = v / λ = 340 / 1.0 >f = 340 Hz	[B1] [A1]
	(aiii)	>T=1/f = 1/340 = 2.94 x 10^{-3} s	[B1]
	(b)	>correct shape >correct amplitude and position  Fig. 10.1	[B1] [B1]
	(ci)	>Region X is shallower >smaller wavelength for X compared to Y	[B1] [B1]
	(cii)	>A wavefront is an imaginary line on a wave that joins all adjacent points that are in phase.	[B1]
	(ciii)	The wavefront is the bright line formed by the converging action of the adjacent wave crest of an advancing wave. The darkest region which is at the centre of the wavelength is formed by the diverging action of the trough.	[A1]

11	(a)	>Points plotting >Label Ball 1 as ball M and ball 2 as ball L correctly >Shape. Most student loses this mark as they will draw line joining 0.70 s to 0.80 s directly instead to 0.75s and then a horizontal line. 	[B1] [B1] [A1]
	(b)	>Ball M has more air/mass and a higher pressure results in a larger force of impact on the ground. From N3L, the Reaction Force from ground to ball pushes the ball to rebound..	[B1]
	(c)	>Distance = area = 0.5 x 0.40 x 4.0 >Distance = 0.80 m	[B1] [A1]
	(d)	>Both balls travels the same distance before it hits the ground at 0.40 s. Or on the graph both line coincides for 0 to 0.40 s.	[B1]
	(d)	>Rebound velocity of ball L = -0.50 m/s	[B1]
	(e)	$GPE_{ball\ L}$ =mx10x0.80 = 8m J $GPE_{ball\ M}$ = Mx10x0.80 = 8M J $KE_{ball\ L}$=0.5xmx4.0^2 = 8m J $KE_{ball\ M}$ = 0.5xMx4.0^2 = 8M J $KE_{ball\ L}$=0.5xmx0.5^2 = 0.125m J $KE_{ball\ M}$ = 0.5xMx1.5^2 = 1.125M J Ball compressed KE of impact change to Elastic PE + Sound + Thermal energy Ball uncompressed and rises. >From POCOE, energy before impact = energy after impact. >As speed of rebound of ball L(=0.50 m/s) < speed of rebound of ball M (=1.50 m/s), KE of rebound of ball L during rebound < KE of rebound of ball M during rebound, implies energy lost for ball L during impact > energy lost for ball M during impact Assume mass of ball L = 0.9 kg, mass of ball M=1.0 kg Energy lost during impact = KE before impact – KE after impact Ball L:=0.5 x 0.9 x(4.0^2 – 0.5^2) = 7.0875 J Ball M = 0.5 x 1.0 x (4.0^2 – 1.5^2) = 6.875 J Hence more energy is lost for ball L. as 7.0875 J> 6.875 J OR a smaller KE of the first rebound implies more energy is lost to the ground as sound and thermal energy	[B1] [B1]

12E	(a)	>Hair dryer produces fast moving hot air molecules which collide with the water molecules on the hair and transfer thermal energy to it. >More water molecules increase its KE and they move more vigorously. >**The larger** number of fast moving surface water molecules successfully breaks the bonds of attraction between the remaining molecules and doing work to overcome atmospheric force. OR combine with >The water molecules once evaporated from the hair are removed away by the movement of the air molecules from the motor thus freeing up the space for the remaining water molecules to escape. > The water molecules can evaporated at a greater rate at a lower humidity level as the hot air from the motor reduces the water moisture level in the air	[B1] [B1] [B1]
	(bi)	>Heat lost by heater in 1 s = heat gained by air in 1 s $V^2/R=mc(\Delta\theta)$ or 2402/30 = 0.055 x 1000 x $\Delta\theta$ $\Delta\theta$ = 34.9 >Temperature of air flowing out = 34.9 + 25 = 59.9 °C or 60 °C	[B1] [A1]
	(bii)	>Assume room temperature is constant or >Assume no heat is lost by the heating circuit to other parts of the circuit or >All the heat energy is transferred to the cold air and not lost to the surrounding eg by radiation Or >Assume resistance of motor is zero ohm.	[B1]
	(c)	>No change in temperature >because pd across the heater is unchanged in a parallel circuit OR the addition of resistor R only reduces current flow to the motor and speed of rotation of the motor produces moving cool air at a slower rate.or OR temperature of air will be hotter <u>after a while</u> because the incoming air later has smaller mass of air per second (=flow rate) and will be heated up.	[B1] [B1]
	(d)	>Total Power of heating element and motor = $240^2/30 + 240^2/20$ = 1920 + 2880 = 4,800 W >Cost = (4,800/1000) x (10/60) x 20 = 16.6 cents	[B1] [A1]
12 OR	(e)	>The induced e.m.f in coil B is due to a change in the magnetic flux linkage created by coil A on coil B when current flows in coil A making it an electromagnet. >When the current is steady, there is no change in magnetic flux linkage between the two coils although there is magnetic flux linkage between the 2 coils. Zero change results in no emf induced according to Faraday's law of electromagnetic induction.	[B1] [B1]
	(fi)	>Direction of current in the outer coil of B is to the right in Fig.12.4	[B1]
	(fii)	>By Lenz's Law, the induced current must be in such a direction as to oppose the decreasing magnetic flux linkage from A to coil Bwhen the switch is off. >The induced current thus produces a North pole at the end of coil B that is facing coil A to oppose the weakening or moving away south pole at the bottom of coil A. >From Flemimg's Right Hand Grip rule, the thumb indicates the direction of North pole and the direction of the curled fingers indicate the direction of the convection current.	[B1] [B1]
	(g)	>P=VI, I=P/V = I_S = 24/12 = 2.0 A	[B1]

		>$I_P/I_S = V_S/V_P$ I_P =(12/16) x 2.0 = 1.5 A	[B1]
	(hi)	>Input Power = IV = 1.7 x 16 = 27.2 W	[B1]
	(hii)	>Lost power = 27.2 – 24 = 3.2 W	[B1]
	(hiii)	>Copper loses ie. Work done against the resistance of the copper wire OR Eddy Current loses OR Leakage of Magnetic flux OR Hysteresis Loses	[B1]

The END

SECTION A [50 marks]
Answer **ALL** questions from this section.

1 Fig 1.1 shows the side view of a stationary ladder leaning against a smooth wall and making an angle of 30° with the ground at point A.

The resultant force (**R**) of the weight of the ladder and the force acting on the ladder due to the wall is 1000 N.

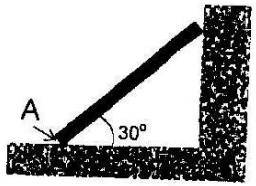


Fig 1.1

For Examiner's User

(a) On Fig 1.1, draw and label the force acting on the ladder due to the wall. [1]

(b) Using the concept of moment, explain why the line of action of the resultant force **R** passes through the point **A**.

_____

_____

_____

_____ [2]

(c) By using a suitable scale, construct a vector diagram to determine the magnitude of the force acting on the ladder due to the wall.

Force = _____ [2]

2 Fig 2.1 shows a hand catapult with an unstretched rubber band. A stone with a mass of 10.0 g is then placed at the centre of the rubber band and the stone is pulled backward with a force **F**. The temperature of the rubber band increases slightly. Fig 2.2 shows the stone on the stretched rubber band.

For Examiner's User

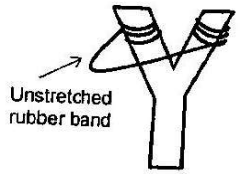


Fig 2.1

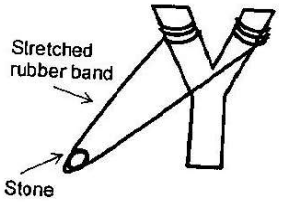


Fig 2.2

(a) Explain how the principle of conservation of energy applies in this case.

_____

_____

_____

_____

_____

_____

_____ [3]

(b) The stone is then released. The speed of the stone at the time of release is 16.0 ms^{-1}. Calculate the kinetic energy of the stone at the time of release.

Kinetic Energy = _____ [2]

(c) The kinetic energy calculated in **(b)** is 90.0% of the work done by force **F**. The mass of the rubber band is 2.00 g and the specific heat capacity of the rubber is 1.25 J g^{-1} $°C^{-1}$. Calculate

For Examiner's User

(i) the thermal energy gained by the rubber band, and

Thermal energy gained = _____[1]

(ii) the increase in the temperature of the rubber band.

Increase in temperature= _____[2]

3 Fig 3.1 shows a light pole with one end inserted into the pole holder that is mounted to the wall. The blanket is placed on the light pole.

For Examiner's User

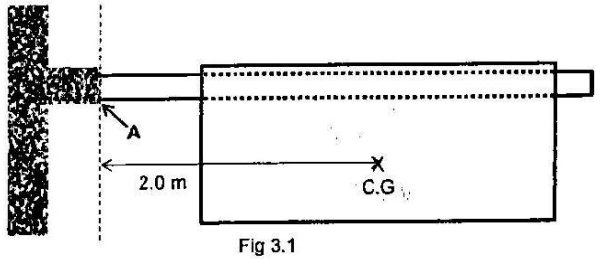


Fig 3.1

The centre of gravity (C.G) for the blanket is 2.0 m from the vertical line passing through point A and the mass of blanket is 3.0 kg.

(a) Define *centre of gravity*.

_____

_____[1]

(b) Calculate the moment due to the weight of blanket about point **A**. State the direction of this moment.

Moment = _____[1]

Direction = _____[1]

(c) The pole will break when the moment about point **A** is greater than 100 Nm. Assume that the blanket is able to absorb all the water that falls on it and the water is uniformly distributed throughout the blanket, calculate the volume of water that is absorbed by the blanket just before the pole breaks. Take the density of the rain water to be 1.02 gcm^{-3}.

Volume = _____[2]

4 (a) Fig 4.1 shows a manometer containing 2 different liquids and connected to two gas supplies. Pressure of gas 1 is 200 kPa. The density of liquid **X** is 5000 kgm^{-3}.

For Examiner's User

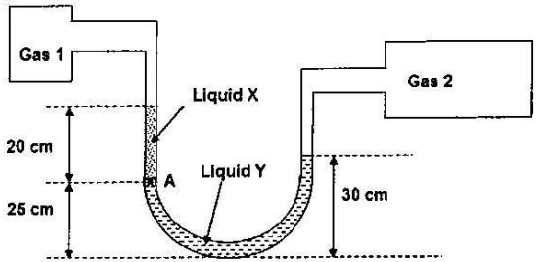


Fig 4.1

(i) Determine the pressure at point **A**.

Pressure at Point A = _____[2]

(ii) Describe, with appropriate equations, how you would calculate the pressure of gas 2.

_____

_____

_____

_____[2]

(b) Mercury, with a density of 13600 kgm^{-3} is usually used in a barometer. Explain why another liquid with a density of 2000 kgm^{-3} is not suitable to be used in a barometer.

_____

_____

_____

_____

_____[2]

5 (a) Fig 5.1 shows a soft hard-boiled egg being trapped in an inverted bottle. The top part of the inverted bottle is subjected to an external heat. The egg is observed to slip out of the mouth piece of the bottle.

For Examiner's User

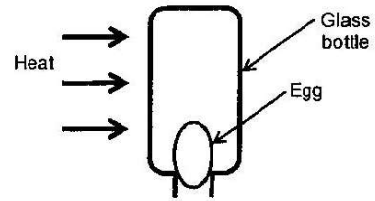


Fig 5.1

Using kinetic model of matter, explain why supplying heat to the gas will cause the egg to slip out of the mouth piece of the bottle.

_____

_____

_____

_____

_____

_____[3]

(b) Mercury-in-glass thermometers are commonly used in a school science laboratory. The thermometer can measure up to 1 decimal place. Fig 5.2 shows the length of mercury thread at 0.0 °C and 100.0 °C.

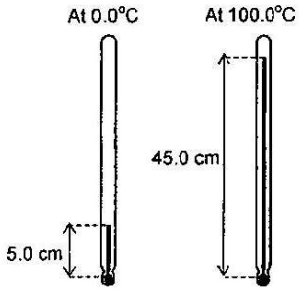


Fig 5.2

(i) Define ice point.

For Examiner's User

_____

_____[1]

(ii) Determine the corresponding temperature when the length of the mercury is 30.0 cm.

Temperature = _____[2]

(iii) State another thermometric property that can be used to determine temperature.

_____[1]

6 (a) Define longitudinal wave.

For Examiner's User

_____

_____[1]

(b) A stethoscope shown in Fig 6.1 is an acoustic medical device for the doctor to listen to the internal sounds of an animal or human body. It is often used to listen to lung and heart sounds. The stethoscope consists of 2 main components, namely the ear piece and the chest piece, which are connected by air-filled hollow tubes.

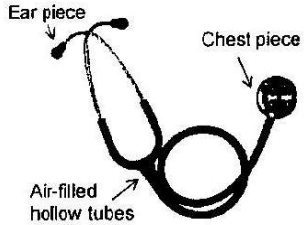


Fig 6.1

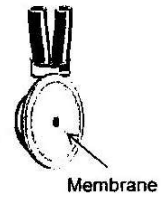


Fig 6.2

Fig 6.2 shows the chest piece which consists of a membrane that can pick up the heart sounds when the chest piece is placed in contact with the skin at the chest area.

Describe how the heart sound is transmitted from the skin to the ear piece. You might want to include a diagram to show how sound wave travels.

_____

_____

_____

_____

_____

_____

_____[3]

(c) Figure 6.3 shows the wavefronts of sound waves travelling from air and into the ear drum (solid medium).

For Examiner's User

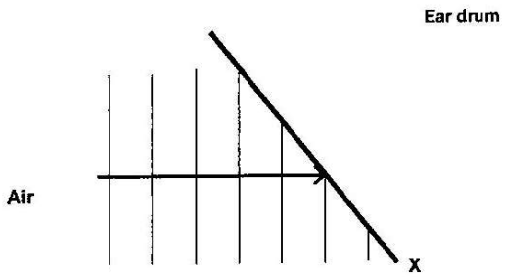


Fig 6.3

Complete the diagram in Fig 6.3 by drawing the wavefronts after they have passed through the boundary **X**. Indicate the direction of travel of the sound waves after passing through **X**. [2]

7 (a) Fig 7.1 shows a car moving in a dry condition. The car body becomes negatively charged. The car tyre is made of rubber and insulates the car body from the ground.

For Examiner's User

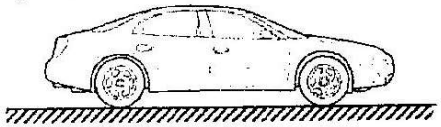


Fig 7.1

Explain why the car body becomes negatively charged.

_____

_____

_____

_____

_____

_____ [3]

(b) A person outside the car attempts to open the car door when the car comes to a stop.

(i) On Fig 7.2, sketch the charge distribution between the car door and the person's hand when the person's hand is near the car door. [1]

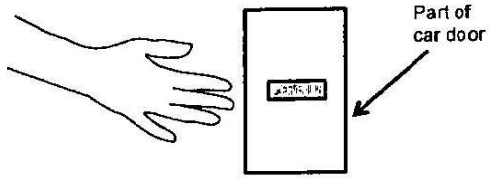


Fig 7.2

(ii) Explain why a person feels a static shock when he touches the negatively charged car body.

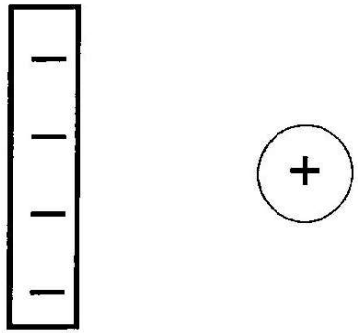
_____

_____

_____ [1]

(c) On the diagram provided, draw the electric field pattern between a negatively charged plate and a positive charge. [2]

For Examiner's User



8 Fig 8.1 shows a cylindrical Neodymium magnet (super strong magnet) being released into a long copper tube. Fig 8.2 shows the magnet moving along the tube.

For Examiner's User

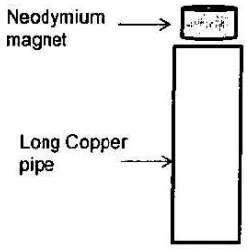


Fig 8.1

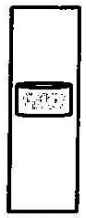


Fig 8.2

(a) State *Faraday's Law of Electromagnetic Induction* and *Lenz's Law*.

Faraday's Law: _____

_____

_____ [1]

Lenz's Law: _____

_____ [1]

(b) The magnet is observed to accelerate along the copper tube at the beginning. After a while, the magnet is travelling at constant speed along the copper tube.

(i) On Fig 8.2, draw and label the forces acting on the magnet. Assume air resistance is negligible. [1]

(ii) Using Faraday's Law and Lenz's Law, explain the observation.

_____

_____

_____

_____

_____

_____ [3]

Section B [30 marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's User

9 Fig 9.1 shows a circuit symbol of a transistor which has three terminals, **X**, **Y** and **Z**.

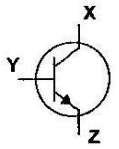


Fig 9.1

A transistor is a semi-conductor that acts like a switch. The transistor will switch on another circuit when the potential difference across terminals **Y** and **Z** is greater than a certain value.

The transistor is connected to the circuit as shown in Fig 9.2 which is to activate the electric bell when there is a fire.

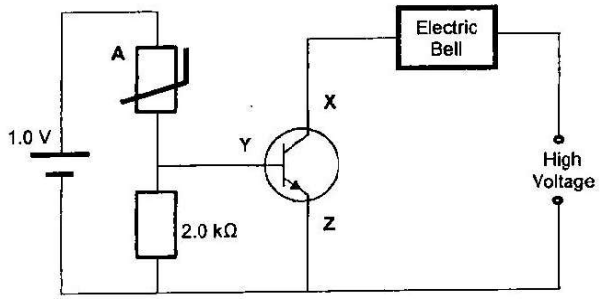


Fig 9.2

The potential difference across **Y** and **Z** is equal to potential difference across 2.0 kΩ resistor.

For Examiner's User

Table 9.3 shows the relationship between the resistance of device **A** with temperature.

Temp / °C	Resistance / kΩ
0	3.8
50	3.6
100	2.8
150	1.2
200	0.4
250	0.2

Table 9.3

(a) State the name of the electrical device **A**.

_____ [1]

(b) Explain, in general, why the electric bell will be activated when there is a fire.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(c) State one advantage of using the circuit in Fig 9.2 to activate the electric bell.

_____

_____

_____ [1]

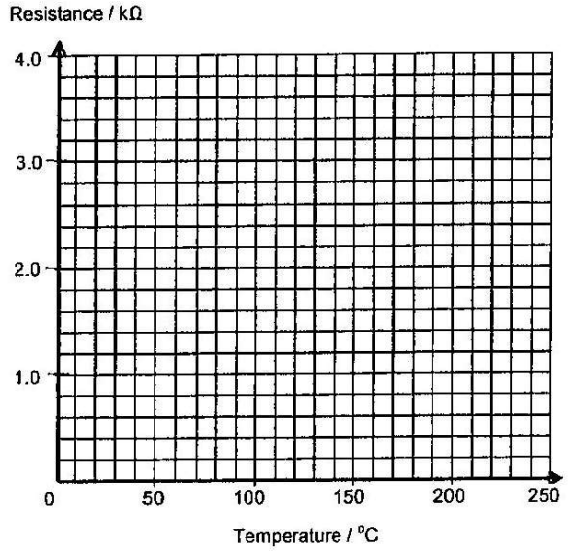
(d) To activate the bell, the minimum potential difference across terminals **Y** and **Z** is 0.60 V. Assume the current flowing into point **Y** is negligible.

For Examiner's User

(i) Determine the maximum resistance of the device **A** to activate the bell.

Resistance = _____[2]

(ii) Using the given grid, plot the graph of resistance of device **A** against temperature. [2]



(iii) Hence, using the graph in part (ii), determine the minimum temperature of the surroundings that can activate the bell.

Temperature = _____[1]

10 Fig 10.1 shows a magnified d.c motor which is connected to an external d.c power supply and housed within a metal casing. The motor is connected to the power supply via wire **A** and **B**. Metal casing is connected to the external power supply via wire **C**.

For Examiner's User

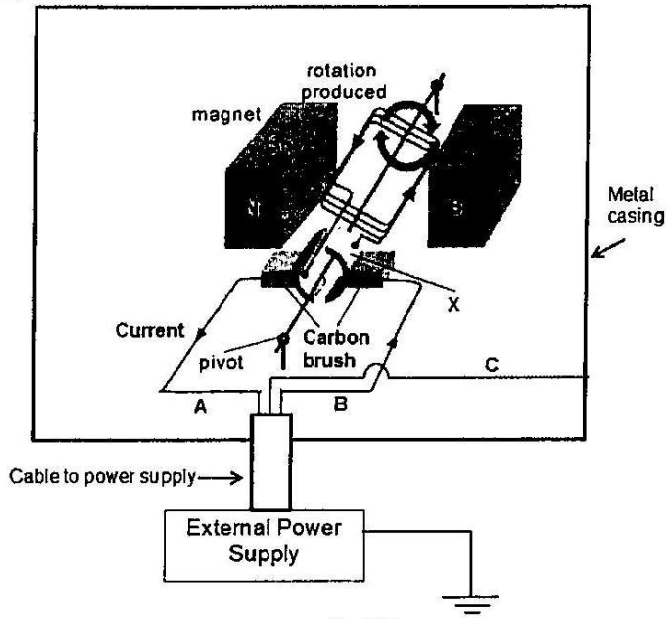


Fig 10.1

(a) State and explain which wire (**A**, **B** or **C**) should the switch for the d.c motor be placed along.

_____

_____

_____

_____

_____

_____[3]

(b) State the name of wire **C** and its purpose.

For Examiner's User

[2]

(c) State the name of component **X** and its purpose.

[2]

(d) Explain, using suitable magnetic field pattern, why the motor turns in the manner as shown in Fig 10.1.

[3]

Either

11 Fig 11.1 shows the position of the radar and the fighter plane at the instant when the fighter plane first sends out the radio wave signal to the radar. The fighter plane is moving along a straight path towards the control tower.

For Examiner's User

Fig 11.2 shows a CRO screen that displayed the fighter plane sending radio wave signal to the radar at 2 different timings with a time lapse of 4.0 s. At both instances, the fighter plane sends out signal of the same strength.

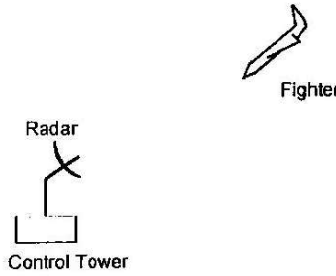


Fig 11.1

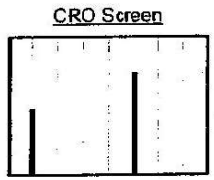


Fig 11.2

The fighter plane is moving with a velocity of 30 ms^{-1} when it sends out the first signal. At the second signal, the plane is moving with a velocity of 60 ms^{-1}. The plane is travelling with a constant acceleration. The total mass of the plane and the pilot is 10 000 kg.

(a) Explain why the second signal received by the radar is stronger than the first one.

[2]

(b) State why high frequency electromagnetic waves such as X-rays and gamma rays are not used in this case.

[1]

(c) Calculate the acceleration of the fighter plane.

For Examiner's User

Acceleration = _____[1]

(d) Determine the distance travelled by the fighter plane between the first and second signal. State one assumption in your calculation.

Distance travelled = _____ [2]

Assumption: _____

_____[1]

(e) After sending of the second signal, the plane decelerates. At one instant, it experiences deceleration of 5.0 ms^{-2} and the forward thrust acting on the plane is 75 000 N.

(i) Determine the total frictional force acting on the plane.

Total Frictional Force = _____[2]

(ii) Explain why the air resistance acting on the plane will not be constant when it decelerates.

_____

_____[1]

Or

11 (a) Converging lens is sometimes used as a magnifying glass.

For Examiner's User

(i) Define converging lens.

_____

_____

_____[1]

(ii) On Fig 11.1, sketch a ray diagram that illustrates the use of converging lens as magnifying glass with the object on the left side of the lens. The point **F** denotes the point which is one focal length from the lens. You are required to draw the position of the object on your own. Label the ray diagram. [3]

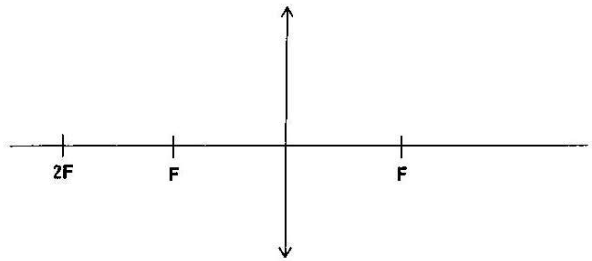


Fig 11.1

(iii) Describe how you can use the ray diagram to determine the number of times the image is magnified.

_____

_____

_____[1]

(b) Fig. 11.2 shows a light ray enters a diamond with a refractive index of 2.42.

For Examiner's User

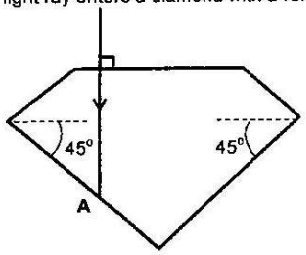


Fig 11.2 (not drawn to scale)

(i) Explain what you understand by the phrase "refractive index of 2.42".

_____

_____

_____ [1]

(ii) Determine the critical angle of the light ray in the diamond.

Critical Angle = _____ [2]

(iii) On Fig 11.2, complete the ray diagram after the ray hits the diamond at point **A**. [2]

—— END OF PAPER ——

Answer **ALL** the questions in this paper.

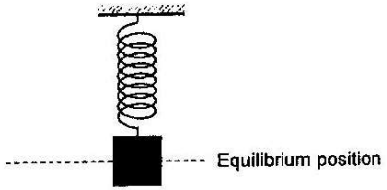
1 A student lists out the following quantities:

Acceleration, Distance, Velocity, Time, Work Done , Moment, Pressure, Electrical Current, Electromotive Force

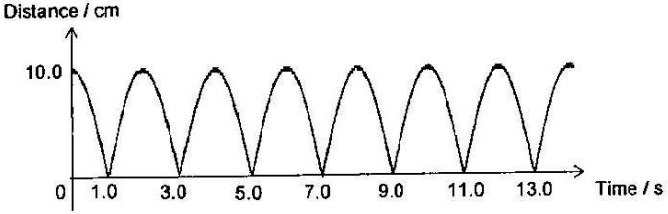
How many vector quantities can be found in the list?

A 2 **B** 3 **C** 4 **D** 5

2 The diagram shows a mass hanging from the bottom of a spring.



The mass is pulled slightly downward and released at time t = 0 s. The graph of how distance of the mass from the equilibrium position varies with time is shown below:



What is the period of the motion?

A 1.0 s **B** 2.0 s **C** 3.0 s **D** 4.0 s

3 Fig 3.1 shows a micrometer screw gauge when it is completely closed with nothing between the anvil and the spindle.

Fig. 3.2 shows the reading of the thickness of a wood.

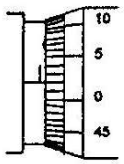


Fig. 3.1

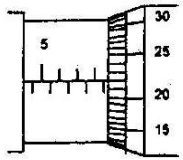


Fig. 3.2

What is the actual thickness of the wood?

A 8.70 mm **B** 8.74 mm **C** 12.20 mm **D** 12.24 mm

4 A small steel ball is thrown down with an initial speed of 2.0 ms^{-1} from a low balcony.

Ignoring air resistance, which of the following best describes the velocity and acceleration of the steel ball during the downward motion?

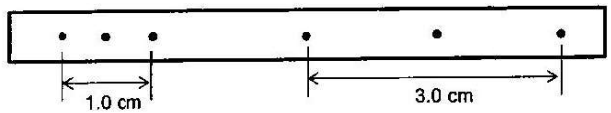
A Both velocity and acceleration of the ball increase.

B Both velocity and acceleration of the ball decrease.

C Velocity of the ball increases and acceleration of the ball decreases.

D Velocity of the ball increases and acceleration of the ball remains constant.

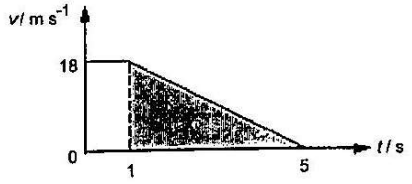
5 A ticker tape is operating at a frequency of 50 Hz. The tape pulled by a trolley is as shown:



What is the average acceleration of the trolley?

A 500 cms^{-2} **B** 833 cms^{-2} **C** 1000 cms^{-2} **D** 1670 cms^{-2}

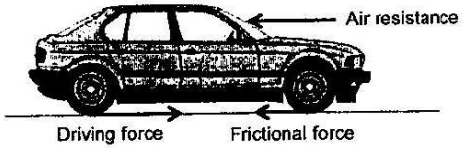
6 When driving on a straight road, a man saw a child dashing across the road at time t = 0 s. He tried to stop the car immediately. The human reaction time of the man is 1.0 s. The velocity-time graph of the car is as shown.



What does the shaded area represent?

A Thinking distance
B Total distance travelled after the man saw the child
C Braking distance
D Deceleration of the car

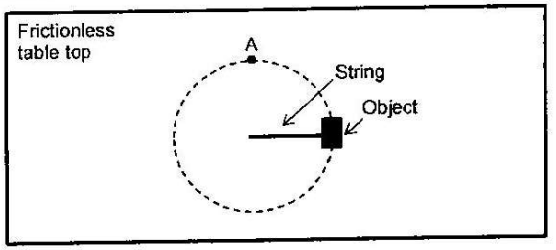
7 The diagram shows the horizontal forces acting on a moving vehicle.



Which combination of forces would result in the car moving at constant speed?

	Air Resistance / N	Frictional Force / N	Driving Force / N
A	700	300	1100
B	700	1000	300
C	300	700	1000
D	300	1000	700

8 The diagram shows the top view of an object attached to a string and moving in circular path on a frictionless table and in anti-clockwise direction due to the tension in the string.

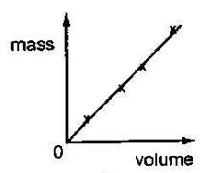


When the object reaches point A, the string is cut. Which of the following best describes the subsequent motion of the object?

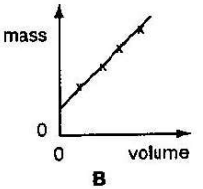
A The object will come to a rest.
B The object will continue to move along the circular path.
C The object will move along a non-straight line path towards the left.
D The object will move along a horizontal straight line path towards the left.

9 Some students measure the masses and volumes of different sized samples of a type of wood.

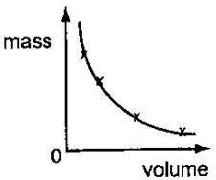
Which graph shows their results?



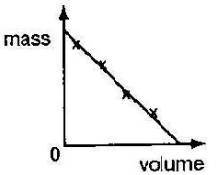
A



B

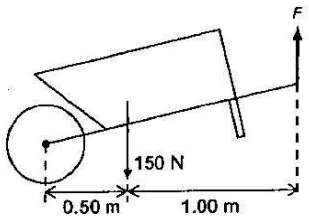


C



D

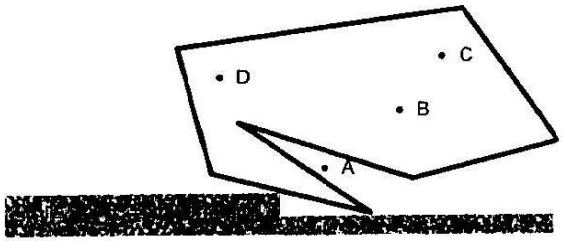
10 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by an upward force F at the ends of the handles.



What is the normal force acting on the wheel by the ground?

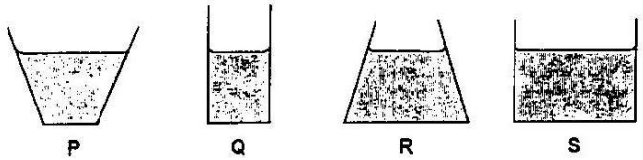
A 50 N **B** 75 N **C** 100 N **D** 200 N

11 The diagram shows an irregular shaped object resting on the edge of a step. The object does not have a uniform density.



Which point is the centre of the gravity of the object?

12 The diagrams show, to the same scale, the vertical sections of a set of circular vessels. Each vessel contains the same depth of water. Vessels **P** and **Q** have the same base area, and vessels **R** and **S** have the same base area.



A student makes the following conclusion:

Statement 1 : The water exerts the same pressure on the base of each vessel.

Statement 2 : The water exerted the same force on the base of each vessel.

Statement 3 : The force exerted on the surface of the water due to the atmospheric pressure is the smallest in vessel **S**.

Which of the following statements are false?

A Statement 1 and 2 only

B Statement 2 and 3 only

C Statement 1 and 3 only

D All statements

13 What are the energy changes in a battery-operated torch?

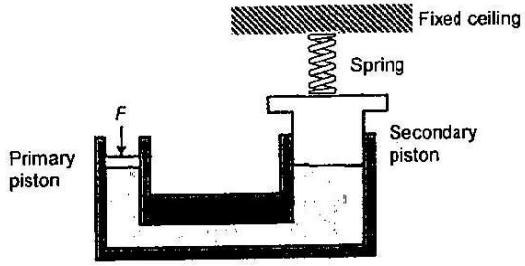
A Electrical energy → Kinetic energy → Light and Heat

B Electrical energy → Kinetic energy → Light and Sound

C Chemical potential energy → Electrical energy → Light and Heat

D Chemical potential energy → Electrical energy → Light and Sound

14 The diagram shows a hydraulic press and a force of F is applied at the primary piston. The primary piston has a radius of 0.20 m. The secondary piston is connected to a spring and the force exerted by the spring on the secondary piston is 500 N. The radius of the secondary piston is 0.40 m.

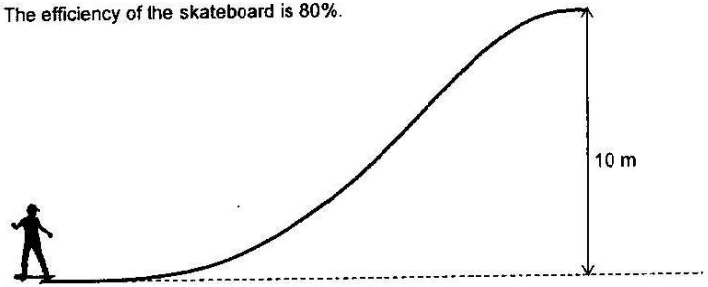


What is the value of F?

A 2000 N B 1000 N C 250 N D 125 N

15 A man of weight 600 N rides up a curved ramp on a skateboard in 5.0 seconds. The length of the curved ramp is 20 m and the vertical height of the ramp is 10 m.

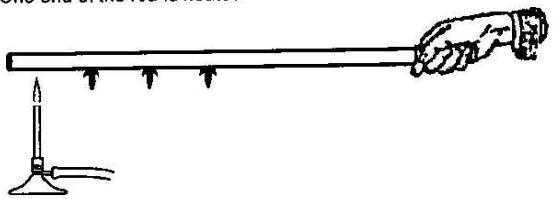
The efficiency of the skateboard is 80%.



What is the average power input by the man to ride up the curved ramp? Assume there is no change in both the initial and final speed of the man.

A 960 W B 1500 W C 1920 W D 3000 W

16 The diagram shows a hand holding a copper rod. Some thumb nails are glued along the rod. One end of the rod is heated.

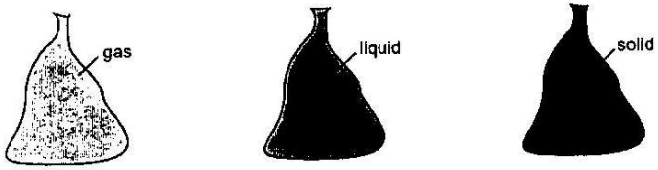


Why does the thumb nail nearest to the flame drop first?

A Convection current set up in air melts the glue.
B Heat transfer from the flame by radiation melts the glue.
C Heat transfer from the flame by conduction melts the glue.
D All of the above modes of heat transfer are responsible in melting the glue.

17 A student has three sealed plastic bags. One bag is filled with gas, one with liquid and one with solid.

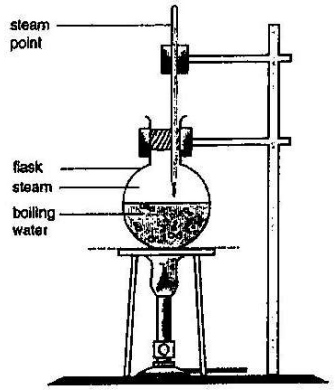
The student squeezes each bag to see if it changes shape, and warms each bag to see if it expands.



Which bag contains solid?

A The one that is fixed in shape and expands the least when heated.
B The one that is fixed in shape and expands the most when heated.
C The one that changes shape easily and expands the least when heated.
D The one that changes shape easily and expands the most when heated.

18 The diagram shows a setup that a student uses in an attempt to determine the steam point.



What is wrong with the setup?

A The flask should not be in contact with the clamp of the retort stand.

B The thermometer should be immersed into the boiling water and near to the base of the flask.

C The thermometer should be placed further away from the surface of the boiling water.

D The gas pressure in the flask is not maintained at standard atmospheric pressure.

19 Heat energy is supplied at the same rate to 2.0 kg of substance **X** and to 500 g of substance **Y** in similar containers for the same amount of time.

Why does the temperature of substance **X** rise more quickly?

A Substance **X** has absorbed more heat energy than substance **Y**.

B Substance **X** has absorbed less heat energy than substance **Y**.

C Substance **X** has a larger specific heat capacity than substance **Y**.

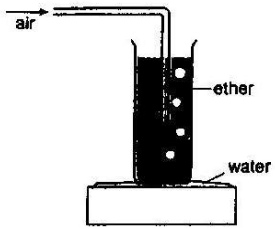
D Substance **X** has a lower specific heat capacity than substance **Y**.

20 Using an electric kettle, 0.10 kg of water at 100 °C is converted into steam at 100 °C. The specific latent heat of vaporisation of water is 2250 J / g.

Assume there is no heat loss, what is the amount of thermal energy supplied?

A 22.5 J B 225 J C 22 500 J D 225 000 J

21 In the diagram, air is blown through a tube containing some ether which is a volatile liquid. Underneath the beaker of ether is a small pool of water. Which of these best describes what will happen?



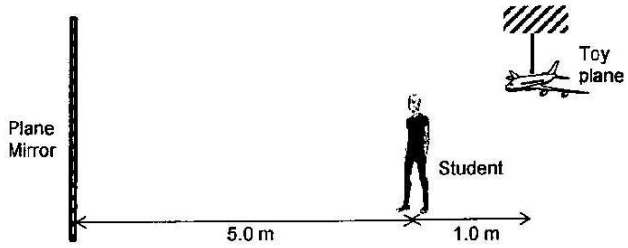
A Ether freezes and water boils.

B Ether boils and water evaporates

C Ether evaporates and water freezes.

D Ether condenses and water evaporates.

22 The diagram shows a student is standing 5.0 m in front of a plane mirror. A toy plane is 1.0 m behind him and is hanging from the ceiling.



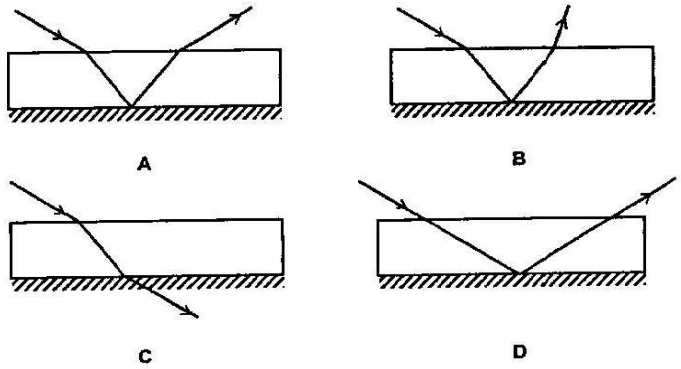
What is the horizontal distance of the image of the toy plane from the student?

A 11.0 m B 10.0 m C 7.0 m D 6.0 m

23 The diagram shows a mirror consisting of a reflective surface and a thick glass.



Which ray diagram shows the correct path of a light ray incident on a mirror with a thick glass?



24 What are the properties of the image formed by an object placed in front of a diverging (concave) lens?

A Real and larger than the object.

B Real and smaller than the object.

C Virtual and smaller than the object.

D The properties of the image are dependent on the distance of the object from the lens.

25 What is the definition of wavefront?

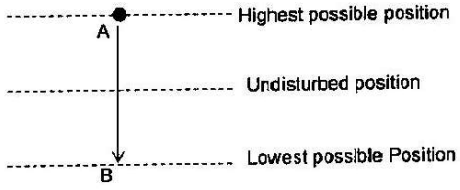
A It is a line that connects all successive crests in the wave.

B It is the path that a particle would have moved for one complete oscillation.

C It is part of the wave that is formed right at the beginning of the wave motion.

D It is a line that connects all the identical points on the waves and they are in the same phase.

26 The diagram shows a particle along a transverse wave with an amplitude of 0.20 m. When the particle moves from point A to point B, it takes 0.40s. The wavelength of the wave is 3.0 m.



What is the speed of the wave?

A 0.5 ms^{-1} B 1.0 ms^{-1} C 3.8 ms^{-1} D 7.5 ms^{-1}

27 Which of the following is a property for all electromagnetic waves?

A All of them are affected by magnetic field.

B All of them can be detected by the human eye.

C All of them can travel faster than the speed of light.

D All of them can either be reflected, refracted or absorbed as they pass through a medium.

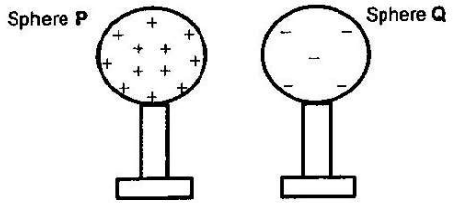
28 Which row lists the applications of parts of the electromagnetic spectrum?

	Microwave wave	Ultra-Violet	Gamma rays
A	Tv communication	Sunbeds	Bone Scanning
B	Satellite phone	Sunbeds	Treatment of cancer
C	Tv communication	Intruder alarms	Treatment of cancer
D	Satellite phone	Intruder alarms	Bone Scanning

29 Which of the following statement best describes ultrasound?

A Sound with particles moving with a period of 5.0 μs
B Sound that cannot be heard by human
C Sound with a frequency of 10 kHz
D Sound with a very high loudness

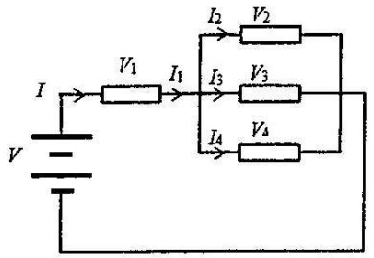
30 Two charged conducting spheres, **P** and **Q**, mounted on insulating stands. Sphere **P** is positively charged and sphere **Q** is negatively charged. Sphere **P** has more excess charges than sphere **Q**.



Both spheres **P** and **Q** are first moved to touch each other and then move apart. What are the final state of charge in sphere **P** and **Q**?

	Sphere P	Sphere Q
A	Positively Charged	Positively Charged
B	Positively Charged	Neutrally Charged
C	Neutrally Charged	Positively Charged
D	Neutrally Charged	Neutrally Charged

31 The circuit shows identical resistors connected to a cell. Which pair of equations is correct for this circuit?



where V_i = voltmeter reading across the device i
I_i = ammeter reading connected in series with the device i

	Current	Potential Difference
A	$I = I_1$	$V = V_3$
B	$I = I_1 + I_3$	$V = V_1 + V_2$
C	$I = I_2 + I_3 + I_4$	$V = V_1 + V_2$
D	$I = I_1 + I_2 + I_3 + I_4$	$V = V_1 + V_2 + V_3 + V_4$

32 In a circuit, a dry cell with an emf of 6.0 V drives 10 C of charges around a circuit for 15.0 s.

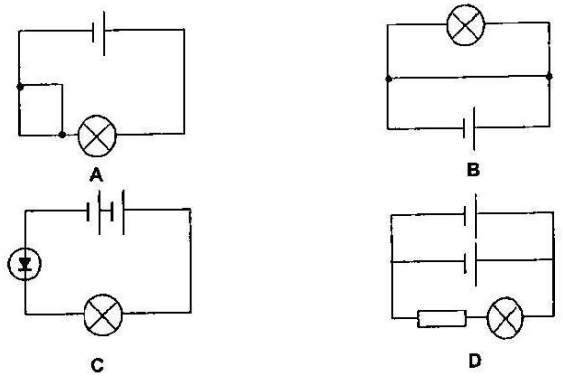
What is the power supplied to the circuit?

A 4.0 W B 24 W C 60 W D 240 W

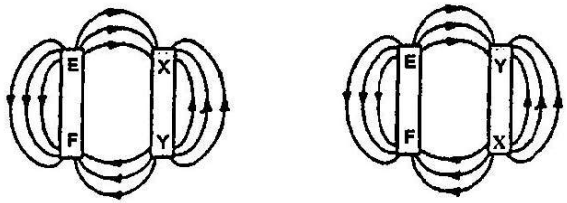
33 The power rating of a vacuum cleaner and a fan is 2000 W and 100 W respectively. For a day, the vacuum cleaner and the fan are switched on for 45 minutes and 6.0 hours respectively. How much will it cost to run these appliances in one day if the cost price of 1.0 kWh of electricity is 22 cents?

A $0.33 B $0.46 C $3.30 D $4.62

34 In which circuit will the bulb glow brightest? [The cells and bulbs are identical.]



35 The two diagrams below show the magnetic field pattern near two objects **EF** and **XY**.



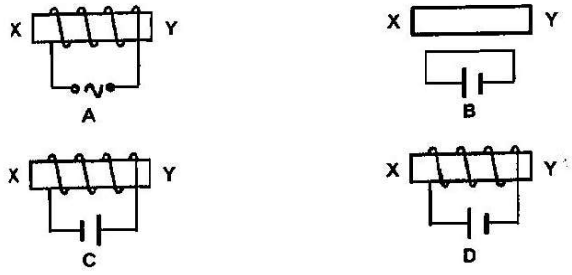
What two objects are **EF** and **XY** likely to be?

	EF	XY
A	an iron rod	a bar magnet
B	a bar magnet	an iron rod
C	an iron rod	a copper rod
D	a steel rod	a copper rod

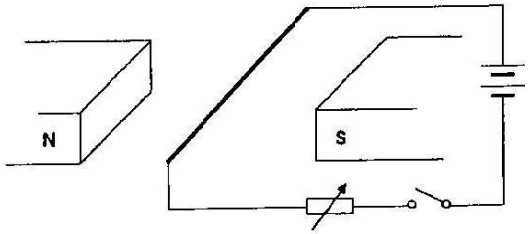
36 It is desired to produce a magnet as shown below, with the ends labelled **X** and **Y** having a polarity of South and North respectively.



Which of the following circuit arrangement will produce the desired magnet?



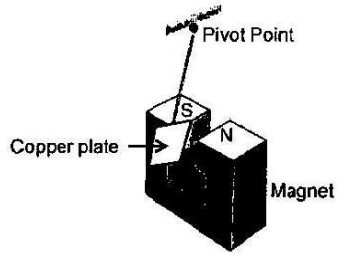
37 A wire connected to a direct current (d.c) supply is placed between the poles of a magnet as shown. The switch is then closed.



Which of the following best describes the magnetic field strength around the wire?

A The magnetic field above the wire is stronger than that below the wire.
B The magnetic field below the wire is stronger than that above the wire.
C The magnetic field at the left side of the wire is stronger than that at the right side of the wire.
D The magnetic field at the right side of the wire is stronger than that at the left side of the wire.

38 The diagram shows a copper plate hung from a pivot point and pulled to one side of the U-shaped magnet.



Which of the following best describes the subsequent motion of the plate after it is released?

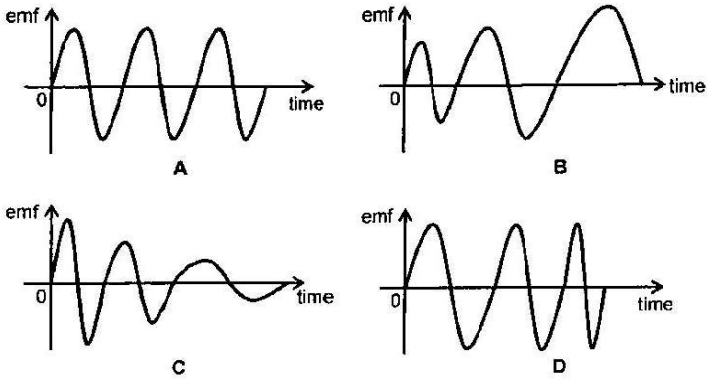
A The copper plate will swing to the other side of the magnet and stop at that side.

B The copper plate will move towards the magnet, be repelled away by the magnet and return back to the original position.

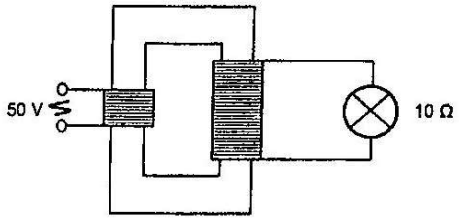
C The copper plate will swing about the pivot point for a few cycles before stopping vertically below the pivot point.

D The copper plate will move towards the magnet, slow down and stop at a position vertically below the pivot point.

39 Which graph shows the relationship of induced emf with time if the speed of rotation of the coil in a generator decreases gradually after each round of rotation?



40 The diagram shows an ideal transformer. The primary coil and secondary coil have 200 turns and 1000 turns respectively. The primary coil is connected to an alternating current supply with a voltage of 50 V. The secondary coil is connected to a light bulb with a resistance of 10 Ω.



What is the power supplied by the alternating current supply?

A 6250 W B 1000 W C 250 W D 10 W

—— END OF PAPER ——

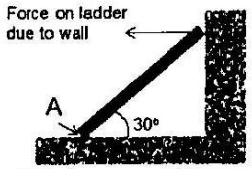
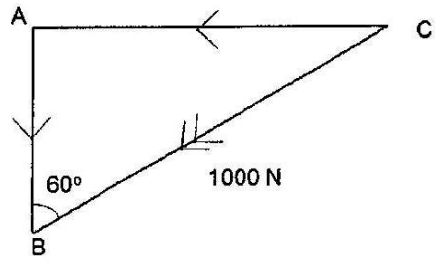
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Solution to Sec 4 Physics Prelim Paper 1 2016

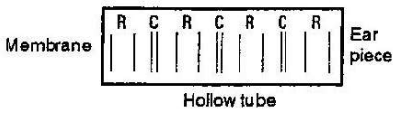
1	B	6	C	11	A	16	C	21	C	26	C	31	C	36	D
2	D	7	C	12	B	17	A	22	A	27	D	32	A	37	B
3	A	8	D	13	C	18	D	23	A	28	B	33	B	38	D
4	D	9	A	14	D	19	D	24	C	29	A	34	A	39	C
5	B	10	C	15	B	20	D	25	D	30	A	35	B	40	A

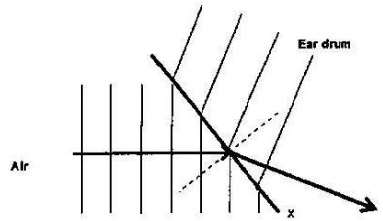
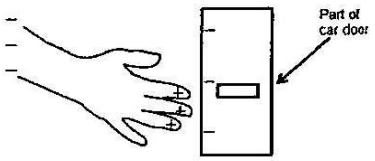
Solution to Sec 4 Physics Prelim Paper 2 2016

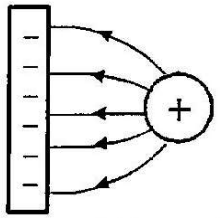
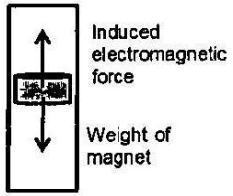
Section A

Qn	Solution
1(a)	
(b)	Moment is equal to the product of force and the perpendicular distance between the line of action of force and the pivot point. Since the ladder is at equilbrium, the resultant moment about point A will be equal to zero. As the resultant force of the weight and the force acting on ladder due to wall is not equal to zero, this means that the line of action of the resultant force must pass through pivot point A so that the perpendicular distance is equal to zero.
(c)	Scale: 1.0 cm to 100 N  Length of AC = 8. 7 cm

	Force acting on ladder due to the wall = 8.7 x 100 = 870 N

2(a)	The work done by the backward force is converted to the elastic potential energy of the stretched rubber. Some of the work done is also converted to thermal energy gained by the stretched rubber. The work done by the backward force is equal to the sum of the elastic potential energy and the thermal energy.
(b)	Kinetic energy of the stone = ½ m v^2 = ½ x (10.0/1000) x 16.0^2 = 1.28 J
c(i)	Gain in thermal energy by the rubber band = 10% of the work done by the force **F** = 1.28 / 9.00 = 0.142 J
(ii)	Gained in thermal energy = mcΔθ 0.142 = 2.00 x 1.25 x Δθ Δθ =0.0568 °C
3(a)	It is a point at which the entire (or total) weight of the object appears to act at.
(b)	Moment due to the weight of blanket about point A = 2.0 x (3.0 x 10) = 60 Nm Direction: Clockwise
(c)	Moment due to the weight of the water = 100 – 60 = 40 Nm Weight of the water = 40 / 2.0 = 20 N Mass of the water = 20 / 10 = 2.0 kg Volume of water = 2000 / 1.02 = 1960 cm^3
4(a) (i)	Pressure at Point A = Pressure of Gas 1 + pressure due to liquid X = 200 x 10^3 + (20.0/100) x 5000 x 10 = 200 x 10^3 + 10 x 10^3 = 210 x 10^3 Pa or = 210 kPa
(ii)	Pressure at left hand column is equal to the pressure at right hand column liquid level at point A.
	Pressure at Point A = $P_{gas\ 2}$ + 0.05 ρ_y g We can use this equation to get pressure of gas 2.
(b)	For barometer with constant atmospheric pressure, the height of the liquid column is inversely proportional to density of the liquid (P_{atm} = hρg). If mercury-filled barometer required a height of 1.0 m, then a liquid of 2000 kg m^{-3} will required a height of about 7.0 m and it will be not be practical as a ladder will be required to take the barometer reading.
5(a)	When heat is supplied to the gas, the gas molecules gain kinetic energy and hitting the interior surface of the egg more frequently and with a greater force as compared when no heat is supplied. Since pressure = force/ surface area, the gas molecules exerts a greater pressure on the interior surface of the egg. This gas pressure is now larger than the atmospheric pressure acting on the exterior surface of the egg. This provides a resultant downward force to push the egg out of the bottle.
(b)(i)	Ice point is the temperature of pure melting ice at standard atmospheric pressure (or 1 atmospheric pressure)
(ii)	Temperature $= \frac{30.0-5.0}{45.0-5.0} \times 100°C$ $= \frac{25.0}{40.0} \times 100°C$ $= 62.5°C$
(iii)	One of the following: Resistance of a wire, density of liquid, electromotive force, pressure of a fixed mass of gas
6(a)	Longitudinal wave is wave with direction of travel parallel to the direction of the vibration of the source.
(b)	 As the skin vibrates, the membrane which rests on the skin also vibrates according to the same frequency.

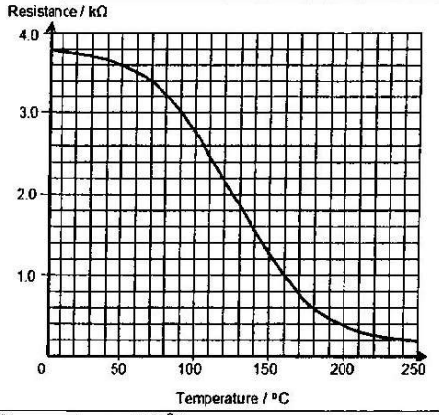
	The layer of air molecules next to the membrane acquires the same oscillatory motion at the same frequency. From the membrane to the ear piece via the hollow tube, the oscillatory motion is passed on to neighbouring layers of air molecules producing a series of high air pressure (compressions) and low air pressure (rarefactions) along the longitudinal wave motion in the hollow tube.
(c)	 Ear Drum is denser than Air => speed of sound increases => direction of travel bends away from the normal at the boundary X. Note: Wavefronts must always be perpendicular to direction of travel.
7(a)	When the car is moving against the air, the air is rubbing against the body of the car and the car body is charged by friction. The electrons from the air are transferred to the car body. Electrons are not able to flow to the ground as the tyre is an insulator. Since the number of electrons is more than the number of protons in the car body, the car body becomes negatively charged.
(b)(i)	
(ii)	When the hand touches the car body, there is a flow of electrons from the car body to the hand. As the excess charges earth through the person, this causes the static shock.

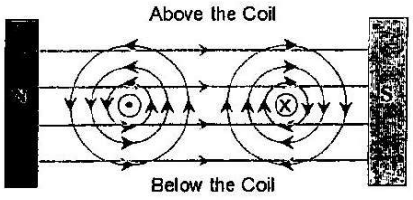
(c)	
8(a)	Faraday's Law: The magnitude of e.m.f. induced in a conductor is directly proportional to the rate of change of magnetic field lines linking the circuit. (Also accept: When the conductor cuts the magnetic field, there is a changing magnetic field. This induces an emf in the conductor.) Lenz's Law: The direction of the induced e.m.f and hence the induced current in a closed circuit, is always such that its magnetic effect opposes the motion or change producing it.
(b)(i)	 • As the magnet falls due to **gravitational force**, the **magnetic flux** through a cross-section of the pipe will be **changing**, so a **current** is **induced (eddy current)** in the copper pipe. • This induced current flows to produce a magnetic field in the copper pipe which will **oppose the downward movement** of the magnet, so it will **slow down** the falling magnet. • Eventually an equilibrium is reached where the magnetic force and the gravitational force balance, and the magnet falls at **constant velocity** until the end of the pipe.
(ii)	As the magnet drops into the copper tube, the copper tube cuts the magnetic field lines of the magnet. By Faraday's Law of Electromagnetic Induction, there is an induced emf produced in the copper tube. By Lenz's Law, the direction on the induced emf and hence the induced current produced an opposing force to act against the downward motion.

	The magnet will accelerate until the induced emf is large enough to produce an opposing force that is equal to the weight of the magnet. When this happens, the magnet will move with constant speed.

Section B

Qn	Solution
9(a)	Thermistor
(b)	When there is a fire, the temperature increases. The resistance of the device A will decrease. The potential difference across 2.0 kΩ resistor will increase. Since 2.0 k kΩ resistor is connected in parallel to terminals Y and Z, the potential difference across terminals Y and Z will increase and the transistor will switch on the secondary circuit and activate the bell.
(c)	A small voltage supply is required to ensure the system is "live" and on standby mode, rather than using a high voltage supply at all time. Thus, it saves electrical energy.
(d)(i)	Using potential divider concept, $0.60 = \frac{2000}{2000 + R_{TH}} \times 1.0$ $R_{TH} = \frac{2000}{0.60} - 2000$ $= 1333$ $\approx 1300\Omega$

(ii)	
(iii)	Temperature = 145 °C
10(a)	Wire B. Since current is flowing out of the current supply, wire B is the live wire. A switch in the live wire will ensure no flow of current to the motor at all time when the switch is open. Even when there is a fault such that the live wire touches the motor, the motor will not be 'live' when the switch is open. Hence, this protects the person from electrical shock when the person touches the motor.
(b)	Earth Wire. The earth wire will ensure the metal casing is at zero potential and will not be live. Thus, this protects the person from electrical shock when the live wire touches the metal casing and the person is touching the metal casing.
(c)	Split Ring Commutator The ring ensures that the motor will always turn in the same direction when there is a change in the direction of the current in the coil for every half of revolution. Also accept: The ring ensures that the current in the coil will always move in the same direction (in this case, anti-clockwise) and hence ensuring the coil is always turning in the same direction.

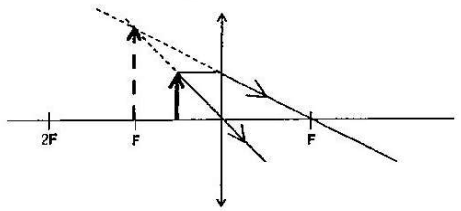
(d)	Viewing from the front:  Magnetic field due to current in coil interacts with magnetic field due to the magnet. For the left coil, the magnetic fields interacts causing the magnetic field above the coil is weaker than the magnetic field below the coil. The resultant magnetic force will be acting upwards. For the right coil, the magnetic fields interacts causing the magnetic field above the coil is stronger than the magnetic field below the coil. The resultant magnetic force will be acting downwards. Hence, these forces cause the coil to turn in clockwise direction.

Either

11(a)	The distance travelled by the 2nd signal is smaller than that of the 1st signal. Thus, the energy loss by the 2nd signal to the surrounding will be smaller. Hence, the 2nd signal received by the radar is stronger than the first one.
(b)	High frequency EM waves have high ionisation energy and can cause harm to the human body when get absorbed by the body.
(c)	Acceleration of the plane $= \frac{60-30}{4}$ $= 7.5\ ms^{-2}$
(d)	Distance travelled = average speed x time duration $= \frac{60+30}{2} \times 4$ $= 180\ m$ Assumption: The time taken for the reflected signal to travel from the plane to the radar is negligible.

	(Distance travelled by the plane during this time lapse is not taken into consideration).
(e)(i)	Using Newton's 2nd Law, $F_{net} = ma$ $75\,000 - f_r = 10\,000 \times (-5.0)$ $f_r = 125\,000\ N$ Also accept: $F_{net} = ma$ $f_r - 75\,000 = 10\,000 \times 5.0$ $f_r = 125\,000\ N$
(ii)	As the plane decelerates, the velocity of the plane decreases. Since air resistance is dependent on the velocity of the plane (and hence speed at which the plane contacting the air particle), the air resistance will not be constant.

Or

11a(i)	Converging lens are lens that causes the light rays (parallel) to bend towards a common point when the light rays passes through it.
(ii)	
(iii)	By measuring the heights of the image and the object and the ratio of the height of the image to the height of the object will provide the information the number of times the image is magnified.
(b) (i)	Refractive index of 2.42 means that the speed of light in the diamond will be 2.42 times slower than the speed of light in vacuum.
(ii)	For critical angle, the angle of refraction is 90°

Name: _____ Class: _____ Index No. : _____

ST JOSEPH'S INSTITUTION

2016 PRELIMINARY EXAMINATION
SECONDARY 4 (O-LEVEL PROGRAMME)

PHYSICS **5059 / 1**

Paper 1 Multiple Choice **19 August 2016**

1 hour

Additional Materials: Multiple Choice Answer Sheet **(1130 – 1230 hr)**

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the cover page of this Question Paper and the Answer Sheet.
Write in soft pencil on the Multiple Choice Answer Sheet.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this Question Paper.
The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, submit the Question Paper and Answer Sheet **SEPARATELY**.

For Examiner's Use	
Total	40

This Question Paper consists of **15** printed pages.

1 The formula used to calculate a gas constant, k is given below.

$$pV = k$$

where p = pressure of gas
V = volume of gas
k = gas constant

Which of the following is a possible unit for the gas constant?

A kg m s^{-1}
B J s^{-1}
C N
D N m

2 A micrometer is used to measure the thickness of a book that has 200 identical pages, including its front and back cover.
With the jaws completely closed, the micrometer reading is shown in Fig 2.1.
With the jaws closed around the book, the micrometer reading is shown in Fig 2.2

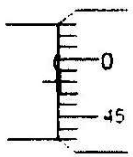


Fig. 2.1

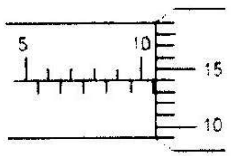


Fig. 2.2

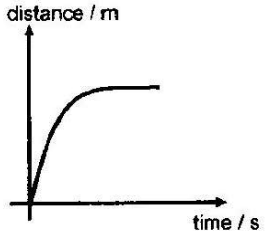
What is the thickness of the book?

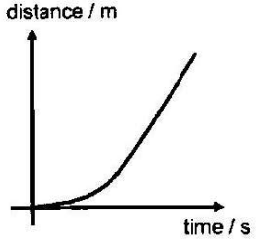
A 0.0533 mm **B** 10.64 mm **C** 10.66 mm **D** 11.12 mm

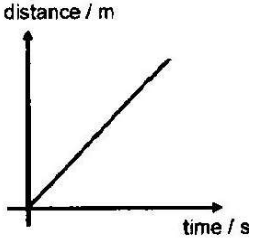
3 An object is propelled vertically upward with an initial speed of 20 m/s.
Ignoring air resistance, what is the magnitude of the displacement of the object 3.0 s later?

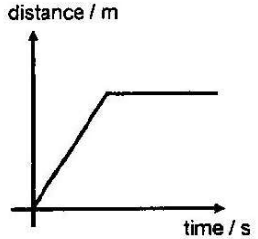
A 5.0 m
B 10 m
C 15 m
D 20 m

4 A car moves forward in a straight line.
If the driving force is constant, which of the following graphs correctly shows how the distance of the car changes with time?

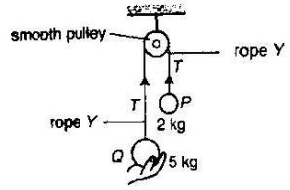
A


B


C


D


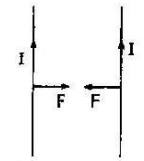
5 Two metal spheres P and Q are attached together to the same rope Y which goes round a smooth pulley as shown below. Steven places his hand to support sphere Q with a 30 N force so that the system is stationary. Take g = 10 N/kg.



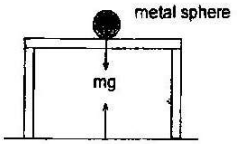
What is the magnitude of the tension, *T*?

A 20 N
B 30 N
C 50 N
D 80 N

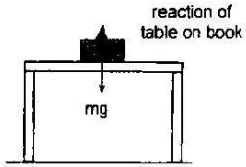
6 Which of the following pairs of forces is not a valid example of action and reaction forces according to Newton's third law of motion?

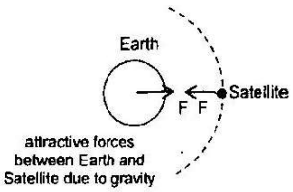
A


attractive forces between current carrying wires

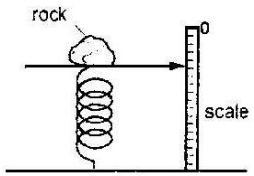
B


force on earth due to metal sphere

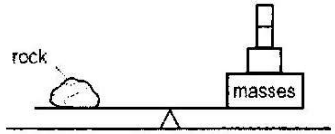
C


D


7 An astronaut conducted the same experiment as shown below on Mars and on the Moon. She placed the same rock on a spring balance and then on a beam balance. The gravitational field strength of Mars is larger than the Moon.



spring balance



beam balance

Which of the following options is correct when the experiment was conducted on the Moon?

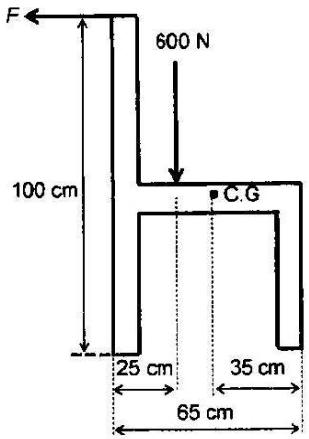
	scale readings of spring balance	*masses needed on beam balance*
A	greater than in Mars	more than in Mars
B	same as in Mars	less than in Mars
C	smaller than in Mars	less than in Mars
D	smaller than in Mars	same as in Mars

8 A mass of liquid of density ρ is thoroughly mixed with an equal mass of another liquid of density 2ρ. The final volume of the mixture is the sum of the volumes of the two liquid.

What is the density of the liquid mixture?

A $\frac{4}{3}\rho$ **B** $\frac{3}{2}\rho$ **C** $\frac{5}{3}\rho$ **D** 3ρ

9 The diagram below shows the dimensions of a chair. A boy sits on the chair and exerts a 600 N force on it as shown. The figure also shows the position of the centre of gravity (C.G.) of the chair.



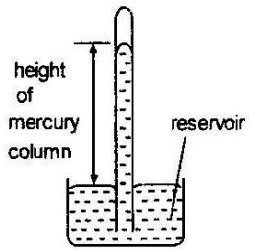
If the mass of the chair is 5.0 kg, what is the magnitude of the horizontal force, F needed to overturn the chair?

A 150 N
B 165 N
C 240 N
D 258 N

10 With reference to question 9, which of the following statements will not help to prevent the chair from overturning?

A Lower the C.G. of the chair.
B Use a heavier chair.
C The boy leaning forward.
D Increase the base area of the chair.

11 The diagram shows a simple mercury barometer.



Which of the following does not cause the height of the mercury column to vary?

A changes in atmospheric pressure
B changes in the temperature of the mercury
C changes in the value of gravitational field strength
D evaporation of mercury from the barometer reservoir

12 Which sequence represents, in the correct order, the transformation of useful energy in a nuclear power station?

A nuclear energy → chemical energy → light energy → electrical energy
B nuclear energy → gravitational potential energy → kinetic energy → electrical energy
C nuclear energy → kinetic energy → thermal energy → electrical energy
D nuclear energy → thermal energy → kinetic energy → electrical energy

13 When Peter sleeps, his body has a power output of 60 W.
He sleeps from 10.00 pm to 7.00 am.

How much energy has he expended?

A 1.5×10^{-1} J
B 3.2×10^{3} J
C 5.4×10^{2} J
D 1.9×10^{6} J

14 A sealed container filled with gas, is submerged into some hot water.

Which of the following describes the change in the density of the gas and the speed of the molecules?

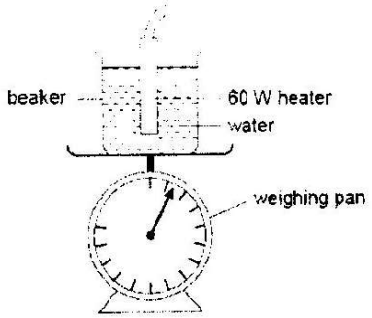
	the density of gas	*the speed of the molecules*
A	denser	faster
B	less dense	same speed
C	less dense	slower
D	remains unchanged	faster

15 A fixed mass of air is trapped inside a cylinder by a piston. The piston is pushed in slowly so that the temperature remains constant.

Which of following explains the increase of pressure of the air in the cylinder?

A Pushing in the piston speeds up the air molecules.
B The air molecules collide more frequently with one another.
C The air molecules collide more frequently with the wall of container.
D There is less wall surface for the molecules to collide with.

16 The following set-up is used to measure the specific latent heat of vaporisation of water.



Three readings are taken by the weighing pan as shown below.
m_1 = reading before heating
m_2 = reading at 3 minutes after water boils
m_3 = reading at 8 minutes after water boils

Which calculation gives the best estimation of the specific latent heat of vaporisation of water in J/kg?

A $\dfrac{300}{m_2 - m_3}$

B $\dfrac{480}{m_1 - m_3}$

C $\dfrac{10800}{m_1 - m_2}$

D $\dfrac{18000}{m_2 - m_3}$

17 Which of the following does not change when a solid is melting?

A average speed of molecules
B density of the mixture
C intermolecular forces of attraction
D internal energy of the molecules

18 The change of the resistance of a copper wire is assumed to be directly proportional to the change of its temperature. At 20 °C, the resistance of the wire is 0.51 Ω. When the wire is placed in a beaker of boiling water, its resistance is equal to 2.91 Ω. The wire is used to measure the temperature of a hot drink.

What is the temperature of the hot drink if the resistance of the wire is 2.55 Ω?

A 48 °C
B 68 °C
C 85 °C
D 88 °C

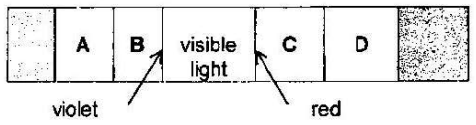
19 Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.

Which statement below correctly describes the type of waves that Wi-Fi uses?

A They cannot be reflected.
B They cannot travel through a vacuum.
C They have the same speed as gamma rays in air.
D The speed of the waves increase with increasing frequency.

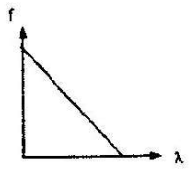
20 The diagram below shows an electromagnetic spectrum and it is not drawn to scale. The visible light spectrum is marked. One of the sections of the spectrum has the characteristic: "Able to transfer heat from high temperature region to low temperature region."

Which section is it?

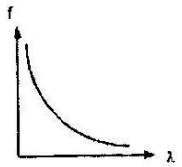


21 Which graph shows the correct relationship between the frequency, f and the wavelength, λ of a wave that is travelling in a uniform material?

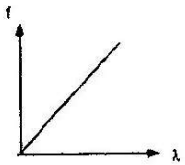
A



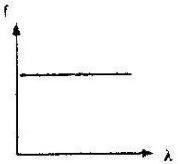
B



C



D



22 A piece of white paper cannot be used as a plane mirror.

What is the reason for this?

A The paper is white in colour.
B The light rays falling on the surface of the paper do not obey the laws of reflection.
C The surface of the paper absorbs most of the light falling on it.
D The surface of the paper is not smooth enough to allow regular reflection of light.

23 A ray of light travels from air to water along the normal at the point of incidence.

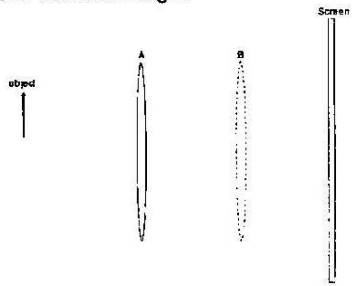
Which of the following properties of light will change?

(1) speed
(2) frequency
(3) direction of travel

A (1) only
B (1) and (3) only
C (3) only
D (1), (2) and (3)

24 When the lens is placed at A, a sharp image is formed on the screen. The image is real, inverted and magnified. After the lens is moved to B, another sharp image is formed on the screen.

What are the properties of the latter image?



A diminished and inverted
B diminished and upright
C magnified and inverted
D magnified and upright

25 A ray of light in a glass block is incident on a boundary with air at an angle of incidence of 30°. The critical angle at this boundary is 32°.

What happens to the ray of light at the boundary?

A It is partly refracted along the boundary and partly reflected back into the glass
B It is partly refracted in the air and partly reflected back into the glass.
C It is totally reflected back into the glass.
D It is totally refracted into the air.

26 A flash of lightning and the corresponding sound of thunder are detected 6.0 s apart. A student calculates that the lightning struck about 1800 m away.

On which assumption is the calculation based on?

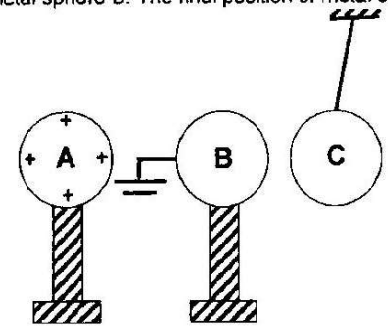
A Light reaches us almost instantaneously, but sound travels at 300 m/s.
B Light travels 300 m/s faster than sound.
C Light travels 300 times faster than sound.
D The sound of the thunder was emitted 6.0 s after the flash.

27 A musical note, of the same pitch, is played first on a flute and then on a trumpet.

Which one of the following correctly compares the notes produced by the two instruments?

A different frequency and different speeds
B different frequency and the same speeds
C same frequency but different speeds
D same frequency and same speeds

28 The diagram below shows a positively charged metal sphere A placed next to a neutral metal sphere B. Metal sphere B is earthed and metal sphere C is then freely suspended next to metal sphere B. The final position of metal sphere C is as shown.



What could be the charge of metal sphere C?

A positively charged only
B positively charged or neutral
C negatively charged only
D neutral

29 Which of the following statements correctly defines electric field direction?

A It is the direction of the electric force acting on a small negative point charge.
B It is the direction of the electric force acting on a small positive point charge.
C It points away from a negatively charged object towards a positively charged object.
D It points away from a positively charged object towards a negatively charged object.

30 Why are birds able to rest on an overhead transmission line without being electrocuted?

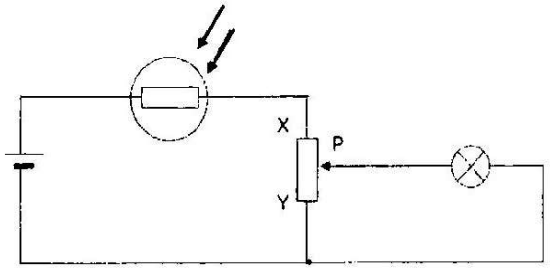
A The bodies have very high resistance.
B The current is too small.
C The air between the feathers is a very good electrical insulator.
D There is no potential difference between their feet.

31 A resistance wire, X, is connected to a battery and an ammeter in series. The reading of the ammeter is 1.60 A. The resistance wire, X is then replaced with resistance wire, Y. The length and the diameter of resistance wire, Y, is double that of resistance wire, X.

If the two resistance wires are made of the same material, what is the new reading on the ammeter?

A 0.20 A
B 0.40 A
C 1.60 A
D 3.20 A

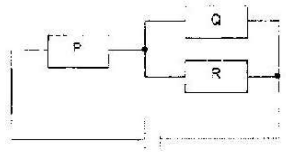
32



Which arrangement will cause the bulb, as shown in the circuit above, to be the brightest?

A Light is incident on the LDR and P is moved to X.
B Light is incident on the LDR and P is moved to Y.
C The LDR is covered and P is moved to X.
D The LDR is covered and P is moved to Y.

33 The diagram below shows 3 resistors connected to a cell of 2.0 V. The resistance of both P and Q are 2.0 Ω and the current flowing in resistor P is 0.80 A.



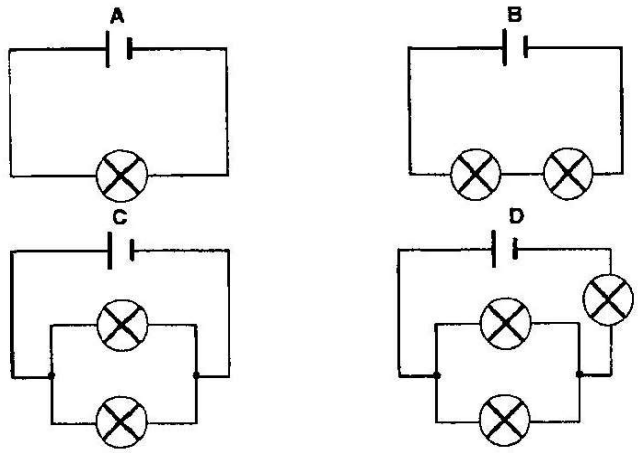
2.0 V

What is the resistance of R?

A 0.40 Ω
B 0.67 Ω
C 1.0 Ω
D 1.5 Ω

34 Identical light bulbs are connected to a cell with an e.m.f. of 3.0 V.

Which of the following arrangements will result in the smallest total power output?



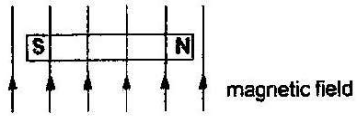
35 An appliance is used in a damp environment. The insulation of the wiring is damaged.

What is/are the possible risk(s) that could happened to the appliance?

(I) The fuse blows
(II) The user gets an electric shock
(III) Electrical fire occurs

A (I) only
B (II) only
C (I) and (II) only
D All of the above

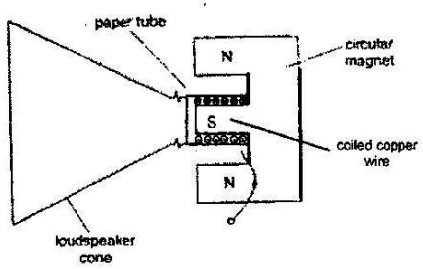
36 The diagram shows a bar magnet placed in a uniform magnetic field.



What will happen to the magnet if it is allowed to move freely?

A It will remain stationary.
B It will turn 90° anticlockwise.
C It will turn 90° clockwise.
D It will turn 180° clockwise.

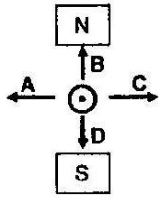
37 The diagram shows the side view of a loudspeaker, which consists of magnets and a coiled copper wire amongst other items. Direct current is flowing in the speaker's coil in the direction as shown below.



What is the direction of the force experienced by the coil?

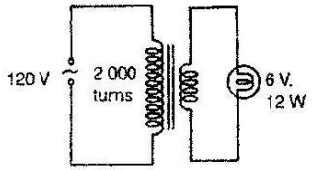
A into the page
B no force is induced
C to the left
D to the right

38 The diagram below shows an induced current, flowing through a conductor as it is moved between two magnets.



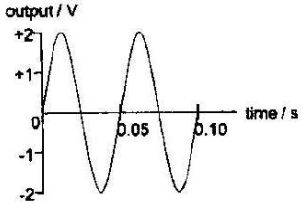
Which arrow indicates the direction of movement of the conductor?

39 A bulb, rated 6.0 V, 12 W is connected to a transformer as shown in the diagram below. The brightness of the bulb turns out dimmer than expected, which of the following is a possible number of turns in the secondary coil?



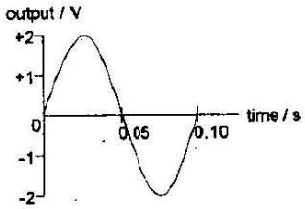
A 90
B 120
C 200
D 1000

40 The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.

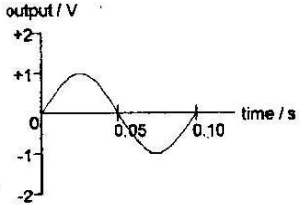


Which graph shows the output when the coil rotates 10 times in one second?

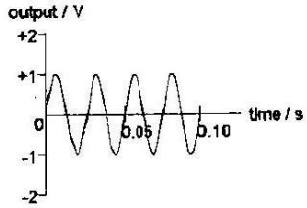
A



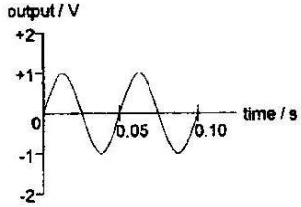
B



C



D



ST JOSEPH'S INSTITUTION

2016 PRELIMINARY EXAMINATION
SECONDARY 4 (O-LEVEL PROGRAMME)

PHYSICS (MARKING SCHEME) 5059

PAPER 1

Q1	Q2	Q3	Q4	Q5
D	C	C	B	A

Q6	Q7	Q8	Q9	Q10
C	D	A	B	A

Q11	Q12	Q13	Q14	Q15
D	D	D	D	C

Q16	Q17	Q18	Q19	Q20
D	A	D	C	C

Q21	Q22	Q23	Q24	Q25
B	D	A	A	B

Q26	Q27	Q28	Q29	Q30
A	D	B	B	D

Q31	Q32	Q33	Q34	Q35
D	A	B	B	D

Q36	Q37	Q38	Q39	Q40
B	C	A	A	B

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2016

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS
Paper 1 Multiple Choice

5059/01

30 August 2016
1 hour

Sec 4 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the OTAS.

There are forty questions in this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the one you consider correct and record your choice in soft pencil on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

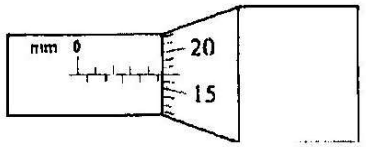
Any rough working should be done in this booklet.

Total Marks
40

1 Sir Isaac Newton discovered gravity by watching an apple fall from an apple tree. Newton's law of gravitation states that any two bodies, at a distance of r metres apart and of masses m_1 and m_2 kilogrammes, will exert a gravitational force of attraction on each other according to the equation $F = G\frac{m_1 m_2}{r^2}$ where G is known as Newton's constant. What is the unit of G?

A $kg\ m^3\ s^{-2}$ **B** $N^{-1}\ m^2\ kg^2$ **C** $N\ m^2\ kg^{-2}$ **D** $m^2\ kg^{-2}$

2 A length of wire is wrapped tightly around the length of a pencil. The diameter of the wire is measured using a micrometer screw gauge and the reading is shown.



If 50 turns of wire is required to cover the whole length of the pencil, what is the length of the pencil?

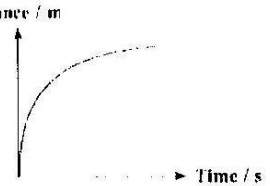
A 20.85 cm **B** 21.15 cm **C** 23.35 cm **D** 23.65 cm

3 Fireworks are fired vertically into the air during National Day with an initial speed of $25\ m\ s^{-1}$. The fireworks reach a maximum height of h m before exploding into beautiful patterns. Given that $g = 10\ m\ s^{-2}$ and ignoring air resistance, what is the maximum height h?

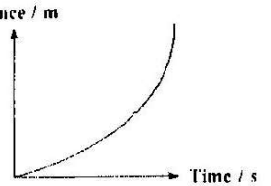
A 22.50 m **B** 25.00 m **C** 31.25 m **D** 45.00 m

4 Which distance-time graph best describes the motion of the fireworks during National Day?

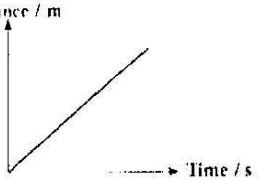
A



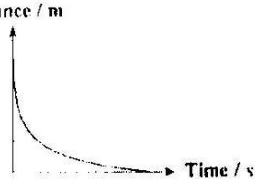
B



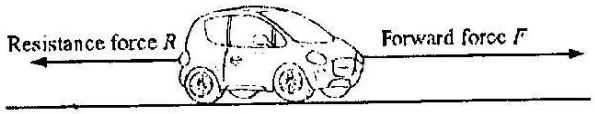
C



D



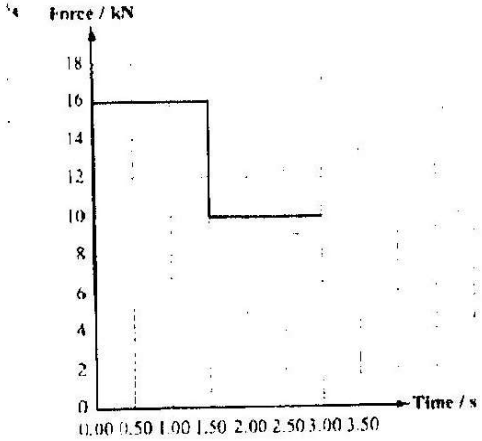
5 The diagram below shows the horizontal forces acting on a car as it travels on a road.



How many forces are acting on the car?

A 0 B 2 C 3 D 4

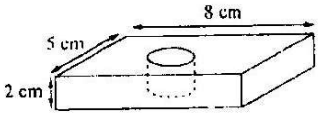
6 The graph below shows the driving force generated by a car engine. The car of mass 2 000 kg starts to cruise at a constant speed of 60 km h^{-1} after travelling for 1.50 s along a rough road. Assume that the friction acting on the car remains constant throughout its journey.



What is the acceleration of the car in the first 0.5 s?

A 0 m s^{-2} B 3 m s^{-2} C 5 m s^{-2} D 8 m s^{-2}

7 The diagram shows a composite rectangular plastic block with a cylindrical hole cut out and fitted with a cylinder of density 2.0 g cm^{-3}. The combined mass is 104 g and the cross-sectional area of the cylinder is 35 % that of the uncut rectangular cross-sectional area.

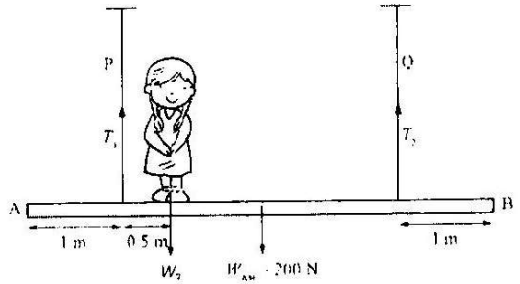


On which of the following liquid(s), chloroform (1 465 kg m^{-3}), coconut oil (925 kg m^{-3}) and/or water (1 000 kg m^{-3}) will the composite block float?

A chloroform B chloroform and coconut oil

C coconut oil and water D chloroform, coconut oil and water

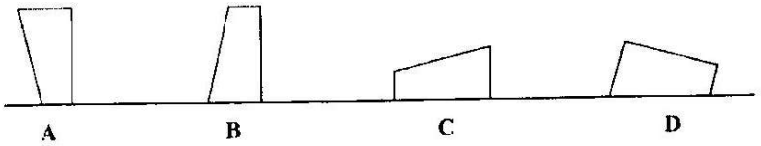
8 A girl of mass 50 kg stands on a uniform plank *AB* supported by two cords *P* and *Q*. The length of the plank *AB* is 5.0 m. Let W_g denote the weight of the girl.



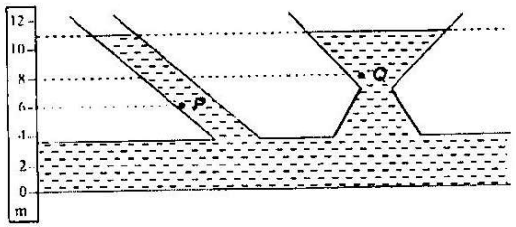
What are the values of T_1 and T_2 when the girl is at her current position?

	T_1 / N	T_2 / N
A	183	517
B	350	350
C	500	200
D	517	183

9 Which of the following diagrams shows a trapezoid placed on the ground such that it has the greatest stability?



10 The diagram below shows two communicating vessels filled with mercury of density 13 600 kg m^{-3}. The height of fluid in the vessels is 11 m.



What is the ratio of the liquid pressure at *P* to that at *Q*?

A 1 : 2 B 3 : 4 C 5 : 3 D 5 : 8

11 A 5.0 cm mercury column is suspended along a glass tube as shown in Fig 11a

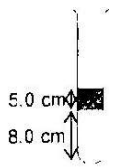


Fig. 11a



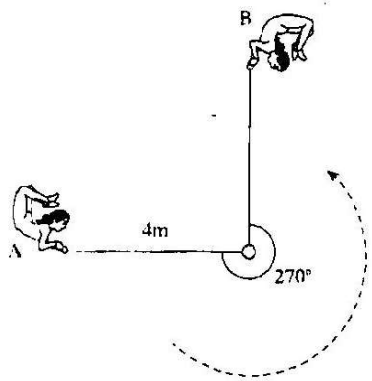
Fig. 11b

(Diagrams are not drawn to scale.)

Given that the length of the trapped air is 8.0 cm and the atmospheric pressure is 75 cm Hg, what is the length of the trapped air when the glass tube is inverted to the position shown in Fig. 11b?

A 7.0 cm B 8.0 cm C 9.1 cm D 10.3 cm

12 An acrobat swings from point *A* to point *B* as shown.



Given that the light swinging rod is 4 m long, what is the minimum initial speed the acrobat must have at point *A*?

A 6.32 m s^{-1} B 8.94 m s^{-1} C 10.0 m s^{-1} D 80.0 m s^{-1}

13 A battery supplies 500 J of electrical energy to a motor. The motor drags an object horizontally for 50 m along a floor with frictional force of 2 N. What is the maximum efficiency of the motor?

A 10 % B 20 % C 80 % D 90 %

14 The table below shows some physical properties of some substances.

Substance	Melting point / °C	Boiling point / °C	Density / kg m^{-3}
Bromine	– 7	59	3 100
Caesium	29	670	1 840
Isobutanol	– 102	108	802
Oxygen	– 219	– 183	1 140
Zinc	420	907	7 140

How many substances have particles that vibrate about fixed positions at 298 K?

A 1 B 2 C 3 D 4

15 Which of the following will occur if the sealed container is heated to 100 °C while the piston is allowed to move freely?

I The average distance between air molecules will increase.

II The average kinetic energy of air molecules will increase.

III The pressure of the trapped air will increase.

A I only B I and II only C II and III only D I, II and III

16 Water at 0 °C is mixed with ice at 0 °C. If energy is only exchanged between the water and ice, which of the following statements is correct?

A All the ice will melt.

B All the water will freeze.

C No ice will melt and no water will freeze.

D Not enough information is known to make the correct deduction.

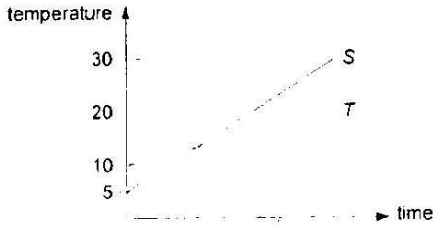
17 Certain pizza restaurant serves baked rice in a white porcelain bowl. Mr Lee puts his finger near the side of the bowl and does not feel heat from the bowl. Unexpectedly, his finger gets burn by the bowl when he touches it. Which of the following explains the situation?

	Bowl is not hot when finger is placed near the side of bowl	**Bowl burns finger when touched**
A	porcelain is a poor conductor	porcelain is a good emitter of radiation
B	porcelain is a poor conductor	porcelain is a poor emitter of radiation
C	porcelain is a poor emitter of radiation	porcelain conducts heat to the finger
D	porcelain is a poor emitter of radiation	porcelain radiates heat to the finger

18 A mercury-in-glass thermometer is calibrated by measuring the length of the mercury thread at different temperatures. The lengths of mercury thread at 0 °C and 100 °C are 7.0 cm and 48.0 cm respectively. What is the temperature when the length of mercury thread is at 32.0 cm?

A 43.8 °C B 52.1 °C C 61.0 °C D 66.7 °C

19 An electric heater is used to heat up two blocks, *S* and *T* for the same period of time. The mass of block *S* is half of block *T*. Their temperature against time graphs are plotted as shown.



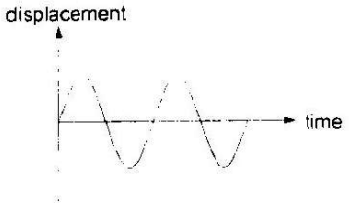
What is the ratio between the specific heat capacities of *S* to *T*?

A 0.40 B 0.80 C 2.5 D 3.0

20 An ice cube of mass 10 g is dropped into a beaker containing 100 g of water at 20.0 °C. The specific latent heat of fusion of ice is 330 kJ kg^{-1} and the specific heat capacity of water is 4 200 J kg^{-1} °C^{-1}. What is the minimum number of identical ice cubes required to lower the temperature of the contents of the beaker to below 5.0 °C?

A 1 B 2 C 3 D 4

21 The graph shows the displacement of a particle from its original position as a wave passes through it

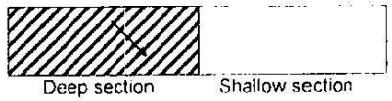


From the graph, the wave is likely to be a .....

I light wave II sound wave III water wave

A I only B III only C I and III D I, II and III

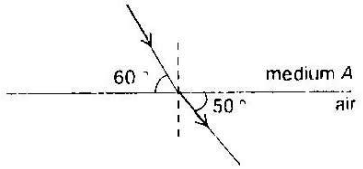
22 The diagram below shows part of a ripple tank. A machine in the deep section generates 1 800 water waves every minute. The waves move in the direction shown into the shallow section such that the distance between the two successive crests is 2 m in deep section.



What is the speed of the waves in the deep section when $\lambda = 0.03$?

A 0.01 m s^{-1} B 0.90 m s^{-1} C 4.05 m s^{-1} D 120 m s^{-1}

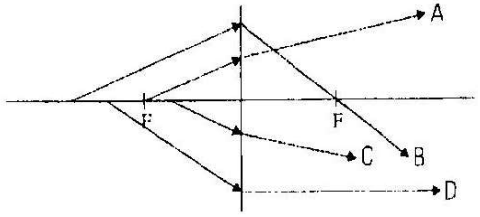
23 Refraction takes place when light travels from medium *A* to air as shown.



What is the critical angle for the above situation?

A 48° B 51° C 55° D 60°

24 Which of the following light rays behaves correctly when it passes through the converging lens?



converging lens

25 Red light travels in optical fibre with a refractive index of 1.62. Given that the frequency of a light source is 4×10^{14} Hz, what is the wavelength of this light ray?

A 2.85×10^{-7} m B 4.62×10^{-7} m

C 7.48×10^{-7} m D 8.23×10^{5} m

26 Which of the following shows the **incorrect** use for each electromagnetic wave?

	electromagnetic wave	use
A	gamma ray	medical treatment
B	infrared	detecting broken bones
C	radio waves	telecommunication
D	X-rays	radiology

27 To measure the length of a room, a sonic 'tape measure' is used. It measures a time interval of 0.06 s between transmitting a sound pulse and receiving the echo. The speed of sound in air is 330 m s^{-1}. What is the length of the room?

A 3.3 m B 6.0 m C 9.0 m D 9.9 m

28 The sound wave from a flute has a smaller amplitude than that of a violin. The sound wave from the flute has a higher frequency than that from the violin. Which instrument produced a softer sound and which instrument produced a higher pitch?

	Softer sound	Higher pitch
A	Flute	Flute
B	Violin	Flute
C	Flute	Violin
D	Violin	Violin

29 When Jasmine brings a positively charged rod near the knob of an uncharged electroscope, the leaves will diverge because

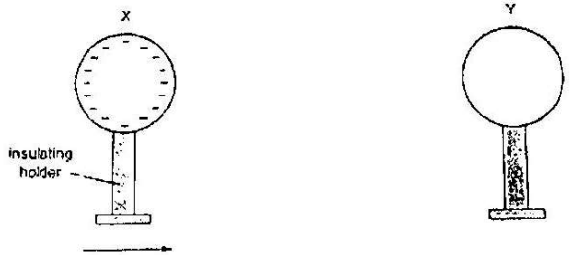
A negative charges are attracted to the knob

B negative charges are transferred from the leaves to the rod

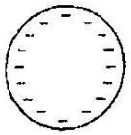
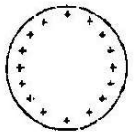
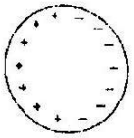
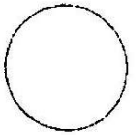
C positive charges are transferred from the rod to the leaves

D positive charges on the knob are moved to the leaves

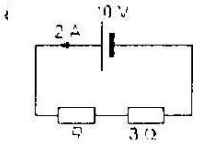
30 A negatively-charged sphere *X* is brought up to an identical uncharged sphere *Y*. The spheres do not touch.



Sphere *Y* is earthed by touching it with a finger. Sphere *X* is then moved away from sphere *Y*, followed by the finger. What is the final charge, if any, on sphere *Y*?

A  B  C  D 

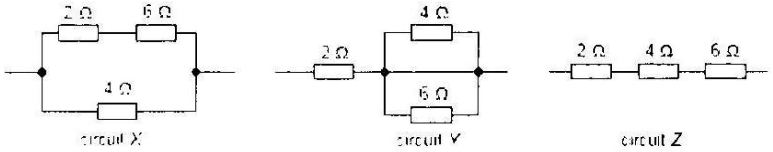
31 The circuit below is switched on for 2 minutes.



What is the amount of energy dissipated by resistor *R*?

A 16 J B 40 J C 240 J D 960 J

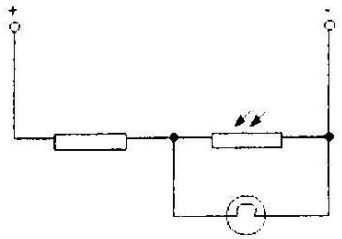
32 Three resistors of resistance 2 Ω, 4 Ω and 6 Ω are used to make circuits *X*, *Y* and *Z*.



Which of the following gives the combinations in order of decreasing resistance?

A *ZXY* B *ZYX* C *YZX* D *XYZ*

33 The bulb in the circuit below will light up .....

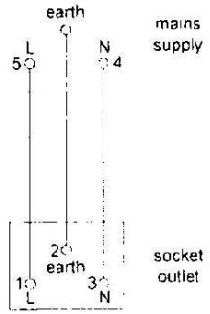


A in a dark room
B on a cold day
C on a hot day
D under bright light

34 A square solar panel has dimensions of 0.2 m × 0.2 m. Under the sunlight, the intensity of the light is 1 000 W m^{-2} and the panel delivers a current of 1.6 A at a voltage of 15 V. What is the efficiency of this solar panel in converting solar energy into electrical energy?

A 9.6 %
B 12 %
C 40 %
D 60 %

35 The wiring from a 240 V mains supply to a socket outlet in a house is shown below in the diagram.



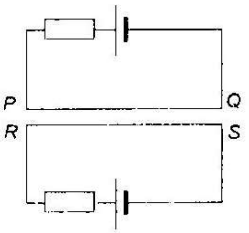
To measure the voltage at the socket outlet, where should the voltmeter be connected?

A 1 and 3
B 2 and 3
C 2 and 4
D 3 and 4

36 Rachel attaches one end of a string to a steel paper clip and the other end to a table. The string is very light. She then uses a magnet to attract it so the clip seems to float in air. However, when she lifts the magnet, the paper clip falls. What is the reason for this?

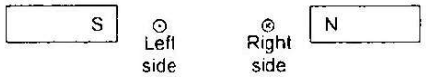
A The gravitational potential energy of the clip increases.
B The gravitational force near the magnet increases.
C The magnetic properties of the clip decreases.
D The magnetic field strength near the clip decreases.

37 Which of the following shows the movements of the wires correctly when the two circuits are brought together as shown?



	PQ	*RS*
A	↓	↑
B	↓	↓
C	↑	↓
D	↑	↑

38 The cross-sectional view of a d.c. motor is shown below.

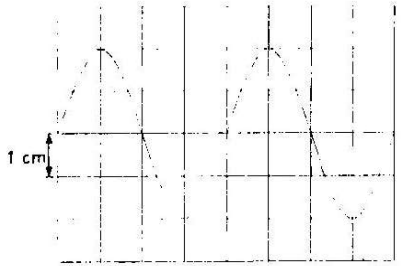


Which of the following will be observed when current flows through the d.c. motor?

I The coil turns anticlockwise.
II The wire on the left moves towards the south pole.
III The wire on the right moves towards the north pole.

A I only
B I and II
C II and III
D I, II and III

39 The diagram below shows the display of a c.r.o. when an a.c. generator is connected to the c.r.o.. The Y-gain is set to 2 V cm^{-1} and the time-base is set to 4.0 ms cm^{-1}.



What is the peak voltage of the waveform shown if the speed of rotation of the coil is halved?

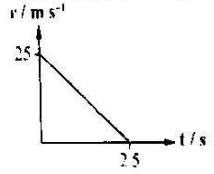
A 2 V B 4 V C 8 V D 16 V

40 A transformer is used to reduce power loss in transmitting cables. A power station produces 1 MW of power at a potential difference 20 kV. What should be the turns ratio such that the output current is reduced to one-fifth of its input value?

A 1 : 25 B 1 : 6 C 1 : 5 D 5 : 1

END OF PAPER

GESS Prelim 2 2016 Physics 5059/01

Question	Answer	Explanation
1	C	$F = G\frac{m_1 m_2}{r^2}$ $G = \frac{Fr^2}{m_1 m_2}$ Unit of $G = \frac{N \times m^2}{kg^2}$ $= \underline{N\,m^2\,kg^{-2}}$
2	C	Micrometer reading = 4.5 mm + 0.17 mm = 4.67 mm Length of pencil = $50 \times \left(\frac{4.67}{10}\right)$ = <u>23.35 cm</u>
3	C	time taken to reach maximum height $= \frac{25\ m\,s^{-1}}{10\ m\,s^{-2}}$ = 2.5 s h = area under v-t graph = ½ × 2.5 s × 25 m s^{-1} = <u>31.25 m</u> 
4	A	Since the firework decelerates as they get higher, the distance travelled increases at a decreasing rate.
5	D	Weight and normal reaction are not shown in the diagram. They are the vertical forces acting on the car.
6	B	$F = ma$ 16 kN – 10 kN = 2 000 kg · a $a = \underline{3\ m\,s^{-2}}$
7	A	density of composite block = $\frac{104\ g}{(8\ cm \times 5\ cm \times 2\ cm)}$ = 1.3 g cm^{-3} Since the density of the composite block is 1.3 g cm^{-3}, it can only float on chloroform.
8	D	Taking moments about Q. $T_1 \times (5\ m - 1\ m - 1\ m)$ $= \{200\ N \times [(\frac{5.0\ m}{2}) - 1\ m]\} + [(50\ kg \cdot 10\ N\,kg^{-1}) \times (5.0\ m - 1m - 1m - 0.5\ m)]$ ↑ $T_1 = \underline{517\ N}$ ↑ 517 N + T_2 = 200 N + 500 N ↑ $T_2 = \underline{183\ N}$

Question	Answer	Explanation
9	D	The trapezoid in D has the largest base area while having a lower centre of gravity. Therefore, it is the most stable.
10	C	ratio of heights of P : Q = (11 – 6) m : (11 – 8) m = 5 : 3
11	C	On the left diagram, pressure of trapped air = 75 cm Hg + 5 cm Hg = 80 cm Hg On the right diagram, 75 cm Hg = pressure of trapped air + 5 cm Hg pressure of trapped air = 70 cm Hg Let A be the cross-sectional area of the glass tube. According to Boyle's Law, $80 \times (8 \times A) = 70 \times (h \times A)$ h = 9.1 cm
12	B	By the principle of conservation of energy, E_k at point A = E_p at point B $\frac{1}{2}mv^2 = mgh$ $\frac{1}{2}v^2 = 10 \times 4$ v = 8.94 m s^{-1}
13	C	Efficiency of motor = $\frac{\text{useful energy}}{\text{total energy}} \times 100\%$ $= \frac{[500 - (2 \times 50)]}{500} \times 100\%$ = 80 %
14	B	298 K = 25 °C Particles vibrate about fixed positions are solids. Caesium and zinc are solids at 25 °C.
15	B	Heating increases the temperature of the air, and the kinetic energy of the air molecules. The piston will move outwards during heating to keep the pressure of the trapped air close to atmospheric pressure, so the volume of the trapped air will increase. This increases the average distance between air molecules. Since the piston can move freely, it will be pushed out and the pressure of the trapped air remains the same.
16	C	No energy transfer occurs when they are at the same temperature.
17	C	The white surface of the bowl is a poor emitter of radiant heat. Many restaurants choose white bowl to minimize heat loss from the bowl to the surroundings. Although the bowl is very hot, the finger near the side of the bowl cannot feel the emission of heat as the rate of heat radiation is low. Air is a poor conductor. The small gap between the finger and the bowl discourages the conduction from the bowl to the finger. When finger touched the bowl, the heat conducts effectively from the bowl directly to the finger, causing pain to Mr Lee.

Question	Answer	Explanation
18	C	$\theta = \frac{l_\theta - l_0}{l_{100} - l_0} \times 100$ $= \frac{32.0 - 7.0}{48.0 - 7.0} \times 100$ = 61.0 °C
19	B	$m_T = 2m_S$ Using the same heater, heat absorbed by S = heat absorbed by T $m_S c_S \Delta\theta_S = m_T c_T \Delta\theta_T$ $m_S c_S (30 - 5) = 2m_S c_T (20 - 10)$ $\frac{c_S}{c_T} = \frac{2 \times 10}{25}$ = 0.80
20	B	Let n be the minimum number of ice cubes needed. heat gained by ice = heat lost by water $n \times 0.010 \times (330 \times 10^3) = 0.100 \times 4\,200 \times (20.0 - 5.0)$ $n \approx 2$
21	D	The graph only shows the displacement of a particle, so it can either be a longitudinal wave or a transverse wave.
22	B	$v = f\lambda$ $= \frac{1800}{60} \times 0.03$ = 0.90 m s^{-1}
23	B	i = 30°, r = 40° $\frac{\sin r}{\sin i} = \frac{1}{\sin c}$ $\frac{\sin 40°}{\sin 30°} = \frac{1}{\sin c}$ c = 51°
24	C	Incident light ray passing through the focal point must move parallel to the principal axis after passing through the converging lens.
25	B	$n = \frac{c}{v}$ $1.62 = \frac{3 \times 10^8}{v}$ $v = 1.85 \times 10^8$ m s^{-1} $v = f\lambda$ $1.85 \times 10^8 = (4 \times 10^{14})\lambda$ λ = 4.62 × 10^{-7} m
26	B	X-rays are used for detecting broken bones.

Question	Answer	Explanation
27	D	$v = \frac{2d}{t}$ $330 = \frac{2d}{0.06}$ $d = \underline{9.9\ m}$
28	A	The smaller the amplitude, the softer the sound. The higher the frequency, the higher the pitch. Flute produces a softer sound with higher pitch than violin.
29	A	Only negative charges can move. The positively charged rod attracts the negative charges in the electroscope to move towards the knob as unlike charges attract. The remaining positive charges in the leaves cause the leaves to diverge as like charges repel.
30	D	Sphere X is removed first before the finger. Hence, sphere Y is neutral as it has been earthed by the finger. No charge is drawn on sphere Y as there is same number of positive and negative charges within it.
31	D	p.d. across the 3 Ω resistor = 2 × 3 = 6 V p.d. across R = 10 – 6 = 4 V amount of charge flowing through R in 2 minutes = 2 × (2 × 60) = 240 C Energy dissipated by R = 240 × 4 = <u>960 J</u>
32	A	Effective resistance of circuit $X = \left(\frac{1}{(2+6)} + \frac{1}{4}\right)^{-1} = 2.67\ \Omega$ Effective resistance of circuit Y = 2 Ω (short circuit) Effective resistance of circuit Z = 2 + 4 + 6 = 12 Ω Order of decreasing resistance is <u>ZXY</u>
33	A	The resistance of a LDR will increase when the surrounding is dark and decrease when the surrounding is bright. For the bulb to light up, the p.d. across the LDR must be higher. The p.d. will increase when its resistance increases. To increase its resistance, the environment must be darker.
34	D	$\text{Efficiency} = \frac{\text{useful energy}}{\text{total energy}} \times 100\ \%$ $= \frac{(15 \times 1.6)}{[1000 \times (0.2 \times 0.2)]} \times 100\ \%$ $= \underline{60\ \%}$
35	A	To measure the voltage of the socket outlet, a voltmeter must be connected across the live and neutral terminals of the socket.
36	D	As the magnet is lifted, the distance between the magnet and the paper clip increases. Hence, the magnetic force of attraction weakens and can no longer overcome the clip's weight, causing it to fall.
37	A	Wires carrying currents flowing in the same direction attract each other.

Question	Answer	Explanation
38	A	The coil will experience a turning effect but not a deformation in shape which means that the wires will not move towards the poles.
39	A	The original peak voltage is 4 V. If the speed of rotation is halved, the peak voltage will reduce by half, i.e. 2 V.
40	D	$I_s = 0.2\ I_p$ $\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$ $\frac{N_s}{N_p} \quad \frac{I_p}{0.2I_p}$ $= \underline{5:1}$

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2016

CANDIDATE NAME

CLASS | INDEX NUMBER

PHYSICS
Paper 2

5059/02

26 August 2016
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

For Examiner's Use

Section A [50 marks]

Answer **all** the questions in this section.

1 Fig. 1 shows how the speed of a sky-diver of mass 75 kg varies with time after he jumps from a helicopter.

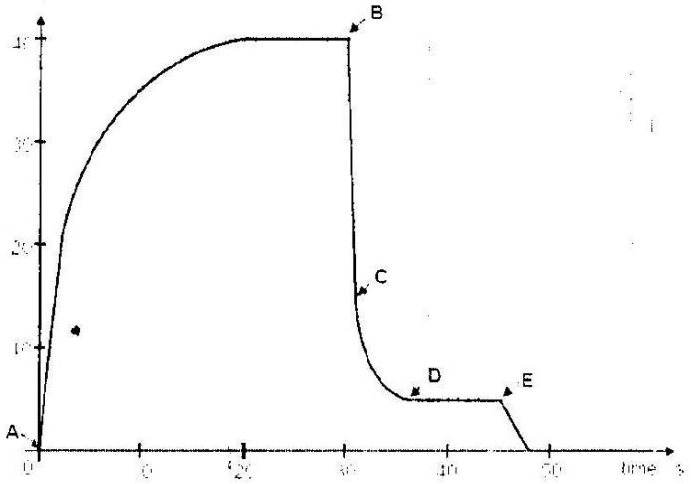


Fig. 1

Assume that the total mass of the parachute and pack is negligible.

(a) Describe the motion of the sky-diver between *A* and *B*.

.....

.....

.....

.....

.....

..... [3]

For Examiner's Use

1 (b) At *B*, the sky-diver opens his parachute.

(i) Determine the value of the acceleration between *B* and *C*.

acceleration = ... [2]

(ii) Explain, in terms of the forces acting on the sky-diver, his motion between *B* and *D*.

.....

.....

.....

..... [2]

(c) The sky-diver touches down at *E*. Explain, in terms of forces acting on him, why a smaller touchdown velocity ensures that he can land safely.

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..... [2]

For Examiner's Use

2 The Mars rover named Curiosity, as shown in Fig. 2, is designed to find out whether the environment on Mars has ever been habitable to life. The rover has a weight of 8 990 N on Earth and a weight of 3 335 N on the planet Mars.

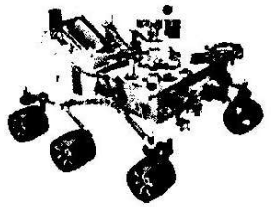


Fig. 2

(a) State what is meant by *gravitational field strength*.

.....

..... [1]

(b) If the gravitational field strength on Earth is 10 N/kg, calculate the gravitational field strength on the planet Mars.

gravitational field strength = ... [2]

(c) The rover falls vertically from rest through a gap in the soil of Mars. It hits the bottom of the gap in 4.2 s. Calculate the depth of the gap.

depth = ... [2]

For Examiner's Use

3 The water current causes the wooden sphere to be displaced until the rope makes an angle of 30° with the vertical as shown in Fig. 3. When the sphere is at this equilibrium position, three forces are exerted on it. These three forces are the tension T in the rope, a horizontal force F_w by water current and a vertical force F_v of 465 N.

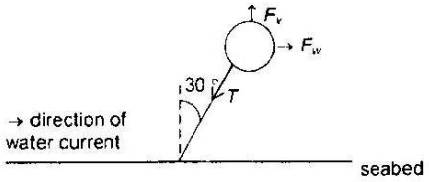


Fig. 3

Use a suitable scale, draw a vector diagram for the three forces acting on the sphere to determine the magnitude of tension T [2]

T = ... [1]

For Examiner Use

4 A manometer is connected to a gas cylinder. The atmospheric pressure is 75 cm Hg.

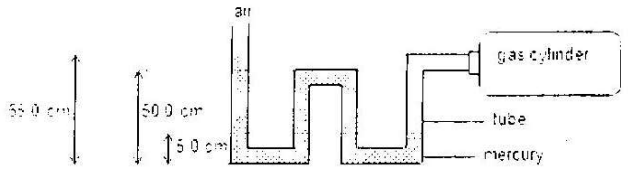


Fig. 4.1

(a) (i) Calculate the gas pressure, in cm Hg.

gas pressure = ... [1]

(ii) Given the density of mercury is 13 600 kg/m^3, calculate the gas pressure in Pascal.

gas pressure = ... [1]

For Examiner's Use

4 (b) Fig. 4.2 shows a car windscreen washer pump.

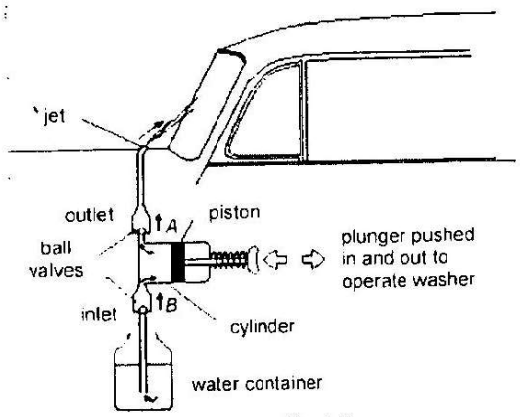


Fig. 4.2

The plunger can be pushed in and out to open the ball valves *A* and *B* to facilitate the flow of water from the water container at the bottom to the jet in front of the windscreen.

(i) If the cross-sectional area of the piston is 16 cm^2, calculate the amount of force exerted at the plunger in order to create a force of 100 N at the jet. The cross-sectional area of the mouth of the jet is 2 cm^2.

force = ... [2]

(ii) State and explain how the force calculated in (i) will differ if some air bubbles enter into the system.

.....

.....

.....

..... [2]

For Examiner's Use

5 (a) Explain why a sleeping bag is made of two layers of plastic and woolen material to keep you warm on a cold night and how it will become useless if the layer is wet.

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..... [2]

(b) Fig. 5 shows part of a table lamp.

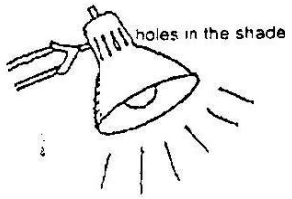


Fig. 5

Explain why there are holes in the shade of the lamp.

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.....

..... [2]

For Examiner's Use

6 (a) Fig. 6.1 gives the names of five components of the electromagnetic spectrum.

gamma rays	microwaves	X-rays	visible light	radio waves

Fig. 6.1

(i) One of the components of the electromagnetic spectrum in Fig. 6.1 is not in the correct position. State the name of this component.

..... [1]

(ii) Explain why ultrasound is not a component of the electromagnetic spectrum.

.....

..... [1]

(iii) Information can be transmitted by light in optical fibres, in copper wires, or by an electromagnetic wave. State **one** advantage of using optical fibres to transmit information rather than using copper wires.

.....

..... [1]

For Examiner Use

6 (b) **RADAR**, short for **RA**dio **D**etection **A**nd **R**anging, has many applications. It is a system used to detect and determine the distance of objects such as aircraft. Strong radio waves are transmitted and a receiver listens for any echoes. Fig. 6.2 shows a radar station that has detected an incoming aircraft.

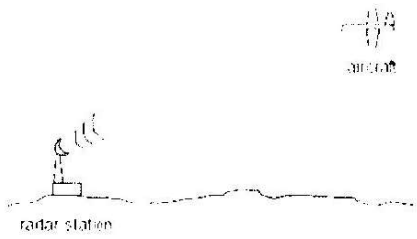


Fig. 6.2

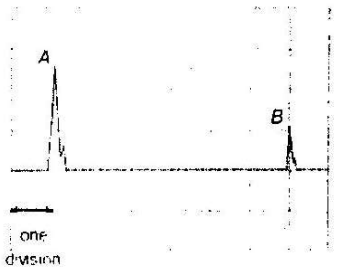


Fig. 6.3

Fig 6.3 shows the display of a c.r.o. screen. *A* represents the pulse of the emitted radio waves while *B* represents the pulse of the echo. Time base is set at 0.2 ms per division. Radio waves travels at a speed of 3×10^8 m/s. Using Fig. 6.3, determine the distance of the aircraft from the radar station.

distance = ... [3]

For Examiner's Use

7 Fig. 7 shows the graphs of current against voltage plotted for bulb *X* and wire *R*.

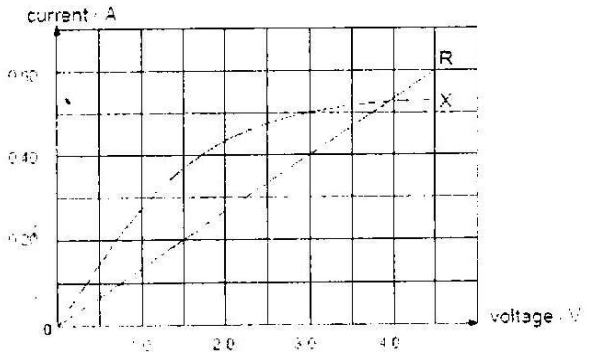


Fig. 7

(a) If the length of wire *R* is 1.5 m and the cross-sectional area is 2.0×10^{-6} m^2, calculate the resistivity of the wire.

resistivity = ... [3]

(b) Bulb *X* and wire *R* are connected in parallel to a 3.0 V cell. Calculate the current passing through the cell and the resistance of the bulb.

current = ... [2]

resistance = ... [1]

For Examiner's Use

8 Fig. 8.1 shows part of the mains electrical circuit in a house. Two lamps *A* and *B*, each rated at 60 W 240 V, are connected to the live wire through fuse *X*. An electric kettle, rated at 840 W 240 V, is connected to the live wire though fuse *Y*. Fuse *Z* protects the whole circuit. The electric kettle has a metal case which is connected to Earth. The mains supply voltage is 240 V.

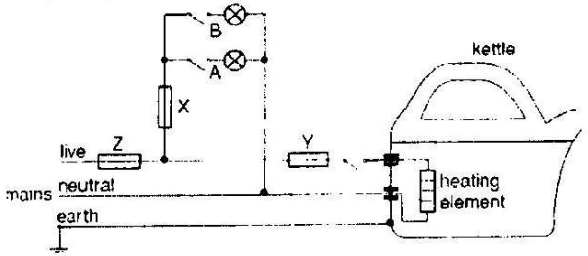


Fig. 8.1

(a) Calculate the current in fuse *Z* when the electric kettle and both the lamps are switched on.

current = ... [2]

(b) A fault develops in the electric kettle, causing a current of 10 A in fuse *Y*. The lamps *A* and *B* remain switched on. The maximum current ratings of the fuses are shown in Fig. 8.2.

	Fuse *X*	Fuse *Y*	Fuse *Z*
current rating / A	3	5	15

Fig. 8.2

Describe and explain what happens to each of the fuses *X*, *Y* and *Z* at the instant when the fault develops.

.....

.....

.....

.....

.....

..... [3]

For Examiner's Use

9 Fig. 9.1 shows a quality control setup of a factory producing magnets. Newly produced permanent magnets are positioned on a conveyor belt and are moved under a detecting device. This device consists of a coil of wire, wound on a soft-iron core and connected to a sensitive voltmeter.

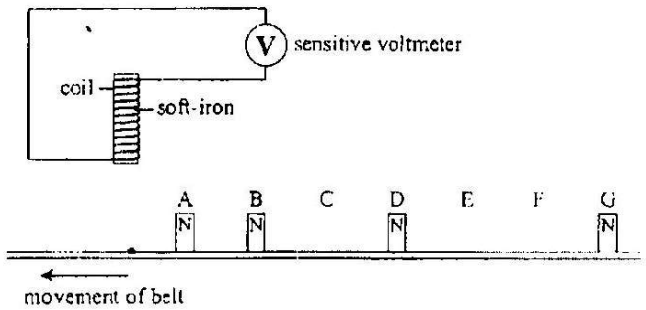


Fig. 9.1

As the conveyor belt moves along at constant speed, voltage pulses are recorded by the voltmeter. These pulses are sent to a c.r.o. and they are displayed in the graph shown in Fig. 9.2. The letters *A* to *G* correspond to the positions on the belt as each magnet passes under the coil.

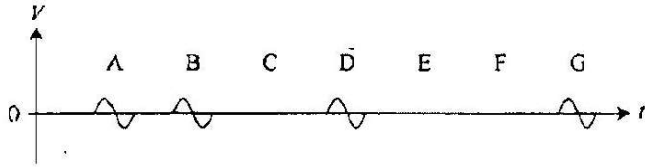


Fig. 9.2

(a) Explain why these pulses occur as each magnet passes under the coil.

.....

.....

.....

..... [2]

For Examiner's Use

9 (b) Explain why the pulse produced by each magnet has a positive and a negative region.

.....

.....

.....

.....

.....

..... [2]

(c) State **one** way in which the detecting device can be made more sensitive.

.....

..... [1]

(d) State how the pulses are affected if the soft iron core is removed.

.....

..... [1]

For Examiner's Use

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12**.

10 A domestic room heater burns natural gas to generate heat for a family.

Table of information	
Description	**Value**
Output power of heater / kW	4.5
Energy obtained from burning 1.0 m^3 of natural gas / MJ	39
Average density of gas / kg m^{-3}	0.72
Specific heat capacity of natural gas / J kg^{-1} $°C^{-1}$	990
Number of gas molecules in 1.0 mol of gas	6.02×10^{23}

Fig. 10

Using the information in Fig. 10,

(a) show that the volume of gas which must be burnt to produce a steady power output of 4.5 kW is 6.9×10^{-3} m^3 each minute. [3]

(b) calculate

(i) the mass of natural gas burnt in one minute.

mass = ... [2]

For Examiner's Use

10 **(b)** **(ii)** the number of molecules of natural gas which pass through the burner each minute if the molar mass of the gas is 1.6×10^{-2} kg/mol.

number of molecules = ... [2]

(c) Explain why the heater cannot be operated using a 13 A, 230 V socket. Include a suitable calculation in your answer.

.....

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..... [3]

For Examiner's Use

11 Fig. 11.1 shows a simplified d.c. motor.

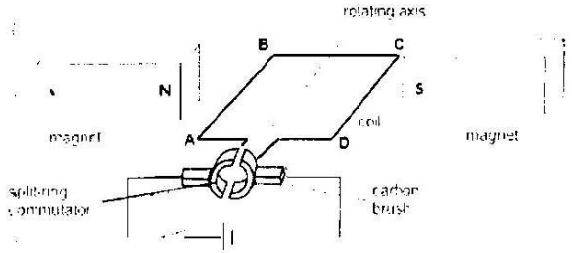


Fig. 11.1

(a) State the direction in which the coil turns when the switch is closed.

..... [1]

(b) Explain why the coil turns when the switch is closed.

.....

.....

.....

..... [2]

(c) The rotating coil is a rectangle. *AB* has a length of 0.04 m and *BC* has a length of 0.03 m. If the total turning effect of the coil is 0.6 N m, calculate the force on each side of the coil which causes the turning effect.

force on side *AB* = ... [1]

force on side *CD* = ... [1]

For Examiner's Use

11 Fig. 11.2 shows the variation of the moment of the coil with time.

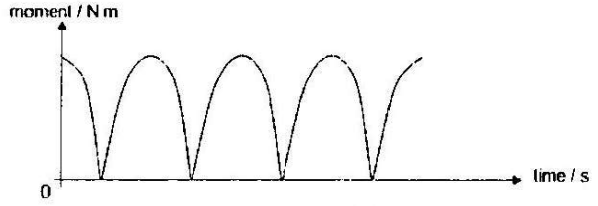


Fig. 11.2

(d) From Fig. 11.2, state the number of complete rounds the coil has rotated.

..... [1]

(e) State and explain the position of the coil at which the moment would be zero.

.....

.....

.....

..... [2]

(f) Describe **two** changes to the graph if the current in the coil is reduced.

.....

.....

.....

..... [2]

For Examiner's Use

12 **EITHER**

A thermistor is placed in an environment where the surrounding temperature increases a constant rate of 1 °C per minute. The graph below shows how the resistance of a thermistor changes with its surrounding temperature.

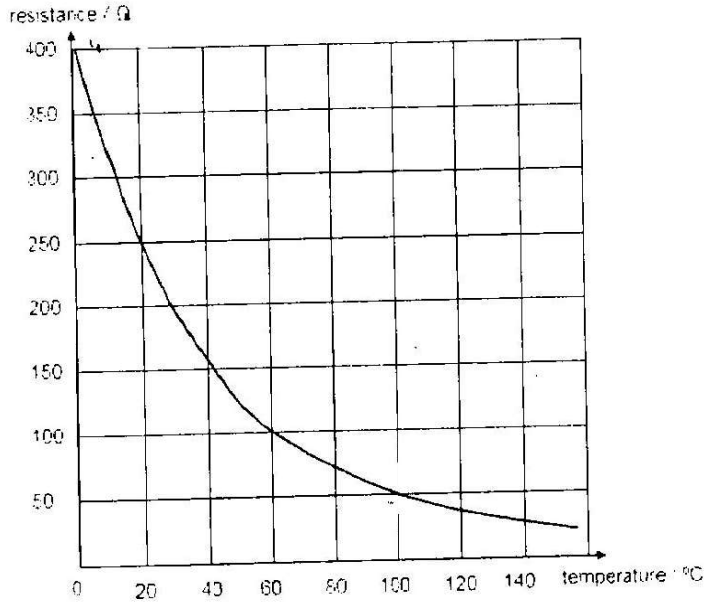


Fig. 12.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature.

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.....

.....

..... [2]

For Examiner's Use

12 The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig 12.2

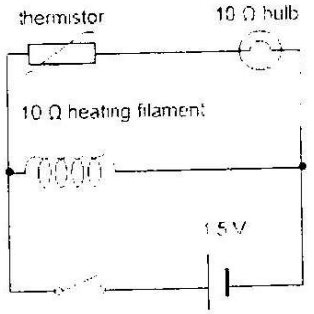


Fig. 12.2

(b) When the switch is closed, the bulb fails to light up at first. Explain why the bulb slowly lights up after a while.

.....

.....

.....

..... [2]

(c) Determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb.

temperature = ... [4]

For Examiner's Use

12 (d) Calculate the effective resistance of the whole circuit when the temperature of the thermistor is 100 °C.

effective resistance = ... [2]

For Examiner's Use

12 OR

(a) State *Faraday's Law*.

..... [1]

(b) State *Lenz's Law*.

..... [1]

(c) Explain how Lenz's Law demonstrates the Principle of Conservation of Energy.

..... [2]

For Examiner's Use

12 (d) In Fig. 12.1, a varying magnetic field is generated within the square loop *ABCD*. The magnetic field is pointing into the page and its magnitude also increases with time. Surrounding the magnetic field is a length of conducting wire of negligible resistance that forms a square loop *ABCD*. At the midpoints of sides *AD* and *BC*, two identical light bulbs *X* and *Y* are connected respectively.

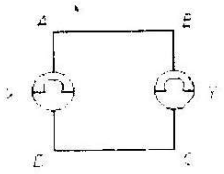


Fig. 12.1

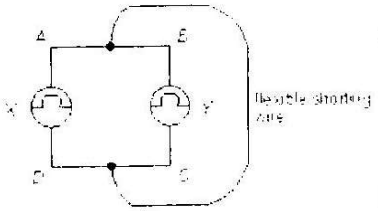


Fig. 12.2

(i) With reference to Fig. 12.1, comment on whether bulbs *X* and *Y* will light up

.....

.....

.....

..... [2]

(ii) A flexible wire with negligible resistance is connected to the midpoint of *AB* and *CD* as shown in Fig. 12.2. This produces a short circuit.

After the shorting wire is placed, discuss what you think will happen to

bulb *X*

.....

.....

..... [2]

bulb *Y*

.....

.....

..... [2]

END OF PAPER

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2016

CANDIDATE NAME	**MARKING SCHEME**
CLASS	**INDEX NUMBER**

PHYSICS
Paper 2

5059/02

26 August 2016
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	50
Section B	30
Total	80

For Examiner's Use

Section A [50 marks]

Answer **all** the questions in this section.

1 Fig. 1 shows how the speed of a sky-diver of mass 75 kg varies with time after he jumps from a helicopter.

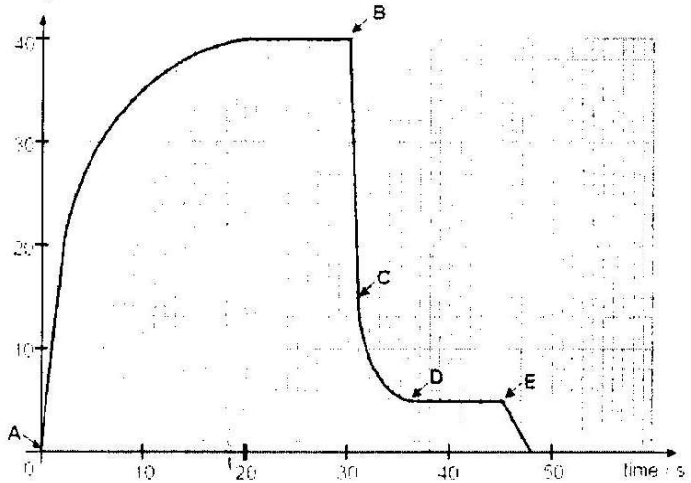


Fig. 1

Assume that the total mass of the parachute and pack is negligible.

(a) Describe the motion of the sky-diver between *A* and *B*.

Either From t = 0 s to 2 s, **velocity increases linearly** from 0 m/s to 20 m/s. [B1] From t = 2 s to 20 s, **velocity increases at a decreasing rate** from 20 m/s to 40 m/s. [B1] From t = 20 s to 30 s, **velocity remains constant at 40 m/s.** [B1]

Or From t = 0 s to 2 s, he experiences **a constant acceleration of 10 m/s^2.** [B1] From t = 2 s to 20 s, **his acceleration decreases.** [B1] From t = 20 s to 30 s, he experiences **zero acceleration.** [B1]

(b) At *B*, the sky-diver opens his parachute.

(i) Determine the value of the acceleration between *B* and *C*.

$$a = \frac{v - u}{t}$$
$$= \frac{15 - 40}{1}$$
$$= -25 \text{ m s}^{-2}$$

[M1]

acceleration = **– 25 m s^{-2}** [A1]

For Examiner's Use

1 (b) (ii) Explain, in terms of the forces acting on the sky-diver, his motion between *B* and *D*.

When the sky diver first opens his parachute, **the air resistance acting upwards increases and is bigger than his weight / net force is acting upwards,** which results in **deceleration.** [B1] As his velocity decreases, **air resistance acting on him decreases. The net force acting upwards decreases,** resulting in a **decreasing deceleration.** [B1]

(c) The sky-diver touches down at *E*. Explain, in terms of forces acting on him, why a smaller touchdown velocity ensures that he can land safely.

The final velocity of sky diver is 0 m/s and assume the time taken to stop to sky-diver is the same. With smaller touchdown speed, **the deceleration upon contact with ground is smaller / kinetic energy is smaller,** hence the **work done on the sky-diver to stop him is smaller.** [B1] **Force acting on sky diver to stop him is smaller.** [B1]

2 The Mars rover named Curiosity, as shown in Fig. 2, is designed to find out whether the environment on Mars has ever been habitable to life. The rover has a weight of 8 990 N on Earth and a weight of 3 335 N on the planet Mars.

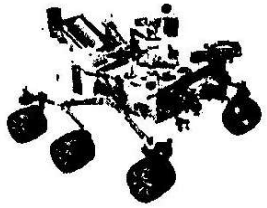


Fig. 2

(a) State what is meant by *gravitational field strength*.

Gravitational field strength is **the gravitational force acting per unit mass.** [B1]

(b) If the gravitational field strength on Earth is 10 N/kg, calculate the gravitational field strength on the planet Mars.

$W_E = mg_E$
$8\,990 = m \times 10$
$m = 899$ kg [B1]
$W_M = mg_M$
$3\,335 = 899 \times g_M$
$g_M = 3.71$ N/kg

gravitational field strength = **3.71 N/kg** [B1]

For Examiner's Use

2 (c) The rover falls vertically from rest through a gap in the soil of Mars. It hits the bottom of the gap in 4.2 s. Calculate the depth of the gap.

$a = \frac{v - u}{t}$
$3.71 = \frac{v - 0}{4.2}$
$v = 15.582$ m s^{-1} [B1]
depth = area under velocity-time graph
$= \frac{1}{2} \times 4.2 \times 15.582$
$= 32.7$ m

depth = **32.7 m** [B1]

3 The water current causes the wooden sphere to be displaced until the rope makes an angle of 30 ° with the vertical as shown in Fig. 3. When the sphere is at this equilibrium position, three forces are exerted on it. These three forces are the tension *T* in the rope, a horizontal force F_w by water current and a vertical force F_v of 465 N.

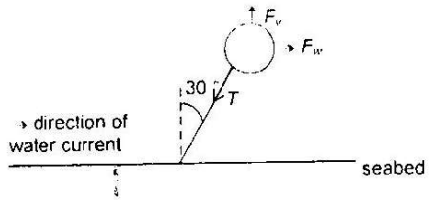


Fig. 3

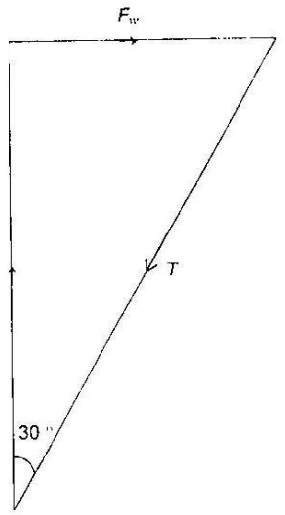
Use a suitable scale, draw a vector diagram for the three forces acting on the sphere to determine the magnitude of tension *T* [2]

Let 1 cm : 50 N.

[B1] for drawing right angle triangle to scale

[B1] for drawing forces and direction of forces

$T = 10.8 \times 50$
$= 540$ N



T = **535 N – 545 N** [B1]

For Examiner's Use

4 A manometer is connected to a gas cylinder. The atmospheric pressure is 75 cm Hg

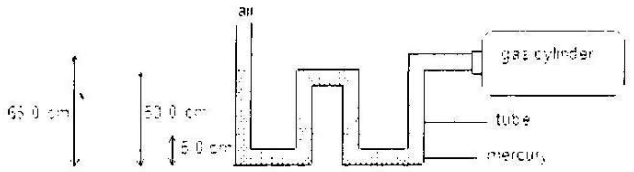


Fig. 4.1

(a) (i) Calculate the gas pressure, in cm Hg.

gas pressure = 75 + (65.0 – 5.0)
= 135 cm Hg

gas pressure = **135 cm Hg** [B1]

(ii) Given the density of mercury is 13 600 kg/m^3, calculate the gas pressure in Pascal

gas pressure = $h\rho g$

$= \frac{135}{100} \times 13\,600 \times 10$

= 183 600 Pa

gas pressure = **184 000 Pa** [B1]

(b) Fig. 4.2 shows a car windscreen washer pump.

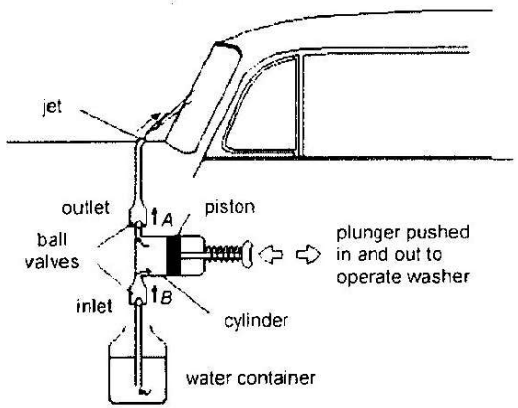


Fig. 4.2

For Examiner's Use

4 **(b)** The plunger can be pushed in and out to open the ball valves *A* and *B* to facilitate the flow of water from the water container at the bottom to the jet in front of the windscreen.

(i) If the cross-sectional area of the piston is 16 cm^2, calculate the amount of force exerted at the plunger in order to create a force of 100 N at the jet. The cross-sectional area of the mouth of the jet is 2 cm^2.

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\frac{100}{2} = \frac{F}{16}$ [M1]

F = 800 N

force = **800 N** [A1]

(ii) State and explain how the force calculated in **(i)** will differ if some air bubbles enter into the system.

The force will be **bigger** [B1] as **air is compressible** and **pressure cannot be transmitted effectively.** [B1]

5 **(a)** Explain why a sleeping bag is made of two layers of plastic and woolen material to keep you warm on a cold night and how it will become useless if the layer is wet.

With the double layers, there is **air trapped. Air is a poor conductor of heat,** thus our body's heat is not lost easily. [B1] When the layer is wet, **evaporation of water will take away our body's heat,** causing us to feel cold. [B1]

(b) Fig. 5 shows part of a table lamp.

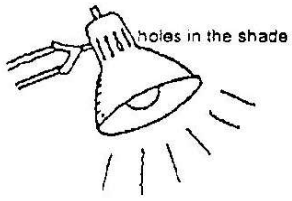


Fig. 5

Explain why there are holes in the shade of the lamp.

Warm air, being less dense, rises from the lamp by convection. [B1] With the holes, this **warm air is not trapped.** [B1]

For Examiner's Use

6 (a) Fig. 6.1 gives the names of five components of the electromagnetic spectrum.

gamma rays	microwaves	X-rays	visible light	radio waves

Fig. 6.1

(i) One of the components of the electromagnetic spectrum in Fig. 6.1 is not in the correct position. State the name of this component.

Microwaves [B1]

(ii) Explain why ultrasound is not a component of the electromagnetic spectrum.

Ultrasound is a longitudinal wave whereas electromagnetic waves are transverse waves. [B1]

(iii) Information can be transmitted by light in optical fibres, in copper wires, or by an electromagnetic wave. State **one** advantage of using optical fibres to transmit information rather than using copper wires.

It is cheaper / transmits faster / is more efficient in carrying information. [B1 for any **one** advantage]

For Examiner's Use

6 (b) **RADAR**, short for **RA**dio **D**etection **A**nd **R**anging, has many applications. It is a system used to detect and determine the distance of objects such as aircraft. Strong radio waves are transmitted and a receiver listens for any echoes. Fig. 6.2 shows a radar station that has detected an incoming aircraft.

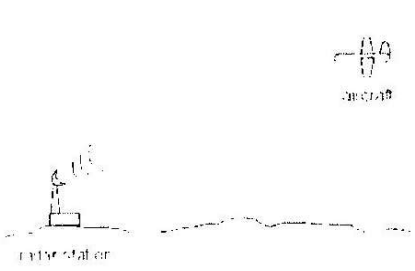


Fig. 6.2

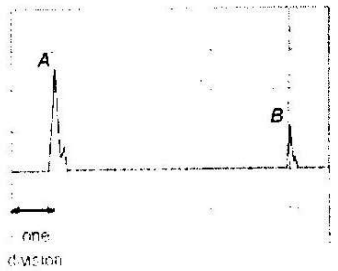


Fig. 6.3

Fig 6.3 shows the display of a c.r.o. screen. *A* represents the pulse of the emitted radio waves while *B* represents the pulse of the echo. Time base is set at 0.2 ms per division. Radio waves travels at a speed of 3×10^8 m/s. Using Fig. 6.3, determine the distance of the aircraft from the radar station.

$v = \frac{2d}{t}$

$3 \times 10^8 = \frac{2d}{[6 \times (0.2 \times 10^{-3})]}$ [M1, M1]

$d =$ **180 000 m**

distance = **180 000 m** [A1]

7 Fig. 7 shows the graphs of current against voltage plotted for bulb *X* and wire *R*.

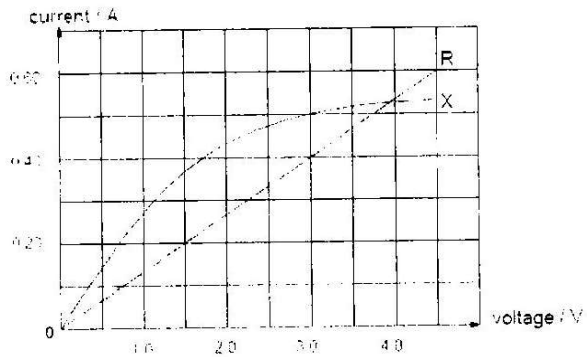


Fig. 7

For Examiner's Use

7 **(a)** If the length of wire *R* is 1.5 m and the cross-sectional area is 2.0×10^{-6} m^2, calculate the resistivity of the wire.

$R = \frac{V}{I}$

$= \frac{4.5}{0.60}$

$= 7.5\ \Omega$ [B1]

$R = \frac{\rho l}{A}$

$7.5 = \frac{\rho \times 1.5}{(2.0 \times 10^{-6})}$ [M1]

$\rho = \underline{1.00 \times 10^{-5}\ \Omega\ m}$

resistivity = **1.00 × 10^{-5} Ω m** [A1]

(b) Bulb *X* and wire *R* are connected in parallel to a 3.0 V cell. Calculate the current passing through the cell and the resistance of the bulb.

current = 0.40 + 0.50 [B1]

= 0.90 A

current = **0.900 A** [B1]

$\text{resistance} = \frac{3.0}{0.50}$

$= \underline{6.0\ \Omega}$

resistance = **6.00 Ω** [B1]

8 Fig. 8.1 shows part of the mains electrical circuit in a house. Two lamps *A* and *B*, each rated at 60 W 240 V, are connected to the live wire through fuse *X*. An electric kettle, rated at 840 W 240 V, is connected to the live wire though fuse *Y*. Fuse *Z* protects the whole circuit. The electric kettle has a metal case which is connected to Earth. The mains supply voltage is 240 V.

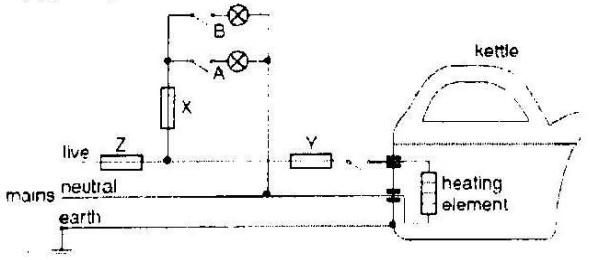


Fig. 8.1

For Examiner Use

8 **(a)** Calculate the current in fuse *Z* when the electric kettle and both the lamps are switched on.

$\text{current} = \left[2 \times \left(\frac{60}{240}\right)\right] + \left(\frac{840}{240}\right)$ [M1]

$= \underline{4.0\ A}$

current = **4.00 A** [A1]

(b) A fault develops in the electric kettle, causing a current of 10 A in fuse *Y*. The lamps *A* and *B* remain switched on. The maximum current ratings of the fuses are shown in Fig. 8.2.

	Fuse *X*	Fuse *Y*	Fuse *Z*
current rating / A	3	5	15

Fig. 8.2

Describe and explain what happens to each of the fuses *X*, *Y* and *Z* at the instant when the fault develops.

Fuse *X* will be unaffected as there is no change in the amount of current flowing through it which is less than its current rating. [B1] **Fuse *Y* will melt and break the circuit as the amount of current flowing through it is more than its current rating.** [B1] **Fuse *Z* will be unaffected as the amount of current flowing through it is less than its current rating.** [B1]

9 Fig. 9.1 shows a quality control setup of a factory producing magnets. Newly produced permanent magnets are positioned on a conveyor belt and are moved under a detecting device. This device consists of a coil of wire, wound on a soft-iron core and connected to a sensitive voltmeter.

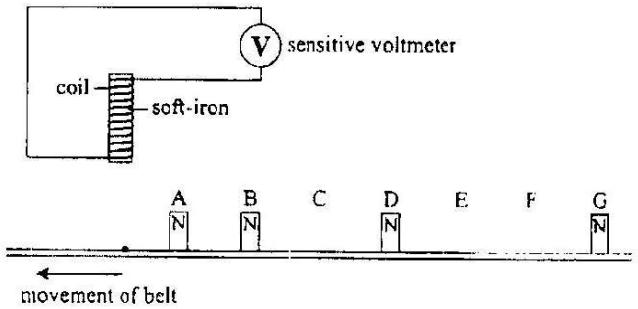


Fig. 9.1

For Examiner's Use

9 As the conveyor belt moves along at constant speed, voltage pulses are recorded by the voltmeter. These pulses are sent to a c.r.o. and they are displayed in the graph shown in Fig. 9.2. The letters *A* to *G* correspond to the positions on the belt as each magnet passes under the coil.

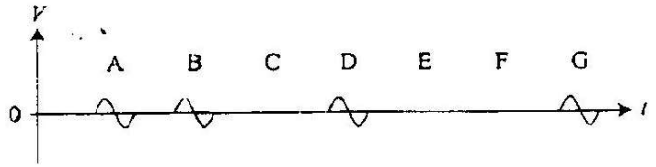


Fig. 9.2

(a) Explain why these pulses occur as each magnet passes under the coil.

As the magnet passes under the coil, **the coil experiences a rate of change of magnetic flux linkage** [B1] **which induces an electromotive force,** [B1] thus these pulses occur.

(b) Explain why the pulse produced by each magnet has a positive and a negative region.

Either
As the magnet **approaches** the coil, the coil experiences a **changing magnetic flux that induces an emf in one direction to try to repel the magnet.** [B1] As the magnet **moves away** from the coil, the coil experiences **a changing magnetic flux, producing an emf in the opposite direction to try to attract the magnet.** [B1]

Or
As the magnet approaches the coil, the coil will **induce a current to produce a north pole** as like poles repel **to resist the magnet from approaching it and thus produce a pulse of positive region.** [B1] As the magnet moves away from it, it will **induce a current** in the opposite direction **to produce a south pole** as unlike poles attract **to resist the magnet from moving away and thus produce a pulse of negative region.** [B1]

(c) State **one** way in which the detecting device can be made more sensitive.

Increase the number of turns in the coil / Move the coil nearer to the permanent magnet / Increase the speed of the conveyor belt [B1 for any one way]

(d) State how the pulses are affected if the soft iron core is removed.

The amplitude of the pulses will be smaller. [B1]

For Examiner's Use

Section B [30 marks]

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 12**.

10 A domestic room heater burns natural gas to generate heat for a family.

Table of information	
Description	**Value**
Output power of heater / kW	4.5
Energy obtained from burning 1.0 m^3 of natural gas / MJ	39
Average density of gas / kg m^{-3}	0.72
Specific heat capacity of natural gas / J kg^{-1} $°C^{-1}$	990
Number of gas molecules in 1.0 mol of gas	6.02×10^{23}

Fig. 10

Using the information in Fig. 10.

(a) show that the volume of gas which must be burnt to produce a steady power output of 4.5 kW is 6.9×10^{-3} m^3 each minute.

energy generated by heater = $(4.5 \times 10^3) \times (1 \times 60)$
= 270 000 J [B1]

volume of gas burnt to produce 270 000 J = $\left(\frac{270000}{10^6 \times 39}\right) \times 1.0$ [M1]

= 0.006 9 m^3
= $\underline{6.9 \times 10^{-3}\ m^3}$ (shown) [A1]

(b) calculate

(i) the mass of natural gas burnt in one minute.

mass = $0.72 \times (6.9 \times 10^{-3})$ [M1]
= $\underline{0.004\ 97\ kg}$

mass = **0.004 97 kg** [A1]
(0.00498 kg is also acceptable)

(ii) the number of molecules of natural gas which pass through the burner each minute if the molar mass of the gas is 1.6×10^{-2} kg/mol.

0.004 97 kg of gas contains $\frac{0.00497}{(1.6 \times 10^{-2})}$ = 0.311 mole of gas. [B1]

number of molecules = $0.311 \times (6.02 \times 10^{23})$
= $\underline{1.87 \times 10^{23}}$

number of molecules = **1.87×10^{23}** [B1]

For Examiner's Use

10 (c) Explain why the heater cannot be operated using a 13 A, 230 V socket. Include a suitable calculation in your answer.

$$I = \frac{P}{V}$$

$$= \frac{(4.5 \times 10^3)}{230}$$

= **19.6 A** [B1]

This current is much higher than the fuse rating of 13 A. [B1] **The fuse will melt if the heater is used.** [B1]

11 Fig. 11.1 shows a simplified d.c. motor.

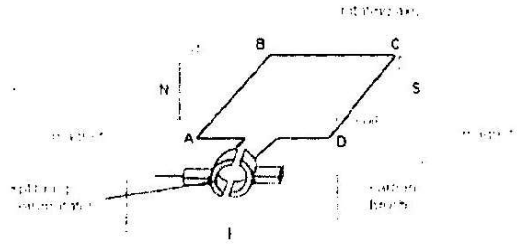


Fig. 11.1

(a) State the direction in which the coil turns when the switch is closed

The coil will rotate **anticlockwise**. [B1]

(b) Explain why the coil turns when the switch is closed.

The magnetic field created by the current flowing in the coil interacts with the permanent magnets. [B1] **This will produce a resultant force, causing the coil to turn.** [B1]

(c) The rotating coil is a rectangle. *AB* has a length of 0.04 m and *BC* has a length of 0.03 m. If the total turning effect of the coil is 0.6 N m, calculate the force on each side of the coil which causes the turning effect.

The force on side *AB* is the same as that on side *CD*.

$$\left[F \times \left(\frac{0.03}{2}\right)\right] + \left[F \times \left(\frac{0.03}{2}\right)\right] = 0.6$$ [B1]

F = 20 N [B1]

force on side *AB* = **20 N**

force on side *CD* = **20 N**

For Examiner's Use

11 Fig. 11.2 shows the variation of the moment of the coil with time.

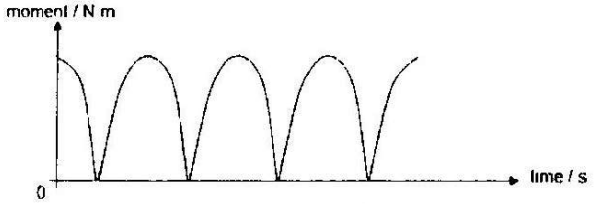


Fig. 11.2

(d) From Fig. 11.2, state the number of complete rounds the coil has rotated.

The coil has rotated 2 complete rounds. [B1]

(e) State and explain the position of the coil at which the moment would be zero.

The moment would be zero when **the coil is at the vertical position** [B1] as there is **no force acting on the coil at this position** [B1]

(f) Describe **two** changes to the graph if the current in the coil is reduced.

The amplitude of the graph will decrease. [B1] **The number of cycles in the graph will fewer for the same period of time.** [B1]

For Examiner's Use

12 EITHER

A thermistor is placed in an environment where the surrounding temperature increases a constant rate of 1 °C per minute. The graph below shows how the resistance of a thermistor changes with its surrounding temperature.

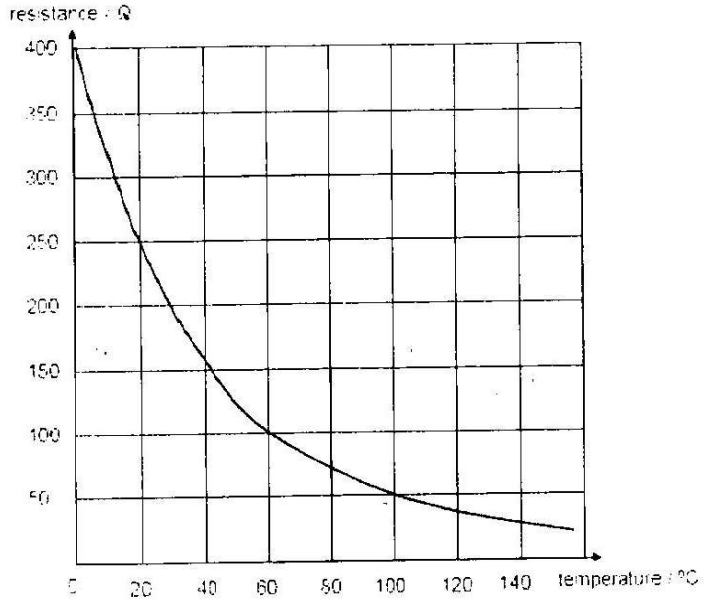


Fig. 12.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature.

The resistance decreases as the temperature increases [B1] **at a decreasing rate.** [B1]

For Examiner's Use

12 The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig. 12.2.

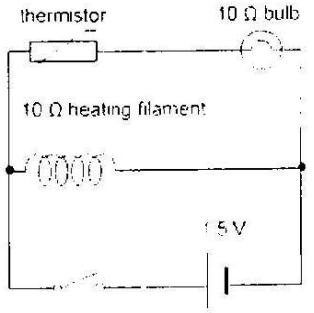


Fig. 12.2

(b) When the switch is closed, the bulb fails to light up at first. Explain why the bulb slowly lights up after a while.

Initially the thermistor's resistance is very high as room temperature is low, thus current flowing through the thermistor and the bulb is very low. [B1] **As the temperature of the heating coil increases, thermistor's resistance drops and current through them increases.** [B1]

(c) Determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb.

p.d. across bulb = 0.025 × 10
= 0.25 V [M1]

p.d. across thermistor = 1.5 – 0.25
= 1.25 V [M1]

thermistor's resistance = $\frac{1.25}{0.025}$
= 50 Ω [M1]

temperature = **100 °C** [A1]

(d) Calculate the effective resistance of the whole circuit when the temperature of the thermistor is 100 °C

$\frac{1}{R} = \frac{1}{10} + \frac{1}{(50 + 10)}$ [M1]

R = 8.57 Ω

effective resistance = **8.57 Ω** [A1]

For Examiner's Use

12 OR

(a) State *Faraday's Law*.

Faraday's Law states that **the magnitude of the induced electromotive in a conductor is proportional to the rate at which magnetic field lines are cut by the conductor.** [B1]

(b) State *Lenz's Law*.

Lenz's Law states that **the induced current is always in a direction to oppose the change producing it.** [B1]

(c) Explain how Lenz's Law demonstrates the Principle of Conservation of Energy.

If the induced current in the coil moves in the direction to create a magnetic field to attract the magnet, no work needs to be done to move the magnet towards the coil and yet the kinetic energy of the magnet and the electrical energy in the coil continue to increase. This violates the Principle of Conservation of Energy where energy cannot be created or destroyed. [B1] **Hence, according to Lenz's Law, the induced current has to flow in a direction to create a magnetic field to oppose the approaching magnet.** [B1]

(d) In Fig. 12.1, a varying magnetic field is generated within the square loop *ABCD*. The magnetic field is pointing into the page and its magnitude also increases with time. Surrounding the magnetic field is a length of conducting wire of negligible resistance that forms a square loop *ABCD*. At the midpoints of sides *AD* and *BC*, two identical light bulbs *X* and *Y* are connected respectively.

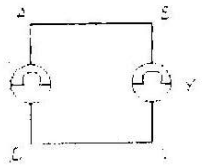


Fig. 12.1

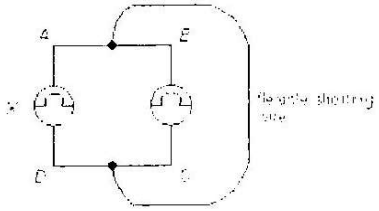


Fig. 12.2

(i) With reference to Fig. 12.1, comment on whether bulbs *X* and *Y* will light up.

The magnetic flux linking the square loop *ABCD* changes with time. An electromotive force is induced in the loop, causing an induced current to flow in the loop. [B1] **Since there is current flowing, both bulbs will light up.** [B1]

For Examiner's Use

12 (d) (ii) A flexible wire with negligible resistance is connected to the midpoint of *AB* and *CD* as shown in Fig. 12.2. This produces a short circuit.

After the shorting wire is placed, discuss what you think will happen to

bulb *X*

Bulb *X* will continue to light up. [B1] **The circuit with bulb *X* still contains the changing magnetic field, thus an induced current will flow in the wires leading to a potential difference across bulb *X*.** [B1]

bulb *Y*

Bulb *Y* will not light up. [B1] **The circuit with bulb *Y* excludes the changing magnetic field, thus no current flows in the wires.** [B1]

END OF PAPER

Exam Index Number	5

Anglo-Chinese School (Barker Road)

PRELIMINARY EXAMINATION 2016

SECONDARY FOUR EXPRESS

PHYSICS 5059/02
(PAPER 2 Theory)

TIME: 1 HOUR 45 MINUTES

READ THESE INSTRUCTIONS FIRST

Write your Exam Index Number in the box provided at the top of this page and any separate answers paper provided.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use		
PAPER 1		/ 40
PAPER 2		
Section A		/ 50
Section B		/ 30
Total		/ 80

This question paper consists of 21 printed pages

Section A

Answer **all** the questions in this section.

1 Fig. 1.1 shows a ship-to-ship cable used to transfer people and goods from one ship to another.

(a) A 500 N object is suspended at the mid-point of the cable ABC. By using a suitable scale drawing, find the tension present in the cable AB and BC.

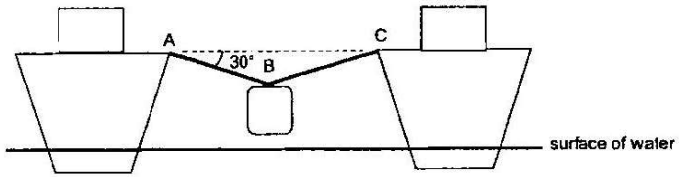


Fig. 1.1 (not drawn to scale)

tension in AB= .....

tension in BC = ... [4]

(b) When both ships are moving apart, the cable may break and cause severe injury. Suggest why an almost horizontal cable is more likely to break as compared to the cable in **(a)**.

.....

..... [1]

(c) Fig. 1.2 shows all the forces acting on one of the ship. The tension, T, of the cable is 100 kN. The centre of gravity is at point C. The weight of the ship, W, is 500 kN. The buoyant force, F_B, by the water acts at point D.

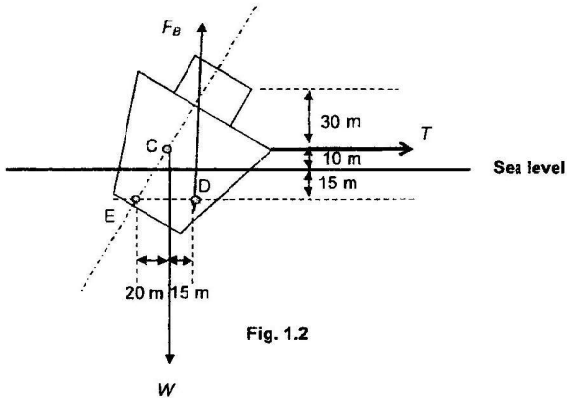


Fig. 1.2

(i) Calculate the sum of the clockwise moments due to the tension of the cable and the weight of the ship about point E. Leave your answer in kNm.

moment = ... [2]

(ii) Calculate the minimum buoyant force, F_B required to prevent the ship from toppling.

force = ... [2]

2 When large buildings are being erected, particularly on soft ground, piles are driven into the ground to provide a firm foundation. Fig. 2.1 shows a pile hammer in operation. The pile hammer has a mass of 5000 kg.

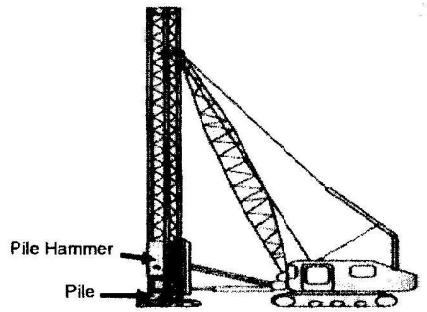


Fig. 2.1

(a) Calculate the loss of gravitational potential energy when the hammer falls 4.0 m to hit the pile.

loss of gravitational potential energy = ... [2]

(b) Assuming negligible air-resistance, calculate the speed of the hammer when it hits the pile.

speed = ... [2]

(c) Calculate the efficiency of the piling process given that 50 000 J of energy is converted sound and thermal energy.

efficiency = ... [2]

3 Fig. 3.1 shows a magnet picking up an iron coin.

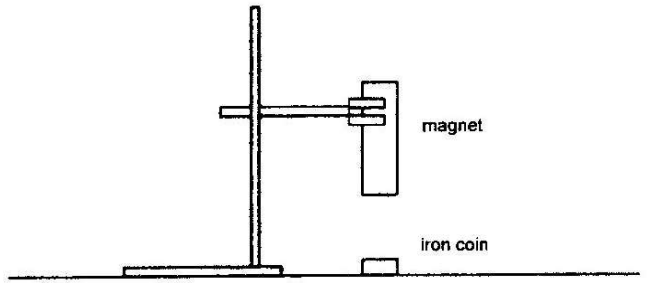


Fig. 3.1

The coin has a mass of 0.02 kg.
The initial attractive force on the iron coin by the magnet was 0.3 N.

(a) Explain why there is an attractive force on the iron coin by the magnet.

.....

.....

..... [2]

(b) Calculate

(i) the initial resultant force acting on the coin,

resultant force = ... [2]

(ii) the initial acceleration of the coin.

acceleration = ... [2]

4 Fig. 4.1 shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump. The tube fits tightly into a bell jar. With tap B open, and air pumped out via A, the mercury rises to a maximum height of 76.0 cm above the dish.

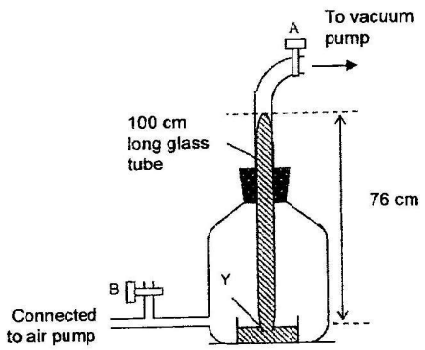


Fig. 4.1

(a) Explain why the mercury in the tube above Y can only rise to a maximum height of 76.0 cm.

.....

.....

..... [2]

(b) Given that the density of mercury is 13 600 kg/m^3, calculate the pressure at Y. Leave your answer in Pa.

pressure = ...Pa [2]

(c) Suggest how you can make the mercury column rise to a greater height.

.....

..... [1]

5 The piston for the bicycle pump in Fig. 5.1 is pushed in slowly until the piston comes to its positions shown in Fig 5.2. The air in the pump remains at a constant temperature throughout.

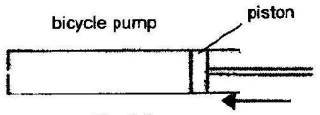


Fig. 5.1

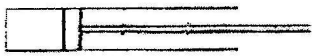


Fig. 5.2

(a) Describe the motion of the air molecules in the pump in Fig. 5.1.

.....

..... [1]

(b) Using ideas about molecules, explain why the pressure in Fig. 5.2 is greater than in Fig. 5.1.

.....

.....

.....

..... [3]

(c) If the piston was pushed in quickly instead, the temperature of the air in the pump would have increased. Using ideas about molecules, explain how this would affect the pressure in the pump as compared to your answer in **(b)**.

.....

.....

.....

..... [3]

6 Fig. 6.1 shows the screen of a cathode ray oscilloscope. The time-base is set at 0.4ms/mm and the length of the time-base sweep MN is 100mm.

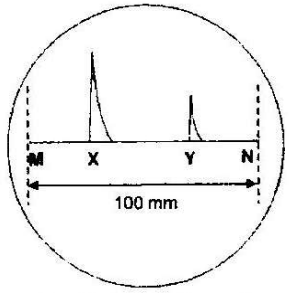


Fig. 6.1 (scaled diagram)

(a) Calculate the time represented by MN.

time = ... [1]

(b) A radar signal, sent from the radar station to a distant aircraft, is displayed on the CRO at X and the signal received back from the aircraft is displayed at Y. The speed of radio waves is 3.0×10^8 m/s. Calculate the distance of the aircraft from the radar station.

distance = ... [3]

(c) State why the signal displayed at Y is weaker than that at X.

..... [1]

7 Fig. 7.1 shows a thin converging lens used to improve the efficiency of a solar cell.

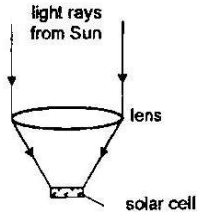


Fig. 7.1

Fig. 7.1 is drawn to scale.

(a) **(i)** State what is meant by the focal point of a lens.

..... [1]

(ii) On Fig. 7.1, draw construction lines to determine the focal length of the lens.

focal length = ... [2]

(b) Explain how the lens affects the amount of electrical power generated by the solar cell.

..... [2]

(c) The lens is replaced with a replacement lens that has a longer focal length compared to the original lens.

State and explain whether the replacement lens has to be placed closer or further away from the solar cell in order for the efficiency of the solar cell to remain the same.

..... [1]

8 Fig. 8.1 shows a magnet being dropped vertically down through a solenoid Fig. 8.2 shows how the induced current in the solenoid changes with time.

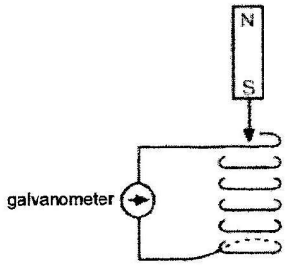


Fig. 8.1

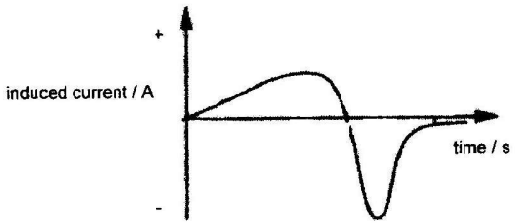


Fig. 8.2

(a) Explain why the second (negative) pulse of induced current is shorter in duration.

.....

.....

..... [1]

(b) Explain why the second pulse of current has a greater magnitude that the first (positive) pulse of induced current.

.....

.....

.....

..... [2]

(c) In the space below, sketch the graph, if the North end of the magnet was dropped first into the coil instead of the South end. [1]

(d) State two ways in which the magnitude of the induced current generated can be increased.

.....

.....

..... [2]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

9 In recycling plants, electromagnets are used to separate empty drink cans from the rest of the other materials. Fig. 9.1 shows an example of an electromagnet used to lift some cans.

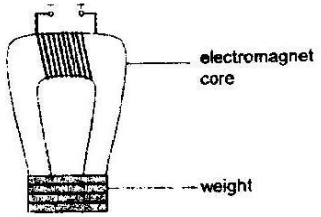


Fig. 9.1

Fig. 9.2 shows the data for four cores made from different materials.

Material	Density / gcm^{-3}	Relative Permeability	Resistivity / Ωm
H	7.87	5000	1×10^{-7}
I	7.85	1000	2.2×10^{-7}
J	8.90	600	6.84×10^{-8}
K	2.71	1	2.62×10^{-8}

Fig. 9.2

The relative permeability of a material is the ease at which the material can be magnetised. The strength of the magnet increases with the ease at which a material can be magnetised.

(a) Identify the best material to be used as an electromagnet core for lifting the most number of cans. Explain why.

.....

.....

..... [1]

(b) If material K is used for the manufacture of the drink cans, explain whether there is an increase or decrease in the number of drink cans that the electromagnet is able to lift compared to the other materials.

.....

.....

..... [1]

(c) The cans are attracted to the electromagnet through the process of induced magnetism. Describe what is induced magnetism.

.....

.....

..... [1]

(d) From Fig. 9.2, state and explain the relationship between hard magnetic materials and their electrical resistance.

.....

..... [2]

(e) Fig. 9.3 shows how the weight lifted by the electromagnet using material H core is dependent on the current in the coil.

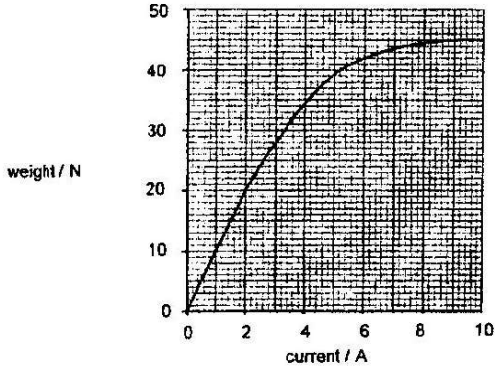


Fig. 9.3

(i) Suggest two methods to modify the electromagnet to lift a heavier load.

.....

.....

..... [2]

(ii) On Fig. 9.3, sketch the relationship between weight and current if material J is used for the core. [1]

(iii) The current is set so that the electromagnet can only lift the weight of 10 cans. One can weighs 2.5 N.

Using Fig. 9.3, explain if the electromagnet is able to lift 20 cans at the same time if the current is doubled.

.....

.....

.....

..... [2]

10 The brightness of the lamp inside a train is built in such a way that it becomes brighter as the external environment gets darker. The train enters a tunnel at t = 0 s.
Fig. 10.1 shows how the brightness of the lamp inside the train changes as it enters and moves through the tunnel at constant speed.

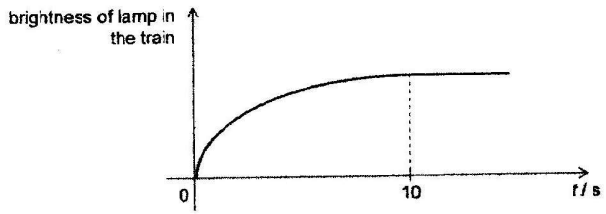


Fig. 10.1

(a) Suggest 2 possible reasons for the shape of the graph in Fig. 10.1 after t = 10 s.

1: .....

2: ..... [2]

(b) If the train were to move at twice the original speed, sketch on Fig. 10.1., how the brightness of the lamp inside the train will change as it moves through the same tunnel. [2]

(c) Fig. 10.2 shows the equipment that is connected in a circuit with the lamp in the train.

Equipment	Quantity
12 V dry cell	1
fixed resistor	1
light-dependent resistor (LDR)	1
lamp	1

Fig. 10.2

(i) In the space below, draw a circuit using the equipment from Fig. 10.2, which can be used for the lighting in the train [2]

(ii) Explain how the circuit in **c(i)** increases the brightness of the lamp in the train as it enters the tunnel.

.....

.....

.....

.....

.....

..... [2]

(d) (i) The lamp in the train is connected to a 12 V dry cell, which dissipates energy at a rate of 270 mW.

Calculate the current flowing through the lamp.

current = ... [1]

(ii) The lamp uses an input transducer to control the brightness of the lamp in the train.

Define the term input transducer.

.....

..... [1]

11 EITHER

A vacuum flask is a container that keeps a substance hot or cold by means of a double wall enclosing a vacuum. Fig. 11.1 shows a cross-sectional view of a vacuum flask.

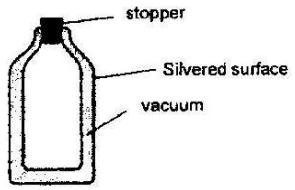


Fig 11.1

(a) Explain why it is not essential to close the top of the vacuum flask to keep water cold for a period of time.

.....

..... [1]

(b) Explain how a silvered surface is able to keep water in the flask cold.

.....

..... [1]

(c) Explain the ways in which a vacuum flask keeps hot liquid warm for a long time.

.....

.....

..... [2]

(d) When a flask was filled with hot water, it felt warm.

Identify and explain the fault(s) present in the flask.

.....

.....

..... [3]

(e) An immersion heater producing 300 W of power is placed in a vacuum flask containing ice at -5 °C.

Calculate the time taken to melt 0.2 kg of ice completely, assuming that all the energy dissipated by the heater is absorbed by the ice.

Specific latent heat of ice = 330 000 J/kg
Specific heat capacity of ice = 2000 J/kg°C

time taken for ice to melt = ... [4]

11 OR

Fig 11.2 shows a part of the main electrical circuit in a house.

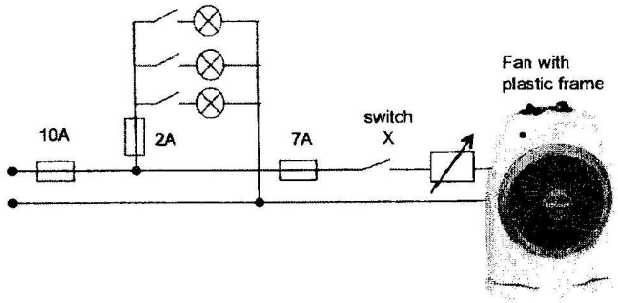


Fig. 11.2

Three lamps, each rated 60 W, 960 Ω are connected to the live wire through a 2 A fuse. An electrical fan rated at 1200 W, 240 V is connected to the live wire through a 7 A fuse. There is a 10 A fuse protecting the whole circuit. The mains supply is 240 V.

(a) State the function of the neutral wire in a circuit.

..... [1]

(b) Explain if it is dangerous to connect only the live and neutral wire to the fan.

..... [1]

(c) Describe how the speed of the rotation of the fan blades can be increased.

..... [2]

(d) Determine the current in each of the fuses when all the appliances are switched on.

current in 2 A fuse = ...

current in 7 A fuse = ...

current in 10 A fuse = ... [3]

(e) With all the appliances being switched on, the live wire touches the neutral wire at switch X.

(i) Describe and explain the effect on the lamps, fan and fuses when this fault happens.

.....

.....

.....

.....

..... [2]

(ii) Suggest another device that can replace the fuse in the circuit. State the advantage of using the device instead of the fuse.

.....

.....

..... [1]

End of Paper

Anglo Chinese School (Barker Road)
2016 Sec 4 5059 Prelim

1	D	21	D
2	A	22	D
3	C	23	B
4	C	24	C
5	A	25	B
6	C	26	A
7	A	27	C
8	B	28	D
9	D	29	D
10	B	30	C
11	B	31	B
12	B	32	B
13	D	33	D
14	B	34	A
15	C	35	C
16	B	36	B
17	B	37	A
18	B	38	C
19	B	39	C
20	B	40	D

Qn.		Answers	Marks	Markers' Comments
1	(a)	Scale: 1 cm : 50N (490N – 510N) or 1cm: 100N (480N to 520N) Correct shape Correct direction of arrows Tension = 500 N Comments: Scale must be mentioned and not inferred from the vector diagram.	B1 B1 B1 B1	Students made common mistakes in the identification of the direction of the tensional forces. Most students make the mistake of pointing the tensional forces towards the weight. Most students have trouble in identifying that the two tensional forces will act to have a resultant upwards force. Students could properly identify a proper scale.
	(b)	As the angle between the ropes increase, tension in the rope increases, causing it to break.	A1	Generally well done although a few students made the mistake of using moments to answer the question.
	(c)	(i) Total clockwise moments =T(25) + W(20) = 100(25)+500(20) = 2500 + 10000 = 12,500 kNm	M1 A1	Many students had trouble identifying the correct perpendicular distances to calculate the moments cause by each force.
		(ii) Take moments about E, T(25) + W(20) = F_B(35) 12500 = F_B(35) F_B = 357 kN	M1 A1	Most students got this question correct due to ecf. Students were able to identify the correct perpendicular distance.

2	(a)	GPE = mgh = 5000 x 10 x 4 = 200, 000 J	M1 A1	
	(b)	Loss in GPE = Gain in KE 200,000 = 0.5 x 5000 x v^2 v = 8.94m/s	M1 A1	Most students were able to equate the GPE to KE.
	(c)	Efficiency = (Output / Input) x 100% = (150 000 / 200 000) x 100 = 75%	M1 A1	Most students were able to use the correct values to calculate the efficiency. Some students showed lack of understanding and used 200 000 / 250 000 to calculate

3	(a)	Iron is a magnetic material. The coin becomes a induced magnet which cause an attraction between the coin and the magnet. Comments: Accept magnetic object (given BOD), magnetic conductor is not accepted. An explanation involving magnetic poles being induced and therefore attracting each other because unlike poles attract.	M1 A1	Most students were able to correctly use the term magnetic material. Some students use magnetic object and were given BOD marks. Students were unable to adequately explain the second point on the induction of magnetic properties/polarity on the coin.
	(b)	(i) F = 0.3 – (0.02 x 10) = 0.1 N	M1 A1	Some students were unable to identify that the attractive force and weight acted in opposite direction.
		(ii) F = ma = 0.1 / 0.02 = 5m/s^2	M1 A1	Most were able to get this question correct due to ecf
4	(a)	Atmospheric pressure of 76 cmHg, acts on the surface of mercury reservoir. The pressure at Y will only be due to the mercury acting above it, so the mercury will rise to a height of 76cm Hg.	M1 A1	Most were able to get answer that atmospheric pressure acted on the surface of the mercury but only a small percentage of students were able to identify that the pressure at Y was due to the height of mercury above it.
	(b)	Pressure = density x g x h = 13 600 x 10 x (76/100) = 1.03 x 10^5 Pa	M1 A1	
	(c)	Pump more air into the bell jar through tap B. Or any logical answer Comment: Accept 1) increase temperature in the jar 2) bring to lower elevation	A1	Most students were able to give sound and logical answers.

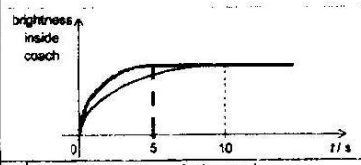
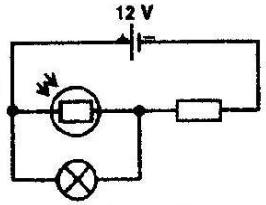
5	(a)	Air molecules are in **continuous random motion** and moving at **high speeds**. Comment: Kinetic energy may be accepted in exchange for speed.	A1	Some of students were unable to give both portions of the answers in the description of the motion.
	(b)	Because the pump is pushed in, the **number of molecule per unit volume is greater.** The **frequency of collision** of the molecules with walls of the pump **increases**, therefore causing a force to be exerted on the piston to be higher. Since pressure is **force per unit area**, pressure is higher Comment: Accept 'space' in exchange for 'volume'	M1 M1 A1	Most of the students had trouble obtaining full credit for this question. They failed to give the following 1) Correct description of no. of molecules per unit volume 2) Identifying the increase in frequency as the cause of the increase in force on the walls 3) Stating that the increase in force per unit area as pressure
	(c)	**Kinetic energy of the molecules increase** due to increase in temperature. Pressure would increase even more than in (b), As molecules will collide **more frequently** and with **greater force** on the walls of the pump. Comment: Accept the use of the word 'speed' instead of 'kinetic energy'	M1 B1 A1	Most students were unable to state that the increase in KE of the molecules results in a increase in frequency of collision and the force of collision.
6	(a)	Time = 100 x 0.4ms = 40 ms or 4 x 10^{-2}s or 0.04s	A1	Some students incorrectly used 100/0.4 to calculate the answer.
	(b)	Time taken = [(2.2/5) x 100] x 0.4 =17.6 ms 2d = speed x time d = [(3x10^8) x (17.6 X 10^-3)]/2 d = 2 640 000 m Comment: Accept range of measurement between 5.1cm to 5cm Range for time taken = 17.2 ms or 17.6ms Range for d = 2 580 000m or 2 640 000m	M1 M1 A1	Most students were unable to calculate the time taken from X to Y. Most students incorrectly used speed x time to calculate the distance when they should have divided that value by 2 to calculate due to the echo.
	(C)	Energy is absorbed by the surrounding air. Thus less energy is received by the radar.	A1	Generally well done although a handful of students were unable to adequately describe energy loss.

7	(a)i	It is the point at which all light rays that travel parallel to the principal axis converge on	1	Most students were unable to correctly define this.
	(a)ii	Correct drawing to extend the light rays to converge at a point 2cm (accept 1.9 to 2.1)	[B1] [B1]	Most students were able to draw the path of the light ray however some students made the error in measuring the focal length from the top part or bottom part of the lens instead of the center.
	(b)	The lens converges the light rays, Allowing more **solar energy** to reach the solar cell **per unit time** which will allow the solar cell to increase the amount of electrical power generated. Comment: Accept as long as the idea of convergence is shown	[M1] [A1]	Most students were able to identify the convergence as a lens for the reason for an increase in solar energy hitting the surface of the solar cell but were unable to relate the quantity energy and power.
	(c)	The lens will have to be positioned further away from the cell. With a larger focal length, light rays will need to travel a longer distance to converge on the same area Comment: Accept as long as the idea of the point of convergence is at a point that that is a longer distance away from the lens is shown	[M1]	*Question Voided* Most students were unable to adequately explain that the longer focal length results in the light rays converging at a distance that is greater.

8	a	The magnet is travelling faster and therefore takes a shorter time to leave the solenoid Comment: Accept – accelerating, speed increasing. Do not accept – Faster velocity/speed	A1	Most students were able to answer the question although a small amount of students used faster velocity instead of greater or larger velocity.
	b	The magnitude of the induced emf and the current is proportional to the rate of change of magnetic flux linkage with coil. Since the magnet is moving faster through the coil as it exits, there is a higher rate of change of magnetic flux linkage with coil. Comment: Accept (BOD) if 'with coil' is not present	[M1] [A1]	Most students could identify the 'rate of change of magnetic flux linkage with coil' as the reason for the greater current. However, most students used the term 'rate of change of magnetic flux'. Most students did not explain why the increase in rate of change of magnetic flux linkage with coil would result in a greater magnitude of current.
	c	The first pulse of the induced current will be negative and the second pulse will be positive	[A1]	

	d	Use a stronger magnet increase the amount of coils in the solenoid. Comment: Do not accept the use of a soft iron core. Accept - throw the magnet in at a higher speed.	A1 A1	Some students incorrectly used soft iron core. Context of problem makes this method to increase the current impossible.

9	(a)	Material H Its high relative permeability allows the material to be magnetized easily		[A1]	Some students incorrectly identified K as the best material due to the lower density. The permeability is 5000 times greater in H compared to K, while the density is 3 times greater. The effect of the increase in permeability outweighs the increase in density
	(b)	Number of drink cans are reduced. Material K is difficult to magnetize compared to material H, I, J		[A1]	
	(c)	Induced magnetism is the process in which an object made of a magnetic material becomes a magnet when it is near or in contact with a magnet. Comment: Accept if 'magnetic material' is replaced with 'magnetic object'		A1	Most students had trouble defining induced magnetism adequately.
	(d)	Hard magnetic material corresponds to low resistivity. Since resistance is proportional to resistivity, hard magnetic materials corresponds to low resistance.		[A1] A1	Very few students were able to use the data to correctly identify the relationship between hard magnetic materials and resistivity. An even smaller amount of students were able to relate the quantities resistivity and resistance
	(e)	i	Increase current in the coil. Increase the number of turns in the coil	[A1] [A1]	
		ii	A curve below curve for material H	[A1]	
		iii	The current required to lift ten can of 25 N is 2.6 A. When the current is doubled to 5.2 A it can only lift up to 40 N. The electromagnet is unable to lift 20 cans which weigh 50N	[M1] [A1]	

10	(a)		1: There is no change in the surrounding light intensity 2: The lamps are already operating at its maximum power / brightness Comment: Accept if the idea of light intensity is not changing is shown.	[A1] [A1]	Most students were able to identify that no change in external light condition as a reason but were unable to identify that the lamp has reached the maximum brightness as a reason.
	(b)		Steeper Value of brightness reach the same max level  	[A1] [A1]	
	(c)	i	Correct circuit symbols used Correct connection with LDR in parallel with lamp  	[A1] [A1]	Most students incorrectly drew LDR. A large number of student were unable to draw a correct circuit.
		i	As the train enters the tunnel, the intensity of the surrounding light decreases, the resistance of the LDR increases. The higher the resistance, the higher the voltage across lamp, therefore increasing the brightness of the lamp.	[M1] [A1]	Most students incorrectly identified the relationship between the brightness of external condition and resistance of LDR. Most students were unable to identify the effect of increasing the resistance of the LDR.
	(d)	i	$I = P / V$ $= (270 \times 10^{-3}) / 12$ $= 0.0225$ A	[A1]	Some students were unable to change milliwatt to watt.
		ii	Input transducer is an electronic device that converts non-electrical energy to electrical energy.	[A1]	Definition was poorly done

11 E	(a)	Cold air sinks as it is denser, hence heat loss via convection cannot effectively occur.	A1	Very few students are able to answer correctly. Most students were not able to identify effective convection cannot occur.
	(b)	Silver surfaces are good reflectors/poor absorbers of thermal energy and reduce heat gain from the surrounding via radiation	[A1]	Very few students are able to answer correctly. Most students were unable to adequately state that silver are poor absorbers of thermal energy and instead only state that silver reflects thermal energy.
	(c)	Surfaces of the walls are silver surfaces reduces heat loss by radiation. OR Vacuum layer reduces heat loss by conduction or convection OR Stopper prevents heat loss via convection and evaporation	M1 [A1]	Most students could only identify one proper way in which thermal energy is kept in the flask.
	(d)	The inner lining would have been damaged Therefore, air replaces the vacuum, hence heat can be lost through conduction. OR The surface maybe black due to accumulation of dirt or wear and tear. Therefore since black are better radiators of thermal energy, the bottle feels warm to the touch.	A1 A1	Most students did not understand the question. They were unable to identify possible faults and what form of transfer of thermal energy was involved to make the flask feel warm.
	(e)	Q = mc(Δθ) = (0.2) (2000) (5) = 2000 J Q = ml = (0.2) (330 000) = 66 000J t = E / P = (66 000 + 2000) / 300 = 227 s	B1 B1 [M1] [A1]	Most students are able to answer correctly.

11 O	(a)	The neutral wire allows current to return from the appliance to the power supply. Comment: Accept 'to complete the circuit'	[B1]	Most students are able to answer correctly
	(b)	No. The fan has a plastic casing and is doubly insulated. As such, the casing can never be live even when there is a fault Comment: Accept if the idea of current not being able to flow through is shown	[1]	Most students could not adequately explain that the plastic frame protects the user since current cannot flow through an insulator.
	(c)	When **resistance of the rheostat is reduced**, the current running through the fan will increase and increase the speed of rotation of the fan	[1] [1]	Most students could not link the information given in 11.2 to solve the question. Some incorrectly identified the rheostat as a thermistor and hence gave weird answers.
	(d)	P = I^2 x R 60 = I^2 x 960 I = 0.25 A I(in 2A fuse) = 0.25A x 3 = 0.75A P=IV 1200 = I x 240 I = 5A Current (10A) = 5 + (0.25x3) = 5.75 A	[1] [1] [1]	Most students had trouble using the correct formula to identify the current running through each of the fuses.
	e	i Short circuit will occur and the lamps and fans will not light up. A large current flows in the circuit and the 7A and 10A fuse will blow	M1 [A1]	Most students could identify that a short circuit will occur but were unable to identify that the 2A fuse will not blow.
		ii Circuit breaker. It can be reset conveniently after the fault is corrected.	[A1]	

Candidate Name:	Class:	Index No:

DUNMAN SECONDARY SCHOOL

where ..... discernment, discipline, daring, determination & duty become a part of life.

PRELIMINARY EXAMINATION 2016
SEC 4 EXPRESS
PURE PHYSICS
5059 Paper 2

1 hour 45 minutes
0800 – 0945

14 September 2016
Wednesday

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black ink.
You may use an HB pencil for any diagrams, graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Section B
Answer all questions. **Question 14** has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.
At the end of the examination, fasten all your work securely together and submit **Section A** and **B separately**. The number of marks is given in brackets [ ] at the end of each question or part question.

This question paper consists of 21 printed pages including the cover page.

Section A (50 marks)
Answer **all** questions in this section.

1 John and Jeremy were staying at a high-rise building but on different floors as shown in Fig. 1.1. The height difference between the two floors is 10 m.

When John dropped Ball A freely, he started his stopwatch. Two seconds later, Jeremy dropped Ball B freely.

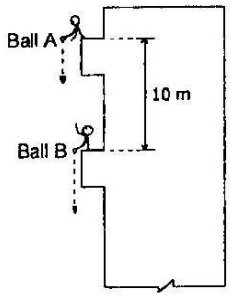


Fig. 1.1

(a) Sketch and label the speed-time graphs of both balls for the first 5.0 s in Fig. 1.2, according to John's timing as recorded by his stopwatch. You may assume that there is no air resistance as the balls fall and the acceleration due to gravity is 10m/s^2. [3]

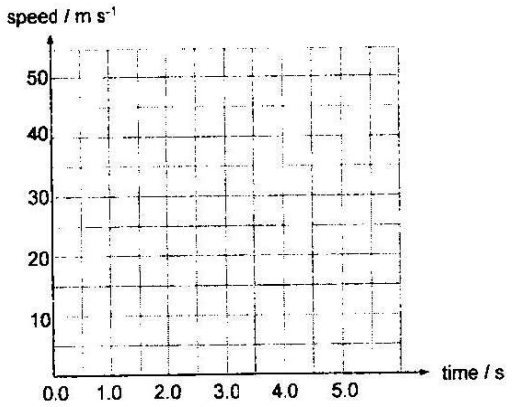


Fig. 1.2

(b) What is the height difference between the two balls at time t = 5.0 s?

height difference = ...[2]

2 Fig. 2.1 shows the top view of a point object acted upon by two forces. The forces are acting in the horizontal plane.



Fig. 2.1

(a) In the space provided below, use a scaled diagram to calculate the magnitude of the resultant force acting on the object.

magnitude of resultant force = ... [4]

(b) The object moves with an acceleration of 2.1 m/s^2 in the direction of the resultant force. Calculate the magnitude of the resistive force acting on the object if the weight of the object is 40 N.

magnitude of resistive force = ... [2]

3 Fig. 3.1 shows a mercury manometer connected to a large vessel containing some neon gas.

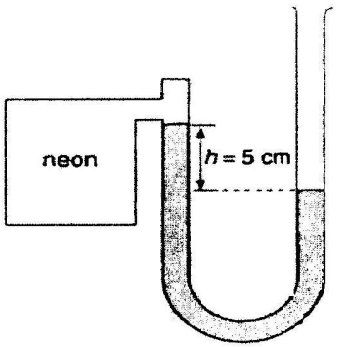


Fig. 3.1

The atmospheric pressure is 76.0 cm Hg and the acceleration of free fall g is 10.0 m/s^2.

The mercury in the manometer has a density of 13 600 kg/m^3.

(a) Calculate the pressure (in Pa) of neon gas inside the vessel.

pressure = ... [2]

(b) Using ideas about molecules, explain why the pressure of neon gas in the vessel falls when the temperature decreases.

.....

.....

.....[2]

4 A car of mass 1200 kg travelling at a speed of 3.5 m/s reaches a rough incline as shown in Fig. 4.1. X is the bottom of the incline and Y is a point 45 metres vertically above the ground. The car maintains its speed as it travels up the incline. The distance along the incline between X and Y is 70 metres.

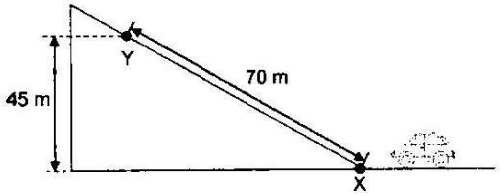


Fig. 4.1

(a) Calculate the rate of energy gain by the car as it travels from X to Y.

rate of energy gained = ... [3]

(b) Calculate the total energy of the car at Y.

total energy = ... [2]

(c) The car's engine outputs a constant power of 50 kW during the journey. Calculate the work done against friction in moving the car from X to Y.

work done against friction = ... [2]

5 Fig. 5.1 shows two aluminium blocks which are identical except that one is painted white and the other painted black. Both blocks weigh 50 N each and are placed on a table. The initial temperatures of both cubes are 80 °C.

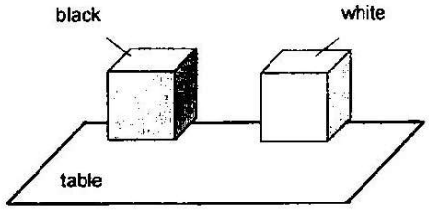
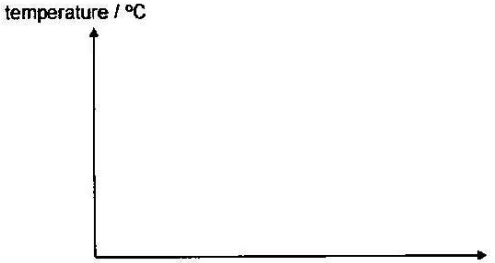


Fig. 5.1

(a) The specific heat capacity of aluminium is 0.90 J/(g°C) and the temperature of the room is 30 °C. Calculate the thermal energy given out by the black painted aluminium block as it cools down to room temperature.

thermal energy = ...[2]

(b) Sketch the temperature-time graph for both blocks. Label your graph clearly with appropriate information.



[2]

6 A monochromatic light ray is directed towards a semi-circular glass prism as shown in **Fig. 6.1**. When the light ray reaches A, the direction of the refracted ray is along the tangent of the prism. P is the centre of BD.

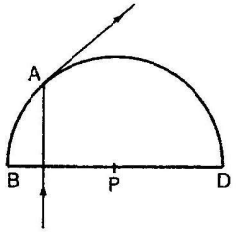


Fig. 6.1

(a) Indicate clearly on **Fig. 6.1**, the critical angle of the glass prism. Label the angle **C**. [1]

(b) If the refractive index of the prism is 1.50, calculate the critical angle of the prism.

critical angle = ...[2]

7 Fig. 7.1 shows the setup of an experiment using the echo method to find the speed of sound in air. An ultrasound transmitter was used to emit a single pulse towards a wall 0.38 km away. Fig. 7.2 shows the wave pattern captured by a microphone connected to a cathode-ray oscilloscope (C.R.O.) placed near the ultrasound transmitter. Assume that the ultrasound transmitter and the microphone are at the same distance from the wall.

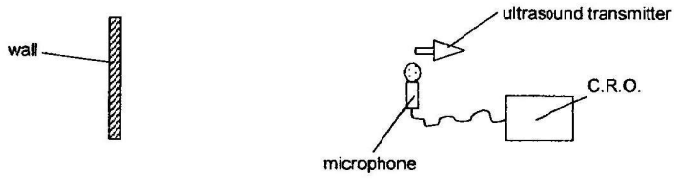


Fig. 7.1

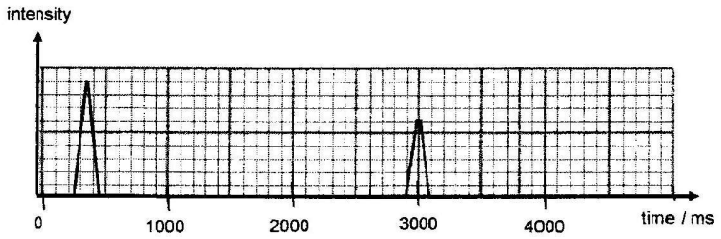


Fig. 7.2

(a) From the graph, state the time at which the **emitted** pulse was at its peak.

time = ... [1]

(b) Calculate the speed of sound.

speed of sound = ... [3]

8 Fig. 8.1 shows two identical conducting spheres mounted on insulating stands. Both spheres are positively charged, but one sphere is at a higher potential than the other. The spheres are connected by a conducting wire and a galvanometer.

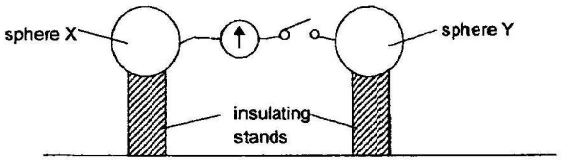


Fig. 8.1

(a) When the switch is closed, the galvanometer deflects to the left. Using ideas about the flow of electrons, state and explain which sphere is at a higher potential.

.....

.....

..... [2]

(b) The switch is opened. State and explain what happens when sphere X is earthed.

.....

.....

..... [2]

9 Fig. 9.1 is a circuit containing a 12 V cell, an ammeter, a variable resistor and a light bulb. Assume that the light bulb is an ohmic conductor.

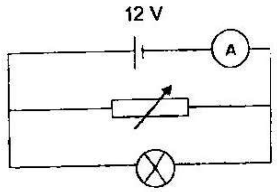


Fig. 9.1

When the variable resistor is set at 15 Ω, the ammeter reads 4.1 A.

(a) Calculate the current through the light bulb.

current through the light bulb = ... [2]

(b) Calculate the resistance of the light bulb.

resistance of the light bulb = ... [1]

(c) The resistance of the variable resistor is reduced to 5.0 Ω. State and explain the changes, if any, to the brightness of the light bulb.

.....

.....

..... [2]

10 A straight wire AB is moved across a magnetic field as shown in Fig. 10.1.

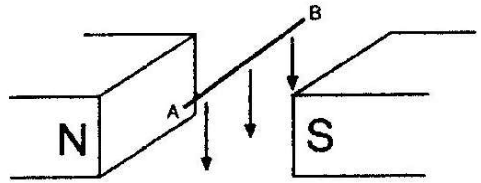


Fig. 10.1

(a) On Fig. 10.1, draw the direction of the current in the wire AB when it is moved across the magnetic field. [1]

(b) State two factors which determine the value of the induced e.m.f. measured between A and B.

.....

.....

..... [2]

(c) The wire AB is then replaced by a single loop of a wire which rotated with constant speed in the magnetic field as shown in Fig. 10.2.

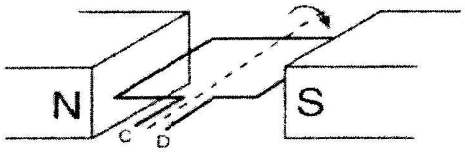
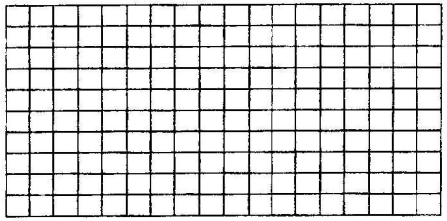


Fig. 10.2

On the grid provided below and using appropriate scales, sketch a graph of the e.m.f. induced across CD (the two ends of the loop) against time t. You should assume t = 0 s for the coil in the position shown, t = 10 s after one complete revolution, the voltage generated is 2.0 V and the magnetic field within which the coil rotates is uniform. [2]



11 To produce sound, an electric guitar senses the vibrations of the strings electronically and routes an electronic signal to an amplifier and speaker. The sensing occurs in a magnetic pickup coil mounted under the strings on the guitar's body. Fig. 11.1 shows a simple magnetic pickup coil. This pickup coil consists of a bar magnet wrapped with as many as 7,000 turns of fine wire.

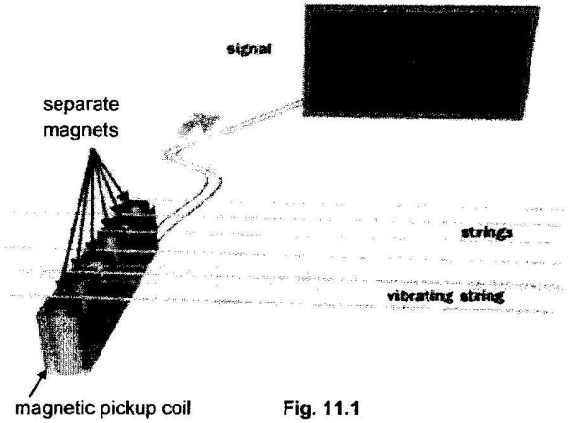


Fig. 11.1

Fig. 11.2 shows the side view of a magnetic pickup coil. It consists of a pickup coil wrapped around a permanent magnet. Note that the magnetic pickup coil is fixed in position during the vibration of the string. The portion of a guitar string as shown in the enlarged Fig. 11.3 can be magnetized.

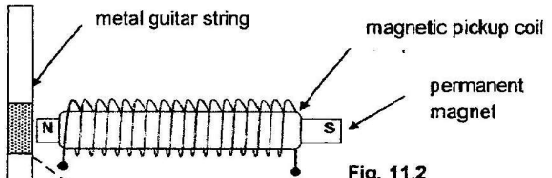


Fig. 11.2

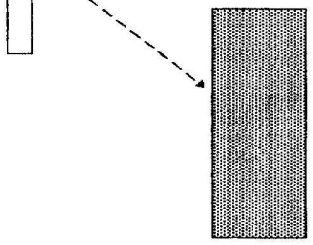


Fig. 11.3

(a) Indicate on the Fig. 11.3, the pole of the induced magnet on the portion of the guitar string nearest to the permanent magnet. [1]

(b) When the guitar string is plucked, it vibrates at a certain frequency, f. Explain how the vibration of the guitar string induces an alternating electromotive force (e.m.f) in the pickup coil.

.....

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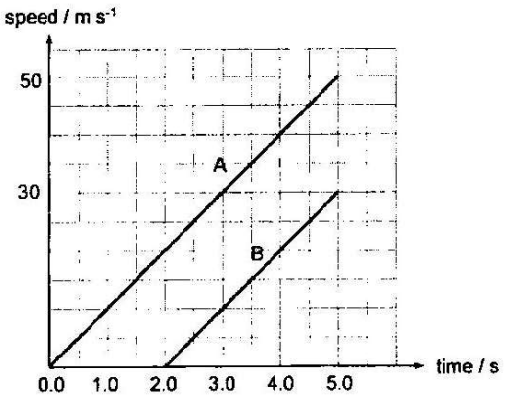
.....[2]

End of Section A

4 Pure Physics Preliminary Examination 2016

Answer Scheme

1(a)



- Correct lines with A and B labelled [B1]
- A and B suggested acceleration at 10 m/s² [B1]
- B starts 2 sec later [B1]
- -1mark for curve A or B

(b)

Distance covered by A in 5 s= ½ x 5 x 50 = 125m

Distance travelled by B in 3 s =1/2 x 3x30 =45 m } [M1] (no ecf)

Height difference = 125 – 45 – 10 = 70 m [A1]

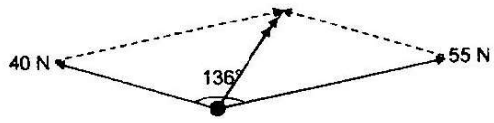
2(a)

Suitable scale used and stated [M1]

Parallelogram or triangle method attempted (with double arrows to indicate resultant force) (as shown) [M1]

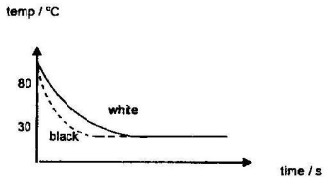
All forces (40N, 55N) and angles labelled (as shown) [M1]

By measurement from diagram, magnitude of resultant = 38 N
(accept 34 N to 42 N) [A1]



	(b)	38 – f = (40/10) (2.1) f = 29.6 N (allow ecf)	[M1] [A1]

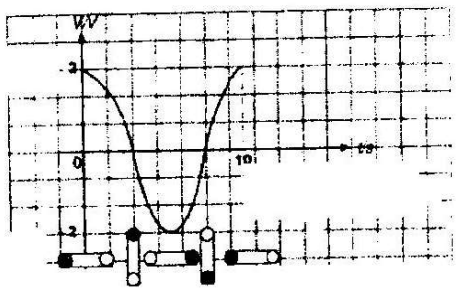
3(a)	P = atm – h ρ g = 0.71 x 13600 x10 [M1] = 9.66 x10^4 Pa [A1]
(b)	When temperature decreases, the **average KE of the particles decreases**, speed decreases, [B1] frequency of collision on the wall decreases and with **smaller force**, [B1] As P = F/ A, therefore pressure decreases.

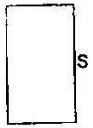
4	**(a)**	Calculate the rate of energy gain by the car as it travels from X to Y. Time taken to go from X to Y = 70/3.5 = 20s [M1] Rate of energy gain = (1200x10x45) / 20 [M1] = 27000 J/s [A1]
	(b)	Total energy of the car at Y = 1200 x 10 x 45 + 0.5 x 1200 x 3.5^2 [M1] = 547000 J (3sf) [A1]
	(c)	Work done against friction = 50000 x 20 – 1200 x 10 x 45 [M1] = 460000 J [A1]
5	**(a)**	m = 50.0 / 10 = 5.0 kg or 5000 g Q = m c θ = 5000 x 0.90 x (80 – 30) [M1] No ecf = 225 kJ = **230 kJ (to 2 s.f.)** **[A1]** for correct ans and 2/3 s.f., no ecf
	(b)	 Graphs with temperature reaching 30°C [B1] Correct **curve** graphs drawn with correct labellings [B1] -1mark for graphs that are not curve

6	**(a)**	Critical angle = ∠ between incident light ray and line AP [B1]
	(b)	sin C = 1 / 1.50 [M1] C = 41.8° [A1]
7	**(a)**	Time = 350 ms or 0.35 s [B1]
	(b)	Time taken for sound to travel to and fro = 3000 – 350 **(GIVE ECF from (a))** = 2650 ms = 2.65 s [M1] Speed = (380 x 2) / 2.65 [M1] **(Give method marks if SPEED = distance x 2 / TIME INTERVAL is seen)** = 287 m/s [A1]
8	**(a)**	Electrons travel from X to Y. [M1] Y is at a higher potential. **(marks only given if explanation matches)** [A1]
	(b)	The electrons from the ground will flow into X. [B1] Sphere X will be neutralized. [B1]

9	**(a)**	Current through resistor = 12 / 15 = 0.80 A [M1] Current through light bulb = 4.1 – 0.80 = 3.3 A [A1]
	(b)	Resistance of the light bulb = 12 / 3.3 = 3.64 Ω **(GIVE ECF from (a))** [A1]
	(c)	Voltage across light bulb remains the same. [B1] Since resistance of light bulb doesn't change. by P = V^2 / R, power and hence brightness does not change.**(must mention power and not just current)** [B1]

10(a)	Draw arrow from B to A (by Fleming's Right Hand Rule) [B1]
(b)	Any two of below (1m each) [B2] 1) strength of the magnetic field 2) speed with which the wire moves**(rate of change of flux not specific, NOT ACCEPTED)** 3) size of the conductor

(c)	(ii)  Correct graph [B1] Max voltage 2V and T=10s shown [B1]

11(a)	N and S poles labelled correctly in Fig. 9.3 [B1] 
11(b)	When the guitar string vibrates, the induced magnetic field on the string fluctuates, produces a changing magnetic field in the pickup coil. This causes a rate of change of magnetic flux linkage with the pickup coil. An e.m.f is induced. [B1] As the magnetic flux linkage increases and decreases when the string vibrates, this sets up an alternating e.m.f. Or According to Lenz's law, the current induced will flow in a direction as to oppose the motion causing it. [B1]

PRELIMINARY EXAMINATION 2016

SECONDARY 4 EXPRESS

PHYSICS 5059

PAPER 1

MARKING SCHEME Dunman

1	2	3	4	5	6	7	8	9	10
C	B	C	A	C	B	D	B	A	D
11	12	13	14	15	16	17	18	19	20
D	A	B	B	C	D	B	A	C	C
21	22	23	24	25	26	27	28	29	30
C	A	A	C	D	B	A	B	D	D
31	32	33	34	35	36	37	38	39	40
D	C	B	A	B	D	A	C	A	C

DUNMAN SECONDARY SCHOOL
SECONDARY 4 PHYSICS 5059
PRELIM EXAMS 2016 PAPER 2 SECTION B ANSWERS

12 (a)	Pressure is defined as the force acting per **unit** area.	B1
12 (bi)	HY-80 – 549 m HY-100 – 686 m	B1 for both correct
12 (bii)	The pressure **increase with depth**. The greater the depth the greater the pressure acting on the vessel.	B1
12 (biii)	$P = h\rho g = 288 \times 1000 \times 10 = 2880000 Pa = 2.88\ MPa$	M1 A1
12 (biv)	6 000 000 = h (1000)(10) + atm pr = 10000h +10^5 h = 590 m The vessel will dive to a maximum depth of 600 m. Hence HY-100 steel should be used.	B1 B1
12 (c)	The submarine sinks and rises by **adjusting its density** to the water around it. By taking in more water and expelling air, the submarine increases its mass and hence increases its density as compared to the water, causing it to sink. By expelling water and taking in more air, the submarines decreases its mass and hence decrease its density as compared to the water, causing it to rise.	B1 B1 B1

13 (a)	The coil will rotate **anticlockwise**	B1
13 (b)	When current flows through the coil, there will be magnetic field interacting with the external magnets. This will cause force to be produced according to Fleming's Left hand rule.	B1 B1
13 (c)	Moment due to one side of the coil = 0.6 / 2 = 0.3 Nm Force on one side of coil = 0.3 / (0.03 / 2) = 20 N	B1 B1
13 (d)	The coil has rotated 2 complete rounds.	B1
13 (e)	The moment would be zero when the coil is at the vertical position. This is because there is no force acting on the coil at that position and thus moment is zero. *-Reject momentum is zero, perpendicular distance is zero.*	B1 B1
13 (f)	The amplitude of graph will decrease and the speed of the coil will reduce which reduce the number of cycles in the graph/frequency decreases / period increases. -Reject no moment/reduce in moment/decrease wavelength	B1 B1

14 EITHER

(a)	For the same power, higher voltage results in **lower current**, **less** electrical **power would be lost** as heat for lower current since P = I^2R.	B1 B1
(b)	Thick cables have lower resistance. Hence less heat is lost from the wire	B1
(c)	Turn ratio : 1:40	B1
(d)(i)	P = IV I = 500 000 / 250 I = 2000 A	 B1

(d)(ii)	Ip/Is = Vs/Vp Ip / 2000 = 250/10000 Ip = 50 A	 M1 A1
(e)(i)	P = I^2R =50^2 x 20 = 50 000 W = 50 kW	 M1 A1
(e) (ii)	Power drawn from power station = 500 kW + 50 kW = 550 kW	 B1

14 OR

(a)	The switch is wrongly connected to the neutral wire. The switch should be connected to the LIVE wire	B1
(bi)	0 A	B1
(bii)	P = IV 50 = I x 240 I = 0.208 A	 M1 A1
(biii)	3 x 0.208 = 0.625 A	B1
(c)	A fuse is used to **prevent excessive current from flowing in the circuit**. When there is excessive current flowing in the circuit, the low resistance wire in the fuse will **get heated up and blow**. Thus breaking the circuit	B1 B1
(d)	If the switch and fuse are on the neutral wire, when the fuse blows or the switch is turned off, the appliance is still 'live' or not electrically isolated from the live wire	B1
(e)	E = I^2Rt = 2 x 2 x 15 x 15 x 60 = 54000 J	M1 A1

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME ( )

CLASS

PHYSICS **5059/01**

Paper 1 Multiple Choice **19 September, 2016**

Secondary 4 Express **1 hr**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the OTAS Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in soft pencil on the separate OTAS Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Where necessary, take acceleration due to gravity, g = 10 m/s^2

This document consists of **15** printed pages, including this cover page.

1 Pendulum A makes 20 complete oscillations in 10 s. Pendulum B makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum B has a shorter period than pendulum A.

B The string of pendulum B is longer than that of pendulum A.

C The mass of the bob of pendulum B is smaller than that of pendulum A.

D The angle of swing of release for pendulum B is smaller than that of pendulum A.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.



diagram 1

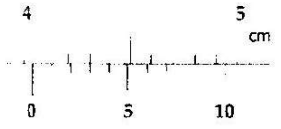


diagram 2

What is the zero error and the actual thickness of the coin?

	zero error / cm	corrected reading / cm
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

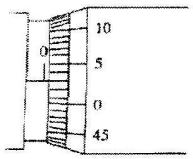


diagram 1

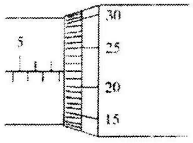
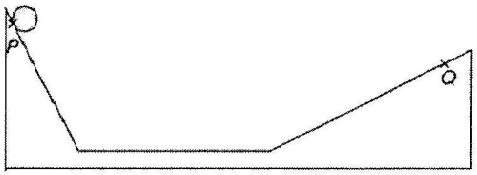


diagram 2

What is the true diameter of the ball bearing?

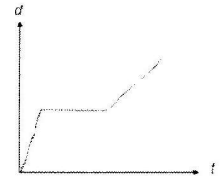
A 7.19 mm **B** 7.69 mm **C** 7.72 mm **D** 7.75 mm

4 A sphere runs along a smooth rail from **P** to **Q** as shown.

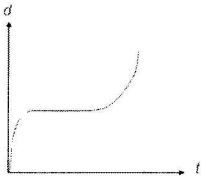


Which of the following graphs best represents the variation of the distance d travelled by the sphere with time t?

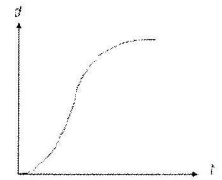
A



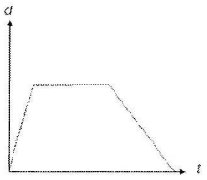
B



C



D



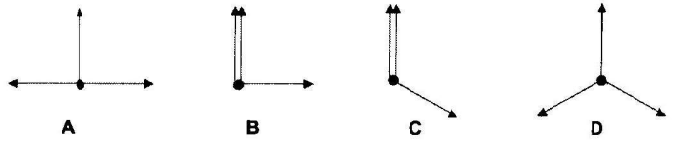
5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

What is its average speed during the journey?

A 4.0 m/s **B** 5.0 m/s
C 6.0 m/s **D** 7.0 m/s

6 Three forces of the same magnitude act simultaneously on a small object.

Which one of the following combination of these three forces will give the greatest resultant force?

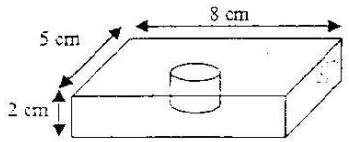


7 A 10.0 kg block of iron is brought from Earth to the surface of Planet Y.

Given that the gravitational field strength of Planet Y is 3.90 N/kg, how will the properties of the iron block change?

	inertia	density	weight
A	decreases	remains unchanged	increases
B	decreases	increases	increases
C	remains unchanged	decreases	decreases
D	remains unchanged	remains unchanged	decreases

8 A rectangular block of steel has a cylindrical hole bored through it as shown. The density of steel is 8.0 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 3.5 cm^2 B 5.0 cm^2

C 2200 cm^2 D 4400 cm^2

9 An object is in static equilibrium. Which of the following statements about the object is true?

A It is moving in a straight line at uniform speed.

B It is rotating at a constant rate at a fixed point.

C It is rotating anti-clockwise and then clockwise in cycles.

D It is at rest and not rotating.

10 A parachutist has opened his parachute and is falling to Earth at constant speed. What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy

C potential energy → kinetic energy

D potential energy → thermal energy

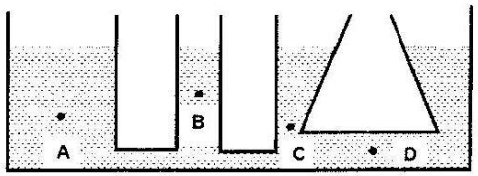
11 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power input by the motor? Take density of water to be 1000 kg m^{-3}.

A 12.5 W B 22.2 W

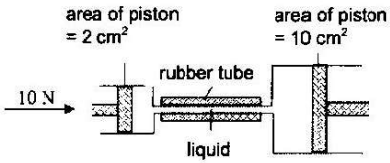
C 556 W D 1330 W

12 The diagram shows a container with openings of different shapes filled with a liquid.

Which of the points **A** to **D** has the greatest pressure?



13 The diagram shows two syringes connected by a rubber tube. The space between the two pistons is filled with a liquid. The areas of the small piston and the large piston are 2 cm^2 and 10 cm^2 respectively. A force of 10 N is applied to the small piston.



What is the ratio of the pressure acting on the small piston to the pressure acting on the large piston?

A 1 : 1 B 1 : 2

C 1 : 5 D 5 : 1

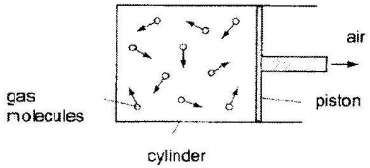
14 A resistance thermometer shows a resistance of 1.0 Ω and 4.0 Ω when placed in melting ice shavings and in a liquid at 60 °C respectively.

What is the thermometer reading when it is placed in a liquid at 80 °C?

A 1.5 Ω B 2.3 Ω

C 4.0 Ω D 5.0 Ω

15 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How does the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	speed of molecules	rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

16 A heated smooth metallic body is allowed to cool in air. Which of the following statements about its heat loss is incorrect?

A Convection currents in the air aid the process of heat loss.

B Conduction is the main mode of heat loss as the body is a good conductor of heat.

C The rate of heat loss by thermal radiation is increased due to its smooth metallic surface.

D The rate of heat loss decreases as the temperature of the body nears room temperature.

17 A person places his two feet on two separate surfaces, a woollen carpet and a marble tile. Both surfaces are initially at the same temperature.

Which statement best describes how the person will feel?

A Both surfaces feel the same since both are at the same temperature initially.

B The foot on the carpet feels warmer because the carpet transfers heat to the foot.

C The foot on the tile feels cooler because the tile transfers coldness to the foot.

D The foot on the carpet feels warmer because the rate of heat transfer is slower through the wool.

18 A piece of ordinary kitchen aluminium foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside and why?

A The dull side should be on the outside because it is a better emitter of thermal radiation.

B The dull side should be on the outside because it absorbs thermal radiation better.

C The shiny side should be on the outside because it is a better thermal conductor.

D The shiny side should be on the outside because it is a better absorber of thermal radiation.

19 Object A is 2 kg. It has a temperature of 40 °C and has an internal energy of 500 kJ. Object B is 2 kg. It has temperature of 50 °C and has an internal energy of 400 kJ. Which of the following statement is correct?

A Heat flows from object A to object B.

B Heat flows from object B to object A.

C No heat flow between object A and object B.

D There is not enough information to determine the direction of heat flow.

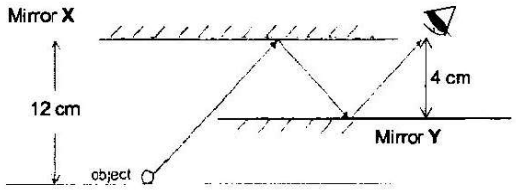
20 An ice tray contains 0.30 kg of water which has an initial temperature of 20°C. The ice tray and water are placed into a freezer that has a constant temperature of – 4.0°C. The specific heat capacity of water is 4180 J/(kg°C), the specific latent heat of fusion of water is 3.34×10^5 J/kg and the specific heat capacity of ice is 2100 J/(kg°C).

What is the energy that is needed to be removed in order to change the water into ice at – 4.0 °C?

A 18 kJ **B** 25 kJ

C 125 kJ **D** 128 kJ

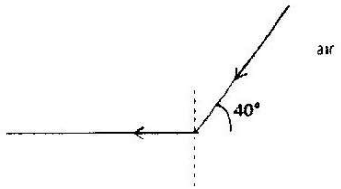
21 The figure below shows how a ray of light from an object enters the eye after being reflected twice.



What is the vertical distance (distance perpendicular to plane mirror) between tne final virtual image of the object in mirror Y and the eye?

A 12 cm **B** 16 cm
C 20 cm **D** 32 cm

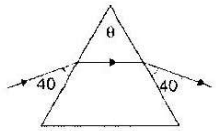
22 The following diagram shows a ray of light entering a transparent block from air.



The speed of light in air is 3.0×10^8 m/s. Calculate the speed of light in the transparent block.

A 1.93×10^8 m/s **B** 2.30×10^8 m/s
C 1.14×10^8 m/s **D** 3.92×10^8 m/s

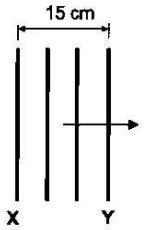
23 A light ray passes through a triangular glass prism of refractive index 1.5.



What is angle θ?

A 51° **B** 53° **C** 61° **D** 65°

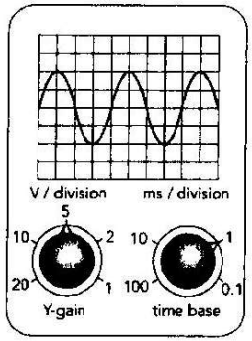
24 The figure below shows a water wave travelling in a ripple tank. The wavefront at **X** travels to **Y** in 5.0 s.



What is the frequency of the water wave?

A 0.60 Hz **B** 3.0 Hz **C** 15 Hz **D** 75 Hz

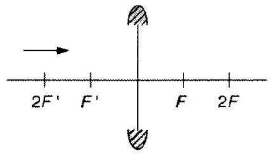
25 A wave is displayed on an oscilloscope with the settings as shown.



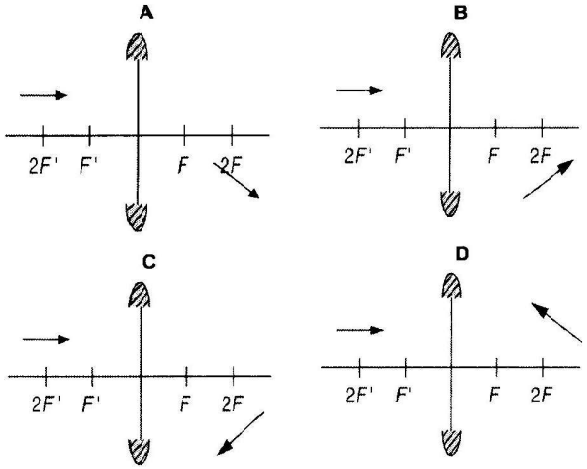
Which of the following shows the correct values for the peak voltage and frequency of the wave?

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

26 In the following diagram, *F* and *F'* are the focal points of a thin converging lens. An object represented by an arrow is placed in front of the lens.

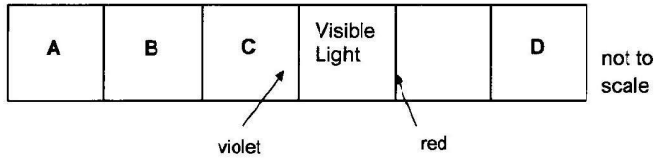


Which one of the following diagrams show the correct location and orientation of the image formed?



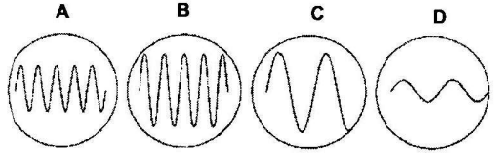
27 The following diagram shows an electromagnetic spectrum. The violet and red ends of the visible spectrum are marked. Which part of the spectrum can be used to detect counterfeit notes?

The Electromagnetic Spectrum



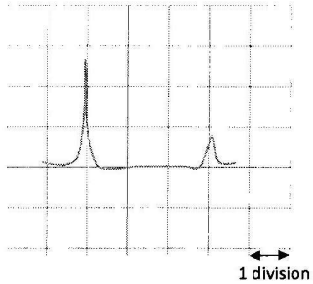
not to scale

28 The diagram shows the waveforms produced by different sounds. Which diagram corresponds to the loudest sound with the lowest pitch?



29 A man shouts on a mountain and detects the echo from the nearest neighbouring mountain after using a microphone attached to a cathode ray oscilloscope (CRO). The following CRO screen shows the original sound and echo trace. Sound travels at 330 m/s in air.

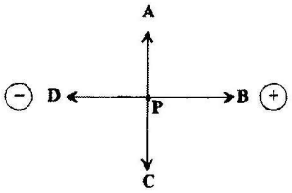
The time-based setting of the CRO is set to 10 s/div.



What is the distance between the man and the mountain?

A 30 m **B** 4950 m **C** 9900 m **D** 19800 m

30 The diagram below shows two electric charges. Which of the following shows the direction of the electric field at point P?

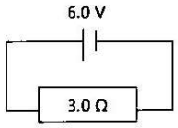


31 Wire X is 1.0 m long and has a diameter of 0.50 mm. It has a resistance of 5.0 Ω. Wire Y is made up of a material that has twice the resistivity of wire X's material. Wire Y is 2.0 m long but it has a diameter of 0.25 mm.

What is the resistance of Wire Y?

A 0.63 Ω **B** 5.0 Ω **C** 40 Ω **D** 80 Ω

32 A 3.0 Ω resistor is connected to a 6.0 V supply. How much charge flows through the resistor in 20 s?

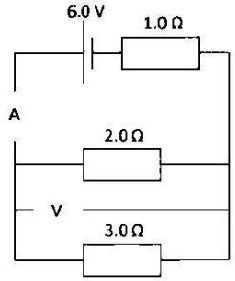


A 10 C **B** 40 C **C** 60 C **D** 120 C

33 Electromotive force is defined as the

A rate of flow of charge at a point
B the magnitude of force required to move a unit charge across the whole circuit
C the amount of energy required to move a unit mass of charge across the whole circuit
D the amount of energy converted per unit charge from non-electrical to electrical energy

34 The following diagram shows three fixed resistors connected to a 6.0 V supply.



Which of the following show the voltmeter reading V and ammeter reading I?

	V/V	I/A
A	6.0	11
B	6.0	5.0
C	3.3	2.7
D	3.3	0.45

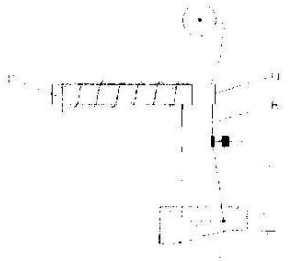
35 An electric iron is connected to the mains supply of 110 V by a cable. Which of the following shows a possible combination of the potential and current of the respective wires under normal operating conditions?

	live wire		neutral wire		earth wire	
	current/A	Potential	current/A	potential	current/A	potential
A	1.0	High	0.0	Low	0.0	Low
B	1.0	High	1.0	Low	0.0	Low
C	1.0	Low	1.0	High	1.0	High
D	0.0	Low	1.0	High	1.0	Low

36 An air-conditioner has a rating of 240 V, 1500 W, The cost of operating the air conditioner came up to $45 for a particular month. What is the duration of time that the air-conditioner was switched on for the month if one unit of electricity costs $0.20?

A 9 min **B** 150 hrs **C** 744 hrs **D** 938 hrs

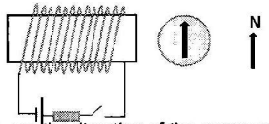
37 The following diagram shows an electric bell.



Which materials would be suited for the parts labelled P, Q and R?

	P	Q	R
A	soft iron	brass	soft iron
B	soft iron	soft iron	spring steel
C	soft iron	brass	brass
D	spring steel	soft iron	spring steel

38 The following diagram shows a solenoid connected to a DC supply and the direction of a compass near it before the switch is closed.

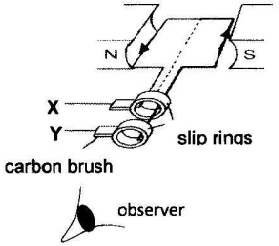


Which of the following shows the direction of the compass after the switch is closed? Assume that a small current flows in the solenoid.



Refer to the following diagram for questions 39 and 40

The following diagram shows a representation of an AC generator connected to leads **X** and **Y**. At the instant shown, the current direction in the coil is as shown.



39 Which of the following shows the direction of rotation of the coil as seen by an observer and the rule used to obtain this direction of rotation?

	direction of rotation	rule used
A	clockwise	Fleming's Left Hand Rule
B	clockwise	Fleming's Right Hand Rule
C	anti-clockwise	Fleming's Left Hand Rule
D	anti- clockwise	Fleming's Right Hand Rule

40 Which of the following states the function of a slip ring in the AC generator?

A To prevent entanglement of the wire
B To ensure electrical contact between the coil and the external circuit
C To ensure the coil rotates continuously by changing the direction of the current in the coil every half a revolution
D To increase the magnetic field strength of the rotating coil

5059 Physics Answer Scheme

1	**B**	11	**B**	21	**C**	31	**D**
2	**A**	12	**D**	22	**B**	32	**B**
3	**B**	13	**A**	23	**C**	33	**C**
4	**C**	14	**D**	24	**A**	34	**C**
5	**C**	15	**B**	25	**B**	35	**B**
6	**B**	16	**C**	26	**A**	36	**B**
7	**D**	17	**D**	27	**C**	37	**B**
8	**B**	18	**B**	28	**C**	38	**C**
9	**D**	19	**B**	29	**B**	39	**D**
10	**D**	20	**D**	30	**D**	40	**A**

--------- END OF PAPER ---------

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME | | ( )

CLASS | | | |

PHYSICS **5059/2**

Paper 2 Theory **30 August, 2016**

Secondary 4 Express **1 hr 45 minutes**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer all **three** questions, the last question is in the form either/or.

Write your answers on the separate answer papers provided.

You are advised to spend no longer than one hour on **Section A** and no longer than 45 minutes on **Section B**.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

All essential working must be shown clearly.

Where necessary, take acceleration due to gravity, g = 10 m/s^2.

For Examiner's Use	
Section A	
B 9	
B 10	
B 11	
Total	

This document consists of **24** printed pages, including this cover page.

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows a velocity-time graph for a ball bouncing vertically on a hard surface on an unknown planet. The ball was dropped at t = 0 s.

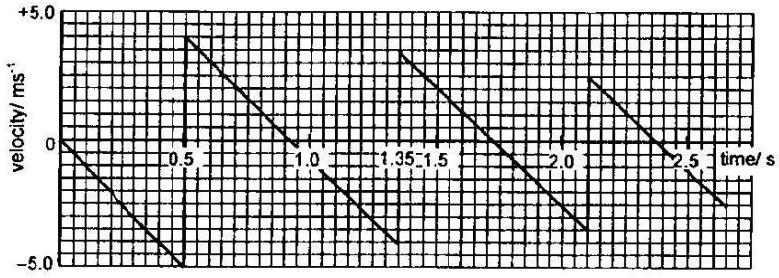


Fig. 1.1

(a) State the time at which the ball was just in contact with the ground for the first time.

..... [1]

(b) Calculate the height from which the ball was first dropped.

height = ... [2]

(c) State the acceleration of the ball at 0 s.

acceleration = ... [1]

Total marks:	

[Turn over

(d) Sketch a displacement-time graph on Fig. 1.2 for the first 1.35 s of the motion.

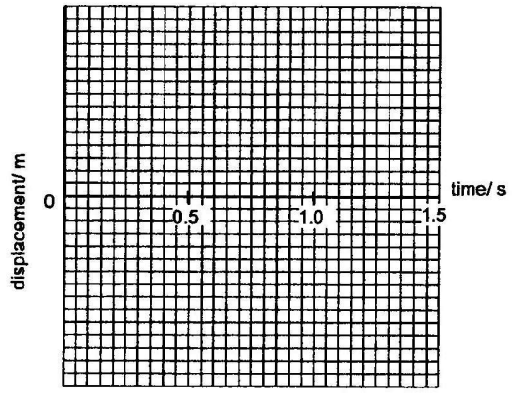


Fig. 1.2

[2]

Total marks:	

2 Fig. 2.1 shows three cubes, **A**, **B** and **C**, of mass 35 kg, 5 kg and 20 kg respectively resting on a smooth horizontal surface initially. The cubes are in contact with each other as shown in Fig. 2.1. A horizontal force of 300 N is then exerted on cube **A**.

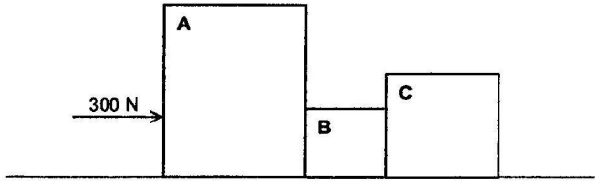


Fig. 2.1

(a) Calculate the acceleration of cube **B** and hence the resultant force acting on it.

acceleration = ...

force = ... [2]

(b) Calculate the force exerted on cube **A** by cube **B**.

force = _____ [2]

(c) Draw all the pairs of action-reaction forces acting on cube **C** and label the forces clearly in Fig. 2.1. [2]

Total marks:	

3 Fig. 3.1 shows an uniform gondola suspended in mid-air that is used to clean the window of buildings. A cleaner of mass 85 kg stands 2.0 m away from rope X inside the gondola. The mass of the gondola is 630 kg and the distance between the ropes is 6.0 m.

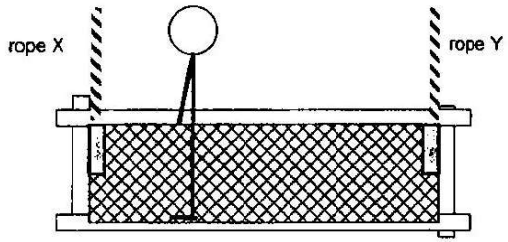


Fig. 3.1

(a) Draw and label all the vertical forces in Fig. 3.1 which are acting on the gondola.

[2]

(b) Calculate the force exerted by rope Y on the gondola.

force = _____ [2]

(c) State and explain qualitatively how the force exerted by rope Y on the gondola will change as the cleaner moves towards rope Y.

_____

_____

_____

_____ [2]

Total marks:	

4 Fig. 4.1 shows part of an experimental arrangement which is used to obtain a value for l_v, the specific latent heat of vaporisation of water.

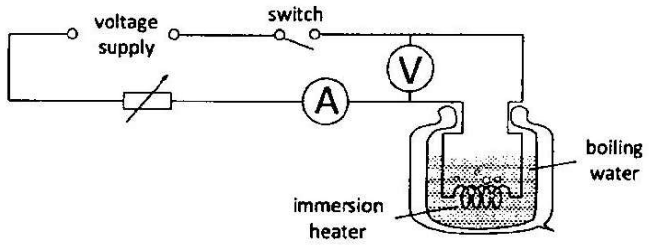


Fig. 4.1

(a) In a particular experiment using the apparatus in Fig. 4.1, a student uses an immersion heater which supplies 300 J of energy per second. He closes the switch for 2 minutes, and 0.015 kg of boiling water is vaporised.

(i) Calculate a value for l_v.

l_v = _____ [1]

(ii) State and explain whether you would expect the answer in **(a)(i)** to be larger or smaller than the true value of l_v.

_____

_____

_____

_____ [2]

Total marks:	

(b) Another student doing the same experiment decides to insert a thermometer into the boiling water at the start of the experiment, as shown in Fig. 4.2, to ensure that the temperature remains at 100 °C throughout the experiment.

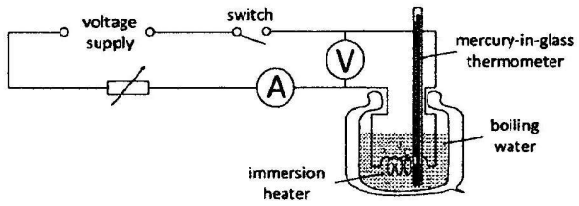


Fig. 4.2

(i) Suggest a reason why this student's concern may be invalid.

_____

_____ [1]

(ii) The student inserts the thermometer at 30 °C into the boiling water, right at the start of the experiment. Given that he uses the same immersion heater and keeps it on for the same 2 minutes, use your answer in **(a)(i)** to calculate the mass of boiling water that will be boiled off.

(You may take the average heat capacity of the mercury-in-glass thermometer to be 28.5 J K^{-1}, and assume that the thermometer reaches 100 °C before the end of the experiment.)

mass = _____ [2]

(ii) Hence explain why thermometers cannot be made of thermometric substances with high heat capacities.

_____

_____ [1]

Total marks:	

[Turn over

5 Fig 5.1 (an actual 1:1 scaled diagram) shows an object and its corresponding virtual image when the object is placed in front of a thin converging lens.

(a) Complete the diagram with two sets of rays to show how the image is formed. Mark the optical centre of the lens clearly with an X.

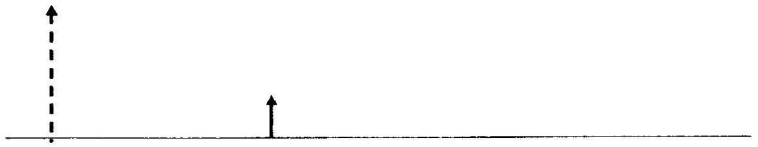


Fig 5.1

[2]

(b) State the magnification of this lens and its focal length.

magnification factor = ... [1]

focal length = ... [1]

6 Fig 6.1 shows a highly negatively-charged metallic ball on an insulated stand.

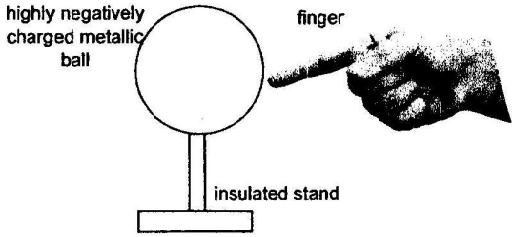


Fig 6.1

Describe and explain what happens to the charges in a person's finger when it approaches the ball without touching it. You may use the diagram to illustrate your answer. Include the idea of an electric field in your answer.

.....

.....

.....

..... [2]

Total marks:	

[Turn over

7 Seismic waves are generated by earthquakes. These waves start from the epicentre. Primary (P) waves travel in a direction parallel to the direction of the vibration of its particles. Secondary (S) waves travel in a direction perpendicular to the direction of vibration of its particles.

(a) State the type of wave that the P wave is.

..... [1]

(b) Fig 7.1 shows the time taken by the waves to travel different distances from the epi centre.

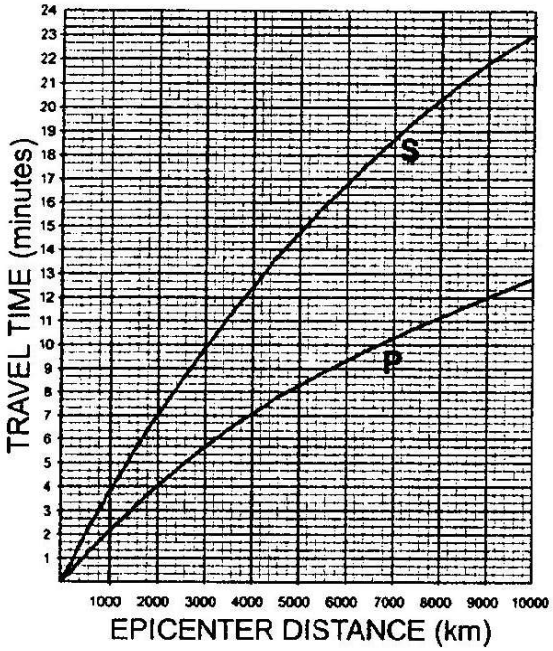


Fig 7.1

Calculate the average speed of the S wave that reached 10 000 km from the epi centre in m/s.

average speed = ... [2]

Total marks:	

(c) A typical S wave has a frequency ranging from 0.50 to 1.0 Hz. Calculate the maximum possible wavelength of the S wave that reached 10 000 km from the epi centre.

wavelength = ... [2]

8 Fig 8.1 shows part of a circuit that is designed to switch on a LED when it is dark.

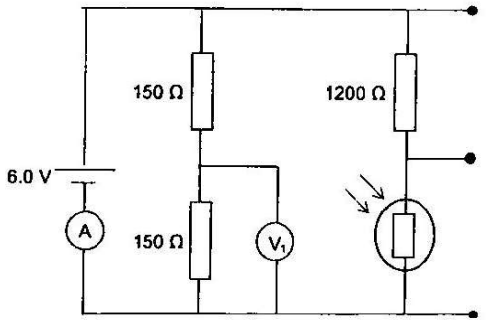


Fig 8.1

(a) Calculate voltmeter reading V_1.

V_1 = ... [1]

(b) State and explain if the LED should be placed across the 1200 Ω or LDR so that it can light up when the light intensity of the surroundings decreases.

.....

.....

.....

..... [2]

Total marks:	

(c) Fig 8.2 shows how the current through a filament lamp changes as the potential difference (p.d) across it varies.

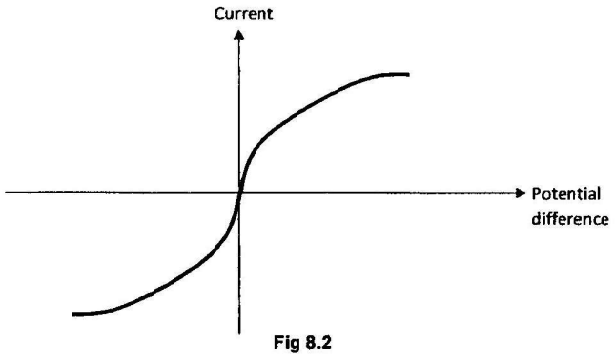


Fig 8.2

(i) Sketch on the same axis above how the current of an LED will change as the p.d across it changes. [2]

(ii) Hence or otherwise, explain the advantage of the LED over a filament lamp.

.....

..... [1]

9 Fig 9.1 shows part of a ring circuit in a phone shop. The ring circuit draws power from a 230 V supply.

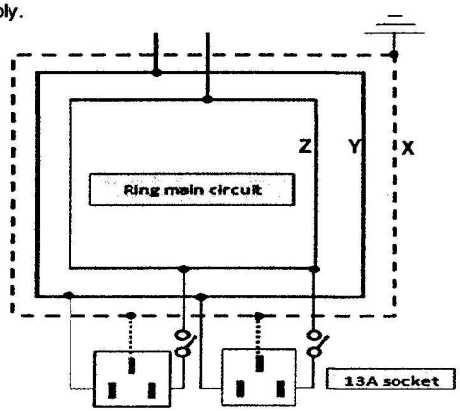


Fig 9.1

Total marks:	

(a) Wire X is the earth wire. Label wires Y and Z.

Y: ..... Z : ..... [1]

(b) Fig 9.2 shows a 6 point multi plug adaptor that is connected to one of the 3 pin sockets in Fig 9.1.

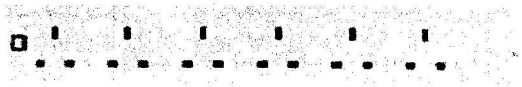


Fig 9.2

The shop owner plugs 6 phone chargers into the multi plug adaptor. Each of the phone charger has an input rating of 230 V, 50 W.

The wires in the 3 pin plug are thin and can only withstand a maximum of 1.0 A. State and explain, with clear working shown, if the 13 A fuse of the 3 pin plug of the adaptor inserted into the socket is able to protect the circuit.

.....

..... [2]

(c) Fig 9.3 shows part of a 3 pin plug with a fuse missing.

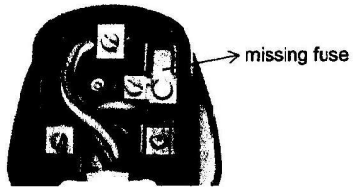


Fig 9.3

The shop owner claims that the missing fuse will not make any difference to the operation of the appliance. Explain if you agree with his statement.

.....

.....

..... [1]

Total marks:	

10 Fig 10.1 shows a simple hand-wound AC generator. The generator consists of a rotating single coil of wire. The emf generated lights up a lamp.

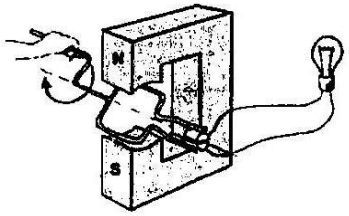


Fig 10.1

(a) Explain using Lenz's law, why the hand that is winding the generator coil experiences a resistive force when the lamp is lit.

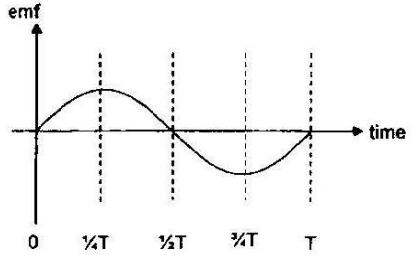
.....

.....

.....

..... [1]

(b) Fig 10.2 shows how the emf across the coil varies with time. Sketch on the same axis how the emf will change if the speed of rotation of the coil is doubled. A complete cycle of rotation of the coil takes a period T.



[2]

Fig 10.2

(c) Explain using Faraday's law, why increasing the number of turns of coil of wire increases the magnitude of the emf generated across the coil.

.....

..... [1]

Total marks:	

[Turn over

Name: _____ ( )

Class: _____

Section B

Answer all **the** questions from this section.
Answer only one of the two alternative questions in **Question 13.**

11 Fig 11.1 shows a small water turbine that generates electricity from a reservoir of water located a height h above the turbine.

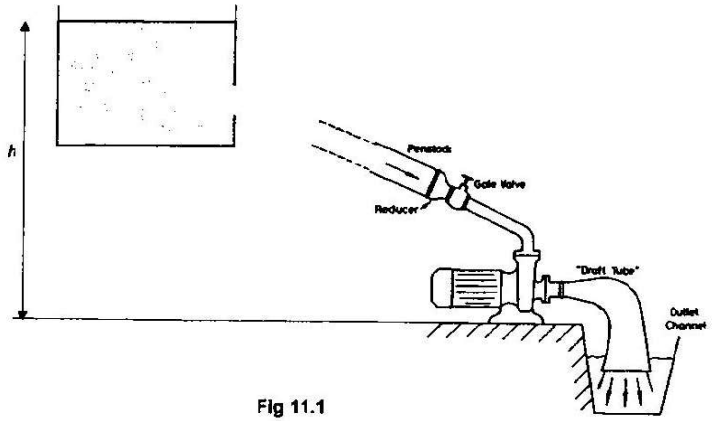


Fig 11.1

(a) Fig 11.2 shows the specifications of the water turbine.

power output (kW)	height h /m	flow rate (m^3/s)
5.0	20	0.035

Fig 11.2

Calculate the efficiency of the water turbine. Assume no frictional losses when the water flows from the reservoir to the water turbine. Take the density of water to be 1000 kg/m^3.

efficiency = ... [2]

Total marks:	

[Turn over

(b) Fig 11.3 shows the cross-section of the water turbine. The water flows into the turbine and turns the rotor blades.

Fig 11.4 shows the interior of the turbine. The rotor blade is wrapped by a coil of wire connected at a DC input. . An e.m.f. is generated across the coils of wire wrapped around a stator (stator coils) when the water flows.

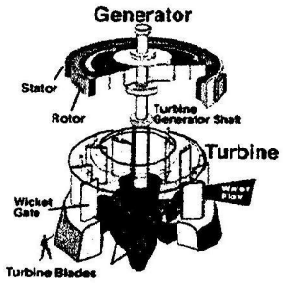


Fig 11.3

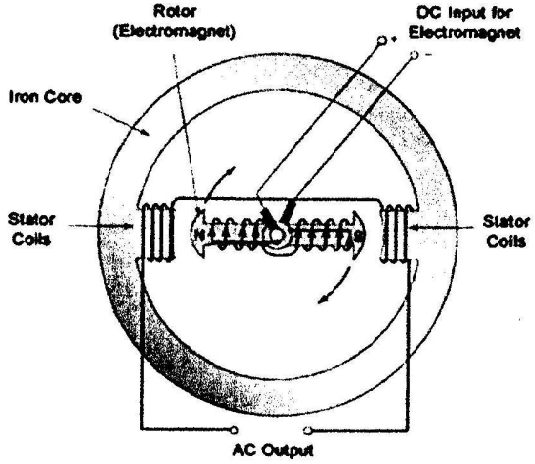


Fig 11.4

Explain how the flow of the water generates an e.m.f. across the stator coils.

.....

.....

.....

.....

.....

..... [3]

Total marks:	

(c) Fig 11.5 shows the representation of how power is generated and transmitted from a hydroelectric plant to homes. Assume both the transformers are 100% efficient.

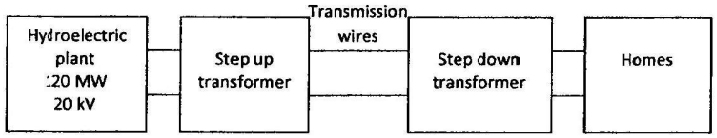


Fig 11.5

(i) Calculate the current generated by the hydroelectric plant.

current = ... [1]

(ii) The step-up transformer has a turns ratio of 40. Calculate the current output of the step-up transformer.

current = ... [1]

(iii) Assuming that each transmission wire has a resistance of 30 Ω, calculate the input voltage to the step-down transformer.

input voltage = ... [2]

(d) State an advantage and a disadvantage generating power using hydroelectric means instead of burning of fossil fuels.

advantage: .....

.....

disadvantage: .....

..... [1]

Total marks:	

12 Fig 12.1 shows the DC motor of a fan. It consists of a single coil rotating in a clockwise manner about a pivot.

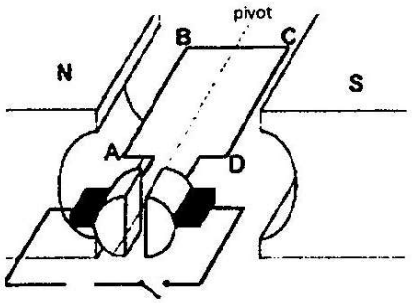


Fig 12.1

(a) (i) Draw the current direction in wire **AB** and **CD** so that the coil rotates in a clockwise manner. [1]

(ii) Complete Fig 12.1 to include a 12 V DC supply as well as a potentiometer that will allow the maximum potential difference across the motor to be 12 V [2]

(b) Fig 12.2 shows the front view of the wire **AB** between the two permanent magnets.



Fig 12.2

Explain, by completing the diagram above, how the magnetic fields interact to produce a force on wire AB.

.....

.....

.....

..... [3]

Total marks:	

(c) The magnetic field strength of the magnets is doubled.

(i) Explain why this would result in an increase in the rotation speed of the fan.

.....

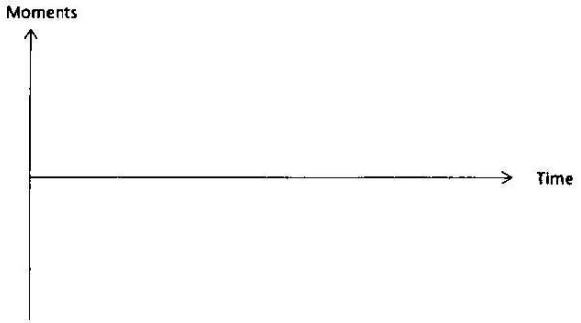
.....

.....

..... [2]

(ii) Sketch in the axis below how the moments about the pivot would vary with time for both the original weaker magnets as well as the stronger magnets. Label the curve due to the weaker magnets as 'W' and the curve due to the stronger magnets as 'S'. The time taken for a complete revolution for the coil with the weaker magnets is T.

Draw the two curves from time 0 to T. Assume both coils are horizontal initially.



[2]

Total marks:	

13 EITHER

Fig. 13.1 shows the Griffon. It opened in August 2006 and is the world's tallest, floorless dive roller coaster. The ride features two nearly-vertical dives, one of which occurs at the start of the ride, subjecting the riders to large changes in speed and thrill of the ride.

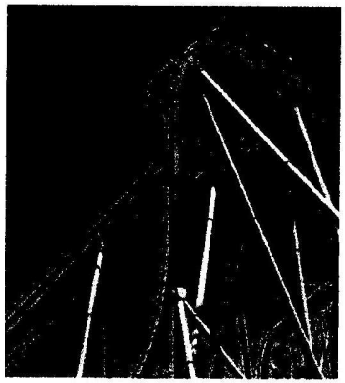


Fig. 13.1

Fig. 13.2 shows the simplified diagram of the first hill of the ride.

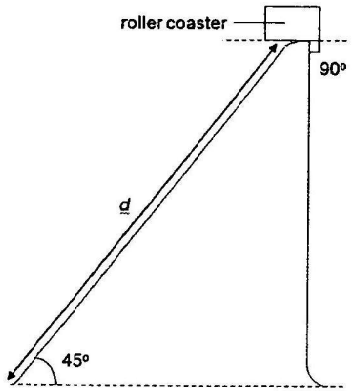


Fig. 13.2

At the start of the ride, the train of mass 3000 kg climbed a 45° lift hill at a constant

Total marks:	

speed of 3.04 m/s. The train then pauses on a holding brake for five seconds before dropping 62.5m at 90° hitting a maximum speed of 31.7 m/s at the bottom of the hill.

(a) State the Principle of Conservation of Energy.

_____

_____

_____

_____ [2]

(b) In dropping from the top to the bottom of the first hill, determine the average friction between the tracks and the train.

mass = _____ [3]

(c) Calculate the distance d and hence the time taken for the train to move up the first hill.

time taken = _____ [2]

(d) The work done in pulling the train is converted to different forms of energy. Name these forms of energy.

_____

_____ [1]

Total marks:	

(e) Calculate the minimum power of the electric motor pulling the train up the first hill. Assume that friction is constant for the entire ride.

power = ... [2]

Total marks:	

OR The Hare's apparatus is a device used for comparing the densities of two different liquids. As shown in Fig. 13.3, the equipment consists of a three-limbed E-shaped glass tube. The two longer limbs at the side are dipped into the beakers containing the liquids, X and Y.

One of the liquids is chloroform and the other is methyl isobutyl ketone. The central limb has a tap which allows air to be pumped out. When the tap is closed after air is pumped out, the densities of the liquids can be compared by measuring and comparing the column heights in the two long limbs.

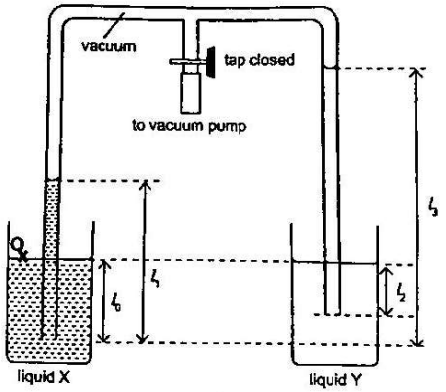


Fig. 13.3

The table below shows the densities of the two liquids.

liquid	density / kg m^{-3}
chloroform	1490
methyl isobutyl ketone	801

(a) Explain, in terms of the air molecules inside and outside the Hare's apparatus, why the liquid levels in the two limbs increase after the air is pumped out.

..... [3]

(b) On Fig. 13.4, sketch a graph to show the relationship between the pressure and

Total marks:	

volume of gas in the Hare's apparatus.

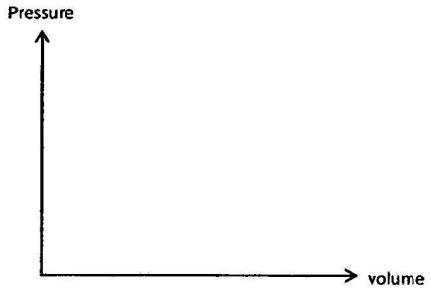


Fig. 13.4

[1]

(c) State which liquid (X or Y) is chloroform. Explain your answer.

_____

_____

_____

_____ [2]

(d) On Fig. 13.3, mark out a point **P** in liquid Y which has the same pressure as point **O**.

[1]

(e) Given that $l_0 = 5.0$ cm, $l_1 = 26.5$ cm and $l_2 = 3.0$ cm, calculate l_3.

l_3 = _____ [2]

Total marks:	

[Turn over

(f) This experiment is repeated at a mountain top where the atmospheric pressure is lower.

State and explain how your answer in **(e)** will be affected.

_____

_____

_____

_____ [1]

- End of Paper 2-

Total marks:	

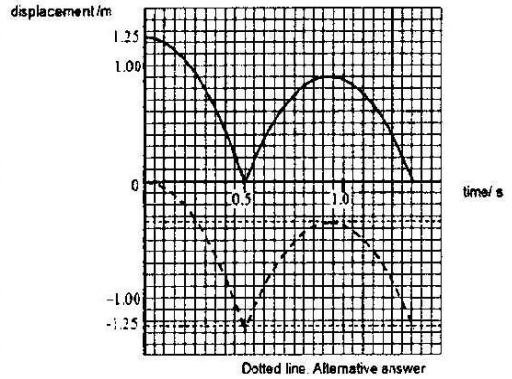
Zhonghua Secondary School

Preliminary Examinations 2016

5059 Physics Answer Scheme

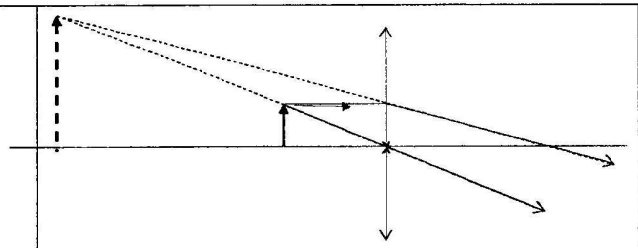
1	B	11	B	21	C	31	D
2	A	12	D	22	B	32	B
3	B	13	A	23	C	33	C
4	C	14	D	24	A	34	C
5	C	15	B	25	B	35	B
6	B	16	C	26	A	36	B
7	D	17	D	27	C	37	B
8	B	18	B	28	C	38	C
9	D	19	B	29	B	39	D
10	D	20	D	30	D	40	A

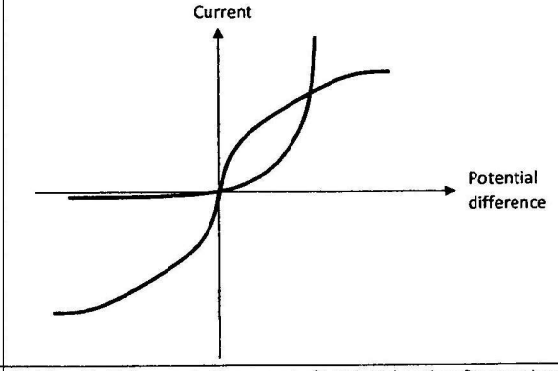
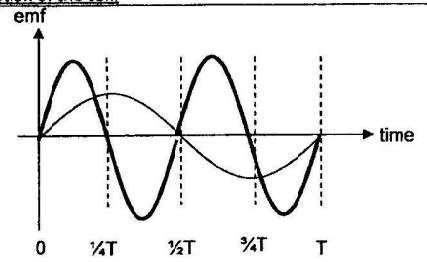
Paper 2

Qn		Mark
1a	0.50 s	1
1b	½ × 0.5 × 5 = 1.25 m	1 1
1c	10 or -10 m/s^2	1
1d	 Dotted line: Alternative answer	1 – shape from 0-0.5 s 2 m – 1.25 m and lower rebound height
2a	F_{net} on A, B and C = ma 300 = (35 + 5 + 20) a a = 5.0 m/s^2 F_{net} = ma F_{net} on B = 5 × 5 F_{net} on B = 25 N	1 1
2b	F_{net} on A = 35 × 5 = 175 N	1

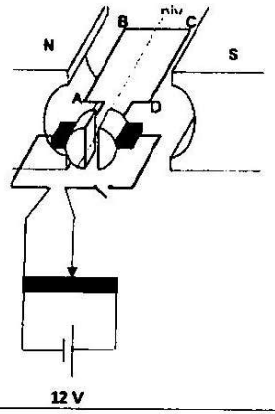
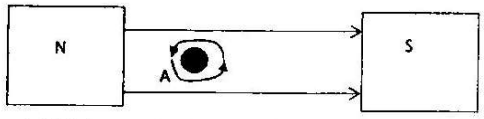
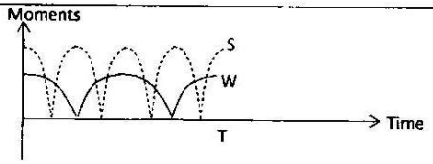
	300 – $F_{(on\ A\ by\ B)}$ = 175 $F_{(on\ A\ by\ B)}$ = 125 N	1

Question	Answer	Marks
2c	F on C by B and F on B by C F on C by surface and F on surface by C F on C by earth and F on earth by C	2
3a	Tension in X Tension in Y Force by cleaner on gondola (850 N) (W not accepted) Weight of gondola (6300 N)	2
3b	Taking X as the pivot: Y × 6 = (850 × 2) + (6300 × 3) Y = 3430 N (to 3sf)	 1 1
3c	Force exerted by rope Y will increase. As the cleaner moves from left to right, the perpendicular distance from the line of action of his weight and the pivot (X) increases. This increases the clockwise moment and hence the force exerted by Y has to increase to ensure the anticlockwise moment is equal to the clockwise moment.	1 1
4ai	$Pt = ml_v$ $(300\ W)(2 \times 60\ s) = (0.015\ kg)l_v$ $l_v = \frac{(300\ W)(2 \times 60\ s)}{0.015\ kg}$ $= 2.4 \times 10^6\ J\ kg^{-1}$	 1
4aii	The answer in (b)(i) is larger than the true value, because in reality energy is lost to the surrounding, and the mass of water *m* vaporised is less. Since l_v = Pt / *m*, a lower mass *m* leads to a higher l_v.	1 1
4bi	The boiling point of water is exactly 100 °C and so when the water is boiling the temperature will be constant at 100 °C.	1
4bii	$Q_{supplied} = Q_{thermometer} + Q_{water}$ $Pt = C_{thermometer}\Delta\theta + ml_v$ $(300\ W)(2 \times 60\ s) = (28.5\ J\ K^{-1})(70\ °C) + (m)(2.4 \times 10^6\ J\ kg^{-1})$ $m = 0.0142\ kg$	 1 1
4biii	If the thermometer has a large heat capacity C, it will take up a significant amount of energy per unit rise in temperature from the heat source and affect the accuracy of the measurements OR a thermometer with a high C is less responsive.	1

5a		1 m – correct X 1 m – all rays
5b	m = 2.8/0.9 = 2.9 to 3.3 f = 3.2 to 3.6 cm	1 1
6	The negative charges in a ball sets up an electric field (an equivalent diagram) which causes electrons t be repelled from the negative charges in the ball as like charges repel (The electric field set up between the finger and the ball eventually causes the electrons to move from the ball to the fingertip. A spark may be seen)	1 1
7a	Longitudinal waves	1
b	Average speed = 10 000 x10^3 / (23X 60) = 7246 m/s = 7200 m/s	1 1
c	Maximum wavelength = Speed / minimum frequency = 7246 / 0.50 m = 14500 m (or 15000 m) (or 14.5 or 15 km)	1 1
8a	V_1 = ½ 6.0 = 3.0 V	1
b	When light intensity decreases, R_{LDR} increases. Since $V_{LDR} = \frac{R_{LDR}}{R_{total}} \times emf$, LED should be placed across LDR	1 1

Question	Answer	Marks
8ci		1 m for curve, 1m for line
cii	If high p.d is high enough, the current of LED is higher than filament lamp for the same p.d, the LED will be brighter than lamp.	1
9a	Y: neutral wire Z: live wire	1
b	I = P/V = 50/230 = 0.217 A Total current flowing in fuse = 6(0.217) = 1.30 A There is no protection as 1.30 A > 1.0 A (or high current melt wire) and the 13 A will not blow to protect the fuse.	1 1
c	No, the appliance will not work as a missing fuse means the circuit is open and there will be no current.	1
10a	Lenz's Law states that the emf generated will produce a current which will flow in such a way to produce a magnetic field that opposes the motion of the coil.	1
b		1 – double amplitude 1 – double f
c	The rate of change of magnetic flux linking the coil and magnet increases. Since Faraday's Law depends on this rate of change, emf increases.	1

Question	Answer	Marks
11a)	Efficiency = (Po/Pi) X 100% = (5000/mgh) X 100% = (5000 / 0.035X1000X10X20) X 100% = (5/7) X 100% = 71%	 1 1
b)	The current carrying coils around rotor generate a magnetic field. when the coil rotates, the flux linking the rotating coil and stator coil changes (or flux cuts stator coil) and induces an emf across the stator coil.	Idea of magnetisation of rotor coil -1 Cause of flux change - 1 Flux change - 1
c)	$I = P/V = 120 \times 10^6 / 20 \times 10^3 = 6000$ A	1
ii)	Assuming no transformer power loss, $P_1 = P_2$ $V_1I_1 = V_2I_2$ $I_2 = (V_1/V_2)I_1$ But $(V_1/V_2) = 1/40$ Hence, $I_2 = (1/40)(6000) = 150$ A	 1
iii)	Input V to step down transformer = Output V of step up transformer – V across 2 transmission wires = (Turns ratio)(Input V of step up transformer) – (Current)(R of 2 wires) Input V to step down transformer = = $(40)(20 \times 10^3) - 2(150)(30)$ =791,000 V	Either 2(150)(30) or $(40)(20X10^3)$ – 1 m Ans-1 m
d)	Advantage : Energy is renewable Disadvantage : Have to clear forests to build dam	1

12a)i)	Using Fleming's Left Hand Rule: Current flows in direction BA Current flows in direction DC	1
ii)		1 m for terminal correct direction to achieve clockwise moment
b)	 Magnetic field of current and permanent magnet interact such that field is weakened above A and strengthened below A Force acts from region of high to low flux density (upwards)	Diagram-1 1 1
c)i)	The force on the coil is increased when the field strength increases This leads to a higher moment OR this is because there is a greater difference between the two interacting magnetic field densities	1 1
ii)		1 m only if cosine curve 1m for double f and amplitude No marks if sine curve

13Ea	Energy cannot be created nor destroyed. It can be converted from one form to another, or transferred from one body to another, but the total amount remains constant.	2
13Eb	Change in gravitational potential energy = (3000)(10)(62.5) = 1.875×10^6 J Increase in kinetic energy = ½ (3000)$(31.7)^2$ = 1.507×10^6 J Work done against friction = $1.875 \times 10^6 - 1.507 \times 10^6$ = 0.368×10^6 J Average friction = $0.368 \times 10^6 \div 62.5$ = 5880 N	3
13Ec	d = 62.5/sin 45 = 88.4 m t = 88.4 / 3.04 = 29.1 s	1 1
13Ed	Gravitational potential energy and thermal energy due to friction. (sound energy)	1
13Ee	Work done by motor against friction = $88.4 \times 5880 = 5.23 \times 10^5$ J Total work done by motor = $5.23 \times 10^5 + 1.88 \times 10^6$ Power = $(5.23 \times 10^5 + 1.88 \times 10^6)/29.1$ = 8.26×10^4 W	 1 1
13Oa	As the air is pumped out, the number of air molecules per unit volume decreases and becomes lesser than outside. The frequency of collision of the air molecules with the liquid decreases. The pressure inside becomes lower than outside and hence the liquid level increases.	1 1 1
13Ob		1

13Oc	X is chloroform. Chloroform has a higher density from table. h= P/ρg. Since pressure on liquids X and Y is the same, the higher density (ρ) of chloroform will lead to a lower liquid level (h) (liquid X)	1 1
13Od	Any point along the same level as point P in liquid Y	1
13Oe	Px = Py $\rho_x g h_x = \rho_y g h_y$ $(1490 \times 10 \times (l_1 - l_0)) = (801 \times 10 \times (l_3 - l_0))$ l_3 = 45.0 cm (to 3sf)	 1 1
13Of	Answer will not be affected. The ratio of the densities of X and Y is related only to the ratio of their column heights. Since there is no change in the ratio of the densities of X and Y, the column height of X will still be lower than Y.	 1

Bukit Batok Secondary School
GCE O–Level Preliminary Examination 2016
Secondary 4 Express

PHYSICS
Paper 1 Multiple Choice

5059 / 01
18th August 2016
1 hour
0745 hrs – 0845 hrs

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

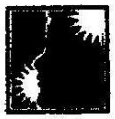
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class, and class register number on the answer sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.
Choose **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.


PERSISTING


ANSWER WITH CLARITY

This document consists of 16 printed pages

1. A micrometer is used to measure the thickness of a piece of gold bar. With the jaws closed, the micrometer reading is as shown in Fig. 1.1. With the gold bar, the micrometer reading is as shown in Fig. 1.2.

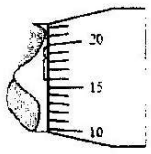


Fig. 1.1

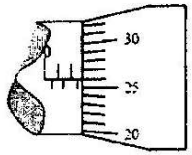
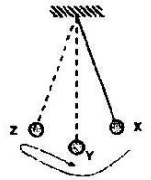


Fig. 1.2

What is the thickness of the gold bar?

A 2.60 mm
B 2.92 mm
C 3.00 mm
D 5.10 mm

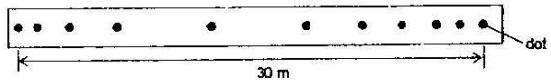
2. A pendulum starts to oscillate from point X. The time taken for the pendulum to move from point X to Z and then to point Y as shown below is 0.60 s.



What is the time taken for the pendulum to make 20 oscillations?

A 4.0 s
B 12.0 s
C 16.0 s
D 24.0 s

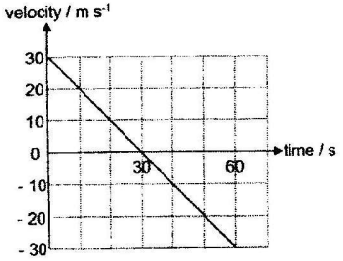
3. The diagram shows a strip of paper tape that has been pulled under a vibrating arm by an object that is in motion. The arm makes 40 dots in 2.0 seconds.



What is the average speed of the object?

A 15.0 m/s
B 54.5 m/s
C 60.0 m/s
D 64.5 m/s

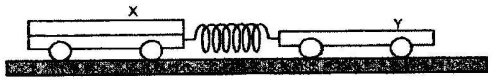
4. The diagram shows a velocity-time graph of an object being thrown vertically upwards.



At time t = 30 s, the object has _____.

A reached the highest point of its motion and the acceleration is –10 m/s^2
B reached the highest point of its motion and the acceleration is 0 m/s^2
C reached terminal velocity and the acceleration is –10 m/s^2
D reached terminal velocity and the acceleration is 0 m/s^2

5. Trolley X and trolley Y are joined together by a compressed spring.
The mass of trolley X is twice that of trolley Y. Both trolleys are initially at rest.
When the trolleys are released, trolley Y accelerates to the right at 1.0 m/s^2.



What is the acceleration of trolley X?

A 0.50 m/s^2 to the left
B 0.50 m/s^2 to the right
C 2.0 m/s to the left
D 2.0 m/s^2 to the right

6. A passenger lift of mass 300 kg is moving upwards at an acceleration of 2.0 m/s^2.

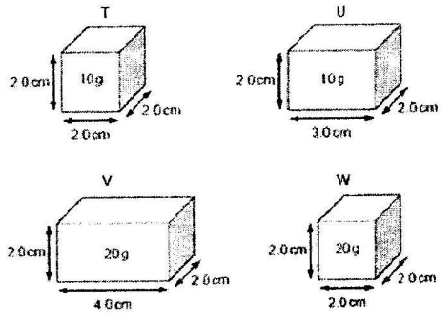
What is the tension in the cable of the lift?

A 600 N
B 2400 N
C 3000 N
D 3600 N

7. Which statement about gravitational fields is correct?

A It is the gravitational force per unit mass.
B It is the region in which a mass experiences a force due to gravity.
C It is the amount of gravitational force acting on an object.
D It is the amount of force acting on an object.

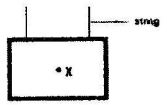
8. Four rectangular blocks, T, U, V and W are shown. Each block is labelled with its size and mass.



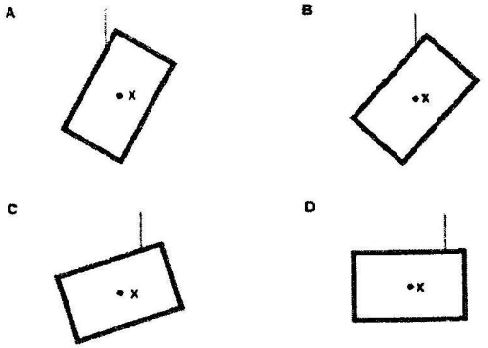
Which two blocks have the same density?

A U and V
B V and W
C T and U
D T and V

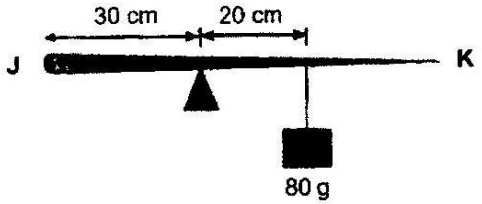
9. The diagram shows a rectangular card with centre of gravity X hanging from two strings.



Which of the diagrams below shows how the card hangs when one of the strings is cut?



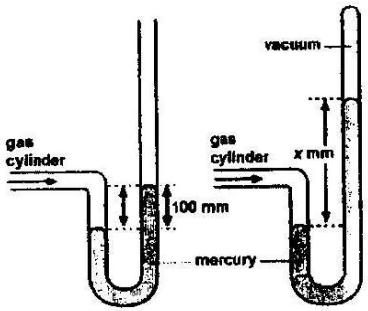
10. A non-uniform rod is balanced as shown below.
The centre of gravity of the rod is 14.0 cm from the end marked J.



What is the mass of the rod?

A 53 g
B 100 g
C 120 g
D 280 g

11. The diagram shows an open-ended manometer (on the left) and a closed tube manometer (on the right) connected to the same gas cylinder with the same volume of mercury. The atmospheric pressure is 760 mm Hg.



What is the height x of the mercury in the closed tube manometer?

A 560 mm
B 660 mm
C 760 mm
D 860 mm

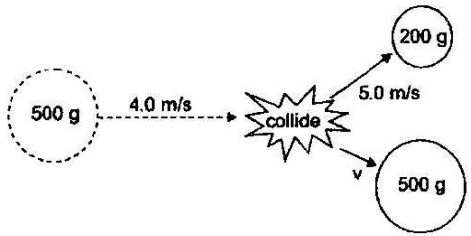
12. A diver deep underwater exhales an air bubble. The air bubble is observed to increase in size as it rises to the surface.

Which of the following explanations may be used to describe this phenomenon?

I The volume increases because the pressure underwater decreases with decreasing depth.
II The volume increases because while there is no pressure underwater, there is atmospheric pressure at the surface of the water.
III The pressure is constant regardless of depth because the temperature of the water is lower with greater depth.

A I only
B I and II
C II and III
D III only

13. A large ball of mass 500 g and an initial velocity of 4.0 m/s, hits a smaller ball of mass 200 g initially at rest. During the collision, 1.0 J of energy is lost as thermal energy. The smaller ball moves away at 5.0 m/s.



What is the final velocity, v of the 500 g mass after the collision?

A 1.00 m/s
B 1.41 m/s
C 2.45 m/s
D 2.82 m/s

14. Eisha has a mass of 50 kg. She runs to the top of a flight of 20 steps in 0.50 minutes. Each step is 0.20 m in height and 30 cm in width.

What is the power she develops?

A 6.7 W
B 67 W
C 400 W
D 4000 W

15. Brownian motion is observed in smoke particles.
Some students made the following statements during a discussion:

I It is due to the bombardment of air molecules.
II It is faster if the particles are smaller.
III It is faster if the temperature of the air is lower.
IV It is at random.

Which of the above statements are correct?

A I and II only
B I, II and IV only
C I, III and IV only
D I, II, III and IV

16. As air is sucked from a straw out of a sealed packet drink, the packet shrinks in volume.

Which of the following explains why the packet drink shrinks in volume?

A The internal surface area of the packet drink exposed to the collision of air molecules has decreased.
B The internal surface area of the packet drink exposed to the collision of air molecules has increased.
C The number of air molecules per unit volume in the packet drink has decreased and the force for each collision has decreased.
D The number of air molecules per unit volume in the packet drink has decreased and the frequency of collisions of the air molecules and packet wall has decreased.

17. A resistance thermometer reads 5.0 Ω at ice point and R Ω at steam point.
At 20 °C, it reads 8.0 Ω. What is the value of R?

A 15 Ω
B 20 Ω
C 40 Ω
D 45 Ω

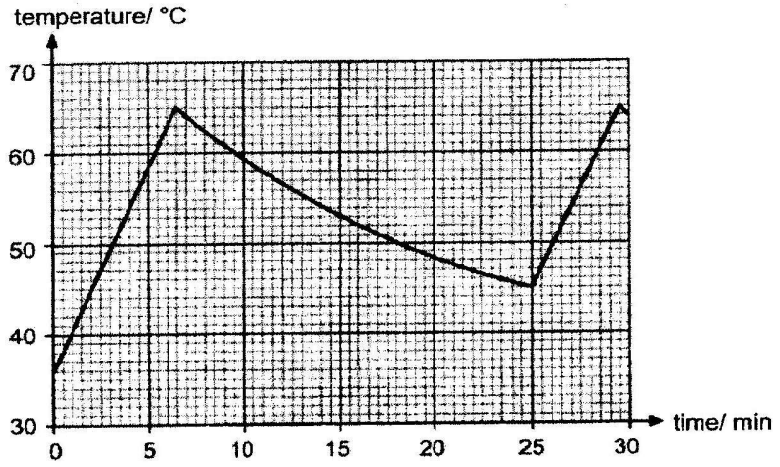
18. Three liquids with their respective boiling and freezing points are shown in the table below.

	Mercury	Alcohol	Pentane
Melting point / °C	– 39	– 112	– 130
Boiling point / °C	357	78	36.5

Which of the above liquids is suitable to be used in a thermometer that can measure a temperature of – 50 °C to 38 °C?

A alcohol
B mercury
C pentane
D any of the above

19. A tank containing 8.0 kg of water is kept warm by an electrical heater placed at the bottom of the tank. The heater is turned on when the temperature of the water in the tank is below 45 °C and turned off when the temperature reaches 65 °C. The variation of the temperature of the water with time for the first 30 minutes is shown in the graph.



The specific heat capacity of water is 4200 J/(kg °C).

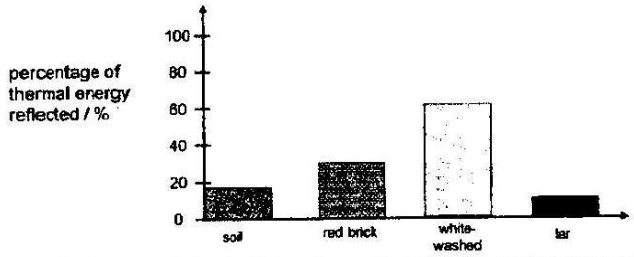
Assuming there is no heat loss due to evaporation and all the energy from the heater is used to increase the temperature of the water, what is the power of the heater?

A 370 W
B 540 W
C 910 W
D 2500 W

20. Latent heat of vaporisation is the energy required to _____.

A separate the molecules of the liquid greatly.
B increase the average kinetic energy of the molecules.
C separate the molecules and to increase the kinetic energy of the molecules.
D separate the molecules and to force back the atmosphere.

21. Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?

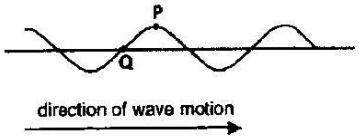
A cover it with a layer of red brick dust
B cover it with a layer of soil
C paint it with tar
D paint it with white-wash

22. At the end of a marathon, runners are sometimes issued with a thermal blanket to keep them warm as they are losing heat at a very fast rate.

Which of the following is a suitable material and colour for the blanket?

	material	colour
A	plastic	silver
B	metallic foil	silver
C	plastic	black
D	metallic foil	black

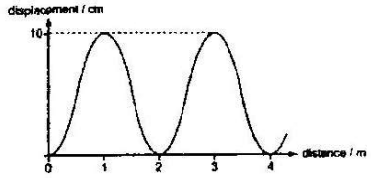
23. The diagram shows a transverse wave travelling from left to right.



What is the direction of vibration of points P and Q at this instant?

	P	Q
A	downwards	upwards
B	upwards	upwards
C	downwards	downwards
D	upwards	downwards

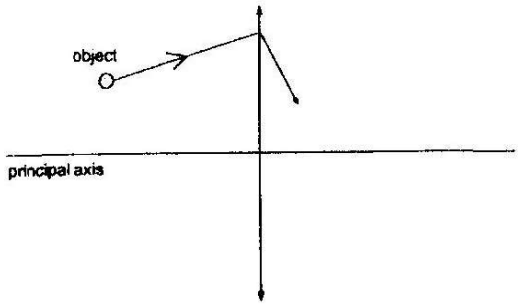
24. The graph below shows the motion of a water wave (at the surface) as it travels from left to right. The speed of the water wave is 25 cm/s.



What is the period of the wave?

A 0.080 s
B 0.125 s
C 8.00 s
D 12.5 s

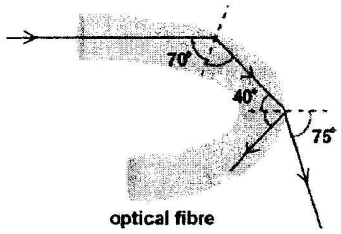
25. The figure below (drawn to scale) shows an object placed in front of a thin converging lens with one ray of light from the object drawn.



How would the image produced by the lens be described?

A real and upright
B real and inverted
C virtual and upright
D virtual and inverted

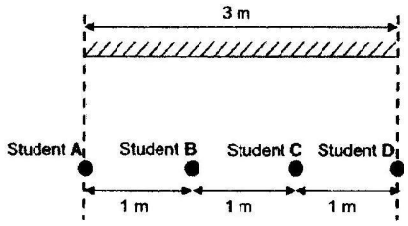
26. The diagram shows a light beam entering a piece of optical fibre.



Which of the following could be the value of the optical fibre's critical angle?

A 40 °
B 42 °
C 70 °
D 75 °

27. Four students stand in a row 1 m apart and parallel to a plane mirror that is 3 m long as shown below.



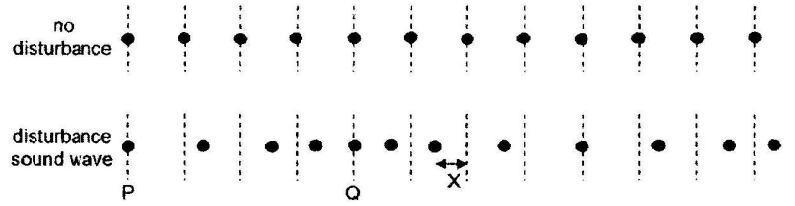
How many images can student B see?

A 1
B 2
C 3
D 4

28. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

A gamma ray → ultra-violet → radio wave
B gamma ray → visible light → ultra-violet
C microwave → ultra-violet → X-ray
D visible light → infrared → X-ray

29. The figures below show the positions of air molecules when there is no disturbance and when there is a disturbance due to a sound wave. The dotted lines represent the rest positions of the molecules.



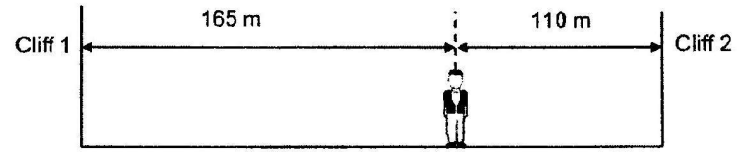
A list of statements is given below:

I Particle Q is always at the rest position.
II X represents the amplitude of the sound wave.
III The distance between P and Q is half the wavelength of the sound wave.

Which of the above statement(s) is(are) correct?

A II only
B III only
C I and II only
D II and III only

30. A man stands between two cliffs as shown in the diagram and claps his hands once.



Assuming that the velocity of sound in air is 330 m/s, what is the time interval between the 2 loudest echoes?

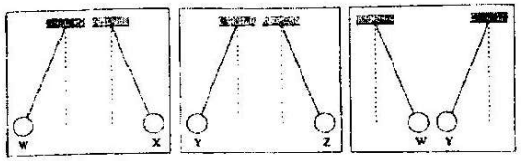
A 0.17 s
B 0.33 s
C 0.67 s
D 0.83 s

31. David attempts to charge a metal rod by rubbing it with a piece of cloth while holding the metal rod with his bare hands. After some time, the metal rod remains neutral.

What could be the reason that the rod remains neutral?

A Metal rod cannot be charged by friction.
B Metal rod need to be rubbed more vigorously with a cloth to be charged.
C David's hand conducted the excess charges away.
D The cloth absorbed all the excess charges.

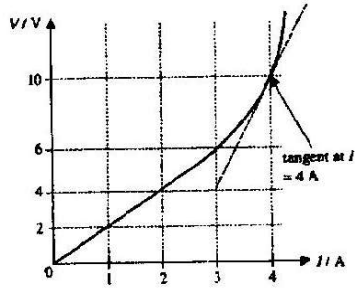
32. Four aluminium-coated plastic spheres, W, X, Y and Z, are attached to insulating threads. The following observations are made when some of the spheres are brought near each other.



Given that sphere Z is positively charged, which one of the following statements is true for sphere X?

A X is positively charged.
B X is negatively charged.
C X is either positively charged or neutral.
D X is either negatively charged or neutral.

33. The V-I graph of a wire is given below.
What is the resistance of the wire at V = 2 V and V = 10 V?



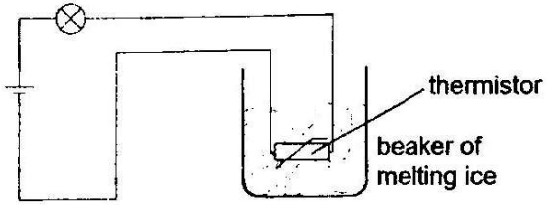
	resistance at 2 V / Ω	resistance at 10 V / Ω
A	0.50	0.40
B	0.50	0.20
C	2.0	2.5
D	2.0	6.0

34. A resistor of length L and cross-sectional area A has a resistance of R.
A second resistor of resistance 3R is made from wire of the same material but of cross-sectional area 2A.

What is the length of the second resistor?

A 0.67 L
B 1.5 L
C 3.0 L
D 6.0 L

35. A filament lamp connected in series with a thermistor is initially lit at room temperature.



What will happen to the lamp as the thermistor is completely immersed in a beaker of melting ice as shown in the figure?

A The brightness of the lamp remains unchanged.
B The lamp becomes brighter.
C The lamp becomes dimmer.
D The lamp starts to flicker on and off continuously.

36. When connecting a washing machine to the mains, which of the following is correct about the wires?

A The earth wire is at high potential and is dangerous to touch.
B The live wire should be connected to the case of the washing machine.
C The neutral wire does not normally carry any current and is safe to touch.
D When the earth wire is disconnected, the washing machine can still operate.

Class	Register Number	Name

Bukit Batok Secondary School
GCE O–Level Preliminary Examination 2016
Secondary 4 Express

PHYSICS
Paper 2 Theory

5059 / 02
12th August 2016
1 hour 45 minutes
0745 hrs – 0930 hrs

Candidates answer on the Question Paper.
Additional Materials: No additional materials needed

READ THESE INSTRUCTIONS FIRST

Write your name, class, and class register number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

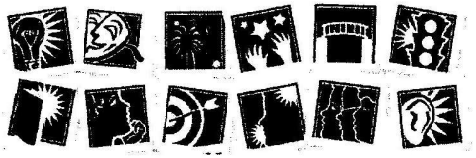
Section A
Answer **all** questions.

Section B
Answer **all** questions. Question **12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

At the end of examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Apply your Habits of Mind



For Examiner's Use	
Section A	
Section B	
Total	

This document consists of 18 printed pages, inclusive of this cover page.

Section A [50 marks]
Answer **all** the questions in this section.

1. Water is transported to a village in a tank pulled by a tractor. The combined mass of the tractor and the tank is 4100 kg when the tank is empty and the combined mass is 6500 kg when the tank is full of water. Fig. 1.1 shows the tank being pulled by a tractor.

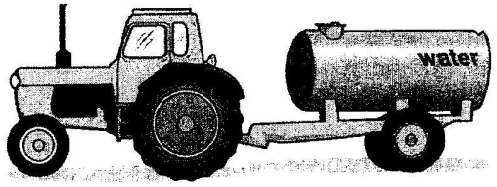


Fig. 1.1

(a) The density of water is 1000 kg/m^3. Calculate the volume of water in the tank when it is half-full.

volume =..... [2]

(b) At the start of the journey, the tractor and full water tank accelerate uniformly from rest along a straight, horizontal (flat) road. As their velocity increases, one form of energy is decreasing.

(i) Explain what is meant by *accelerate uniformly*.

.....
..... [1]

(ii) Identify the form of energy that is decreasing and hence explain what happens to it.

.....
.....
.....
..... [2]

(iii) A village is located on a mountain at a vertical height of 0.850 km above the source of water supply. Calculate the gravitational potential energy gained by the water as it is transported from the source of water supply to the village.
The gravitational field strength g is 10 N/kg.

gravitational potential energy =..... [2]

2. Fig. 2.1 shows the velocity-time graph of a 150 kg unmanned rocket *Explorer* launched from the surface of a planet Z. Planet Z has no atmospheric layer. The rocket rises vertically upward and after some time, a malfunction causes the rocket's engine to cut off suddenly.

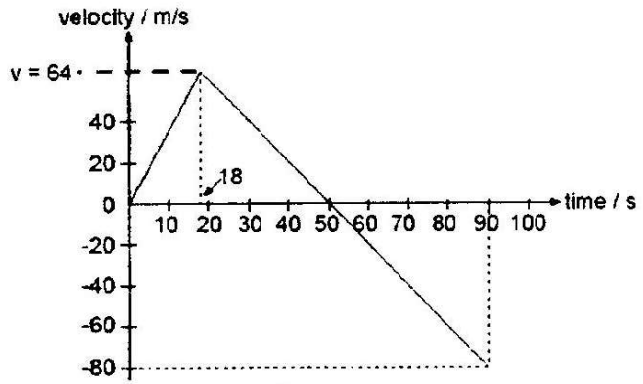


Fig. 2.1 (not to scale)

(a) Describe the motion of the unmanned rocket from t = 50 s to t = 70 s.

.....

..... [1]

(b) Determine the maximum height above the surface of planet Z in which the unmanned rocket rose to.

maximum height =..... [2]

(c) Explain, using newton's laws, the motion of the rocket for the first 10 seconds.

.....

.....

.....

..... [2]

(d) Determine the weight of the rocket after malfunctioning.

weight =..... [2]

3. (a) Fig. 3.1 shows a screwdriver of mass 120 g resting horizontally on a pivot.
The screwdriver is 27.0 cm long.

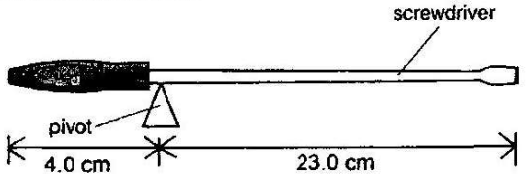


Fig. 3.1

Mark on Fig. 3.1, an 'X' to show the centre of gravity of the screwdriver. [1]

(b) Fig. 3.2 below shows a long uniform ladder **AB** resting against a smooth vertical wall. Horizontal distance **OA** is 3.0 m, while vertical distance **OB** is 6.0 m. The weight of the ladder is 0.50 kN.

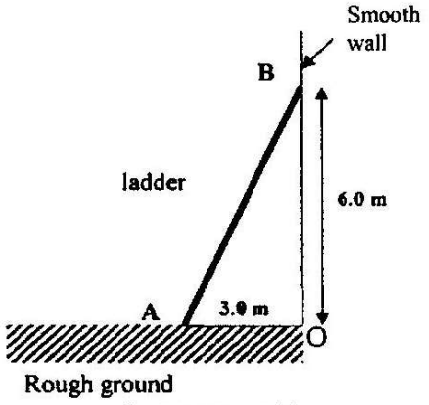


Fig. 3.2 (not to scale)

(i) The ladder does not slide down due to the rough ground.
Draw and label on Fig. 3.2 all the four forces acting on the ladder. [2]

(ii) Taking moments about point **A**, calculate the size of the reaction of the wall on the ladder.

size of reaction force =..... [2]

4. Double boil cooking is a process by which food (broth) is cooked by indirect heating.
Fig. 4.1 below shows a cross-sectional view of how it is done.

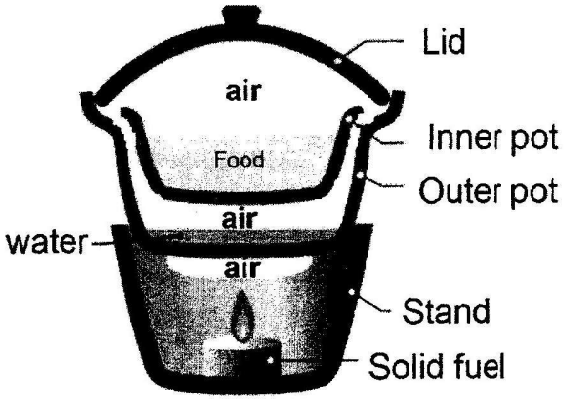


Fig. 4.1

The double boil system consists of 2 ceramic pots, one contained within the other.
There is no direct heat applied to the food contained in the inner pot.

(a) Explain how is thermal energy transferred from the water in the outer pot to the food in the inner pot.

.....

.....

.....

..... [3]

(b) As the water in the outer pot boils, the lid is observed to be vibrating.
Explain this in terms of the kinetic molecular theory.

.....

.....

..... [2]

(c) Water (both in the inner and outer pots) is used to slowly cook the food. Other than water being a poor thermal conductor, what property of water makes it possible to do so?

.....

..... [1]

(d) The temperature of the broth is measured at regular intervals of time.
Fig. 4.2 shows how the temperature varies with time t.

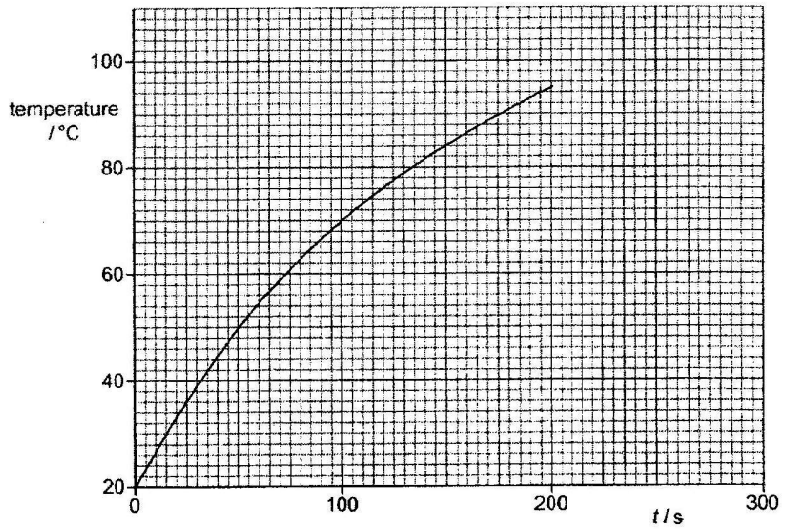


Fig. 4.2

(i) Explain why the increase in temperature is different for the first 100 s (0 s to 100 s) and the second 100 s (101 s to 200 s).

.....

.....

..... [1]

(ii) The 2.0 kW heater supplies 78 kJ of thermal energy (heat) to the broth (of mass 720 g) and the temperature of the broth changes from 50 °C to 73 °C.
Calculate the specific heat capacity of the broth.

specific heat capacity of broth = ... [2]

5. Fig. 5.1 shows straight wavefronts that are produced by a wave generator in a ripple tank. The wave generator dips the surface of the water 900 times in 3 minutes. A distance of 10.0 cm is measured with a metre rule between a few wave fronts.

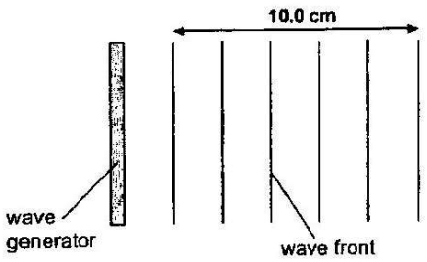


Fig. 5.1

(a) Explain what is meant by a *wave front*.

.....

..... [1]

(b) Determine the speed of the wave.

speed =..... [2]

(c) To study the effects of depth of water on the wave properties, the wave is made to enter a region of greater depth. State and explain the change to the speed, frequency and wavelength of the wave as it enters this region.

.....

.....

.....

..... [2]

6. Fig. 6.1 shows a diagram of an X-ray machine capturing an image of the chest of a person. The distance between the X-ray tube and the X-ray receiver is 1.0 m.

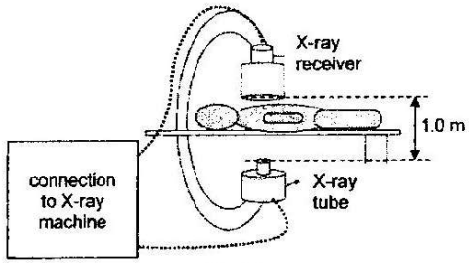


Fig. 6.1

(a) Calculate the time taken for the X-ray receiver to receive the signal from the X-ray tube. State any assumptions made.

time taken = ... [2]

(b) Explain whether X-rays are suitable to be used to obtain images of the unborn foetus in the womb.

.....

.....

..... [1]

(c) State an electromagnetic wave that has a frequency higher than X-ray and describe a practical use of this wave.

.....

.....

..... [1]

7. Parallel rays of light coming from an object travel towards a polystyrene plastic converging lens as shown in Fig. 7.1. The focal points of the lens are labelled as **F**.

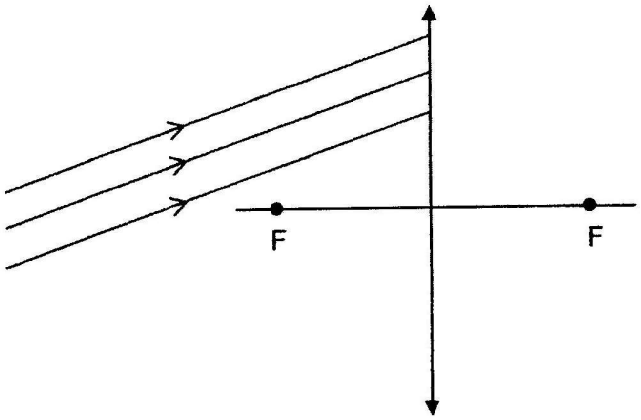


Fig. 7.1

(a) Continue the paths of light in Fig. 7.1 to show how the rays bend after passing through the lens. Include any working lines in your answer. [2]

(b) The polystyrene lens is now placed in water. The rays of light strike the lens at the same angle. The refractive indices of various materials are shown in Fig. 7.2.

Material	Refractive index
Vacuum	1.00
Air	1.00
Water	1.33
Glass	1.52
Polystyrene plastic	1.59

Fig. 7.2

Determine the critical angle of polystyrene plastic.

critical angle = ... [2]

8. During an experiment, an insulated copper wire is coiled around the middle of the soft iron rod and connected to a cell as shown in Fig. 8.1.

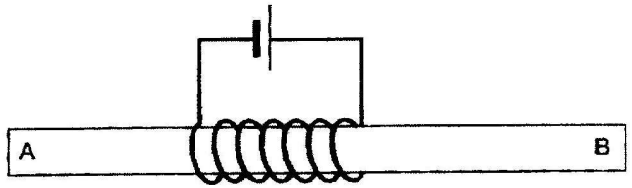


Fig. 8.1

(a) Deduce the polarity of end A of the rod, explaining your answer.

.....

.....

.....

..... [2]

(b) End B of the rod was used to pick up steel paper clips. Suggest two other methods of increasing the number of steel paper clips that can be attracted off the ground.

.....

.....

.....

..... [2]

9. Fig. 9.1 shows an electric kettle, which has a label with "230 V, 1.1 kW" marked on it. The kettle is connected to a 230 V mains supply by the live, neutral and earth wires.

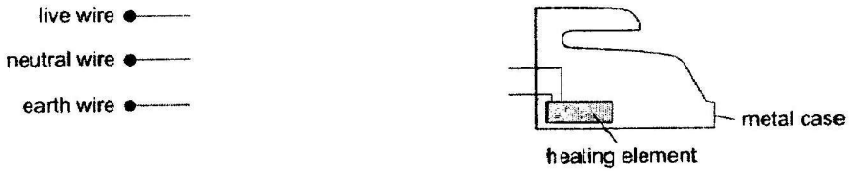


Fig. 9.1

(a) Complete the diagram by drawing suitable wires to connect the kettle to the mains supply. Include a fuse and a switch for the kettle, showing where they should be connected. [3]

(b) Suggest a suitable fuse rating, explaining your answer.

fuse rating = ... [2]

Section B [30 marks]

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 12**.

10. (a) Under the Environmental and Protection and Management Act, all refrigerators sold in Singapore must carry energy labels which will show the number of "Green Ticks" awarded to them. A refrigerator with more Green Ticks is more energy efficient than one with fewer Green Ticks. The table in Fig. 10.1 below shows some data of refrigerators and the number of Green Ticks that they carry. The Annual Energy Consumption is the amount of energy the refrigerator would consume if it is used continuously for an entire year (of 365 days).

Refrigerator	Cost / S$	Green Ticks	Volume / litres	Exterior Colour	Annual Energy Consumption / kWh
A	1600	2	200	White	530
B	1650	3	200	Silver	480
C	1700	2	400	Black	720
D	1900	3	400	Red	550

Fig. 10.1

Using information from Fig. 10.1,

(i) calculate the average power consumed by Refrigerator **A**.

average power =..... [2]

(ii) John is deciding whether to buy a 400-litres refrigerator. Assuming that the lifespan of each refrigerator is 10 years and that the average cost of electricity is S$0.20 per kWh over the 10 years, determine which refrigerator he should buy and estimate the amount of money that he would save.

Refrigerator =.....

amount of money saved =..... [3]

(b) John places a bottle of orange drink in a freezer and records the temperature of the orange drink every five minutes. His results are shown in Fig. 10.2 below.

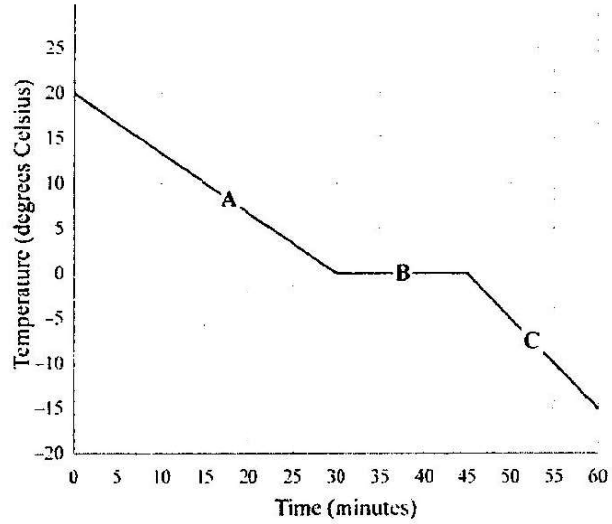


Fig. 10.2

(i) The mass of the orange drink is 0.150 kg. Calculate the amount of thermal energy lost by the orange drink during section **B** of the graph.
The specific heat capacity of the orange drink is 4.2 J / (g °C) while the specific latent heat of fusion is 334000 J / kg and the specific latent heat of vaporisation is 2260000 J / kg.

amount of thermal energy =..... [2]

(ii) Explain why there is no temperature drop during section **B**, even though the orange drink is continuously cooled.

..... [2]

(iii) State the difference in molecular arrangement for Sections **A** and **C**.

..... [1]

11. Thin copper wire, covered in plastic insulation, is used to make a solenoid. The solenoid is connected to a sensitive centre-zero ammeter. Fig. 11.1 shows the North-pole of a steel magnet placed next to the solenoid. Point X and point Y are on the centre axis of the solenoid, near to the right-hand end of the solenoid.

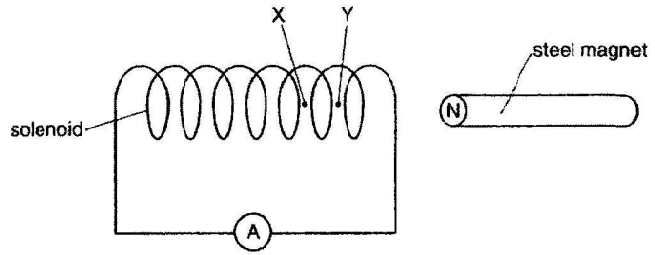


Fig. 11.1

(a) In one experiment, the magnet in Fig. 11.1 is moved to the left and passes into the solenoid. The North-pole of the magnet moves into the solenoid at a constant speed.

(i) Explain why there is a current in the solenoid when the magnet is moving from Y to X.

.....

.....

..... [1]

(ii) State the polarity of Y when the steel magnet approaches it, explaining your answer.

.....

.....

.....

..... [2]

(iii) The North-pole travels from Y to X in 0.14 s. As it moves, the current shown on the ammeter is 0.045 mA. The resistance of the solenoid is 1.2 Ω.

Calculate

1. the potential difference (p.d.) across the solenoid,

potential difference =..... [2]

2. the charge that passes through the solenoid as the N-pole moves from Y to X.

charge = ... [1]

(b) In a second experiment, the speed of the North-pole is greater than its speed in the first experiment. It now takes only 0.070 s to travel from Y to X. A current in the same direction is shown on the centre-zero ammeter.

The same quantity of charge passes through the coil in both the first and second experiments. Explain, comparing the magnitude of current in both situations, why this is the case.

.....

.....

.....

..... [2]

(c) Draw the magnetic field around the steel magnet shown below. [2]



EITHER

12. Fig. 12.1 shows high voltage cables used to transmit electrical energy. The cables are hung on tall transmission towers. Fig. 12.2 shows the typical voltage levels used for transmission.

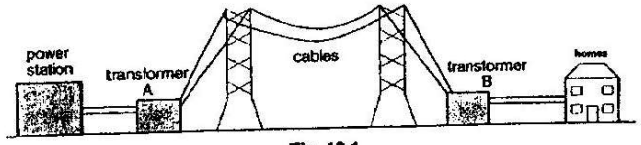


Fig. 12.1

Voltage level	Range of voltage / kV	Maximum length of cable / km
High voltage	100 to 230	320
Extra-High voltage	230 to 800	640 to 800
Ultra-High voltage	Above 800	Above 800

Fig. 12.2

(a) Using information from Fig. 12.1 and 12.2, explain why higher voltages are used to transmit electrical power over very long distances.

.....

.....

..... [2]

(b) The 980 MW power station produces 50 Hz alternating electricity at a voltage of 20 kV. Transformer A in Fig. 12.1 is ideal, with 48000 turns in the secondary coil and it produces an output voltage of 280 kV. Transformer B takes in 900 MW and change the voltage before providing electricity to homes.

(i) Explain whether or not the transformer will work with a direct current power supply.

.....

.....

..... [2]

(ii) Calculate the number of turns in the primary coil of transformer A.

number of turns =..... [2]

(iii) Determine the efficiency of power transmission in the cables.

efficiency =..... [1]

(c) In one part of the homes, a long transmission line is connected to the output of transformer B.

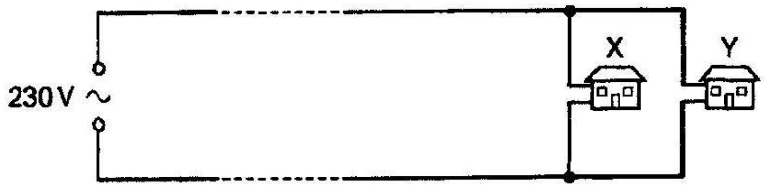


Fig. 12.3

The occupier of house X switches off the water heaters and air-conditioners in his house.

(i) Would the voltage supplied to house Y increase, remain the same, or decrease? Explain.

.....

.....

..... [2]

(ii) An electrician measures the voltage-time properties of the mains supplied to houses X and Y. On Fig. 12.4, mark out the values on the axes. [1]

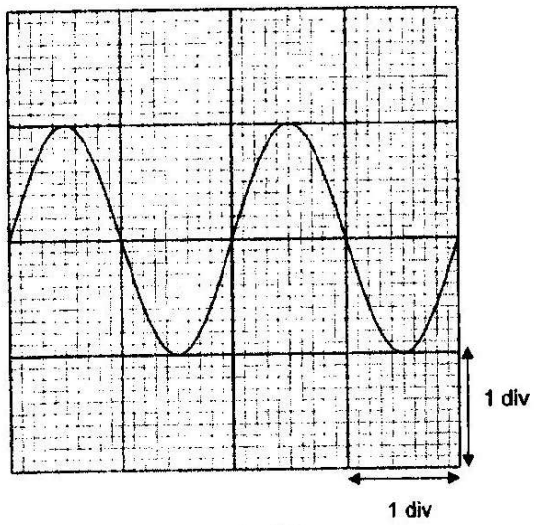


Fig. 12.4

OR

12. **(a)** Fig 12.5 shows a simple D.C. motor. An observer stands in front of the split-ring commutators.

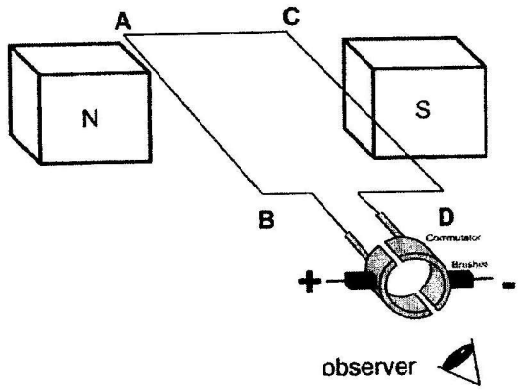


Fig. 12.5

(i) Explain why there is a force acting on part **AB** of the rectangular coil.

.....

.....

..... [1]

(ii) State and explain the direction of the force acting on part **AB** of the rectangular coil.

.....

.....

.....

..... [2]

(iii) The set-up was assembled wrongly by a student with no split-ring commutators. Describe the motion of the coil without the use of split-ring commutators.

.....

.....

.....

..... [2]

(b) Fig. 12.6 shows a hydraulic press that is activated by exerting a force of 50 N on the end of an arm 30 cm from the hinge. The arm transfers the moment to an input piston 5.0 cm from the hinge which then transfers the pressure to push the output piston with a force F.
The area ratio of the output piston to input piston is 5:1.

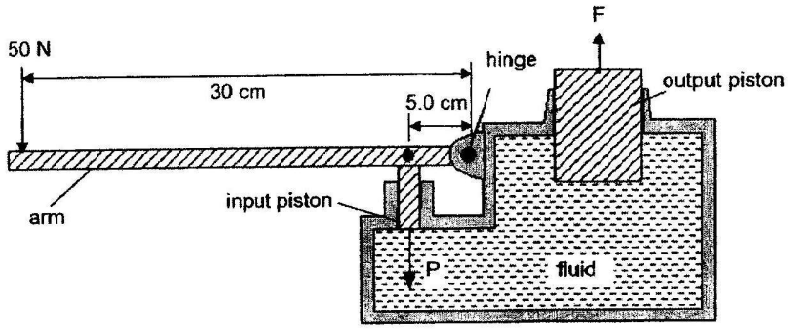


Fig. 12.6

(i) The output force **F** is always greater than the force at the arm.
Explain why, using ideas of energy.

.....

.....

.....

..... [2]

(ii) Calculate

1. the force **P** due to the input force of 50 N, stating the principle involved and hence,

force **P** =.....

2. the force **F** produced.

force **F** =..... [3]



—— End of Paper ——
When you come to the end of the rope, tie a knot and hang on.
Do not let go! Persist!

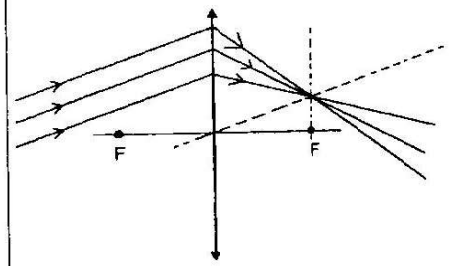
BUKIT BATOK SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS WITH SPA (5059)
GCE O-LEVEL PRELIMINARY EXAMINATIONS
SUGGESTED ANSWERS AND COMMON MISTAKES FOR STUDENTS – PAPER 2

Question	Suggested Answer
1a	Mass of water = (6500-4100)/2 = 1200 kg Volume = mass / density = 1200 / 1000 = 1.20 m^3 **Common mistakes:** • Did not write formula • Did not halve (divided by two) the mass • Wrong units used for volume
1b(i)	• Velocity increases (or changes) constantly (or steadily) per unit time • Constant rate of change of velocity **Common mistakes:** • Wrote rate of change of velocity per second • Wrote rate of change of velocity per unit time • Wrote speed instead of velocity • Did not explain uniform
1b(ii)	• Chemical energy (accept chemical potential energy) • Converted to heat (or thermal energy) and light energy in the combustion engine (burning) • Converted to kinetic energy of the tractor and tank **Common mistakes:** • Did not mention burning or combustion • Wrote about forces decreasing instead of energy decreasing • Mixed up energy with friction (a force) • Did not describe where the energy was converted to
1b(iii)	GPE = mg Δh = (2400) (10) (850) = 20400000 J **Common mistakes:** • Did not write formula • Mixed up the mass to be the mass of the tractor • Mixed up the full mass with half the mass • Did not convert 0.850 km to 850 m
2a	It falls vertically at uniform acceleration **Common mistakes:** • Did not mention the shape of the graph – uniform/constant/steady • Did not mention change in velocity (used speed instead)

Question	Suggested Answer
2b	Maximum height = area under graph = ½ (50) (64) = 1600 m **Common mistakes:** • Did not identify the time period of t = 0 s to t = 50 s • Wrote distance = speed x time • Did not halve (divided by two) the mass • Used the area of triangle of t = 0 s to t = 18 s
2c	• The upward thrust is larger in size than downwards weight • Net force is upwards • By F = ma, rocket accelerates upwards **Common mistakes:** • Did not mention net force • Did not mention upthrust and weight • Did not mention acceleration • Memorised and stated first law blindly • Assumed no resultant force
2d	Weight = m g = (150) (80 ÷ 40) = 300 N **Common mistakes:** • Assumed g = 10 due to no atmospheric layer • Assumed g = 10 (= on earth) • Used the acceleration for t = 0 s to t = 18 s
3a	X marked out on screwdriver directly above the pivot **Common mistakes:** • Marked out the middle of the rod • Marked out the middle of the handle • Left the question blank
3b(i)	• Downward weight at geometrical centre of ladder • Upward surface reaction force at A • Frictional force at A to the left along ground • Surface reaction force at B to the left **Common mistakes:** • Did not draw the arrow of weight in the middle of the ladder • Did not consider the smooth nature of the vertical wall • Did not consider that the ladder did not slip and slide down due to rough ground with friction • Did not draw a total of 4 forces
3b(ii)	Taking moments about A, for equilibrium, Clockwise moments = anti-clockwise moments (500)(1.5) = (F)(6.0) F = 125 N **Common mistakes:** • Wrongly assumed distance of weight = 3.0 m • Wrongly assumed distance of force = 3.0 m • Did not write the principle of moments properly – used shorthand

Question	Suggested Answer
4a	• Hot steam from the boiling water in outer pot rises up due to smaller density to reach the bottom of inner pot as well as to the top of the food. • Heat is conducted through the inner pot into the food. • Thermal radiation (transfer of infrared radiation) from hot water toinner pot. **Common mistakes:** • Overly wrote on convection • Focused on convection of water in outer pot • Did not consider conduction • Did not consider radiation
4b	• Steam (gas particles) move randomly at high speeds • The change from liquid state to gaseous state also involves a large increase in volume. • Steam particles collide against inner walls of lid, exerting a force on it to push it out **Common mistakes:** • Did not consider the huge increase in volume upon vapourisation • Focused on convection in boiling water • Focused on how water heats up via convection
4c	• Water has a high specific heat capacity **Common mistakes:** • Focused on convection of water • Focused on properties of fluid (liquid) • Repeated poor conductor of heat for water
4d(i)	• The higher the temperature difference of the water with the surroundings (20 °C), the larger the rate of heat loss to the surroundings. **Common mistakes:** • Stated but did not explain the trend of the graph • Stated that the initial 100 s rose more in temperature than the second 100 s
4d(ii)	$Q = m\ c\ \Delta\theta$ $78000 = (0.720)\ (c)\ (23)$ $c = 4710$ J / (kg K) [accept 4.71 J / (gK)] **Common mistakes:** • Wrong units • Missing units • Used the wrong data
5a	Imaginary line connecting points on a wave that are in phase **Common mistakes:** • Wrong definition • Many left blank

Question	Suggested Answer
5b	$V = f\lambda$ $= (900 / 180)\ (2.0\ cm) = 10.0$ cm/s [accept 0.100 m/s] **Common mistakes:** • Wrongly determined frequency • Wrongly determined wavelength (use 10 ÷ 5 or used 10 cm) • Wrote the wrong units as m/s
5c	Speed increases as there is less friction Frequency remains the same as the source is the same Wavelength increases as by $V = f\lambda$, speed increases **Common mistakes:** • Wrongly assumed that speed decreases • Wrongly assumed that frequency changes • Stated but did not explain
6a	Speed of X-rays in air ~ 3.0×10^8 m/s Time = distance / speed $= 1.0 / 3.0 \times 10^8 = 3.33 \times 10^{-9}$ s = 3.33 ns **Common mistakes:** • Did not use the correct speed for X-rays • Left blank • Did not use calculator to check answer • Wrote 3.0×10^{-9} s • Did not write the formula
6b	Not suitable X-rays are highly energetic and ionizing, killing the cells in the foetus. **Common mistakes:** • Unable to bring out idea of highly ionising
6c	• Gamma rays • Used to kill cancer cells in treatment of cancer • Use in the sterilization of canned food or medical equipment in hospitals or surgical equipment • Used to detect cracks in metals or cement • Used to kill bacteria in vegetables and fruits **Common mistakes:** • Did not mention the use • Incomplete answer

Question	Suggested Answer
7a	All 3 rays converge at the same point vertically above the focal point F on the right side of lens Two working lines to guide the rays to the correct position to intersect  **Common mistakes:** • All rays converged to focus point (F) on the principal axis • Incomplete answer
7b	$n = \frac{1}{\sin c}$ $\sin c = \frac{1}{1.59}$ $c = 39.9^0$ **Common mistakes:** • Used the wrong refractive index • Mixed up with water • Tried to use water and plastic together
8a	• North pole • Solenoid is magnetized to have a North pole on the left side by Right-hand Grip rule, with the thumb pointing to the North pole direction and the fingers curling in the direction of current in the solenoid. [accept Maxwell corkscrew rule explanation] **Common mistakes:** • Confused Maxwell corkscrew rule with right hand grip rule • Unable to verbalise right hand grip rule • Did not mention fingers or thumb or both • Applied right hand grip rule wrongly
8b	• Increase current in the coil by increasing e.m.f. of cell or using more cells connected in series • Use thicker wire (coil) with lower resistance so as to increase the current flowing in the coil • Increase number of turns of coil per unit length **Common mistakes:** • Wrote number of coils (= number of wires) instead of number of turns of coil • Did not mention connecting more cells in series • Wrongly identified cell of diagram as battery • Used voltage instead of e.m.f. (electromotive force) • Went on to explain when they wanted stating

Question	Suggested Answer
9a	• Correct connection of live and neutral wires to heating element • Correct connection of earth wire to metal casing • Correct symbol and placement of fuse and switch along live wire **Common mistakes:** • Drew fuse as fixed resistor (rectangle) • Did not draw switch and did not draw fuse • Short-circuited live and neutral by joining them together • Crisscrossed wires • Drew fuse inside the kettle
9b	P = I V 1100 = (I) (230) I = 4.78 A Fuse rating = 5A, 6A, 7A **Common mistakes:** • Confused fuse rating with power • Used 2 d.p. or 3 s.f. for fuse rating – fuse rating should be whole number • Did not write units for final answer in working • Did not use 3 s.f. for final answer in working • Did not convert 1.1 kW to 1100 W
10a(i)	P = energy / time = (530 x 1000 x 3600) / (365 x 24 x 3600) = 60.5 W **Common mistakes:** • Confused kWh as power – kWh is energy • Did not use seconds – used number of days
10a(ii)	kWh savings per year for D compared to C = 720 – 550 = 170 kWh Electricity cost savings for 10 years for D compared to C = 170 x 10 years x $0.20 = $340 Savings = $340 – $200 = $140 He should buy D as he will save $140. **Common mistakes:** • Did not consider total cost of using D and C • Did not identify D and C as 400-litre refrigerators • Got ridiculously large numbers of more than $10000
10b(i)	$Q = m l_f$ = 0.150 x 334000 = 50100 J **Common mistakes:** • Apply $Q = mc\Delta\theta$ and got zero joules • Did not identify region B properly • Used specific latent heat of vaporisation

Question	Suggested Answer
10b(ii)	• Energy is released by particles as they come closer to stronger intermolecular forces of attraction • Solidification (liquid to solid state) • Same average KE of particles **Common mistakes:** • Wrote one point and gave a one-mark answer • Did not write about freezing • Did not mention forming stronger bonds or stronger intermolecular forces of attraction (IMFA) • Did not write same/constant average KE of particles
10b(iii)	• In A, particles are randomly arranged and closely packed (slightly farther apart than solid state). • In C, particles are orderly arranged and VERY closely packed. **Common mistakes:** • Did not compare the same thing for A and C • Did not compare randomness and packing of particles • Wrote closely packed for both A and C without any difference that solid is VERY closely packed
11a(i)	The coil experiences a change in magnetic flux (of magnet) linked to it, inducing an e.m.f. in the coil, leading to an induced current. **Common mistakes:** • Did not mention the linking to the coil • Thought that the solenoid has a magnetic field initially • Wrote that the steel magnet cut its own magnetic field lines
11a(ii)	• North-pole (accept N-pole) • By lenz's law, solenoid tries to oppose the incoming N-pole of magnet by inducing a North pole to repel it • As like poles repel **Common mistakes:** • Unable to verbalise lenz law • Confused with the magnetic fields present • Did not write that like poles repel
11a(iii)	V = I R = (0.000045) (1.2) = 0.000054 V **Common mistakes:** • Unable to convert 0.045 mA to 0.000045 A • No formula given
11a(iii)	Q = I t = (0.000045) (0.14) = 0.0000063 C **Common mistakes:** • Unable to convert 0.045 mA to 0.000045 A • No formula given • Wrong formula used • Wrong or missing units

Question	Suggested Answer
11b	• The current in the second experiment has a larger size than that in the first experiment • due to a larger rate of change of magnetic flux linked to the coil as the magnet moves faster **Common mistakes:** • Unable to link to current in second experiment being larger • Tried to prove using Q = It when it is already told that Q is the same • Unable to link to Faraday's law • Unable to use the right terms (rate of change) for Faraday's law • Missed out on the "linked to coil" part
11c	• Correct shape and symmetrical and sufficient (at least 6) field lines • Correct magnetic field lines direction • Increasing gap between field lines • Field lines originate from poles (near to the ends of bar) **Common mistakes:** • Equal gap • Insufficient lines drawn • Lines drawn out the paper or out of answer space – try not to • Wrong arrow directions • Lines intersecting
12-E	**12-EITHER**
12E-(a)	• The higher the voltage, the longer the maximum length of cables that can be used. • For same power P = IV, a higher voltage implies a lower current, and that leads to a smaller I^2R heating loss. **Common mistakes:** • Unable to use the table of numbers • Unable to mention maximum length of cable and unable to use data • Unable to verbalise loss and heating loss with the formula I^2R
12E-b(i)	• It will not work. • Direct current gives a constant magnetic field. • Secondary coil would not experience continuous change in magnetic flux linked to it, hence no continuous induced e.m.f. **Common mistakes:** • Unable to link to secondary coil (where the output is) • Did not mention change in magnetic flux linkages • Did not mention continuous (time-frame)
12E-b(ii)	Ns / Np = Vs / Vp Np = (48000 x 20000) ÷ 280000 = 3428.6 ~ 3430 turns **Common mistakes:** • Used power values (900 MW and 980 MW) instead of voltages • Used 4 s.f. = 3429 instead of 3 s.f. or 2 s.f.
12E-b(ii)	Efficiency = useful output power / total input power = 900 000000 / 980 000000 = 0.918 (accept 91.8 %) **Common mistakes:** • Did not write formula

Question	Suggested Answer
12-E	**12-EITHER**
12E-c(i)	• Increases. • Smaller current (**without X**) is drawn from the supply, and for the same power supplied by transformer source, P = IV, voltage V increases. **Common mistakes:** • Not aware of how transformer works • Did not take into account long transmission lines • Used parallel circuit connections as error-carried-forward
12E-c(ii)	• Period = 0.020 s • Amplitude = 230 V **Common mistakes:** • Did not calculate the Period (= time for one sine curve) • Did not bring in 230 V • Some used 240 V from memory • Did not draw the vertical and horizontal axis • Did not mark out (0,0) for sine curve
12-OR	**12-OR**
12OR-a(i)	• Current in AB creates a magnetic around AB that interacts with the magnetic field of the magnets. • A (perpendicular) force is produced on AB (due to catapult effect). **Common mistakes:** • Directly applied fleming's left hand rule • Wrote that the current interacted with the magnetic field
12OR-a(ii)	• Vertically downwards • By Fleming's left hand rule, with middle finger pointing in direction of current from B to A, index finger pointing in direction of magnetic field from N-pole to S-pole, the thumb points in the direction of induced force downwards. **Common mistakes:** • Unable to identify the conventional current flow • Unable to verbalise fleming's left hand rule • Unable to link to the fingers and thumb of fleming's left hand rule
12OR-a(iii)	• It will rotate 90 degrees until it reaches the vertical position, • and start to oscillate about the vertical position with decreasing amplitude until it comes to a stop. **Common mistakes:** • Unsure if it started to rotate clockwise or anti-clockwise • Thought that it will rotate in one direction (= normal operation!) • Wrote about use of split-ring commutator merely • Did not write about it stopping eventually • Wrote that it would rotate 180 degrees (half a round) before anything happens to it

Question	Suggested Answer
12-OR	**12-OR**
12OR-b(i)	By conservation of energy, work done by input force downwards is equal to work done by F upwards. Since the end of arm (where 50 N is) will move down much more (larger distance) than the piston moving up (smaller distance), the size of 50 N input force will be smaller than size of F. **Common mistakes:** • Did not apply the conservation of energy • Merely wrote the principle of conservation of energy without the local context • Used Pascal's law of pressure in enclosed liquid • Tried to compared force P and force F • Did not use nor mention force of 50 N at end of arm
12OR-b(ii)	By principle of moments, for equilibrium, clockwise moments = anti-clockwise moments (50) (30) = (P) (5.0) P = 300 N **By newton's 3rd law, the oil has a force of 30 N acting on the piston P in the upward direction.** **Common mistakes:** • Wrongly assumed that distance of 50 N from pivot (hinge) is 25 cm • Did not write down principle of moments properly
	Pressure at input piston = Pressure at output piston Force at P / Area of piston P = Force at F / Area of piston F F = 5 x 300 N = 1500 N Allow e.c.f. of F from P. **Common mistakes:** • No formula and no working • Did not use answer from earlier part

SECONDARY FOUR EXPRESS PHYSICS WITH SPA (5059)
GCE O-LEVEL PRELIMINARY EXAMINATIONS
SUGGESTED ANSWERS – PAPER 1

Question	Answer	Question	Answer
1	**A**	21	**D**
2	**C**	22	**A**
3	**C**	23	**C**
4	**A**	24	**C**
5	**A**	25	**B**
6	**D**	26	**B**
7	**B**	27	**D**
8	**D**	28	**A**
9	**B**	29	**D**
10	**B**	30	**B**
11	**D**	31	**C**
12	**A**	32	**B**
13	**B**	33	**C**
14	**B**	34	**D**
15	**B**	35	**C**
16	**D**	36	**D**
17	**B**	37	**C**
18	**A**	38	**C**
19	**D**	39	**C**
20	**D**	40	**D**

S

Section A

Answer **all** questions in this section.

For Examiner's Use

1 During the SG50 National Day Parade performance, a parachutist leaped off a plane and experienced free fall.

(a) On Fig. 1.1, draw and label the forces acting on the parachutist if he fell vertically downwards. [2]



Fig. 1.1

(b) Fig. 1.2 shows how the speed of the parachutist varied with time.

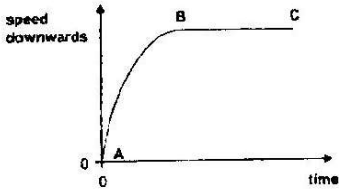


Fig. 1.2

(i) What would be the initial value of the acceleration of the parachutist?

Initial acceleration: ..... [1]

(ii) Explain why the acceleration of the parachutist decreases from A to B and why he finally fell at a constant speed after B.

..... [2]

(iii) On Fig. 1.3, draw the acceleration-time graph for the parachutist from A to C. Label your graph clearly with the letters A, B and C. [1]



Fig. 1.3

2 Fig. 2.1 shows a firefighter of total weight 840 N in equilibrium at the top of the ladder that is pivoted at point P.

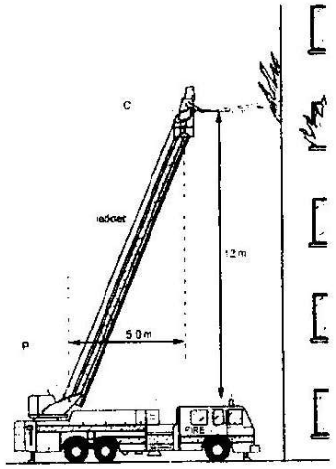


Fig. 2.1

(a) The ladder leans towards a burning building at an angle such that the centre of gravity C of the fire-fighter is 12 m above and 5.0 m to the right of P. The firefighter holds a hose that directs a high-speed jet of water horizontally into a burning building.

(i) Calculate the moment M of the firefighter's weight about P.

moment M = ... [2]

(ii) The jet of water causes a horizontal force R on the firefighter that acts towards the left, through C. This opposes the turning effect of his weight.

Calculate the size of R that, **on its own**, ensures that M is exactly cancelled.

force = ... [2]

(iii) Suggest a third force that has a turning effect about P on the ladder.

..... [1]

(b) Fig. 2.2 shows the firefighter.

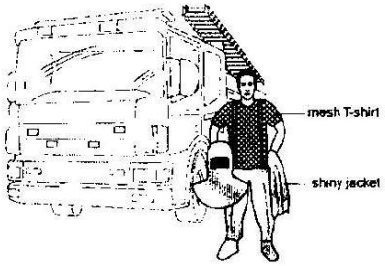


Fig. 2.2

The jacket of his protection suit has a **shiny, silver-coloured outer surface**. Underneath it, he wears a **loosely-woven mesh** T-shirt. Explain how wearing the shiny jacket and the mesh T-shirt helps to keep the firefighter cool when he is close to a source of intense heat.

.....

.....

.....

.....

.....

.....

..... [4]

3 A small amount of helium gas is trapped in a test-tube as shown in Fig. 3.1.

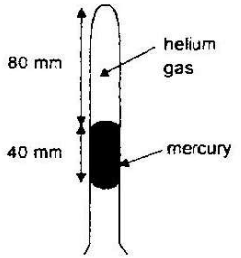


Fig. 3.1

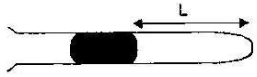


Fig. 3.2

(a) Calculate the pressure of the helium gas in Pa given that the atmospheric pressure is 760 mmHg. Take the density of mercury to be 13 600 kg/m^3 and the acceleration due to gravity to be 10 m/s^2.

pressure = ... Pa [2]

(b) The test-tube is slowly rotated 90° as shown in Fig. 3.2. Assuming that there is no change in temperature, state whether the length L will remain as 80 mm, longer than 80 mm or shorter than 80 mm. Explain your answer.

.....

.....

.....

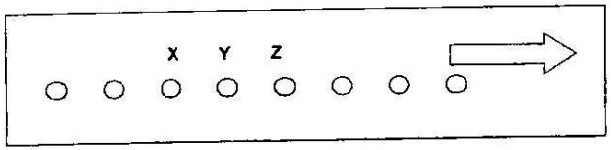
.....

..... [2]

4 (a) Light is a transverse wave and sound is a longitudinal wave. Illustrate and explain their differences *in separate diagrams below* using particles **X**, **Y** and **Z** to represent in a medium which the waves are passing continuously in the direction indicated by the arrow. [4]

For Examiner's Use

Transverse Wave

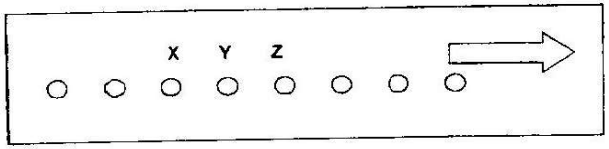


Explanation: .....

.....

.....

Longitudinal Wave



Explanation: .....

.....

.....

(b) A boy, using a stopwatch, notes that there is a 3.0 seconds delay between seeing a flash of lightning and hearing the sound of the thunder. How far is he from the thunderstorm? Take the velocity of sound in air to be 330 ms^{-1}.

distance = ... [2]

(c) Fig. 4.1 shows an incorrect electromagnetic spectrum drawn by a student. The parts of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct parts of the spectrum.

For Examiner's Use

[illegible]						[illegible]
microwaves	radio waves	ultraviolet rays	infra-red rays	gamma rays	X-rays	visible light
10^{3} m	10^{-14} m	10^{-10} m	10^{-6} m	10^{-2} m	10^{-8} m	10^{-5} m

Fig. 4.1

(i) On Fig. 4.2, complete the table of the electromagnetic spectrum. Radio waves and their correct wavelength have been inserted for you. [3]

[illegible] wavelength						[illegible]
						radio waves
						10^{3} m

Fig. 4.2

(ii) State the magnitude of the speed of all electromagnetic waves in air.

..... [1]

(iii) State two applications of ultra-violet rays.

.....

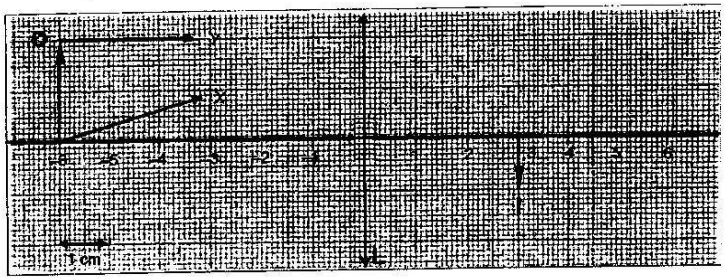
.....

.....

..... [2]

For Examiner's Use

5 The scale diagram below represents a converging lens L, object O and image I. Object O is 6.0 cm away from L while image I is 3.0 cm away from L.



(a) Complete the ray diagram above such that light rays X and Y from the object O passes through the lens L and end up on the image I. [2]

(b) From the completed ray diagram in part (a), determine the focal length of L.

focal length of L = ... [1]

(c) Object O is now moved such that it is 3.0 cm away from the lens. State the characteristics of the image produced.

.....

..... [2]

6 When an aircraft is being refuelled as shown in Fig. 6, the fuel can become negatively charged as it flows along the metal pipe to the fuel tanks.

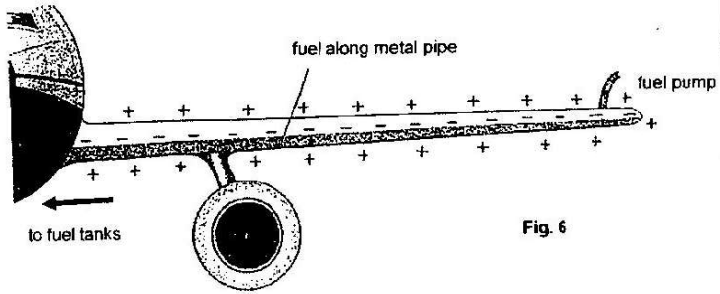


Fig. 6

(a) How does the fuel become negatively charged?

..... [1]

For Examiner's Use

6 (b) Why is the metal pipe positively charged?

..... [1]

(c) The build-up of charge on the wings of the aircraft could be dangerous. State a reason for this.

..... [1]

(d) During refuelling, the metal air frame of the aircraft is connected to the ground. Give a reason for this.

..... [1]

7 Fig. 7 shows a circuit containing a light-dependent resistor (LDR) in series with a resistor of resistance 1500 Ω. It also contains two resistors of resistance 250 Ω each, connected in series. The circuit is connected to a power supply of 9.0 V.

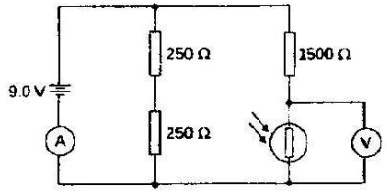


Fig. 7

When no light falls on the LDR, its resistance is 3000 Ω. Calculate

(a) the reading on the ammeter,

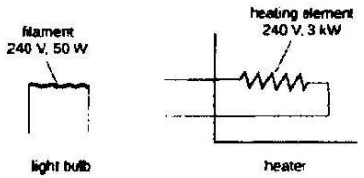
ammeter reading = ... [2]

(b) the reading on the voltmeter.

voltmeter reading = ... [2]

8 The diagrams below show the filament in a light bulb and the heating element in a heater with different power ratings.

For Examiner's Use



(a) Which one, filament in a light bulb or the heating element in a heater, has a higher resistance? Explain your answer.

.....

.....

.....

.....

.....[2]

(b) The connecting wires have a large cross-sectional area.
Explain how this feature helps the connecting wires of the heating element in the heater to remain relatively cool even when the heater has been turned on for a period of time.

.....

.....

.....

.....

.....[2]

(c) Determine a suitable fuse rating for the heater. Show your working clearly.

fuse rating = ...[2]

Section B
Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's Use

9 **Water from icebergs**

Some hot countries cannot rely on rain or the water from rivers to supply enough water.

One suggestion is to use water from icebergs found in the Atlantic Ocean. Icebergs made from fresh water can be towed to a port in the hot country. When they arrive, they are allowed to melt in the Sun or energy from a local power station can be used to melt them.

You are asked to make calculations on this suggestion using the data provided.

Data

Distance to tow an iceberg	1.0×10^4 km
Towing speed	0.80 m/s
Mass of iceberg	1.0×10^{11} kg
Effective surface area of iceberg exposed to Sun	4.0×10^5 m^2
Sun's radiation at the Earth's surface	600 W/m^2
Specific latent heat of ice	3.4×10^5 J/kg
Electrical power output from local power station	500 MW

(a) Estimate the time taken to tow an iceberg to the port.

time = ...[2]

(b) Show that 3.0×10^{15}J of energy from the Sun are incident on the iceberg whilst it is towed to the port.

energy = ...[2]

(c) (i) Estimate the mass of ice melted by the Sun as it is towed to the port.

For Examiner's Use

mass = ... [2]

(ii) State one assumption that you have made in your estimate for (i).

.....

..... [1]

(d) Discuss, using suitable calculations, the choice between allowing the ice to melt in the Sun and melting the ice with energy from the power station.

.....

.....

.....

.....

.....

..... [3]

10 (a) A torch contains a filament lamp connected to a battery. The battery contains four 1.5 V cells connected in series.

For Examiner's Use

Fig. 10.1 shows the current/potential difference (voltage) graph for the filament lamp.

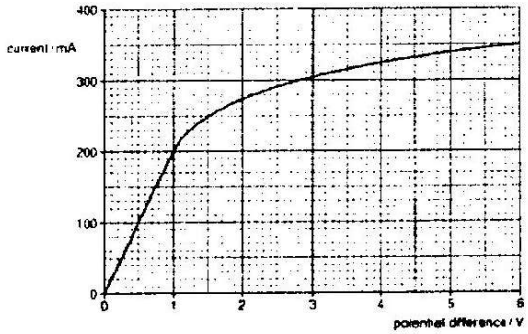


Fig. 10.1

(i) State what is meant by the *potential difference* (p.d.) across the lamp.

.....

..... [1]

(ii) Fig. 10.1 shows that the current in the lamp is not proportional to the p.d.

1. State how Fig. 10.1 shows this.

.....

..... [1]

2. Suggest why the current is not proportional to the p.d.

.....

..... [1]

(iii) The lamp is at normal brightness and there is a p.d. of 6.0 V across the lamp.

1. Use Fig. 10.1 to find the current in the lamp.

current = ... [1]

2. Calculate the charge that passes through the lamp in 2.0 hours.

For Examiner's Use

charge = ... [2]

3. The battery in the torch is able to keep the lamp lit for 2.0 hours.
Estimate the initial energy stored in the battery.

energy = ... [2]

4. Explain why your value is only an estimate.

..... [1]

(b) Suggest an advantage of using two cells in parallel rather than a single cell.

..... [1]

11 EITHER

(a) Fig. 11.1 shows a light aluminium rod AB resting between the poles of a U-shaped magnet. A current is passed through the rod from the two brass strips connected to a power supply.

For Examiner's Use

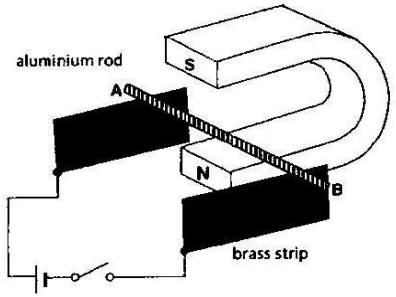


Fig. 11. 1

(i) State which way the rod moves when the switch is closed. Give a reason for your answer.

..... [2]

(ii) State the effect on the movement of the rod when

1. the current is increased;

..... [1]

2. the current is reversed.

..... [1]

(b) The set-up is modified as shown in Fig. 11.2. A stiff wire, CD, is connected to a galvanometer by flexible wires so that it can move freely in any direction. The wire CD is set swinging by pulling the wire outwards and then releasing it as shown in Fig. 11.3.

For Examiner's Use

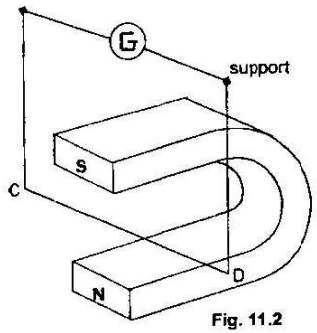


Fig. 11.2

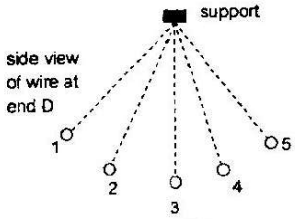


Fig. 11.3

Fig. 11.4 shows how the reading on the galvanometer varies with time after the wire has been set swinging.

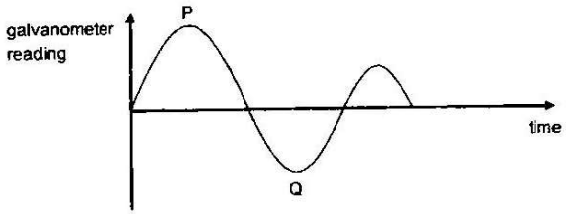


Fig. 11.4

(i) Briefly explain why there is a deflection in the galvanometer.

.....

.....

..... [1]

(ii) State the direction of the current in the stiff wire CD when it is released from position 1.

..... [1]

(iii) Which of the stages 1 to 5 corresponds to the reading shown as 'P' on the graph? Explain your answer.

.....

.....

.....

.....

..... [2]

(iv) Explain why the magnitude of the reading on the galvanometer is less at 'Q' than at 'P'.

.....

.....

.....

.....

..... [2]

11 OR

(a) Fig. 11.5 shows a simple alternating current generator.

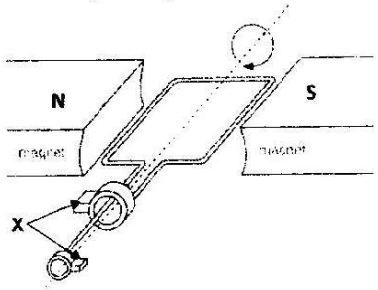


Fig. 11.5

(i) Indicate on Fig. 11.5 the direction of the current induced in the coil when the coil is in the horizontal position as shown. [1]

(ii) The current changes direction as the coil rotates. At which position(s) of the coil will the current change its direction?

..... [1]

(iii) Name and describe the purpose of component X.

.....

.....

..... [2]

(b) Transformers are used to step up voltage in order to transmit electrical power at very high voltage using alternating currents.

(i) Why should electrical power be transmitted at high voltage and using alternating current?

.....

.....

.....

.....

..... [2]

(ii) A transformer has 2000 turns in its primary coil and 100 turns in its secondary coil. The output voltage is 12 V. Calculate the voltage of the a.c. supply.

voltage = ... [2]

(iii) Suggest two ways in which the efficiency of a practical transformer can be improved.

.....

.....

.....

.....

.....

..... [2]

PAPER 2 SECTION A

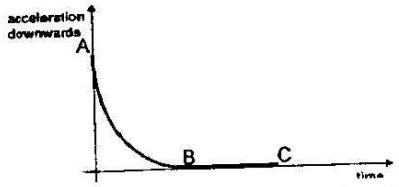
1 a)
- Arrow for weight / gravitational force
- Arrow for air resistance

Note: penalise 1 mark
- ➢ if arrows not drawn from c.g. or touching the body
- ➢ if symbols are used for labelling forces

b) i) Initial acceleration = $10\ m/s^2$

ii)
- From A to B, air resistance increases as he fell and **resultant force decreases** (which decreases his acceleration)
- At B, air resistance is equal to his weight, **resultant force** /acceleration is **zero** (and he fell at constant speed)

iii)



2 a) i) Moment M = 840 x 5.0
= 4200 Nm

ii) 4200 = R x 12
R = 350 N
ECF from (i)

iii) the weight of the ladder or
the weight of the hose & water

b)
- Shiny surface is a good reflector or poor absorber of radiation
- hence **suit/jacket** gets heated up at a slow rate.
- Mesh T-shirt traps **air** which is an insulator/poor conductor
- therefore heat is **conducted** to the **body** at a slow rate.

3 a) pressure due to helium + pressure due to mercury = atm pressure
p = (760 – 40) mmHg = 720 mm Hg
= 0.720 x 10 x 13600
= 9.79×10^4 Pa

b) Atmospheric pressure does not need to support the mercury column and hence will be greater than pressure of helium gas. Mercury column will be pushed inward, making L smaller. Length will be shorter than 80 mm.
OR
Pressure of helium gas will be equal to the atmospheric pressure and hence is greater than before.
For pressure to increase, volume must decrease and hence length will decrease. Length will be shorter than 80 mm.

4 a) **Transverse Wave**

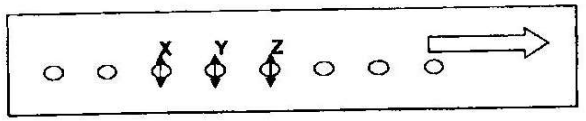


Diagram shows perpendicular vibration for X, Y, Z (all 3)
Explanation: In a transverse waves, the **particles vibrate perpendicularly** to the wave motion.

Longitudinal Wave

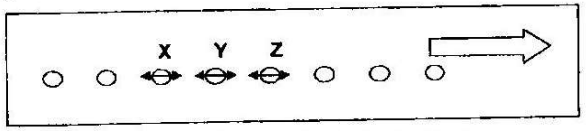


Diagram shows parallel vibration for X, Y, Z (all 3)
Explanation: In a longitudinal waves, the **particles vibrate parallel** to the wave motion.

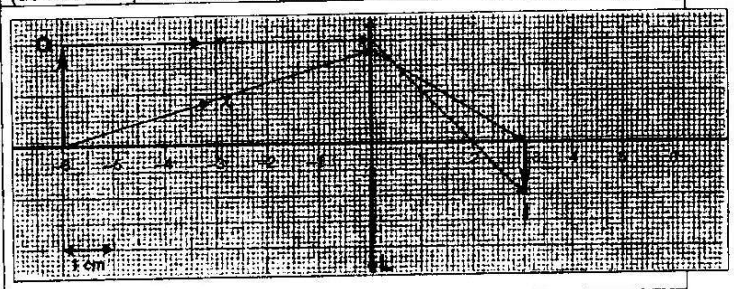
b) Distance = speed x time
= 330 x 3
= 990 m

c) i)

Gamma rays	X-rays	Ultra violet rays	Visible Light	Infra red rays	Micro waves	radio waves
10^{-14}	10^{-10}	10^{-8}	10^{-6}	10^{-5}	10^{-2}	10^{3} m

Correct order of magnitude of wavelength – 1 mark
Correct order of waves – 2 marks; 2 errors – 1 mark

ii) 3.0×10^8 m/s

	iii)	Any 2 correct uses for UV • to detect fake notes • in sun-bed for artificial sun-tanning • to sterilise hospital equipment (or any other suitable uses) (do not accept 1 word answer eg sun-bed, bank, sterilisation)
5	a)	
	b)	f = 1.9 cm or 2.0 cm (or based on diagram)
	c)	real, inverted, magnified (since f < u < 2f ; based on (b) answer)
6	a)	It gains electrons from metal pipe **by friction** (or as it rubs against the metal pipe)
	b)	It loses electrons to the fuel
	c)	The build-up of charges can produce **sparks** which can ignite the fuel / cause an explosion
	d)	To the earth/discharge the metal aircraft OR electrons flow up (from ground) to neutralise the aircraft
7	a)	$\frac{1}{R} = \frac{1}{250+250} + \frac{1}{1500+3000}$ R = 450 Ω I = 9 / 450 = 0.020 A
	b)	$V = \frac{3000}{3000+1500} \times 9.0$ V = 6.0 V

8	a)	The power of the filament is lower than that of the heating element and since $P = \frac{V^2}{R}$ (and V is the same), the resistance of the filament is higher. OR The power of the filament is lower and hence the current through it is lower. Since V is the same, the resistance of the filament is higher.
	b)	A larger cross-sectional area means that the wire has a lower resistance. Hence, the heat produced ($E = I^2Rt$) will be much lower and hence it remains relatively cooler.
	c)	I = 3000 / 240 = 12.5 A Fuse rating : 13A, 14 A or 15 A
9	a)	$t = \frac{s}{v} = \frac{1.0 \times 10^4 \times 10^3\ m}{0.80\ m/s}$ t = 1.25 x 10^7 s (208000 min / 3470 h / 145 days)
	b)	P = 600 W/m^2 x (4.0 x 10^5 m^2) = 2.4 x 10^8 W E = (2.4 x 10^8) x (1.25 x 10^7) = 3.0 x 10^{15} J
	c) i)	Q = m ℓ 3.0 x 10^{15} = m x 3.4 x 10^5 m = 8.82 x 10^9 kg
	ii)	Any one of the following or other reasonable assumption: • surface of the iceberg remains the same • Sun is shining throughout the journey • Power of /energy from the sun is constant • iceberg is not melted by any other means like water etc
	d)	Power from the Sun to melt the ice = 2.4 x 10^8 W (part b) Power from the power station = 500 MW = 5.0 x 10^8 W OR Time taken by Sun to melt remaining iceberg = (1.0x10^{11} - 8.8x10^9) x 3.4x10^5 / 500 x 10^6

		= 6.2 x 10^7 s Time taken by power station to melt = (1.0x10^{11} - 8.8x10^9) x 3.4x10^5 / 600 x 4.0 x 10^5 = 1.29 x 10^8 s Hence, it will be **more efficient** to melt the ice using the energy from power station since it has a larger power OR it takes a shorter time. *Bonus points (max score for question is 3 marks):* *Power from the power station can be more controlled than power from the Sun.* *Energy from the Sun is free but need to use fossil fuel in power station.*
10	a) i)	P.d. is the work done by one coulomb of charges passing through **the lamp** P.d. is the energy per unit charge converted as it passes through **the lamp**
	ii) 1)	Graph is not straight or is a curve or its gradient changes
	2)	Filament gets hotter or its temperature increases or its resistance increases
	iii) 1)	350 mA or 0.35 A
	2)	Q = 0.35 x (2 x 60 x 60) (ECF) = 2520 C or 2500 C Accept: Q = 350 mA x 2 h = 700 mAh
	3)	E = QV = 2520 x 6.0 = 15100 J or 15000 J
	4)	Any one of the following: • current and / or voltage falls / varies • or some energy remains (in cell) • or some energy / heat produced in cell / in connecting wires • or correct argument involving internal resistance of cell
	b)	Any one of the following: • cells will be able to supply current for a longer period / last longer

		• if one cell fails, the other cell can still supply current • *cells in parallel supply higher current as internal resistance is decreased*
11 E	a) i)	Rod moves out of the magnet / to the left. Current flows from A to B/magnetic field from N to S and using Fleming's Left Hand Rule, the direction of the force on the rod is out of the magnet.
	ii) 1)	The rod moves out of the magnet at a faster rate / moves further outwards.
	2)	The rod moves into the curved part of magnet or in the opposite direction.
	b) i)	As the wire swings, it is cutting the magnetic field and an emf is induced and an induced current flow to cause deflection.
	ii)	Current flows from C to D
	iii)	Stage 3. Speed of the wire is greatest at this position as it has the greatest K.E.. Hence, the **rate of cutting of magnetic field is greatest** and emf induced is largest (Faraday's Law).
	iv)	The induced current flows in such a way that it opposes the swinging of the wire (Lenz's Law). Hence, maximum speed of wire as it swings back is reduced and induced emf is also reduced. (note: effect of friction or air resistance is not as significant to cause the decrease so quickly)
11 O	a) i)	Direction of current – clockwise around the coil
	ii)	when the coil is in the vertical position
	iii)	carbon brushes To provide electrical contact between the coil and the external circuit

	b) i)	At high voltage, current in the cable is very low and hence it reduces power loss during transmission. Transformers are needed for transmission and they can only work using alternating current. OR Alternating current is required to create a continuous changing magnetic field in order for the **transformer** to work.
	ii)	$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$ $$V_p = \frac{2000}{100} \times 12$$ $$= 240V$$
	iii)	Any two of the following: • **Low resistance copper wires** should be used to reduce heat loss • Using **laminated core** to reduce eddy currents • **Design the core** to reduce magnetic field leakage between primary and secondary coils • Use **effective** soft magnetic material for the core to reduce energy loss in flipping magnetic fields

Name: Register Number: Class:

南僑中學

NAN CHIAU HIGH SCHOOL
PRELIMINARY EXAMINATION THREE 2015
SECONDARY FOUR EXPRESS

For Marker's Use

PHYSICS **5059/02**

Paper 2 Theory **15 Sep 2015, Tuesday**

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions. Question 12 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include appropriate units.
You may lose marks if you do not show your working or if you do not use appropriate units.
The number of marks is given in brackets [ ] at the end of each question or part question.

The total marks for this paper is 80.
g = 10.0 N/kg on earth.

Section A
Answer **all** the questions in this section

1. (a) Define velocity. [1]

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(b) A solid rubber ball drops and hits the floor 0.60 s later. A velocity-time graph of the motion is shown in Fig. 1.1 below.

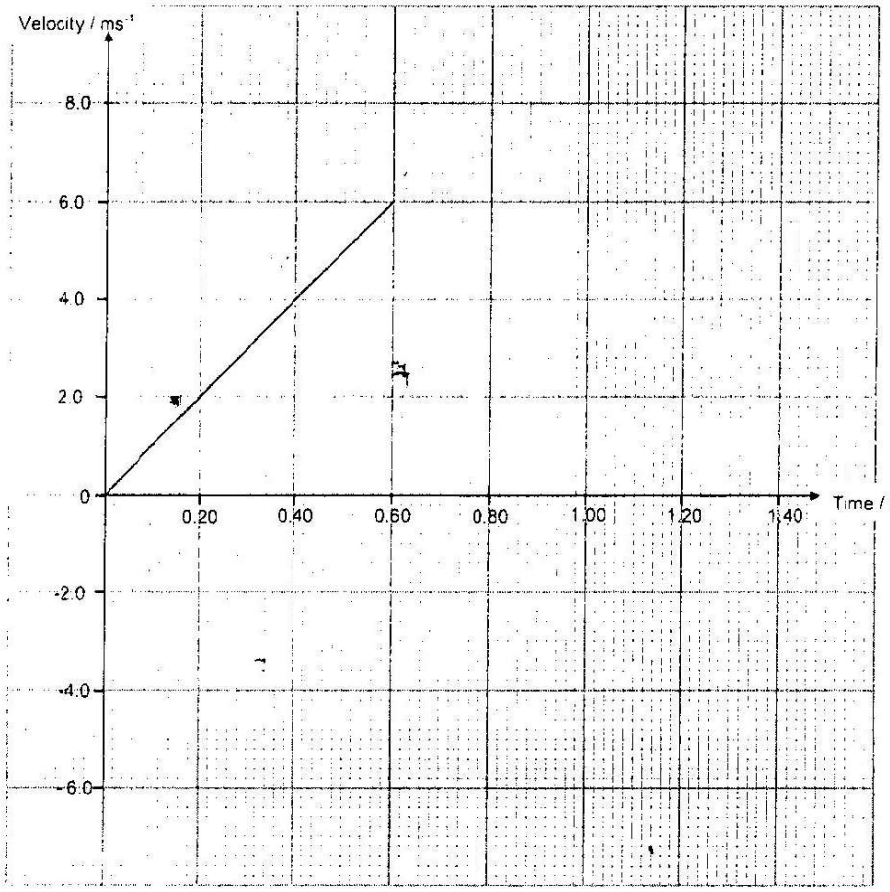


Fig. 1.1

1. (b) The ball makes contact with the floor for 20 ms, after which it **rebounds vertically** with an initial **speed** of 5.6 ms^{-1}.

(i) Calculate the acceleration of the ball while it makes contact with the floor and rebounds. [2]

(ii) Calculate the maximum height during the ball's bound [1]

(iii) Draw on Fig. 1.1 the velocity-time graph for the ball during its rebound to the maximum height. [2]

2. A box with a mass of 4.0 kg was pushed by a force of 18 N along a table-top as shown in Fig. 2.1. The displacement-time graph of the motion is given in Fig. 2.2.

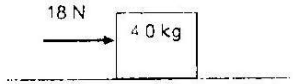


Fig. 2.1

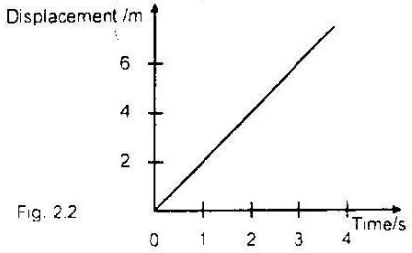


Fig. 2.2

(a) From Fig. 2.2, determine the frictional force acting on the block when the box is moving. Explain your answer. [2]

(b) While the box is still moving on the same surface, the push was increased to 20 N. Describe the subsequent motion of the box after the change in force occurs, giving numbers where necessary. [2]

3. A uniform trap door weighs 80 N. It is lifted up and held stationary by a force of 50 N as shown in Fig. 3. The centre of gravity of the trap door is located at 60.0 cm from the hinge as shown.

(a) State the meaning of centre of gravity. [1]

(b) By means of a scaled diagram, determine the reaction at the hinge of the trap door. [3]

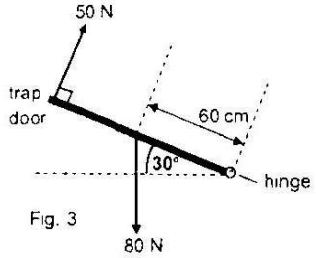


Fig. 3

4. A 1.00 m long barometer tube was filled with mercury to the brim of the tube. The open end was held carefully by the thumb and then inverted in a trough of mercury. The thumb was then removed. Fig. 4.1 shows the barometer at the instant when the thumb was just removed.

(a) (i) Show that the level of mercury in the tube above the surface of mercury in the trough would become 0.743 m eventually.
The atmospheric pressure has been determined to be 101000 Pa and mercury has a density of 13.6 g/cm^3. [2]

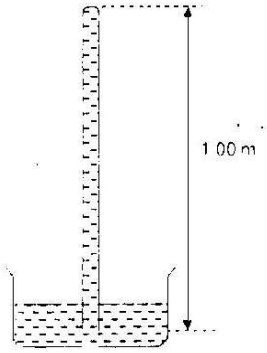


Fig. 4.1

(ii) Suggest a simple way to check that the barometer reads only the atmospheric pressure and not any additional pressure due to any gas trapped in the tube [1]

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(b) A mercury barometer is shown in Fig. 4.2. Draw the new level of the mercury level in the barometer and the reservoir when the barometer is brought to a mountain top, which has an altitude of 4000 m. Assume that the density of air is constant at 1.23 kg/m^3 and atmospheric pressure on the sea level is 103360 Pa. Show all calculations clearly. [2]

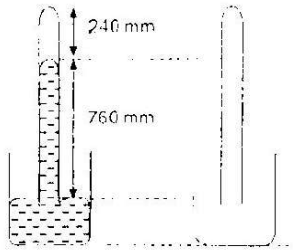


Fig. 4.2

5. Fig 5.1 below shows a hand-operated hydraulic jack.

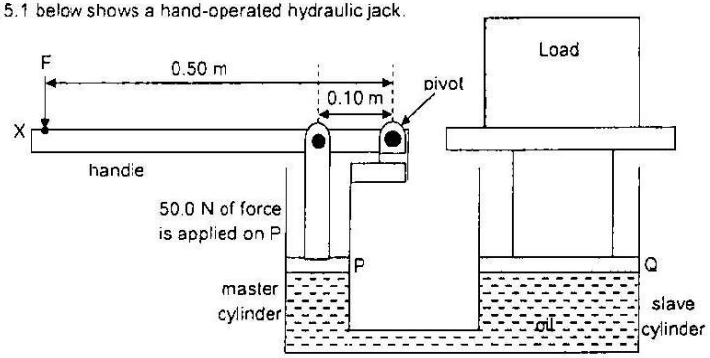


Fig. 5.1

Piston P and the handle are linked through the same pivot. When a force is applied downwards at point X, piston P in the master cylinder is pushed down with a force of 50.0 N, causing oil to flow into the slave cylinder.

(a) Calculate the moment of the force of 50.0 N applied on piston P. [1]

(b) The area of piston P is 20.0 cm^2 and the area of piston Q is 800 cm^2.
Calculate the load being pushed upwards by piston Q. [2]

(c) If piston P moved a distance of 10.0 cm downwards, determine the distance moved by piston Q upwards. [2]

6. (a) State a difference between boiling and evaporation. [1]

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(b) In an experiment to demonstrate how the boiling point of water depends on the surrounding pressure, a beaker containing hot water at 80 °C was placed inside a bell jar, which was all sealed up other than allowing for an exit to a vacuum pump.

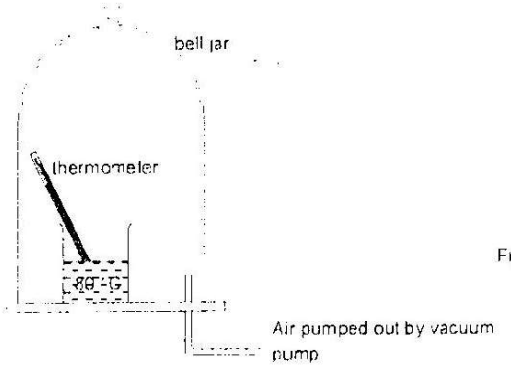


Fig. 6.1

Explain using kinetic model of matter.

(i) why some of the water boil when the air was being pumped out? [2]

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(ii) why the temperature of the remaining water becomes lower? [2]

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7. At coastal areas, the sea breeze is formed at around 3.00 p.m.

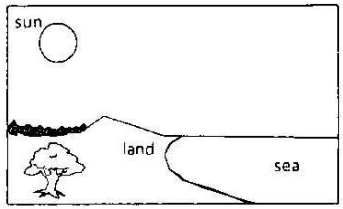


Fig. 7.1

(a) (i) In Fig. 7.1, draw the direction of the convection currents to form the sea breeze. [1]

(ii) Explain how the sea breeze could have been formed. [2]

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(b) The following data may be useful in this question.
Specific heat capacity of water = 4.20 kJ kg^{-1} K^{-1}.
Specific heat capacity of aluminium at 100°C = 0.910 kJ kg^{-1} K^{-1}.
Latent heat of vaporisation of water = 2260 kJ kg^{-1}.
Latent heat of fusion of water = 334 kJ kg^{-1}.

A 3.00 kg block of aluminium is heated to 600°C. It is placed in a container holding 2.00 kg of water at 25°C. The hot aluminium brings the water to its boiling point at 100°C quickly.

(i) Calculate the amount of energy given out by the aluminium block when its temperature is lowered to 100°C. [1]

(ii) Calculate the mass of water which will boil when the temperature of aluminium is at 100°C and 5000 J of energy has heated up the air surrounding the container. [3]

8. (a) A positively-charged sphere is placed near a neutral metal plate which was placed on an insulator shown in Fig. 8.1.
Draw the electric field between the sphere and the metal plate. [2]

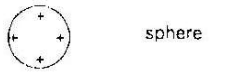




Fig. 8.1

(b) Fig. 8.2 shows part of an electrostatic spray gun applying paint onto a piece of metal part. The nozzle sprayed out fine paint droplets. The droplets are charged positively as they emerged.

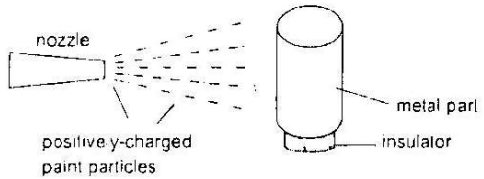


Fig. 8.2

(i) Explain why the positively-charged paint droplets are attracted to the neutral metal part. [2]

(ii) Explain how the positively-charged paint droplets are spread out evenly to form a coat of paint on the metal part. [2]

9. (a) A 200 m long spool of wire has a diameter of 0.30 mm. If the wire has a resistance of 48.8 Ω, calculate the resistivity of the wire. [2]

(b) A circuit is connected as shown in Fig. 9.1. The bulb is intended to be lit up when the surroundings has become darker.

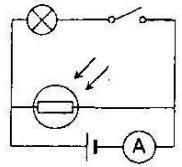


Fig. 9.1

(i) Explain why the circuit in Fig. 9.1 will not work as intended after the switch is closed. [2]

(ii) A second identical bulb is connected in parallel to the first bulb as shown in Fig. 9.2.

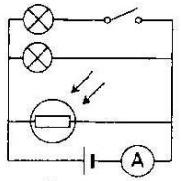


Fig. 9.2

Describe how the additional bulb affects the ammeter reading when the switch is closed. [1]

9. (c) John wants to construct a circuit that switches on a 18 V fan motor for his computer when the temperature is high.

(i) Complete the design of the circuit below to switch on the fan motor when the temperature rises. No calculation is required.

Choose from the following components:

- Light dependent resistor,
- light emitting diode (LED),
- rheostat,
- connecting wires,
- switch and
- negative temperature-coefficient thermistor. [2]



(ii) Explain how the circuit would be switched on. [1]

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Section B

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 12**.

10. (a) (i) What do you understand by the refractive index of water is 1.33? [1]

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(b) A ray of light is incident towards the centre of a semi-circular glass block as shown in Fig. 10.1. X is the curved surface area of the semi-circular glass block.

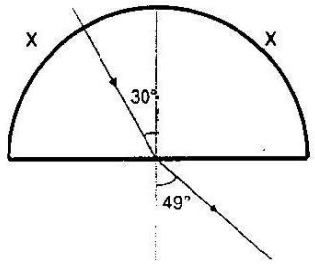


Fig. 10.1

(i) Explain why the ray of light will not undergo total internal reflection if it is incident on anywhere along X. [1]

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(ii) Calculate the critical angle of the glass block in Fig. 10.1. [2]

10. (c) What do you understand by the focal length of a converging lens is 6.0 cm? [1]

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(i) Fig. 10.2, which was drawn to full scale, shows rays from a distant object reaching a converging lens with a focal length of 6.0 cm.
Complete the ray diagram in Fig. 10.2 to show how the converging lens forms an image [3]

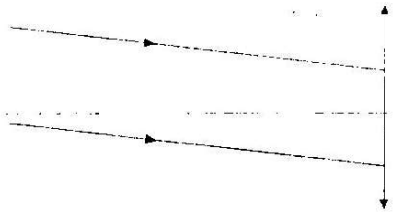


Fig. 10.2

Describe the effect on the image [1]
(ii) as the lens is moved towards the left side.

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(iii) when half of the lens is cut away as shown in Fig. 10.3. [1]

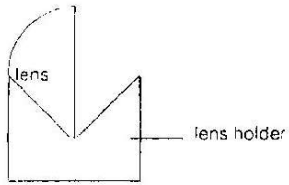


Fig. 10.3

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11. An ignition coil (see Fig. 11.1) is used to produce sparks to ignite fuel in the engine. The ignition coil produces high-voltage pulses from a d.c. supply. An ignition coil consists of a transformer made from two coils of insulated copper wire wound around a common iron core. One wire forms the external primary coil, with the secondary coil wrapped within the primary coil.

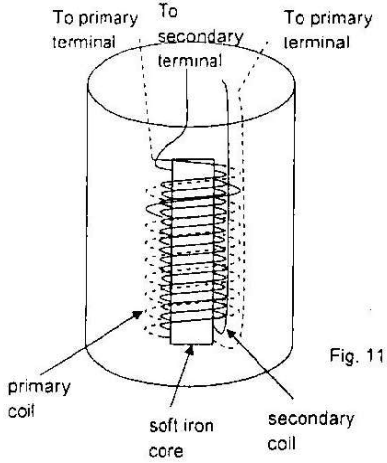


Fig. 11.1

Some information of the device is presented in Fig. 11.2.

Type A	Primary coil	Secondary Coil
Voltage (V)	12	30000
Current (A)		0.050
Number of turns	100	250000

Type B	Primary coil	Secondary Coil
Voltage (V)	36000	12
Current (A)	0.042	
Number of turns	300000	100

Fig. 11.2

(a) Explain why a voltage is developed across the secondary coil when the current in the primary coil is interrupted suddenly. [1]

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(b) State and explain which transformer, Type A or B is suitable as an ignition coil. [2]

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11. (c) The primary voltage (V_P) versus time graph is shown in Fig. 11.3, when t_1 and t_2 are the times when the controlling switch is closed and opened respectively.
Sketch the corresponding secondary voltage (V_S) versus time graph on the given axis [2]

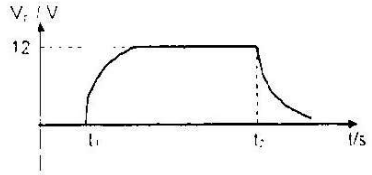
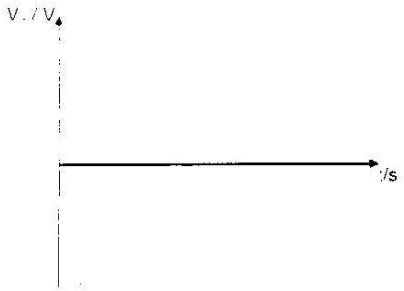


Fig. 11.3



(d) Explain with a reason if the wire used for the primary coil solenoid should be thick or thin [1]

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(e) The secondary winding of an ignition coil is connected as shown in Fig. 11.4 to a light bulb.
Explain why the light bulb did not lit up continously when the switch is closed. [1]

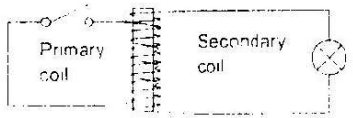


Fig. 11.4

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11. (f) In a set-up to demonstate motional electromotive force, a conducting rod was moved across a magnetic field from right to left in Fig. 11.5. The magnetic field is going perpendicularly into the paper. The rod was sliding on fricitonless metal rails which were linked by connecting wires with crocodile clips.

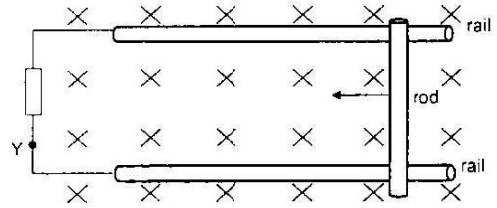


Fig. 11.5

(i) Determine the direction of the current flow in the external circuit by marking an arrow at point Y in Fig 11.5. [1]

(ii) Explain your answer [2]

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12. EITHER

Infrared toasters are considered parts of the modern day convenience in kitchen and food preparations. An infrared toaster, rated at 650 W 230 V, operates through 2 infrared lamps positioned above and below the holding tray (sees Fig. 12.1).

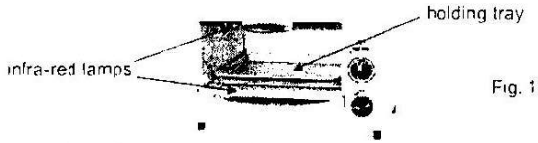


Fig. 12.1

(a) (i) Explain why the interior of the toaster is silver-coloured and smooth. [1]

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(ii) Discuss why the infrared toaster cooks the same quantity and type of food in a shorter time compared to a conventional oven which is much bigger physically [2]

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(iii) Calculate the current drawn when the infrared toaster is switched on. [1]

(b) The insulation of the mains cable has worn away and this causes the live wire to make contact with the outer metal casing of the infrared toaster.

(i) Explain the hazard that results if the outer metal casing is not earthed. [1]

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(ii) Explain how connecting the earth wire to the outer metal casing and using a circuit breaker of a suitable rating removes this hazard. [2]

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(b) (iii) Fig. 12.2a and Fig. 12.2b show a circuit breaker before and after it has been activated respectively.

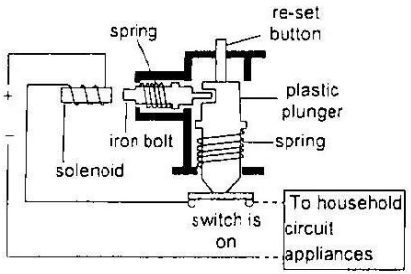


Fig. 12.2a

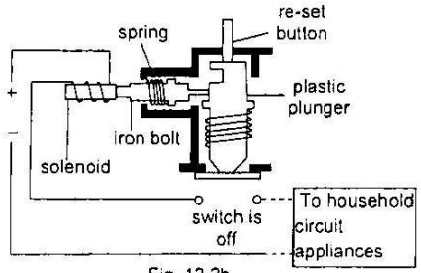


Fig. 12.2b

Referring to Fig. 12.2a and Fig. 12.2b, explain how the circuit breaker works when a fault occurs. [3]

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OR

Fig. 12.3 shows circular wavefronts produced at the centre of a wave pool. Two plastic buoys, A and B, float on the water in the pool. Buoy A is on the crest of a wave at the instant shown.

(a) State the meaning of a wavefront. [1]

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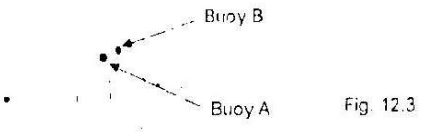


Fig. 12.3

(b) Fig. 12.4 shows a snapshot of the displacement-distance graph of A and B. A wave takes 0.800 s to move from A to B.

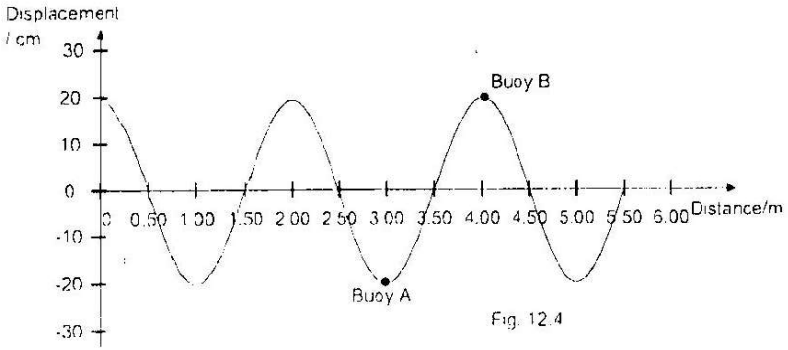


Fig. 12.4

(i) Calculate the frequency of the wave. [2]

(ii) Sketch a displacement–time graph of buoy B, starting from the instant shown in Fig. 12.3. Draw at least 2 cycles in your graph. [2]



(c) A vessel is detecting schools of fish in the ocean. Sonar is used to locate schools of fish and the depth of the seabed in the sea. The sonar sends pulses of ultrasound of frequency 45 kHz from the bottom of the ship to determine the depth of the seabed. The reflected pulses are picked up by a receiver and displayed on a cathode-ray oscilloscope (c.r.o.) as shown in Fig. 12.5. The time-base of the c.r.o. is set to be 50 ms/ div. The speed of the ultrasound in water is known to be 1450 m s^{-1}.

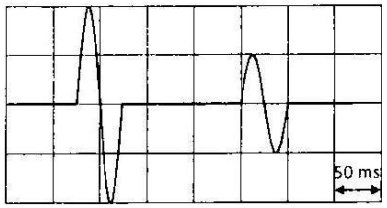


Fig. 12.5

(i) On Fig. 12.5, label the reflected pulse as *R*. Explain your choice. [1]

.....

.....

(ii) Calculate the wavelength of the ultrasound. [1]

(iii) Determine the depth of the seabed. [2]

(d) If the frequency of the ultrasound is doubled, what is the effect on the speed of the wave? [1]

.....

.....

End of paper

Marking scheme for Physics Paper1

1	2	3	4	5	6	7	8	9	10
A	B	B	C	A	C	C	C	D	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	A	D	A	D	D	D	A	B	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	B	C	A	C	C	B	C	C	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
B	C	C	C	C	C	C	A	D	C

scheme for Physics Paper1

1. (a) Rate of change of displacement. B1

(b) (i) $a = \Delta v / \Delta t = = (-5.6 - 6.0) / 20 \times 10^{-3}$ M1

$= -580\ ms^{-2}$ A1

(ii) $v^2 = u^2 + 2as$, $s = (0^2 - 5.6^2) / 2(-10.0) = 1.568$

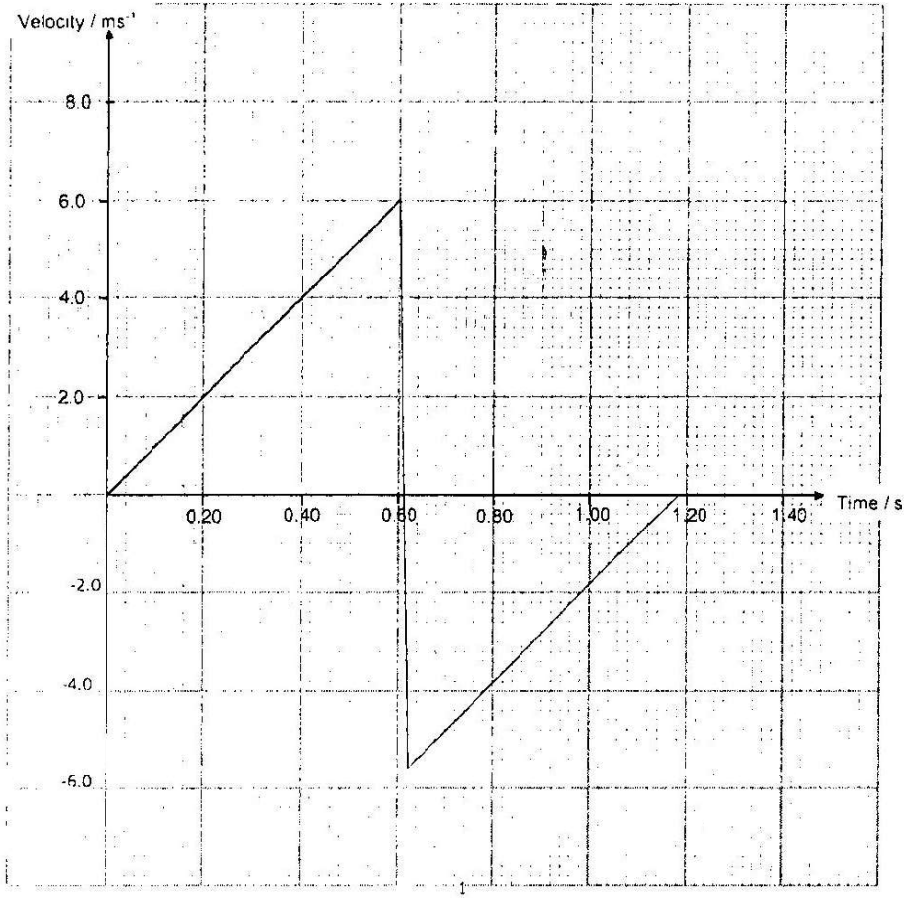
$s = 1.6$ m (2 sf) B1

(iii) $v = u + at$, $t = (0 - 5.6) / (-10.0)$ B1

$t = 0.56$ s (2 sf) A1

(B1may be awarded if student failed to draw any line), a low ecf

B1 for line from (0.60, 6.0) to (0.62 ,-5.6) and B1 for line from (0.62 ,-5.6) to (1.18, 0); without proper marking on axes deduct 1 m



2 (a) Friction = 18 N as slope of the graph gives us velocity of the box. Since the slope of the position time graph is constant, velocity of the box is also constant. As a result, acceleration of the box becomes zero indicating the forces acting on box are balanced.

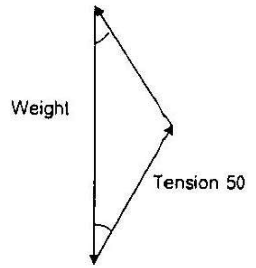
(b) The box starts to accelerate [B1] at $a = (20 - 18) / 4 = 0.50\ ms^{-2}$ (B1 for magnitude).

3(a) It is a point where the entire weight of the object appears to act irrespective of its orientation. [B1]

(b) Scale: 1 cm : 5 N [B1]

Reaction = 44.0 N [B1]

Correct closed triangle [B1]



4 (a) (i) $P = hpg$

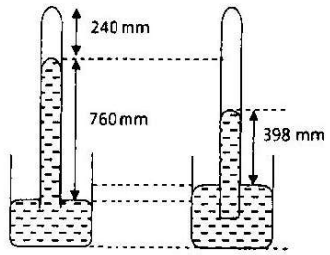
$101000 = h \times (13600) \times 10.0$ [M1]

$h = 0.74265$

$= 0.743$ m [A1]

(ii) To test for a faulty vacuum, incline the tube until its top end is below the horizontal level extended from 0.743 m of the height above the reservoir. If the whole of mercury fills the tube then there is no air trapped inside. [B1]

(b)



$h_{atm}\rho_{air} = h_{Hg}\rho_{Hg}$

$h_{atm}(1.23) = 0.760 \times 13600$

$h_{atm} = 8403.3$ m [B1]

Hence at 4000m height $h_{Hg} = (8403.3 - 4000) / 8403.3 \times 0.760$

$= 0.398$ m Hg (3 sf) [B1]

Drawing [B1]

5(a) Moment = $50 \times 0.10 = 5.0$ Nm [B1]

(b) At P, Pressure $P = F/A = 50.0 / 20.0 = 2.50\ Ncm^{-2}$ [B1]

This pressure is transmitted to Piston Q.

Hence $F_Q = P \times A_Q = 2.50 \times 800 = 2000$ N [B1]

(c) Method 1: work done is same at P and Q,

$F_P \times D_P = 50.0 \times 0.100 = 5.00$ J [B1]

Hence $D_Q = 5.00 / F_Q = 5.00 / 2000 = 2.5 \times 10^{-3}$ m [B1]

OR Method 2: Volume of fluid is conserved

At P volume of fluid pushed downwards, $V = 20.0 \times 10.0 = cm^3$

At Q, rise in height $= V / A_Q = 200 / 800 = 0.250$ cm $= 2.5 \times 10^{-3}$ m

6 (a) Any of the 6 differences Eg no bubbles against bubbles (boiling); boiling occurs at a fixed temperature ... [B1]

(b)(i) The air pressure in the bell jar is lower than atmospheric pressure as less air particles are present now. [B1]

Although the internal work done to overcome forces of attraction between molecules remains unchanged, the external work done against the atmosphere has been reduced significantly. This reduces the amount of PE required by the water particles to vaporise. [B1]

(ii) As the temperature of a substance is directly proportional to its sum of KE, the more energetic molecules still need sufficient energy to **overcome attractive forces** due to other molecules to escape from the surface into the atmosphere. As less energetic molecules are left behind, the **average** kinetic energy of the molecules **decreases** and the temperature **decreases.[B1]**

7(a)(i) Shows convection current in clockwise direction from the sea.
7(a)(ii) Land and the adjacent water body are subjected to the uneven heating during the daytime. The land, which has a low specific heat capacity heats up much more quickly than water. (B1)
As the land warms up, the air next to it heats by conduction and rises. (or first B1 here)
As the warmer air rises by **due to its lower density,** cooler air is drawn from the ocean to fill the void. The warmer air mass returns to sea at higher levels to complete a convective **current.** (need to write different density for second B1)

(n)

(i) Energy given up by the aluminium in cooling to 100°C

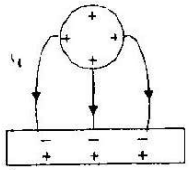
$= mc\ \theta = 3 \times 910 \times (600 - 100) = 1365000$ J. B1

(ii) To heat 2 kg of water from 25°C to 100°C requires $2 \times 4200 \times (100 - 25) = 630000$ J. B1

Available energy for boiling water = 1365000 J – 630000 – 5000 = 730000 J B1

Mass of water boiled away = E/l = 730000 / 2260000 = 0.323 kg. A1

8 (a)



B1 direction

B1 pattern

(b) (i) When the positively charged particles are brought near to the metal, the electrons of the metal part are induced to the surface nearer to the positively charged paint particles. [B1]
Since unlike charges attract, the positively charged particles will be attracted to the electrons of the metal. [B1]
(ii) All paint particles are positively charged of the same amount. [B1]
Since like charges repel, the particles will be repelled away from each other, allowing them to be spread out more uniformly on the metal. [B1]

9 (a)$\rho = RA/l = 48.8 \times [(3.142/4 \times (0.30 \times 10^{-3})^2] / (200)$ M1

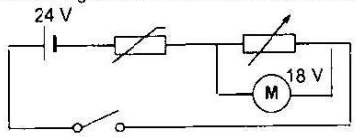
$= 1.73 \times 10^{-8} = 1.7 \times 10^{-8}\ \Omega m$ A1 (2 sf) check sf here

9 (b) (i) No. When the intensity of light reduces, the resistance of LDR increases but potential **difference across lamp remains unchanged as lamp is connected in parallel.** B1
Current flowing through lamp does not change and therefore the lamp remains lit throughout when the switch is closed. B1

(b) (ii) ammeter reading increases. B1

(c) (i) B1: thermistor drawn in series with variable resistor
B1: motor in parallel with variable resistor

(ii) B1: (When the switch is closed) and temperature rises, the potential difference across the variable resistor would become higher than the thermistor. Hence there is enough pd to drive the motor.



10 (a) (i) The ratio of the speed of light in vacuum to the speed of light in water is 1.33. [B1]

(ii) The ray of light is incident from an optically less dense (rarer) medium to optically denser medium. Hence TIR cannot occur.[B1]

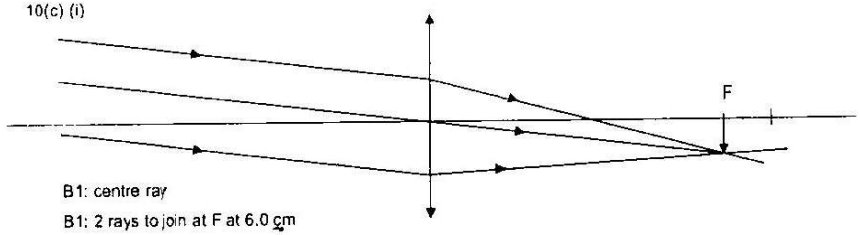
(iii) $n_1 \sin i = n_2 \sin r$

$n_2 = (1) \times \sin 49 / \sin 30 = 1.51$ [B1]

$c = \sin^{-1}(1/1.51) = 41.5°$ [B1]

10(b) The distance between the optical centre and principal focus is 6.0 cm

10(c) (i)



B1: centre ray

B1: 2 rays to join at F at 6.0 cm

B1: inverted image at 6.0 cm

10(c)(ii) Image remains unchanged in size. Still inverted. [B1]
(ii) The image becomes less bright, while still being inverted [B1]

11 (a) The change in current in the primary coil sets up changing magnetic flux linkage within the secondary coil and hence induce an emf in it according to Faraday's law of EMI. B1

11(b) Type A. A High output or secondary voltage is required for a spark to be formed.[B1]

CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination 2 in preparation for
the General Certificate of Education Ordinary Level 2016

CANDIDATE NAME

CLASS

REGISTER NUMBER

PHYSICS

5059/01

Paper 1 MCQ

23 August 2016

1 hour

Additional Materials: Multiple Choice Answer Sheet (OMR)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate

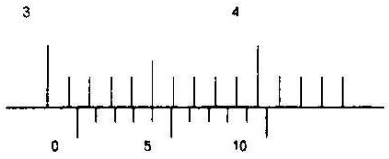
This document consists of **13** printed pages and **1** blank page.

[Turn over

1 Which list of SI units contains only base units?

A candela, second, kelvin, watt
B candela, Joule, metre, second
C ampere, kelvin, second, pascal
D ampere, metre, second, kelvin

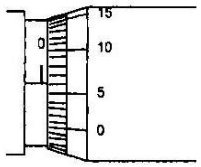
2 The diagram shows the scale of the vernier callipers that is used to measure the diameter of a coin.



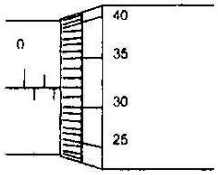
What is the radius of the coin?

A 1.57 cm **B** 3.14 cm **C** 3.15 cm **D** 3.55 cm

3 The diameter of a piece of wire is measured using a micrometer screw gauge. A student takes an initial zero reading followed by a reading of the diameter. The following diagrams show enlargements of the micrometer screw gauge reading.



Zero reading



Diameter reading

What is the diameter of the wire?

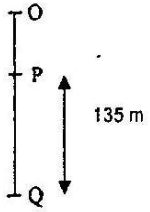
A 1.26 mm **B** 1.38 mm **C** 1.76 mm **D** 1.88 mm

4 A car driver takes a total of four hours to make a journey of 160 km. She has a coffee break and spends half an hour stationary in a traffic jam. During the remaining time, she is travelling at a speed of 60 km/h.

How long was her coffee break?

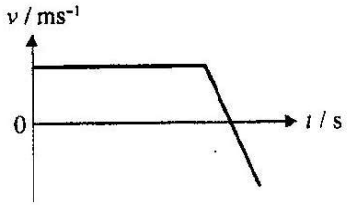
A 30 minutes **B** 50 minutes **C** 60 minutes **D** 90 minutes

5 An object released from rest at O falls freely under gravity and passes through P and Q as shown.
If the object takes 3 s to move from O to P and PQ = 135 m, how much time does it take to fall from O to Q?

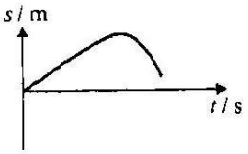


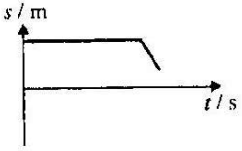
A 3 s
B 4 s
C 5 s
D 6 s

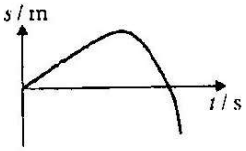
6 The velocity-time graph of a moving object is shown.

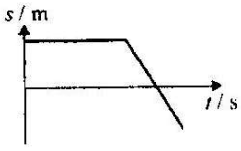


Which of the followings is the corresponding displacement-time graph?

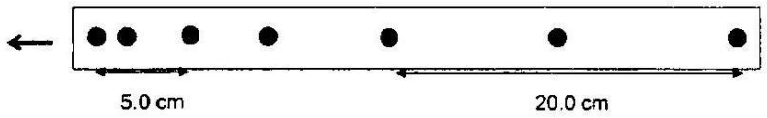
A 

B 

C 

D 

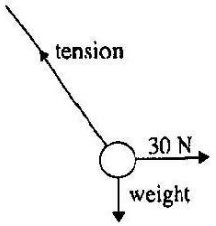
7 Celine used a ticker tape timer to investigate the acceleration of a remote control car. The ticker tape timer is set to vibrate at 50 Hz and a portion of the tape obtained is shown below.



What is the acceleration of the remote control car during the portion shown?

A -9375 cm/s² B -4688 cm/s² C 4688 cm/s² D 9375 cm/s²

8 A pendulum bob of mass 5 kg is pulled horizontally to the right by a 30 N force as shown. What will be the approximate tension in the string when the bob is in equilibrium?

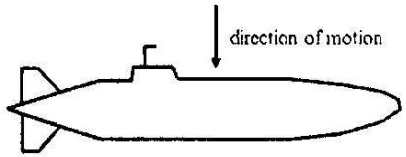


A 50 N B 58 N C 60 N D 68 N

9 A bottle full of water has a mass of 200 g. When the same bottle is filled with liquid X, the mass becomes 180 g. If the mass of the empty bottle is 100 g, what is the density of liquid X? Take density of water as 1.0 g/cm³.

A 0.2 g/cm³ B 0.8 g/cm³ C 0.9 g/cm³ D 1.2 g/cm³

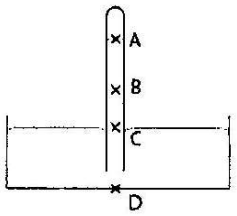
10 An object experiences upthrust whenever it is in water.
A submarine is sinking vertically through the water at a constant velocity.



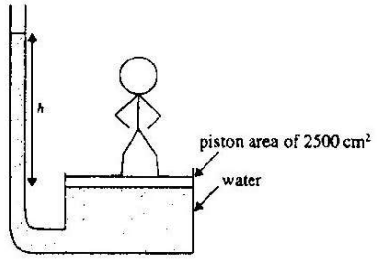
Which statement is correct?

A Resultant force in the downward direction is not zero.
B Upthrust is zero.
C Weight is equal to the upthrust.
D Weight is more than the upthrust.

11 An ideal barometer is used to measure the atmospheric pressure in a room. At which point is the pressure slightly less than the atmospheric pressure?



12 A person of 60 kg is standing on a platform over the piston of area 2500 cm^2. Given that the liquid is water, what will be the height, h? (Assume that the density of water is 1000 kg/m^3 and the atmospheric pressure is 10^5 Pa)



A 2.4 m **B** 0.24 m **C** 2.4 cm **D** 0.024 mm

13 A fixed mass of gas is cooled in a cylinder with a movable piston. The piston is pushed inward into the cylinder by the gas to maintain a constant pressure in the piston.

Which of the following about the gas molecules is correct?

	Average speed	Frequency of collision with the inner wall of container
A	no change	increase
B	no change	decrease
C	decrease	decrease
D	decrease	increase

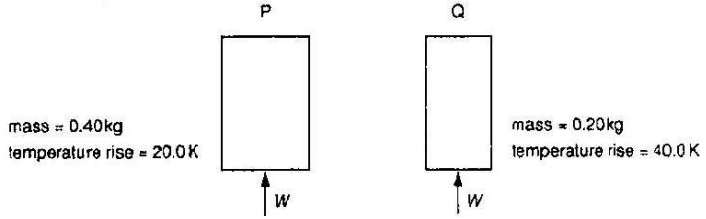
14 Which of the following is a possible unit for power?

A J s **B** $kg\ m^{-1}\ s^{-2}$ **C** $kg\ m^2\ s^{-3}$ **D** $kg\ m^2\ s^{-2}$

15 What is 178 K in degree Celsius?

A 451°C **B** - 95°C **C** - 105°C **D** - 125°C

16 The diagram represents two blocks, P and Q. Each of them received the same amount of energy, W. The mass of P is twice the mass of Q. The temperature rise of Q is 2 times the temperature rise of P.

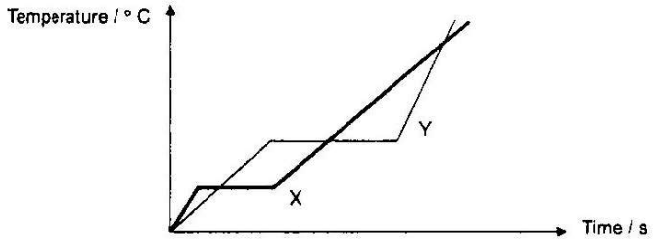


Which statement about P and Q is correct?

A The heat capacity of P is half the heat capacity of Q.
B The heat capacity of P is twice the heat capacity of Q.
C The specific heat capacity of P is half the specific heat capacity of Q.

D The specific heat capacity of Q is half the specific heat capacity of P.

17 Equal mass of two solids X and Y are heated successively in a well-lagged calorimeter. Heat energy is supplied to each of them at the same rate. A temperature-time graph for the process is shown below.



Which statement below is correct about X and Y?

A Liquids X has a lower specific heat capacity than liquid Y.
B Liquid X has a lower boiling point than liquid Y.
C Solid Y has a lower specific heat capacity than solid X.
D Solid X has a lower specific heat capacity than solid Y.

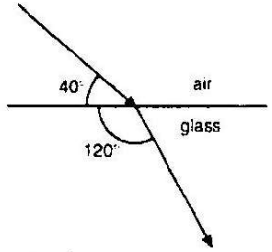
18 The distance between the 20 °C mark and the 100 °C mark on a mercury thermometer is 25.0 cm. When the mercury level is 5.0 cm below the 100 °C mark, the temperature is

A 64 °C **B** 75 °C **C** 80 °C **D** 84 °C

19 A piece of aluminium foil is shiny on one side and dull on the opposite side. When it is used to wrap around food to be cooked in a barbecue fire, which side of the foil should face the fire and why?

	side facing the fire	reason
A	dull	better conductor of thermal energy
B	dull	better absorber of thermal energy
C	shiny	better reflector of thermal energy
D	shiny	better conductor of thermal energy

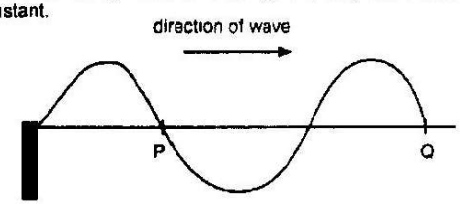
20 The diagram below shows a ray of light passing from air into glass.



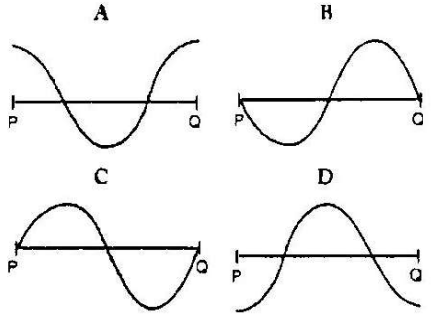
What is the critical angle for glass?

A 31° **B** 41° **C** 51° **D** 61°

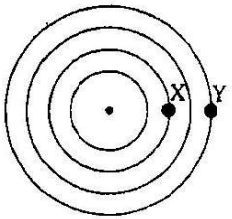
21 A vibrator generates a travelling wave on a string. The diagram shows the shape of the string at a certain instant.



Which of the following shows the shape of the string between P and Q after half of a period?



22 A series of circular wavefronts are created in a ripple tank as shown in the diagram.



Given that the speed of wave is 6.0 cm/s and the wavelength is 1.6 cm, what is the time taken for the wavefront to travel from X to Y?

A 3.75 s **B** 0.80 s **C** 0.53 s **D** 0.27 s

23 What is meant by '*the refractive index of the medium is 1.7*'?

A The speed of light in the medium is 1.7 times the speed of light in vacuum.
B The speed of light in the medium is 1.7 times the speed of light in air.
C The speed of light in vacuum is 1.7 times the speed of light in the medium.
D The speed of light in air is 1.7 times slower than the speed of light in the medium.

24 Ultra-violet waves, microwaves and X-rays are all part of the electromagnetic spectrum.

What is the correct order of increasing frequency?

	Lowest	⟶	Highest
A	X-rays	microwaves	ultra-violet waves
B	X-rays	ultra-violet waves	microwaves
C	microwaves	X-rays	ultra-violet waves
D	microwaves	ultra-violet waves	X-rays

25 Which of the following statements about the electromagnetic spectrum is true?

A All parts of the electromagnetic spectrum is invisible to the human eye.
B The frequencies of electromagnetic spectrum vary directly with wavelength.
C Their wavelength decrease as they propagate into an optically denser medium.
D It is possible to reflect all electromagnetic spectrum except for infra-red radiation.

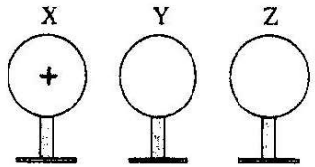
26 A man stands between two vertical walls. After making a loud clap, he hears two echoes at an interval of 1s. If the distance between the two walls is 1000 m, what is his distance from the nearest wall? Speed of sound in air is 300 m/s.

A 213 m **B** 425 m **C** 850 m **D** 1700 m

27 Which of the following frequencies cannot be heard by a normal human being?

A 10^2 Hz **B** 10^3 Hz **C** 10^4 Hz **D** 10^5 Hz

28 Three conductors are placed close to each other. Conductor X is positively charged. Both conductor Y and Z are neutral.



What will be the charge in conductor Z after it is being earthed momentarily?

A neutral **B** positive **C** negative **D** no charge

29 A resistor with resistance **R** is made from a length **L** of resistance wire with a cross-sectional area **A**.

A second resistor with resistance halved of **R** is made from wire of the same material and same cross-sectional area of **A**.

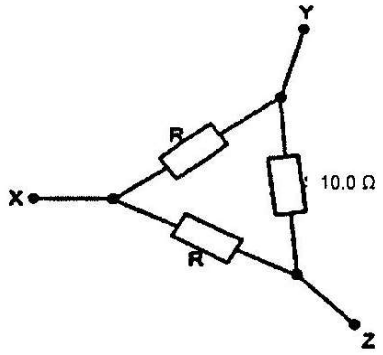
What length of wire is needed for the second resistor?

A L/2 **B** L **C** 2L **D** 4L

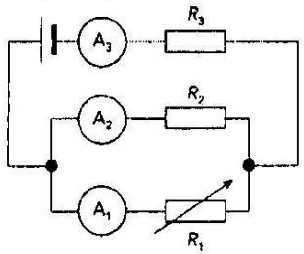
30 The diagram below shows a network of three resistors. Two of these, marked R, are identical. The other one has a resistance of 10.0 Ω.

The effective resistance between Y and Z is found to be 5.0 Ω. What is the resistance between X and Z?

A 0.26 Ω
B 1.9 Ω
C 2.5 Ω
D 3.75 Ω



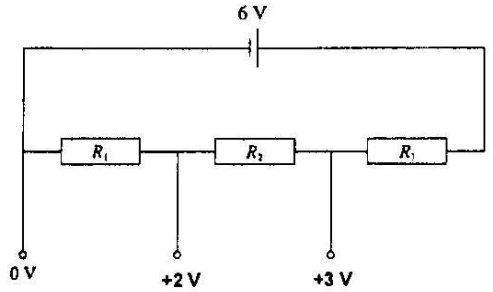
31 In the circuit shown, resistors R_2 and R_3 are both 100 Ω fixed resistors.



What will be the effect on the readings of the three ammeters if the resistance of R_1 is decreased from 100 Ω to 50 Ω?

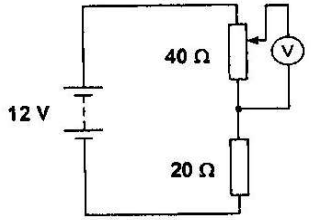
	A_1	A_2	A_3
A	increases	decreases	increases
B	decreases	unchanged	decreases
C	decreases	increases	increases
D	decrease	increases	decreases

32 Three resistors are connected in series to form a potential divider. Which of the following combination of resistances, R_1, R_2 and R_3 will provide the required output voltages of 2 V and
3 V from the 6 V d.c. source as indicated in the figure?



	R_1 / Ω	R_2 / Ω	R_3 / Ω
A	2	2	8
B	2	2	6
C	2	4	6
D	4	2	6

33 The diagram shows a circuit with a potential divider joined in series with a fixed resistor.



What are the minimum and maximum readings that can be obtained on the voltmeter when the potential divider is adjusted?

	minimum reading / V	maximum reading / V
A	0	4
B	0	8
C	2	8
D	4	12

34 Which of the following will be the cheapest to operate?
(Cost of 1 kWh is 25 cents)

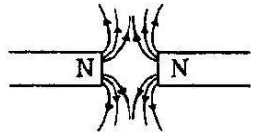
	Appliance	*Power rating / W*	*Time switched on*
A	Computer	1500	8 hours
B	Table lamp	800	18 hours
C	Lights	3000	3 hours

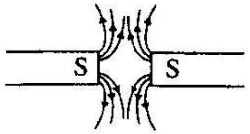
D Water heater 2500 6 hours

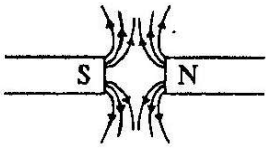
35 During the process of magnetic induction,

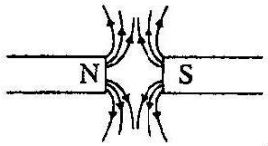
A a coil of wire must be present.
B an induced current is formed.
C soft iron is magnetised.
D there must be the presence of a changing magnetic field.

36 Which of the following indicates the correct magnetic field pattern between the poles of two bar magnets?

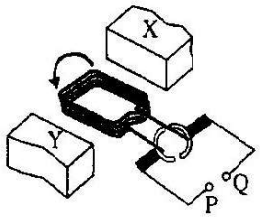
A 

B 

C 

D 

37 The diagram shows a simple d.c. motor.

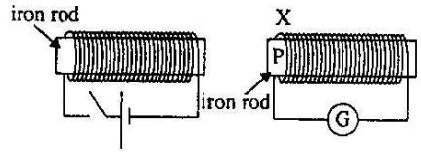


Which combination will achieve the direction of rotation shown in the diagram?

	Polarity	Direction of current
1	X is S-pole, Y is N-pole	P is +, Q is –
2	X is N-pole, Y is S-pole	P is -, Q is +
3	X is N-pole, Y is S-pole	P is +, Q is –

A 2 only
B 1 and 2 only
C 2 and 3 only
D 1 and 3 only

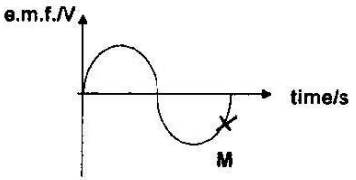
38 An electromagnet is placed near a coil connected to a galvanometer as shown.



Given that X is the magnetic pole induced on the solenoid and P is the magnetic pole induced in the iron rod, what will the polarities of X and P be when the switch is closed?

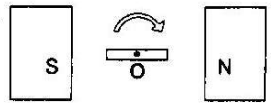
	X	P
A	N-pole	N-pole
B	N-pole	S-pole
C	S-pole	S-pole
D	S-pole	N-pole

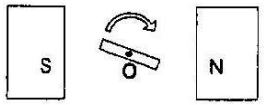
39 The graph below shows how the e.m.f. of an A.C. generator varies with time.



The diagrams below show the front view of the coil of an A.C. generator. The coil is being rotated about an axis through O in an uniform magnetic field. Which of them shows the position of the coil when the value of the induced emf is at M?

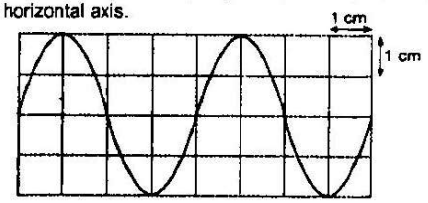
A 

B 

C 

D 

40 The diagram shows a trace on an oscilloscope set at 2.0 V/cm on the vertical axis and 20 ms/cm on the horizontal axis.



What is the peak voltage and frequency of the alternating voltage applied across the Y-input terminals?

	Peak voltage / V	Frequency / Hz
A	4.0	6.25
B	4.0	12.5
C	8.0	12.5
D	8.0	6.25

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CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination 2 in preparation for
the General Certificate of Education Ordinary Level 2016

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS **5059/02**

Paper 2 Theory

22 August 2016

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black ink.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **20** printed pages.

[Turn over

Section A
Answer **all** the questions in this section.

1 Fig. 1.1 shows the velocity-time graph of an object moving in a straight line for 10 minutes.

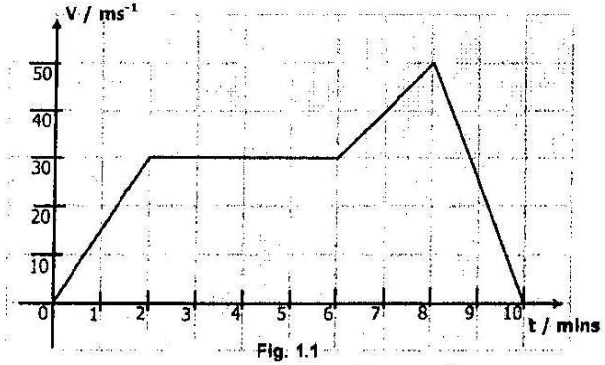


Fig. 1.1

(a) Describe the motion of the object for the first 6 minutes of the journey.

.....

.....[2]

(b) Calculate the deceleration of the object during the last minute of the journey.

deceleration = ...
[2]

(c) How far did the object travel during the last 4 minutes of the journey?

distance travelled = ...
[2]

(d) What is the average speed of the object during the last 4 minutes of the journey?

average speed = ...
[2]

2 A pole-vaulter runs along a track, reaching a maximum speed of 8.4 m/s. At the end of the track, he places a pole into the ground as shown in Fig. 2.1, and uses the pole to push himself vertically upwards.

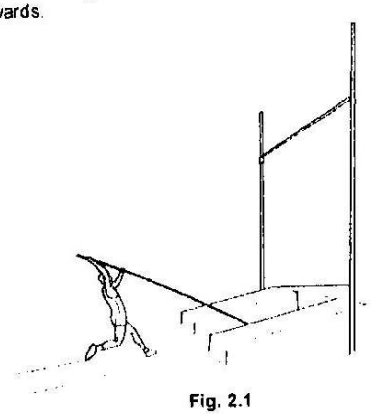


Fig. 2.1

When the pole-vaulter runs along the track, there is a constant forward force of 320 N on him and a backwards resistive force that varies with his speed as shown in Fig. 2.2.

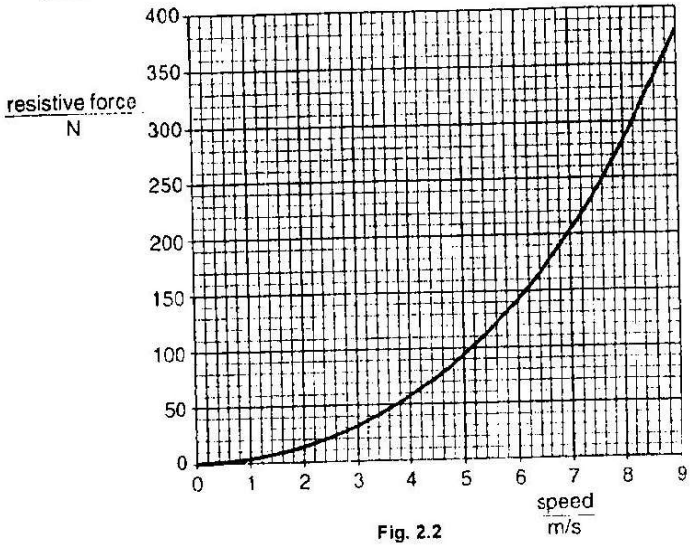


Fig. 2.2

(a) Explain why the maximum speed that he can reach is 8.4 m/s.

.....

.....[1]

The mass of the pole-vaulter is 60 kg.

(b) Calculate the maximum kinetic energy of the pole-vaulter as he runs along the track.

kinetic energy = ...
[2]

(c) The pole is used to convert all this kinetic energy into gravitational potential energy. Calculate the height through which the pole-vaulter rises.
The gravitational field strength is 10 N/kg.

height = ...
[2]

3 Fig. 3.1 shows a non-uniform cue stick suspended horizontally by two spring balances, S_1 and S_2. The centre of gravity of the cue stick is closer to B.

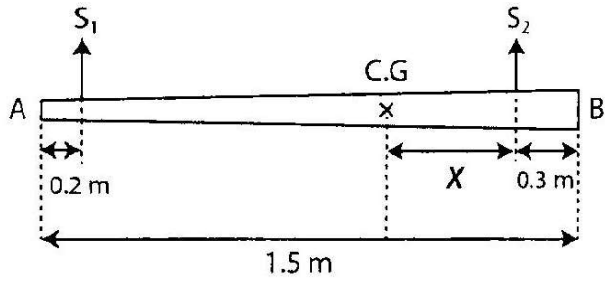


Fig. 3.1

(a) By taking moments about the centre of gravity of the cue stick, show why the cue stick will not balance in this particular position shown in Fig. 3.1, when the force exerted by the two spring balances S_1 and S_2 are equal in magnitude.

[3]

(b) The cue stick is then placed vertically upright on its end at point A. State the type of equilibrium the cue stick is in. Explain your answer.

.....

.....

.....[2]

4 Fig. 4.1 shows a water manometer used to measure the pressure inside a gas pipe.

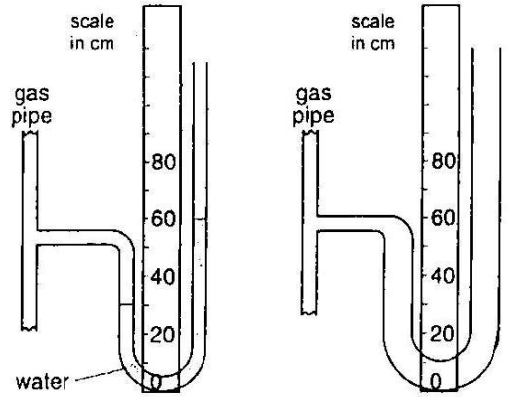


Fig. 4.1 Fig. 4.2

(a) Explain how the manometer in Fig 4.1 shows that the pressure inside the gas pipe is greater than the atmospheric pressure.

.....

.....[1]

(b) The density of water is 1000 kg/m^3, the gravitational field strength is 10 N/kg and the atmospheric pressure is 10^5 Pa. Calculate the pressure of the gas inside the pipe.

gas pressure = ...
[3]

The manometer shown in Fig. 4.2 is connected to the same gas pipe at the same pressure as shown in Fig. 4.1.

(c) On Fig. 4.2, draw the levels of the liquid in the manometer if the manometer contains a liquid with density half that of water and has tubes with twice the diameter of the tubes in Fig. 4.1.

[1]

5 (a) When light travels from air into glass, it changes direction.
State and explain how two other physical quantites changes when light travels from air into glass.

1. .....

.....

2. .....

.....[2]

(b) On Fig. 5.1, draw a ray diagram to show how a converging lens is used as a magnifying glass.

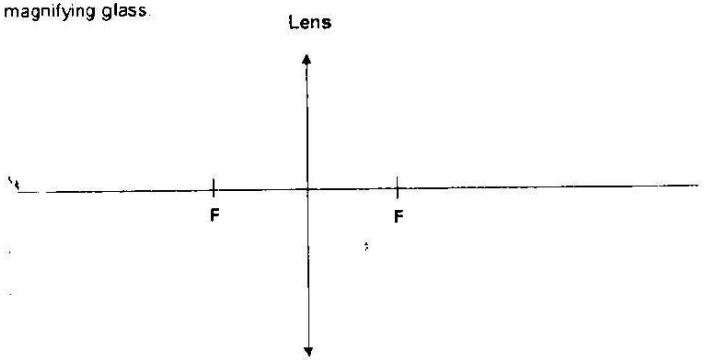


Fig. 5.1 [2]

(c) On Fig. 5.2, draw a ray diagram to show how a converging lens is used in an overhead projector.

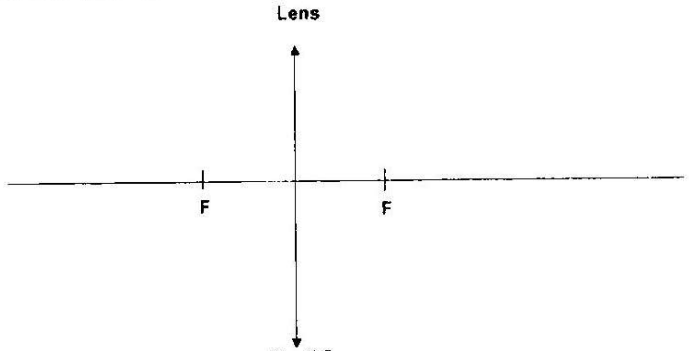


Fig. 5.2

[2]

6 A battery with an e.m.f. of 20 V is connected to three resistors, a light bulb, an ammeter and a voltmeter as shown in Fig. 6.1. A switch S is connected across points K and L.

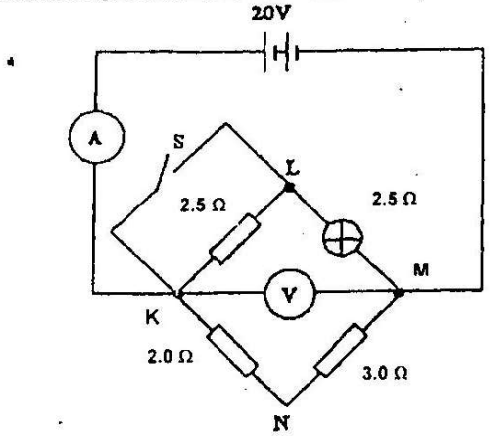


Fig 6.1

When the switch is closed,

(a) calculate the effective resistance of the entire circuit.

effective resistance = ... [2]

(b) determine the amount of current flowing through the light bulb.

current = ... [2]

(c) What will be the effect on the brightness of the bulb if the switch S is opened?
Support your answer with numerical calculations.

.....

.....

.....

.....[2]

7 Fig. 7.1 shows part of the lighting circuit of a house.

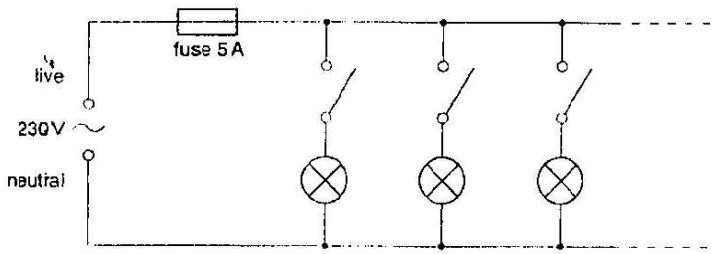


Fig. 7.1

(a) Explain why a fuse is included in the circuit.

.....

.....

.....[1]

(b) Explain why the fuse is placed on the live wire rather than on the neutral wire.

.....

.....

.....[1]

(c) Each lamp draws 250 mA from the power supply. The fuse has a rating of 5 A. Calculate the maximum number of lamps that can be connected and switched on without the fuse blowing.

maximum number of lamps = ...[1]

The table shows the maximum current that may be carried safely by wires of various diameter.

wire diameter / mm	maximum current / A
0.50	3
0.75	6
1.00	10
1.25	13
1.50	15

(d) From the table, select the smallest diameter of wire that can be used safely in wiring up the lighting circuit in the house.

.....[1]

(e) Explain why it is dangerous to use a wire thinner than that in **(d)**

.....

.....[1]

(f) Suggest a reason why the earth wire is not connected to the lighting circuit.

.....

.....[1]

8 Fig 8.1 below shows a simple a.c. generator.

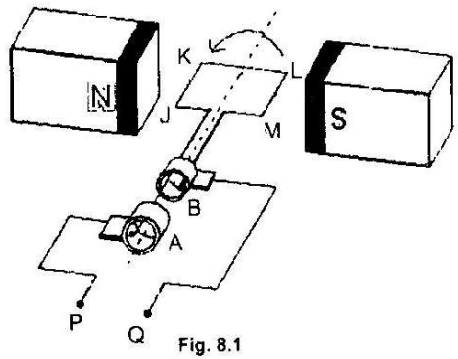


Fig. 8.1

(a) Explain how an electromotive motive force is formed across the terminals, PQ, as the coil rotates

.....

.....

.....[2]

(b) The coil of the generator makes 4 complete turns in one second. At this speed, the maximum induced e.m.f. is 0.4 V. Sketch a graph of induced e.m.f. against time for a time interval of 1s from the instant shown in Fig. 8.1. Label your axes appropriately.

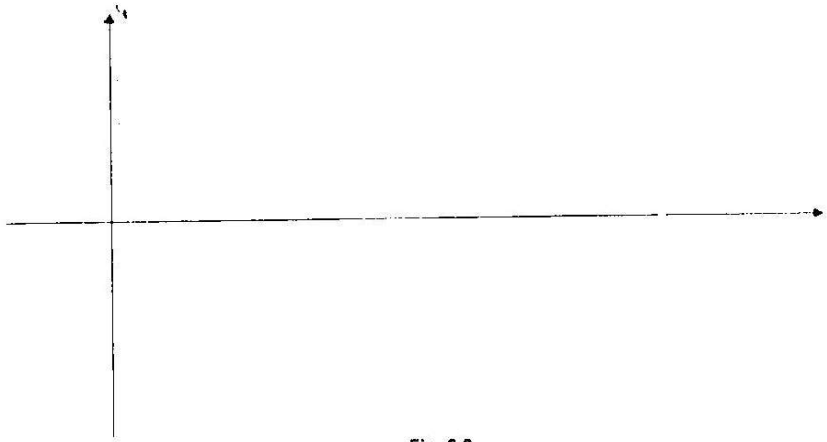


Fig. 9.2

[3]

(c) Without changing the frequency of the output waveform, state 2 ways to increase the maximum induced e.m.f.

1.....

.....

2.....

.....[2]

(d) On Fig. 8.1, indicate the direction of the induced current along JK.
Hence, indicate the polarity of the induced e.m.f. formed at the terminals, PQ, at that particular instant.

[2]

Name:	Index number:	Class:

Section B

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11**.

9 Two blocks of mass 5 kg and 8 kg are attached and pulled on top of a table in the direction as shown in Fig. 9.1.

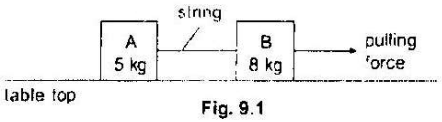


Fig. 9.1

The experiment is repeated on the same table but with a different pulling force. The velocity for both experiments is measured and tabulated in Fig. 9.2.

	velocity / cms^{-1}	
time / s	experiment 1	experiment 2
1	3	3
2	6	3
3	9	3
4	12	3
5	15	3

Fig. 9.2

(a) Explain why the velocity of the blocks in experiment 1 changes over time but remains unchanged in experiment 2.

.....

.....

.....

..... [2]

(b) Given that the friction between the table and block A is 2.0 N, calculate the tension in the string for experiment 1.

tension in string = ... [3]

(c) The blocks are now pulled by 2 forces, A and B, as shown in Fig. 9.3.

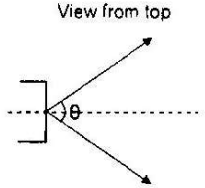


Fig. 9.3

Given that Force A = 1000 N, Force B = 1200 N and the angle θ between the forces is 80°, draw a scale diagram to determine the magnitude of the resultant force on the block.

scale = ...

resultant force = ... [5]

10 Fig. 10.1 shows an electric kettle.

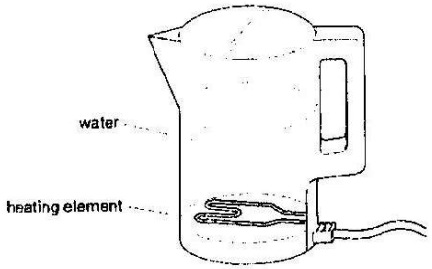


Fig. 10.1

(a) The specific heat capacity of water is 4200 J/kg°C.

Using this value for the specific heat capacity of water, describe an experiment to determine the electrical power of the kettle. You should state clearly how the readings are obtained and how the power is calculated. You may assume that the energy lost to the surrounding is negligible.

Suggested apparatus: kettle, thermometer, electronic balance, stopwatch.

.....

.....

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.....[4]

10 (b) Explain the meaning of "specific heat capacity of water is 4200 J/kg°C".

.....

.....

.....

.....[1]

(c) When the kettle is switched off, the water cools down as evaporation takes place. The latent heat of vaporisation is taken in by the water molecules as they leave the water surface.

(i) State one difference between boiling and evaporation.

.....

.....[1]

(ii) Explain how do the components of the internal energy of the water molecules change as they evaporates.

.....

.....

.....[2]

(d) The 2.5 kW electric kettle was containing 1.5 kg of water at 25.0 °C before it was switched on. It was switched on for 8 minutes.
Assuming there is no energy lost to the surrounding and the kettle, what is the mass of the water in the kettle at the end of the 8 minutes?
Specific latent heat of vaporisation of water is 2260 000 J/kg.

mass of water after 8 minutes = ...

[2]

11 **EITHER**

A lamp marked 6.0 V, 36 W is to be run from a power supply. The power supply can provide either direct current or alternating current.

To operate at normal brightness, the lamp needs an effective potential difference across it of 6.0 V.

(a) Explain what is meant by potential difference.

.....

.....[1]

(b) Determine the current through the lamp when it is operating normally.

current = ...

[2]

(c) Explain why the lamp should not be connected directly across a 10 V power supply.

.....

.....

.....[1]

Two students A and B suggest different ways to run the lamp at normal brightness using a 10 V power supply.

Student A suggests that the lamp is used with a series resistor R, as shown in Fig. 11.1.

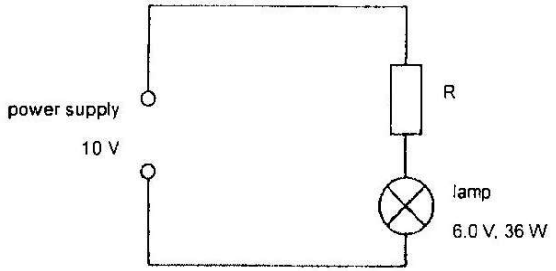


Fig. 11.1

(d) State values for the potential difference across resistor R and the current through it, when the lamp is at normal brightness.

Potential difference = ...

current = ...

[1]

Student B suggests that a transformer is used to transform the power supply voltage down to 6 V.

(e) Draw a labelled diagram of a transformer that could be used with a 10 V a.c. supply to operate the lamp normally. Suggest suitable values for the number of turns in each coil. Indicate these values clearly on your diagram.

[2]

(f) Explain how the transformer produces an output voltage.

.....

.....

.....[1]

(g) Suggest and explain which student, A or B, has the better solution.

.....

.....

.....[2]

OR

A student designs an electrical circuit to turn on a fan motor when the temperature is high. The motor is designed to operate normally from a 12 V supply, and has a resistance of 4.0 Ω.

The student's first design is shown in Fig. 11.2

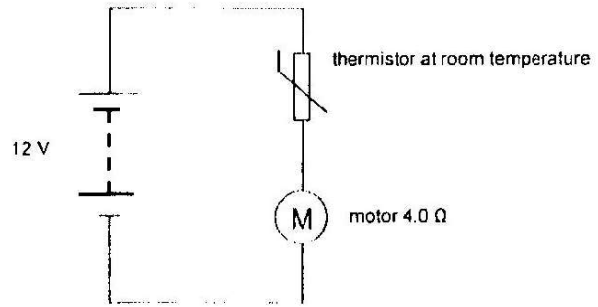


Fig. 11.2

(a) Describe and explain what happens to the current in the circuit when the temperature in the room rises.

.....

.....

.....[2]

(b) For the thermistor of resistance 500 Ω, calculate

1. the current in the circuit,
2. the potential difference across the motor.

current = ...

potential difference = ...
[3]

The student improves the design and uses a relay, as shown in Fig. 11.3.

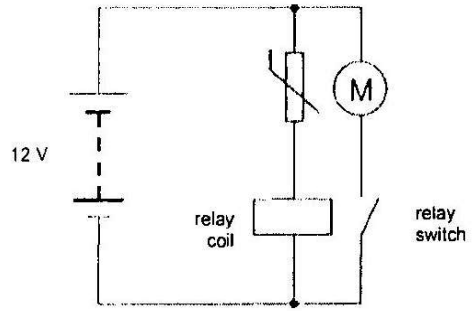


Fig. 11.3

(c) Explain how the motor is made to operate as the temperature rises.

.....

.....

.....[2]

The relay switches when the current through the relay coil is 0.10 A and the potential difference across the relay coil is 2.0 V.

(d) Calculate, for the conditions when the relay switches,

1. the potential difference across the thermistor,
2. the resistance of the thermistor.

potential difference = ...

resistance = ...
[2]

(e) Explain why the circuit in Fig. 11.3 is better than the circuit in Fig. 11.2.

.....

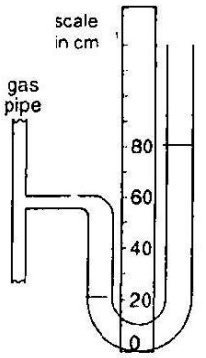
.....[1]

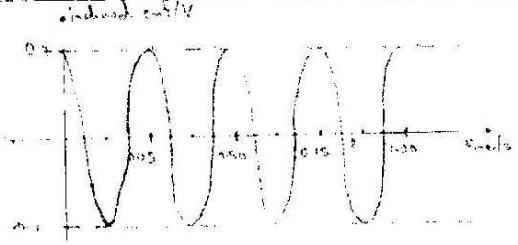
CHIJ SECONDARY (TOA PAYOH)
PRELIMINARY TWO EXAMINATION 2016
SECONDARY 4(EXPRESS)

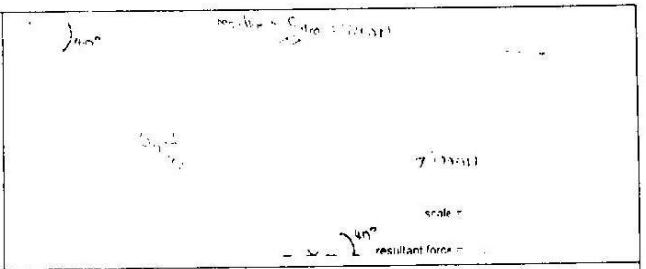
PHYSICS 5059/01
Paper 1

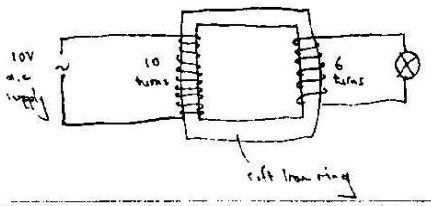
1	D	11	B	21	C	31	A
2	A	12	B	22	C	32	D
3	C	13	D	23	C	33	B
4	B	14	C	24	D	34	C
5	D	15	B	25	C	35	C
6	A	16	B	26	B	36	A
7	C	17	D	27	D	37	B
8	B	18	D	28	C	38	B
9	B	19	B	29	A	39	C
10	C	20	B	30	D	40	B

Paper 2 5059/02

Qn	Answers
1(a)	First 2 minutes, object is accelerating uniformly. Next 4 minutes, object is travel at constant velocity.
1 (b)	Acceleration = gradient of graph = 0-50/[2x60] = - 0.417 m/s^2 Deceleration = 0.417 m/s^2
1(c)	Distance = area under graph = ½ x[30+50]x[2x60] + ½ x 50 x[2x60] = 7.8 km
1(d)	Average speed = total distance / total time = 7800 / [4x60] = 32.5 m/s
2(a)	At his maximum speed. constant forward force = resistive force = 320 N. (resultant force = 0 N) From the graph, when resistive force is 320 N, speed is 8.4 m/s.
2(b)	Maximum K.E = ½ mv^2 Maximum K.E = ½ x 60 x 8.4^2 = 2120 J
2(c)	P.E at top = K.E at bottom mgh = 2116.8 60 x 10 x h =2116.8 h = 3.53 m
3(a)	Taking moment about X, Sum of clockwise moment = S_1 x [1.5-0.2-0.3-X] = S_1 x [1.0-X] Nm Sum of anti-clockwise moment = S_2 x X = S_2X Nm If S_1 and S_2 are equal, sum of clockwise moment will not be equal to sum of anti-clockwise moment. Hence, the cue stick will not balance.
3(b)	Unstable equilibrium When tilted slightly, the line of action of the weight will fall out of the small base area of the cue stick and cue stick will topple.
4(a)	The water level on the left side of the manometer exposed to the gas is much lower than the water level on the right side of the manometer exposed to the atmosphere.
4(b)	Pressure of gas = phg + atmospheric pressure = [1000x0.3x10] + 10^5 = 103000 Pa
4(c)	
5(a)	1. Speed of wave decreases as the wave is traveling through an optically less dense medium to an optically denser medium. 2. Wavelength of wave decreases as the speed decreases and frequency remains constant, wavelength will decrease.
5(b)	 - Dotted enlarged image behind object - Correct pair of rays passing through lens
5(c)	 - Correct pair of rays passing through lens - Correct real, diminished invert image
6(a)	Effective resistance = 1/[1/2.5 +1/5.0] = 1.67 Ω
6(b)	Current = I = V /R = 20 / 2.5 = 8 A
6(c)	When switch S is opened, voltage across bulb = 10 V Current through bulb = I = V / R = 10 / 2.5 = 4 A

	Since current is reduced when switch S is opened, brightness of bulb will reduce.
7(a)	The fuse is a safety device. When the current exceeds the fuse rating, the fuse wire will melt, protecting the electrical appliances and the user from damage and electrical shock.
7(b)	On the live wire, the fuse will be able to break open the circuit when the incoming current exceeds the safety limit, preventing it from entering the circuit to damage the electrical appliance. If placed on the neutral wire, the appliance may still be connected to the live wire even when the fuse has melted. Note: Unacceptable answer: "Fuse blow when current is too high or too large"
7(c)	Maximum number of lamps = 5/0.25 -1 = 19
7(d)	0.75 mm
7(e)	If a thinner wire (higher resistance) is selected and the maximum current flows through it, it might heat until the insulation starts to melt. The insulation might catch fire.
7(f)	Earth wire is not used in the lighting circuit as there are no metal casing used.
8(a)	When coil rotates between the magnetic poles, it will experience a rate of change of magnetic line of force linked with it. By Faraday's Law of Electromagnetic Induction, an induced e.m.f. is formed on the coil.
8(b)	 - Correct amplitude of 0.4 V - Correct period - 4 complete waves, starting from maximum value
8(c)	Any two: 1. Use stronger magnets 2. Increase the number of turns on the coil 3. Insert a soft iron core at the centre of coil.
8(d)	Current direction: K to J P is +, Q is -
	END OF SECTION A
9(a)	- In experiment 1, there is an resultant force. - In experiment 2, there is zero resultant force.
9(b)	$a = [v-u]/t = [15-3]/4 = 3\ cm/s^2$ T – Friction = Resultant Force $T = 2\ N + (5\ kg)(0.03\ ms^{-2})$ T = 2.2 N
9(c)	- Appropriate scale - Correct resultant force with double arrow indicated - Correct vector triangle - Correct magnitude for resultant force = 1690 N

	
10(a)	- Place empty kettle on electronic balance. - Pour 1 kg of water into kettle. - Place thermometer into kettle. - Record initial temperature of water, θ_1 °C. - Switch on the kettle and start the stopwatch at the same time. - Record the time taken for the temperature of the water to increase by 10 °C, t s. - Power = Energy x time Power = $mc\theta \times t = 1 \times c\ 10 \times t = 10ct$ W
10(b)	It means that 4200 J of energy is required to increase the temperature of 1 kg of water by 1 °C.
10(c)(i)	Any one: - Boiling is a fast process, evaporation is slow. - Boiling occurs throughout the liquid, evaporation occurs only at the surface of liquid. - Boiling requires a heat source, evaporation absorbs energy from the surrounding. - During boiling, bubbles are formed within the liquid. During evaporation, nothing visible happens.
10(c)(ii)	During evaporation. Kinetic energy of molecules remain constant. Potential energy of the molecules increases.
10(d)	Energy supplied by kettle = Power x time = 2500 x 8 x 60 = 1200 kJ Let m be the mass of water boiled into steam. Energy absorbed = $mc\theta + ml_v$ = 1200 kJ 1.5 x 4200 x [100-25] + m x 2260 000 = 1200 000 m = 0.322 kg Amount of water remaining = 1.5 – 0.322 = 1.18 kg
11	**EITHER**
11(a)	Potential difference is defined as the amount of work done in driving a unit charge through an electrical component.
11(b)	Current = Power / Voltage = 36 / 6 = 6 A
11(c)	If connected directly across the 10 V supply, the current drawn from the supply will be higher than the rated current. This might result in the breaking of the filament wire inside the lamp.
11(d)	Potential difference = 10 – 6 = 4 V Current = 6 A (Both answers must be correct to obtain the mark)

11(e)	$V_s / V_p = N_s / N_p$ $10 / 6 = N_s / N_p$ - Correct turn ratio - Primary and secondary coil wound around a soft iron ring with ac supply connected to primary coil and bulb connected to secondary coil. 
11(f)	When the a.c. supply is switched on, an alternating electromagnetic forms on the primary coil. By Faraday's Law of electromagnetic Induction, the secondary coil experience a rate of change of magnetic field lines link with it. Hence, an induced voltage is formed on the secondary coil.
11(g)	Student B's solution is better because it will reduce the amount of energy lost as heat as it does not require a resistor is connected in series with the lamp as shown in A's solution. **OR**
11(a)	- As temperature increases, the resistance of the thermistor decreases. - The current in the motor will start to increase.
11(b)	1. Current in the circuit = $I = V / R$ $= 12 / [500+4] = 23.8$ mA 2. Pd across motor = $V = IR = 23.8 \times 10^{-3} \times 4 = 95.2$ mV
11(c)	- As temperature rises, resistance of thermistor decreases. - Current through the relay coil increases until it reaches a level that would activate the relay switch. - When activated, the relay switch will switch on the motor.
11(d)	1. Pd across thermistor = $12 - 2 = 10$ V 2. Resistance of thermistor = $R = V / I = 10 / 0.10 = 100\ \Omega$
11(e)	Fig 11.3 is better because when the relay switch is activated, the pd across the motor is 12 V, which is required for the motor to work normally. In Fig 11.2, when motor is switched on, the pd across the motor will be lower than 12 V.
	END OF PAPER 2

HILLGROVE

United We Soar

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics **5059 / 1**

Paper 1

Date: 25 August 2016

Time 0900 – 1000 hr **Duration**: 1 hour

Additional Materials: OTAS

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in
Write in soft pencil.
Do not staples, paper clips, highlighters, glue or correction fluid.

There are forty questions on this paper. Answer **all** questions. For each question, there are four possible answers A, B C and D. Choose the one you consider correct and record your choice in soft pencil on the separate Answer Sheet (OTAS)

The use of approved scientific calculator is expected, where appropriate.

At the end of the examination, hand in the OTAS and question paper separately

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

Name of Student _____ ( )

Class: Secondary 4-8

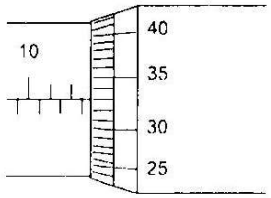
Setter: Mrs Jennifer Peng

This question paper consists of **12** printed pages, including cover page.

SECTION A (40 Marks)
Multiple Choice Questions
Answer all questions on the OTAS sheet provided.

1. A metre rule is used to measure a length. Which of the following is a possible reading obtained?
   (A) 0.6 m (C) 0.643 m
   (B) 0.64 m (D) 0.6431 m

2. A student used a micrometer screw gauge to measure the thickness of a metal sheet. The diagram below shows part of the micrometer.

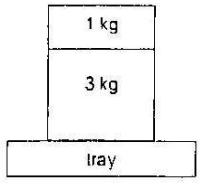


What is the thickness of the metal sheet?
   (A) 10.33 mm (C) 12.83 mm
   (B) 12.33 mm (D) 15.33 mm

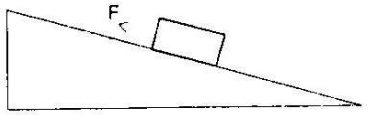
3. Which car, moving from rest, has an average acceleration of 2.0 m/s^2?
   (A) a car reaching a speed of 10 m/s in 2 s.
   (B) a car reaching a speed of 20 m/s in 5 s.
   (C) a car reaching a speed of 30 m/s in 10 s.
   (D) a car reaching a speed of 40 m/s in 20 s.

4. Two objects have the same size and shape but one is heavier than the other. They are each dropped from rest. Comparing the two objects, the heavier object has
   (A) the higher initial acceleration and the higher terminal velocity
   (B) the higher initial acceleration and the same terminal velocity.
   (C) the same initial acceleration and the higher terminal velocity.
   (D) the same initial acceleration and the same terminal velocity.

5 A tray supports a 1 kg mass and a 3 kg mass as shown below. What is the force acting on the 1 kg mass by the 3 kg mass? (g = 10 N / kg)
   (A) 10 N
   (B) 20 N
   (C) 30 N
   (D) 40 N

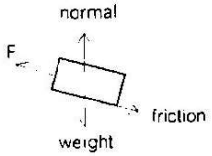


6 The diagram below shows a box being moved up by a force, F, on a rough inclined plane. F is parallel to the inclined plane.

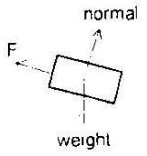


Which of the following diagrams correctly shows all the forces acting on the block?

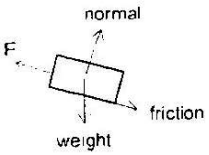
(A)



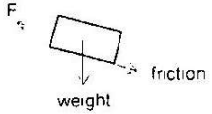
(C)



(B)

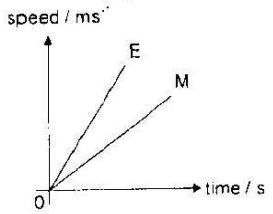


(D)

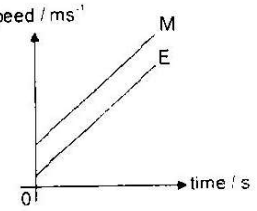


7 The acceleration due to the gravity of the Moon is one-sixth of that of the Earth. If a stone is thrown upwards, which graph shows the variation of the speed of the stone with time as it goes up on the Moon (**M**) and on the Earth (**E**)?

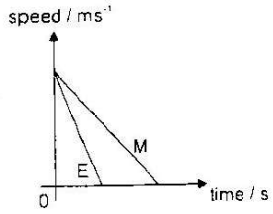
(A)



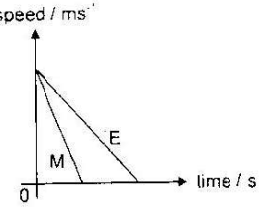
(C)



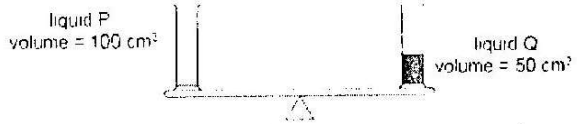
(B)



(D)



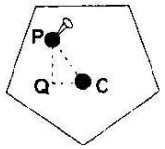
8. Two identical measuring cylinders containing different liquids are placed on a simple balance. They balance as shown.



How does the density of P compare with the density of Q?

(A) Density of P is half the density of Q.
(B) Density of P is equal to the density of Q.
(C) Density of P is twice the density of Q.
(D) Density of P is four times the density of Q.

9 A plane lamina is freely suspended from point **P**. The mass of the lamina is 0.3 kg and the centre of gravity is at **C**. The lamina is displaced to the position shown. What is the moment that will cause the lamina to swing?

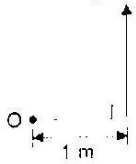


QC = 0.30 m
PC = 0.50 m
PQ = 0.40 m

(A) 0.09 Nm clockwise
(B) 0.10 Nm clockwise
(C) 0.12 Nm clockwise
(D) 0.90 Nm clockwise

10. Which of the following force produces the greatest moment about O?

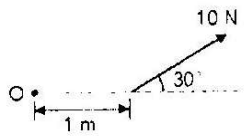
(A)



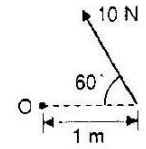
(C)



(B)



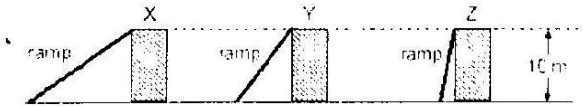
(D)



11. During the flag raising assembly, a pupil pulls the rope with a force of 15 N and the flag rises at a uniform speed of 0.5 m/min. Calculate the power supplied by the pupil.

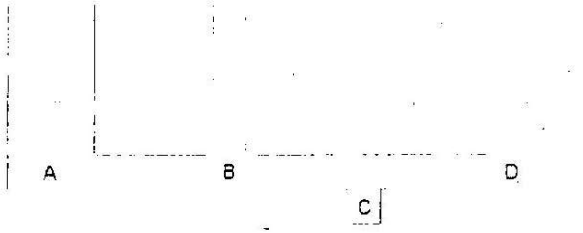
(A) 0.125 W
(B) 7.5 W
(C) 40 W
(D) 450 W

12 A load is to be lifted on three different lengths of ramps from ground level to a height 10 m above the ground. All the ramps are of the same material, but placed at different angles from the ground. Which path will require the most amount of work done in lifting the load? Assume that the surface is frictionless and the load moves at constant speed



(A) Path X
(B) Path Z
(C) Path Y
(D) Equal amount of work is done for every path

13. At which position will the pressure be the greatest?



14. Which of the following physical properties can be used to measure temperature?

1. Expansion of gas
2. Change in resistance
3. Change in mass

(A) 1 only
(B) 1 and 2 only
(C) 1 and 3 only
(D) 2 and 3 only

15 A piece of wire has an electrical resistance of 2.0 Ω in melting ice and 2.5 Ω in boiling water. What is the resistance at 20 °C assuming that resistance changes uniformly with temperature?

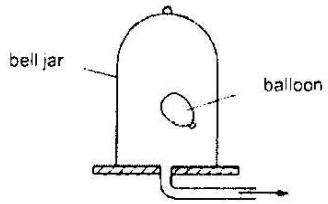
(A) 2.1 Ω
(B) 2.2 Ω
(C) 2.3 Ω
(D) 2.4 Ω

16. Which of the following statements about the movement of smoke particles in a Brownian motion experiment using smoke particles are correct?

I. It is due to the bombardment of air molecules.
II. It is faster if the particles are larger.
III. It is faster if the temperature of the air is higher.
IV. It is at random.

(A) I and II only
(B) I, II and IV only
(C) I, III and IV only
(D) I, II, III and IV

17 A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.



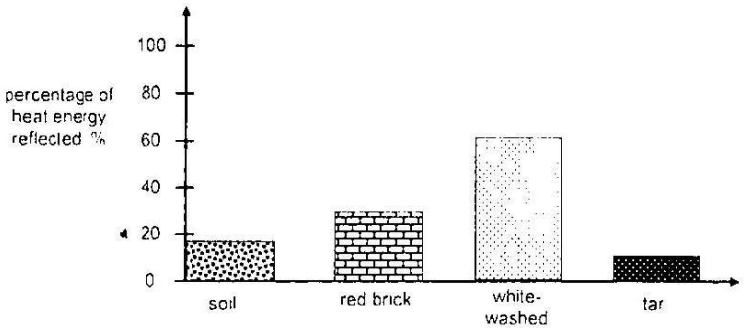
Air is then pumped out of the bell jar. What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
(A)	decreases	decreases
(B)	decreases	increases
(C)	increases	decreases
(D)	Increases	increases

18. A copper rod is heated at one end. Which statement describes how heat transfer occurs in the copper?

(A) Energetic copper molecules move from the cooler end to the hotter end.
(B) Energetic copper molecules move from the hotter end to the cooler end.
(C) Energetic free electrons move from the cooler end to the hotter end.
(D) Energetic free electrons move from the hotter end to the cooler end.

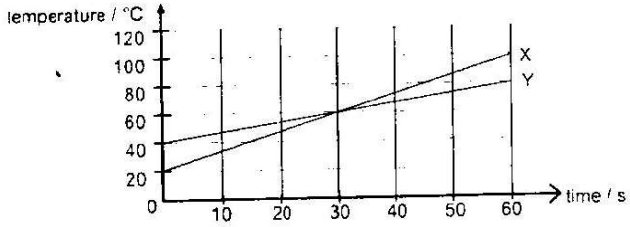
19. Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?

(A) cover it with a layer of red brick dust
(B) cover it with a layer of soil
(C) paint it with tar
(D) paint it white-washed

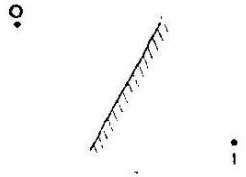
20. Two blocks X and Y, which are made of the same metal, are heated by heaters at the same power rating. The variations of temperature with time are given below.



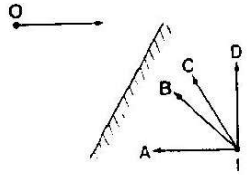
What is the ratio of masses X to Y?

(A) 1 : 2
(B) 1 : 4
(C) 2 : 1
(D) 4 : 1

21 An object placed in front of a plane mirror at O produces an image I.

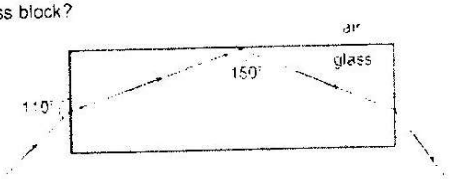


If the object moves towards the mirror in the direction shown by the arrow, In which direction does the image move?



22. A ray of red light enters a glass block as shown and is reflected off one of its side. The diagram is not drawn to scale.
What is the refractive index of the glass block?

(A) 0.97
(B) 1.32
(C) 1.88
(D) 3.63

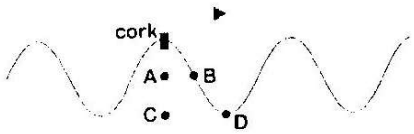


23. When water wave flows from shallow water into deep water, how do the frequency, wavelength and speed change?

	frequency	wavelength	speed
(A)	no change	decreases	decreases
(B)	no change	no change	decreases
(C)	no change	increases	increases
(D)	increases	no change	increases

24. A water surface wave (ripple) is travelling to the right on the surface of a lake. The wave has period T. The diagram shows the surface of the lake at a particular instant of time. A piece of cork is floating in the water in the position shown.

Which is the correct position of the cork a time $\frac{T}{4}$ later?



25. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

(A)	Gamma ray	→	Ultra-violet	→	Radio wave
(B)	Gamma ray	→	Visible light	→	Ultra-violet
(C)	Microwave	→	Ultra-violet	→	X-ray
(D)	Visible light	→	Infra-red	→	X-ray

26. Below are four statements about the uses of electromagnetic radiation.
1. Gamma rays are used in medical treatment.
2. Infra-red waves are used in sunbeds.
3. Microwaves are used in satellite television.
4. X-rays are used in intruder alarms.

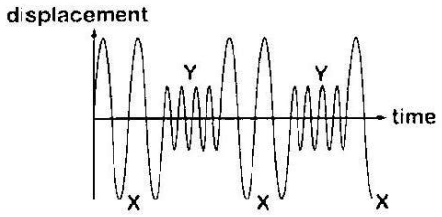
How many of these statements are correct?

(A) 1
(B) 2
(C) 3
(D) 4

27. A student stands between two vertical walls. One wall is 300 m away and the other is 600 m away. After making a loud clap, he hears two echoes at an interval of time t. What is the time interval, t? Take the speed of sound in air to be 300 m/s.

(A) 1.0 s
(B) 1.5 s
(C) 2.0 s
(D) 4.0 s

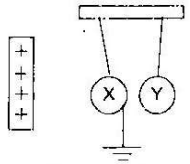
28. An ambulance siren emits two different sounds X and Y. These are produced alternately. The diagram represents the sounds emitted.



Which sound is louder and which has lower pitch?

	louder	lower pitch
(A)	X	X
(B)	X	Y
(C)	Y	X
(D)	Y	Y

29 Two isolated metal spheres X and Y are initially uncharged. The diagram shows a positively charged strip being placed near metal spheres X and Y. X is then earthed momentarily During the whole process, X and Y do not touch.

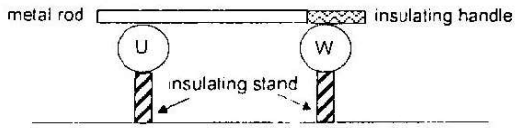


With the strip still in position, what would be the charges on X and Y?

	X	Y
(A)	negative	neutral
(B)	negative	negative
(C)	positive	neutral
(D)	neutral	negative

30. Two spheres U and W are mounted on insulating stands. Sphere U is initially uncharged and made of brass and sphere W is initially weakly positively charged and made of polythene.

A metal rod, held by an insulating handle, is placed in contact with U and W as shown.



What are the charges on U and W after the rod is placed in contact with them?

	charge on U	charge on W
(A)	positive	positive
(B)	positive	uncharged
(C)	uncharged	positive
(D)	uncharged	uncharged

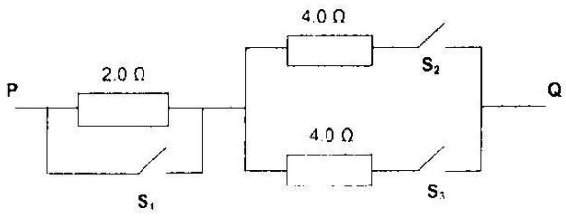
31. The potential difference across two identical resistors in series is 8.0 V. How much energy is dissipated in one of the resistors when 5.0 C of charge flows through it?

(A) 0.8 J (C) 20 J
(B) 1.6 J (D) 40 J

32. A 1.0 m length of wire, having a cross-sectional area of 0.40 mm^2, has a resistance of 2.0 Ω. What is the resistance of a 0.50 m length of wire (made of the same material), with a cross-sectional area of 0.80 mm^2?

(A) 0.5 Ω (C) 2.0 Ω
(B) 1.0 Ω (D) 8.0 Ω

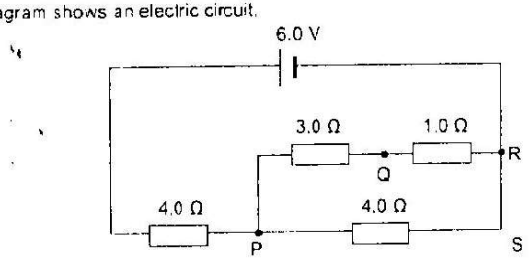
33. The diagram shows part of a circuit in which all the switches are open.



Which of the following combinations will result in a resistance of 2.0 Ω between P and Q?

	S_1	S_2	S_3
(A)	Closed	Closed	Closed
(B)	Closed	Opened	Closed
(C)	Opened	Closed	Closed
(D)	Opened	Opened	Closed

34. The diagram shows an electric circuit.



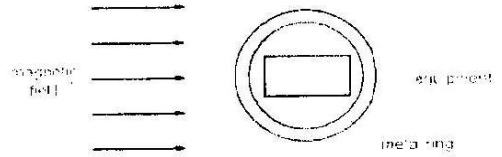
What is the potential difference between P and Q?

(A) 1.5 V (C) 2.5 V
(B) 2.0 V (D) 3.0 V

35. Which of the following best gives the reason why the earth wire is a necessity for many household appliances?
(A) To protect the fuse in the electric plug.
(B) To complete the circuit in order for the device to work.
(C) To protect the user against electrocution if the appliance becomes faulty.
(D) To protect the device against damage by preventing the excess current from flowing through the device.

36. Which of the following observations confirms that an object is a magnet?
(A) The object is attracted by a strong bar magnet.
(B) The object causes a compass needle to move.
(C) The object rotates before being attracted to a bar magnet.
(D) The object is attracted to both poles of a horseshoe magnet.

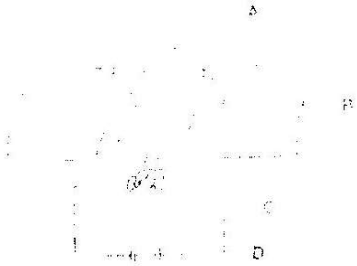
37 A metal ring shields a piece of equipment from a magnetic field.



Which metal should be used for the ring, and why?

	metal	reason
(A)	copper	The metal carries the field lines around the equipment.
(B)	copper	The metal is non-magnetic.
(C)	iron	The metal carries the field lines around the equipment.
(D)	iron	The metal is non-magnetic.

38 The diagram shows a simple d.c. motor. Which part needs to be made of soft iron to increase the efficiency of the motor?

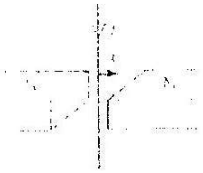


39 Which diagram shows the direction of the force F that is produced by a current I in a magnetic field?

(A)



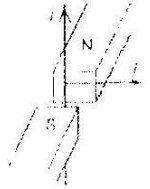
(C)



(B)



(D)



40. Two parallel wires each carry a current into the plane of the paper. Which diagram shows the magnetic field pattern due to the currents in the two wires?

(A)



(C)



(B)



(D)



*** END OF PAPER 1 ***

United We Soar

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics **5059 / 2**

Paper 2

Date 25 August 2016

Time: 1100 – 1245 hr Duration: 1 hour 45 minutes

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in.
Write in the dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working
Do not staples, paper clips, highlighters, glue or correction fluid.

SECTION A (Short Structured Questions)
Answer all questions.
Write your answers in the spaced provided on the question paper.

SECTION B (Long Structured Questions)
Answer all questions.
Question **12** has a choice of parts to answer

Candidates are reminded that all quantitative answers should include appropriate units
The use of approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for the sound use of Physics than for correct answer.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Name of Student: _____ ( )

Class: Secondary 4-8

Parent's Signature: _____

Setter: Mrs Jennifer Peng

Section	Marks
A	/ 50
B	/ 30
Total	**/ 80**

This question paper consists of 18 printed pages, including cover page.

SECTION A [50 Marks]
SHORT STRUCTURED QUESTIONS
Answer all questions in the spaces provided on the question paper.

1. A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The velocity-time graph for the stone is shown in Fig. 1.2.

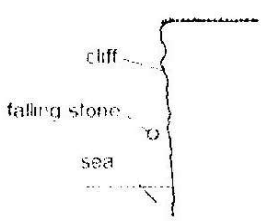


Fig. 1.1

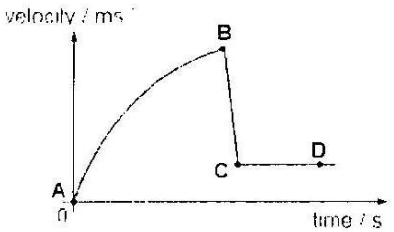


Fig. 1.2

(a) Describe the changes in motion of the stone between point A and D. [3]

(b) Explain, in terms of the forces acting, for your answer in (a). [3]

2 A uniform rod AB of length 3 m weighs 10 N. It is suspended by two identical strings at points X and Y as shown in Fig. 2.1. T_1 and T_2 are the tension in the strings.

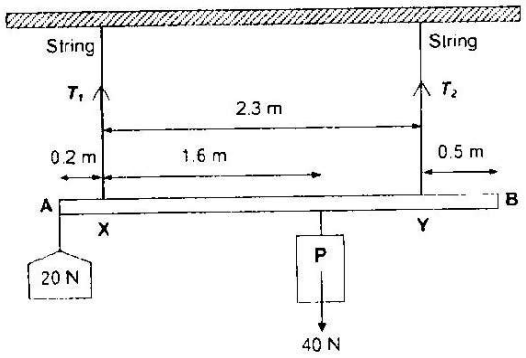


Fig. 2.1

Two weights, 20 N and P, are hung from the rod at point **A** and 1.6 m from **X** respectively.

(a) Draw the weight of the rod in Fig. 2.1 and label it **W**.
Indicate clearly its distance from point A. [1]

(b) Determine T_2, the tension of the string at **Y**.

T_2 = [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X**

T_1 = [1]

3. In an Olympic game, a man of mass 58 kg is trying to swing on a high bar as shown in Fig 3. He is momentarily at rest at the top of the swing. At this position, his centre of mass is at a height of 0.9 m above the bar as shown in the diagram.

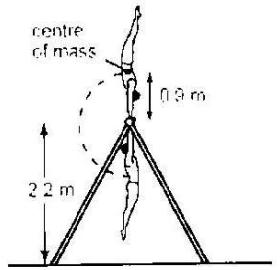


Fig 3

(a) Calculate his gravitational potential energy at the top of the swing.

gravitational potential energy = [2]

(b) Calculate his speed at the bottom of his swing.

speed = [2]

(c) State two assumptions that are made in (b) [2]

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4. Fig. 4 shows two identical pots containing the same soup at different temperature, 90 °C and 75 °C. The mass of soup in both pots are the same and they are both left to cool under the same surrounding conditions.

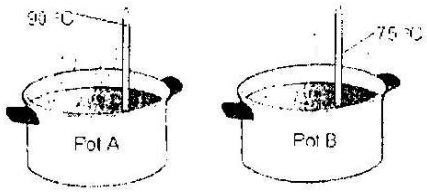


Fig. 4

(a) Explain why the following features of a pot are advantageous to cooking:

(i) The pot is made of metal. [1]

(ii) The pot has low heat capacity. [1]

(b) State and explain which pot will see a larger drop in temperature at the end of ten minutes. [2]

(c) State and explain if your answer in (b) would differ if both pot A and pot B are painted black. [2]

5. A 2 kW heater is used to melt 1.5 kg of solid lead from a room temperature of 27 °C.

(a) The heater takes 29.25 s to heat the lead to its melting point of 327 °C. Calculate the specific heat capacity of lead.

specific heat capacity of lead = [2]

(b) Given that the specific latent heat of fusion of lead is 22.4 kJ/kg. Calculate the amount of time to further heat the lead until it is completely melted

time = [2]

(c) Describe clearly the changes in kinetic energy and potential energy of the solid lead throughout the entire process. [4]

6 Fig. 6.1 below shows a thin converging lens being used to produce an image X' of an object X. Show on Fig. 6.1 how the given light ray will travel after passing through the converging lens.

(a) Complete Fig. 6.1 with suitable light rays to locate the position of the principal focus F. [3]

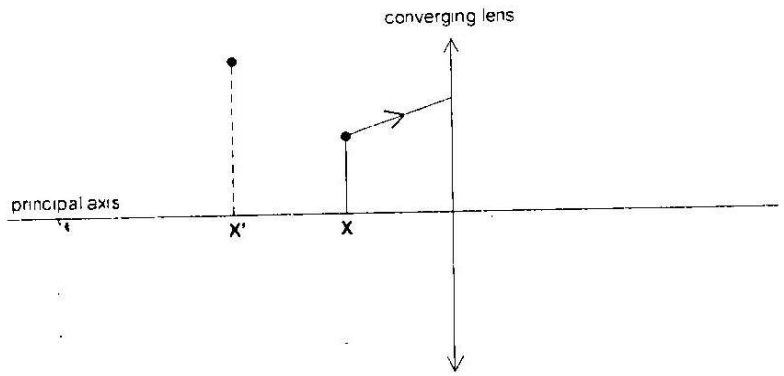


Fig. 6.1

(b) Give one common application for the lens set-up in Fig. 6.1. [1]

.....

.....

7 Two metal conductors **P** and **Q** are mounted on insulating stands. Conductor **P** is given a negative charge, which is initially spread uniformly over the surface of the conductor. Conductor **Q**, initially uncharged, is brought close to **P** as shown in Fig. 7. There is now more negative charge on the right-hand side of **P** than its left-hand side.

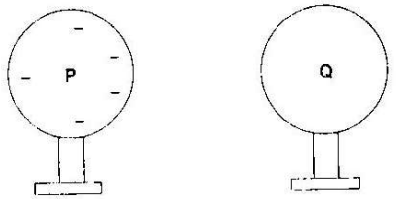


Fig 7

(a) On the diagram above, draw the induced charges on **Q**. [1]

(b) Explain how these charges are induced in **Q**. [2]

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(c) The conductors **P** and **Q** are brought closer and are in physical contact. State what happens to the charges on P and **Q**. [2]

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8. In the circuit shown in Fig. 8.1, a 4 700 Ω resistor is connected in series with a light-dependent resistor (LDR), which has a resistance of 3300 Ω, and with a 12 V power supply.

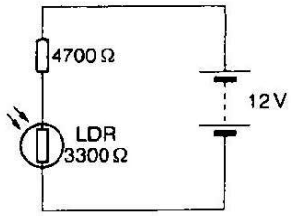


Figure 8.1

(a) Calculate the current through the LDR

current = [2]

(b) Calculate the voltage across the LDR.

voltage = [1]

(c) Describe how the resistance of the LDR changes as brighter light falls on it. [1]

(d) A student claims that in theory if the resistor is replaced by a buzzer, it can function as a burglar alarm. Describe and explain how the student's setup will work when a burglar shines a very bright light on the LDR. [2]

9. Fig. 9 below shows a science exhibit consisting of three vertical hollow tubes, T_1, T_2 and T_3, each about 2 m long. The tubes are identical in size. With the tubes are three identical small cylinders, one to each tube.

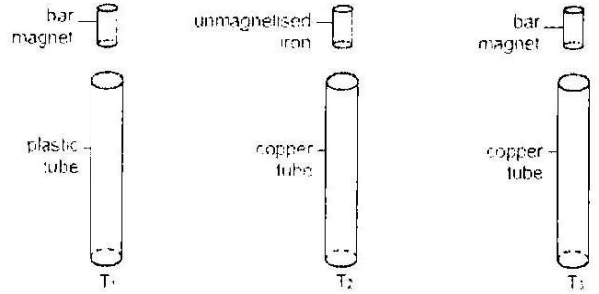


Fig. 9

The three cylinders are released from rest and dropped into the hollow tubes at the same time. When the cylinders are dropped down the hollow tubes, those in T_1 and T_2 reach the bottom in less than 1 second, while that in T_3 takes a few seconds.

(a) Explain why the cylinder in T_3 takes longer to reach the bottom of the tube than the cylinder in T_1. [2]

(b) Explain why the cylinder in T_1 and the cylinder in T_2 take the same time to reach the bottom. [3]

SECTION B [30 Marks]

Answer Question 10 and 11 in the spaces provided.
Answer only one of the two alternative questions in Question 12

10. Many electrical devices, such as television and computers, have stand-by mode.

Fig 10.1 shows the 230 V mains supply connected to a television.



Fig. 10.1

When switch S is open, the television is in stand-by mode. No energy is supplied to the main television circuit. Some energy is supplied to the stand-by circuit.

When the television is in full use, switch S is closed and energy is supplied to both circuits. In the house of a student, the television is never unplugged. In one week, the television is in full use for 30 hours and in stand-by mode for 138 hours.

Fig 10.2 shows the current in the two circuits when in full use and in stand-by mode.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main television circuit / mA	450	0
current in stand-by circuit / mA	34	34

Fig 10.2

(a) Calculate the total power supplied to the two circuits by the 230 V mains supply when the television is in full use.

power = [3]

(b) (i) Calculate the amount of energy supplied in one week by the mains supply to the television when in stand-by mode. Give your answers in joules.

energy = [2]

(ii) The cost of 1 kWh of electrical energy is 25 cents. Calculate the cost of the energy in (b) (i)

cost = [3]

(c) In the same house, there is a computer which is also never unplugged. This computer has a stand-by circuit and a switch similar to those in the television.

In one week, the computer is in full use for 50 hours and in stand-by mode for 118 hours.

Fig 10.3 gives data for the computer similar to the data in Fig 10.2.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main computer circuit / mA	270	0
current in stand-by circuit / mA	34	34

Fig 10.3

(i) To save energy, the student decides to unplug either the television or the computer when not in use.

Explain, in words, why unplugging the television saves more energy. [1]

(ii) Suggest one disadvantage in completely unplugging a computer when not in use. [1]

11 Fig. 11.2 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.

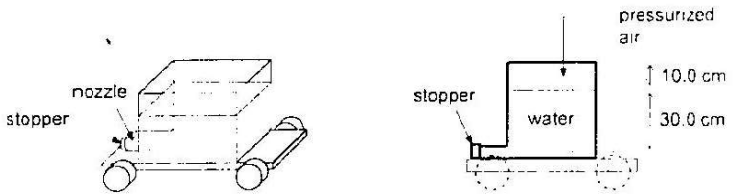


Fig. 11.2

The following information is provided.

Initial height of the water in the tank	30.0 cm
Initial height of the air in the tank	10.0 cm
Initial air pressure in the tank	2.50×10^5 Pa
Cross-sectional area of the nozzle	4.00×10^{-4} m^2
Atmospheric pressure	1.00×10^5 Pa
Density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

total pressure = [2]

(b) The calculated pressure in part (a) is larger than the atmospheric pressure. Explain why the stopper is not forced out of the nozzle. [2]

(c) When the stopper is removed, the water will be pushed out of the nozzle, causing a forward force which propels the trolley to move forward. Calculate the maximum forward force due to this propulsion.

maximum forward force = [2]

(d) After a short period of time, the height of the water drops to 15.0 cm. Calculate the air pressure inside the tank.

air pressure = [2]

(e) The cross-sectional area of the nozzle is enlarged. State two changes that will occur with reference to the trolley. [2]

12. EITHER

In an experiment to study sound waves, a tuning fork is struck and placed near a microphone.

(a) Explain how the sound waves are transmitted from the tuning fork to the microphone. [2]

.....

.....

.....

.....

(b) The microphone converts the sound into electrical signal which is input into a cathode ray oscilloscope. Fig. 12.1 shows the trace obtained on the screen of the CRO when the input signal is applied to it. The time-base of the CRO is set at 2 ms/div

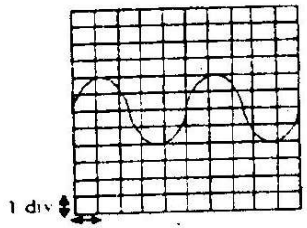


Fig. 12.1

(i) Calculate the frequency of the sound waves produced by the tuning fork.

frequency = [2]

(ii) Calculate the wavelength of the sound waves, given that the speed of sound in air is 340 ms^{-1}.

wavelength = [1]

(c) State and explain the effect on the trace on the screen when the tuning fork is moved further away from the microphone. [2]

.....

.....

.....

.....

(d) In a second experiment, the tuning fork is replaced by a device which emits an ultrasound.

(i) Explain the term *ultrasound*. [1]

.....

.....

(ii) State the effect on the trace on the screen when the ultrasound is input into the CRO [1]

(e) State one practical application of ultrasound. [1]

.....

.....

OR

The table contains data about a transformer. The turns ratio of primary coil to the secondary coil is 0.5. This is not an ideal transformer as seen from the data. The load resistance, connected to the secondary coil has been varied.

input voltage / V	output voltage / V	load resistance / Ω	input power / W
6.00	0.57	1.0	6.86
6.00	4.00	10.0	4.80
6.00	6.00	20.0	3.60
6.00	7.20	30.0	2.88
6.00	7.64	35.0	2.62

(a) State what is meant by an ideal transformer. [1]

.....

.....

.....

(b) Explain why the transformer under study is NOT ideal [1]

.....

.....

.....

(c) Use the table to calculate

(i) the current in the primary coil when the input power is 2.62 W.

current = [2]

(ii) the corresponding current in the secondary coil.

current = [2]

(d) Determine the output power when the input power is 2.62 W.

power = [2]

(e) Sketch a graph of the output voltage against the input voltage if this transformer is ideal. [2]

*** END OF PAPER 2 ***

HILLGROVE SECONDARY SCHOOL
Pure Physics Preliminary Examination 2016
Secondary 4 Express

Question	Answer	Remarks / Explanation
1	C	Accuracy of metre rule is 3 dp when measured in metres
2	C	12.5 + 0.33 = 12.83 mm
3	D	a = 10/2 = 5 a = 20/5 = 4 a = 30/10 = 3 a = 40/20 = 2
4	C	Both objects fall with an initial acceleration of 10 m/s^2. However as the heavier object has a larger weight, as a result the downward force is larger. By the time the air resistance manages to balance the downward force (*i.e. resultant force is zero*), the downward velocity is greater than that of the lighter man.
5	A	Look at only the 1 kg mass. There are only two forces acting on the 1 kg mass. The gravitational force acts on the 1 kg mass by the Earth and the reaction forces acts on the 1 kg mass by the 3 kg mass. For the system to be in equilibrium, action = reaction force and the two forces must be equal and opposite.
6	B	Weight acts vertically downwards. Normal force is perpendicular to the plane. Friction acts in a direction opposite to motion.
7	B	Acceleration = gradient of speed-time graph. E has a steeper gradient as acceleration due to gravity is higher. If the stone is thrown upwards, acceleration due to gravity is negative as it is downwards (acting in the opposite direction)
8	A	Mass of P and mass of Q is equal. As volume of P is double volume of Q, then density (mass/volume) of P will be half that of Q
9	D	Weight = mg = 0.3 x 10 = 3 N Moment = Fd = 3 x 0.30 = 0.90 Nm clockwise
10	A	Greatest perpendicular distance between pivot and line of action of force
11	A	Power = (15 x 0.5) / 60 = 0.125 W
12	D	Vertical height is the same
13	C	Lowest point
14	B	
15	A	20 = [(R – 2) / (2.5 – 2)] x 100 0.2 = (R – 2) / 0.5 R = 2.1 Ω
16	C	
17	B	
18	D	
19	D	
20	A	Q = mcθ $m_1c(80) = m_2c(40)$ $m_1 / m_2 = 40 / 80 = 1 / 2$
21	C	
22	B	n = sin (20) / sin (15) n = 1.32
23	C	
24	A	
25	A	Gamma, X-ray, Ultra-violet, Light, Infrared, Microwave, Radio
26	B	
27	C	The interval is the time take for the sound to travel the extra distance made by the longer sound path. Extra distance travelled by the longer sound path = 2 x 600 – 2 x 300 = 600 m Distance = speed x time 600 = 300 t t = 2 s
28	A	
29	A	
30	C	
31	C	V = 4 V, Q = 5 C, E = ? V = E / Q 4 = E / 5 E = 20 J
32	A	When length + 2, R = 2 / 2 = 1 ΩWhen A x 2, R = 1 / 2 = 0.5 Ω
33	A	1/R = ¼ + ¼ = ½ R = 2 Ω
34	A	$R_T = (¼ + ¼)^{-1} + 4 = 6$ Ω $V_{PR} = 2/6 \times 6 = 2$ V $V_{1\Omega} = ¼ \times 2 = 1.5$ V
35	C	
36	C	
37	C	
38	A	
39	D	
40	B	

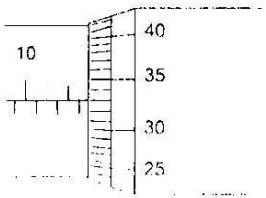
SECTION A (40 Marks)
Multiple Choice Questions
Answer all questions on the OTAS sheet provided

1 A metre rule is used to measure a length. Which of the following is a possible reading obtained?

(A) 0.6 m (C) 0.643 m
(B) 0.64 m (D) 0.6431 m

Accuracy of metre rule is 3 dp when measured in metres

2 A student used a micrometer screw gauge to measure the thickness of a metal sheet. The diagram below shows part of the micrometer.



What is the thickness of the metal sheet?

(A) 10.33 mm (C) 12.83 mm
(B) 12.33 mm (D) 15.33 mm

12.5 + 0.33 = 12.83

3 Which car, moving from rest, has an average acceleration of 2.0 m/s^2?

(A) a car reaching a speed of 10 m/s in 2 s. a = 10/2 = 5
(B) a car reaching a speed of 20 m/s in 5 s. a = 20/5 = 4
(C) a car reaching a speed of 30 m/s in 10 s. a = 30/10 = 3
(D) a car reaching a speed of 40 m/s in 20 s. a = 40/20 = 2

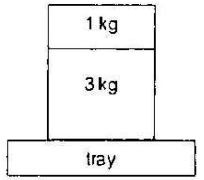
4 Two objects have the same size and shape but one is heavier than the other. They are each dropped from rest. Comparing the two objects, the heavier object has

(A) the higher initial acceleration and the higher terminal velocity.
(B) the higher initial acceleration and the same terminal velocity.
(C) the same initial acceleration and the higher terminal velocity.
(D) the same initial acceleration and the same terminal velocity.

Both objects fall with an initial acceleration of 10 m/s^2. However as the heavier object has a larger weight, as a result the downward force is larger. By the time the air resistance manages to balance the downward force (*i.e. resultant force is zero*), the downward velocity is greater than that of the lighter man.

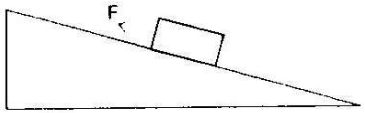
5 A tray supports a 1 kg mass and a 3 kg mass as shown below. What is the force acting on the 1 kg mass by the 3 kg mass? (g = 10 N / kg)

(A) 10 N
(B) 20 N
(C) 30 N
(D) 40 N



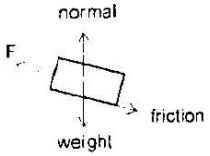
Look at only the 1 kg mass. There are only two forces acting on the 1 kg mass. The gravitational force acts on the 1 kg mass by the Earth and the reaction forces acts on the 1 kg mass by the 3 kg mass. For the system to be in equilibrium, action = reaction force and the two forces must be equal and opposite

6 The diagram below shows a box being moved up by a force, F, on a rough inclined plane. F is parallel to the inclined plane.

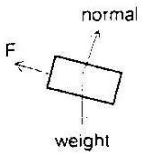


Which of the following diagrams correctly shows all the forces acting on the block?

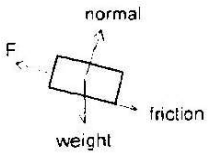
(A)



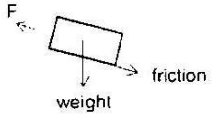
(C)



(B)

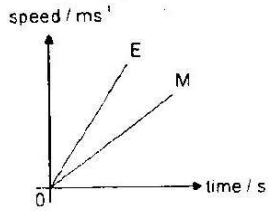


(D)

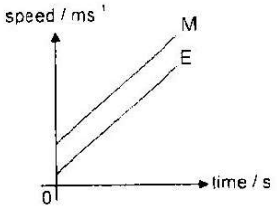


7 The acceleration due to the gravity of the Moon is one-sixth of that of the Earth. If a stone is thrown upwards, which graph shows the variation of the speed of the stone with time as it goes up on the Moon (**M**) and on the Earth (**E**)?

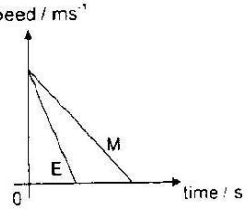
(A)



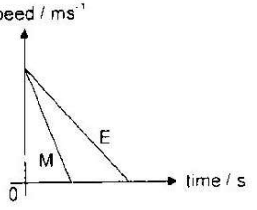
(C)



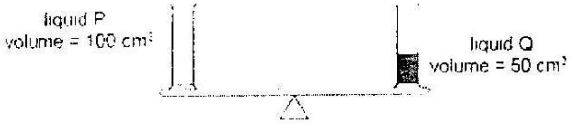
(B)



(D)



8. Two identical measuring cylinders containing different liquids are placed on a simple balance. They balance as shown.

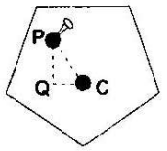


How does the density of P compare with the density of Q?

(A) Density of P is half the density of Q.
(B) Density of P is equal to the density of Q.
(C) Density of P is twice the density of Q.
(D) Density of P is four times the density of Q.

Mass of P and mass of Q is equal. As volume of P is double volume of Q, then density (mass/volume) of P will be half that of Q.

9. A plane lamina is freely suspended from point **P**. The mass of the lamina is 0.3 kg and the centre of gravity is at **C**. The lamina is displaced to the position shown. What is the moment that will cause the lamina to swing?



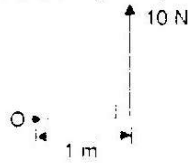
QC = 0.30 m
PC = 0.50 m
PQ = 0.40 m

(A) 0.09 Nm clockwise
(B) 0.10 Nm clockwise
(C) 0.12 Nm clockwise
(D) 0.90 Nm clockwise

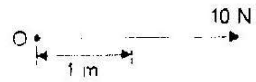
Weight = mg = 0.3 x 10 = 3 N
Moment = Fd = 3 x 0.30 = 0.90 Nm clockwise

10. Which of the following force produces the greatest moment about O?

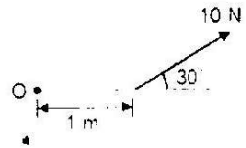
(A)



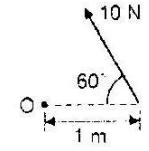
(C)



(B)



(D)

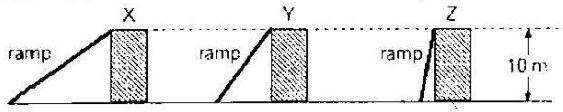


11. During the flag raising assembly, a pupil pulls the rope with a force of 15 N and the flag rises at a uniform speed of 0.5 m/min. Calculate the power supplied by the pupil.

(A) 0.125 W
(B) 7.5 W
(C) 40 W
(D) 450 W

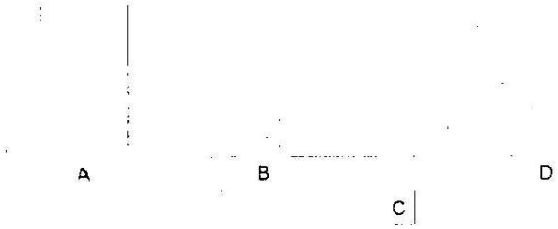
Power = (15 x 0.5) / 60 = 0.125 W

12. A load is to be lifted on three different lengths of ramps from ground level to a height 10 m above the ground. All the ramps are of the same material, but placed at different angles from the ground. Which path will require the most amount of work done in lifting the load? Assume that the surface is frictionless and the load moves at constant speed.



(A) Path X
(B) Path Z
(C) Path Y
(D) Equal amount of work is done for every path

13 At which position will the pressure be the greatest? C (lowest point)



14. Which of the following physical properties can be used to measure temperature?
1. Expansion of gas
2. Change in resistance
3. Change in mass

(A) 1 only (C) 1 and 3 only
(B) 1 and 2 only (D) 2 and 3 only

15 A piece of wire has an electrical resistance of 2.0 Ω in melting ice and 2.5 Ω in boiling water. What is the resistance at 20 °C assuming that resistance changes uniformly with temperature?

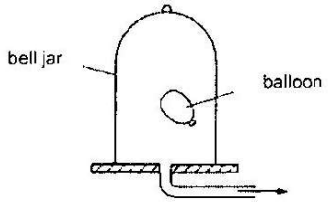
(A) 2.1 Ω (C) 2.3 Ω
(B) 2.2 Ω (D) 2.4 Ω

20 = [(R – 2) / (2.5 – 2)] x 100 0.2 = (R – 2) / 0.5 R = 2.1 Ω

16. Which of the following statements about the movement of smoke particles in a Brownian motion experiment using smoke particles are correct?
I. It is due to the bombardment of air molecules
II. It is faster if the particles are larger.
III. It is faster if the temperature of the air is higher.
IV. It is at random.

(A) I and II only (C) I, III and IV only
(B) I, II and IV only (D) I, II, III and IV

17. A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.

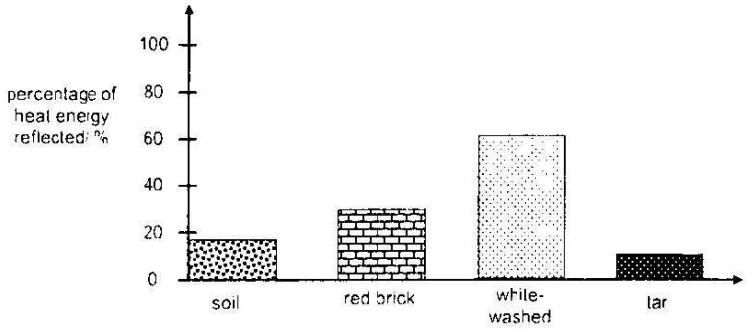


Air is then pumped out of the bell jar. What happens to the pressure and to the volume of the gas inside the balloon?

	pressure	volume
(A)	decreases	decreases
(B)	decreases	increases
(C)	increases	decreases
(D)	Increases	increases

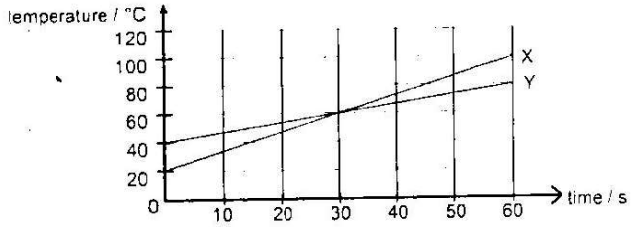
18. A copper rod is heated at one end. Which statement describes how heat transfer occurs in the copper?
(A) Energetic copper molecules move from the cooler end to the hotter end.
(B) Energetic copper molecules move from the hotter end to the cooler end.
(C) Energetic free electrons move from the cooler end to the hotter end.
(D) Energetic free electrons move from the hotter end to the cooler end.

19 Different surfaces reflect different proportions of the Sun's radiant energy. The diagram shows the percentage of thermal energy which is reflected by some surfaces.



Which is the best way to treat a flat roof so as to reduce the amount of heat absorbed by the roof?
(A) cover it with a layer of red brick dust
(B) cover it with a layer of soil
(C) paint it with tar
(D) paint it white-washed

20. Two blocks X and Y, which are made of the same metal, are heated by heaters at the same power rating. The variations of temperature with time are given below.



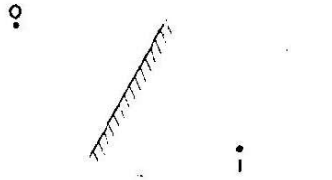
What is the ratio of masses X to Y?

(A) 1 : 2 (C) 2 : 1

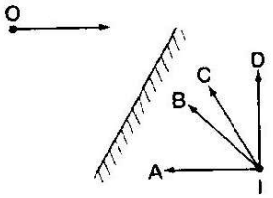
(B) 1 : 4 (D) 4 : 1

$Q = mc\theta$ $m_x c(80) = m_y c(40)$ $m_x / m_y = 40 / 80 = 1 / 2$

21 An object placed in front of a plane mirror at O produces an image I.



If the object moves towards the mirror in the direction shown by the arrow, In which direction does the image move? C



22. A ray of red light enters a glass block as shown and is reflected off one of its side. The diagram is not drawn to scale.
What is the refractive index of the glass block?

(A) 0.97

(B) 1.32

(C) 1.88

(D) 3.63



$n = \sin(20) / \sin(15)$

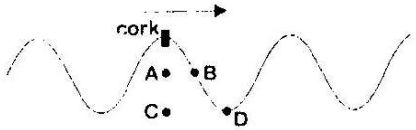
$n = 1.32$

23. When water wave flows from shallow water into deep water, how do the frequency, wavelength and speed change?

	frequency	wavelength	speed
(A)	no change	decreases	decreases
(B)	no change	no change	decreases
(C)	no change	increases	Increases
(D)	increases	no change	increases

24. A water surface wave (ripple) is travelling to the right on the surface of a lake. The wave has period T. The diagram shows the surface of the lake at a particular instant of time. A piece of cork is floating in the water in the position shown.

Which is the correct position of the cork a time $\frac{T}{4}$ later? A



25. Which of the following groups of electromagnetic waves is in the order of increasing wavelength?

(A)	Gamma ray	→	Ultra-violet	→	Radio wave
(B)	Gamma ray	→	Visible light	→	Ultra-violet
(C)	Microwave	→	Ultra-violet	→	X-ray
(D)	Visible light	→	Infra-red	→	X-ray

Gamma, X-ray, Ultra-violet, Light, Infrared, Microwave, Radio

26. Below are four statements about the uses of electromagnetic radiation.
1. Gamma rays are used in medical treatment.
2. Infra-red waves are used in sunbeds.
3. Microwaves are used in satellite television
4. X-rays are used in intruder alarms.

How many of these statements are correct?

(A) 1 (C) 3

(B) 2 (D) 4

27. A student stands between two vertical walls. One wall is 300 m away and the other is 600 m away. After making a loud clap, he hears two echoes at an interval of time t. What is the time interval, t? Take the speed of sound in air to be 300 m/s.

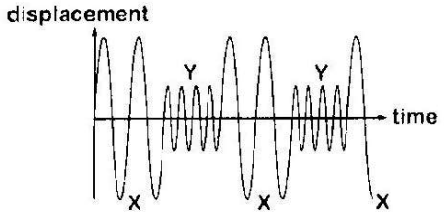
(A) 1.0 s (C) 2.0 s

(B) 1.5 s (D) 4.0 s

The interval is the time take for the sound to travel the extra distance made by the longer sound path. Extra distance travelled by the longer sound path = 2 x 600 – 2 x 300 = 600 m

Distance = speed x time $600 = 300\ t$ $t = 2$ s

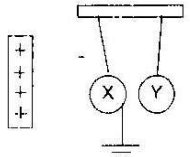
28. An ambulance siren emits two different sounds X and Y. These are produced alternately. The diagram represents the sounds emitted.



Which sound is louder and which has lower pitch?

	louder	lower pitch
(A)	X	X
(B)	X	Y
(C)	Y	X
(D)	Y	Y

29 Two isolated metal spheres X and Y are initially uncharged. The diagram shows a positively charged strip being placed near metal spheres X and Y. X is then earthed momentarily. During the whole process, X and Y do not touch.

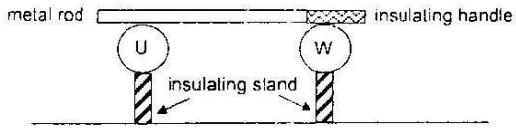


With the strip still in position, what would be the charges on X and Y?

	X	Y
(A)	negative	neutral
(B)	negative	negative
(C)	positive	neutral
(D)	neutral	negative

30 Two spheres U and W are mounted on insulating stands. Sphere U is initially uncharged and made of brass and sphere W is initially weakly positively charged and made of polythene.

A metal rod, held by an insulating handle, is placed in contact with U and W as shown.



What are the charges on U and W after the rod is placed in contact with them?

	charge on U	charge on W
(A)	positive	positive
(B)	positive	uncharged
(C)	uncharged	positive
(D)	uncharged	uncharged

31. The potential difference across two identical resistors in series is 8.0 V. How much energy is dissipated in one of the resistors when 5.0 C of charge flows through it?

(A) 0.8 J (C) 20 J
(B) 1.6 J (D) 40 J

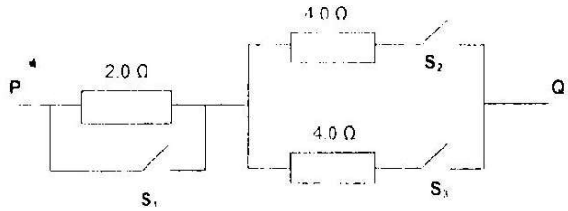
V = 4 V, Q = 5 C, E = ? V = E / Q 4 = E / 5 E = 20 J

32. A 1.0 m length of wire, having a cross-sectional area of 0.40 mm^2, has a resistance of 2.0 Ω. What is the resistance of a 0.50 m length of wire (made of the same material), with a cross-sectional area of 0.80 mm^2?

(A) 0.5 Ω (C) 2.0 Ω
(B) 1.0 Ω (D) 8.0 Ω

When length ÷ 2, R = 2 / 2 = 1 Ω When A x 2, R = 1 / 2 = 0.5 Ω

33 The diagram shows part of a circuit in which all the switches are open.

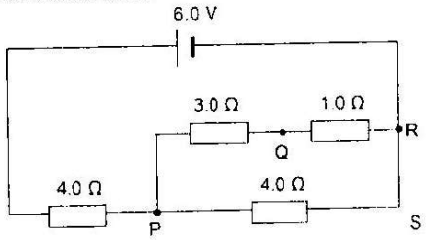


Which of the following combinations will result in a resistance of 2.0 Ω between P and Q?

	S_1	S_2	S_3
(A)	Closed	Closed	Closed
(B)	Closed	Opened	Closed
(C)	Opened	Closed	Closed
(D)	Opened	Opened	Closed

1/R = ¼ + ¼ = ½ R = 2 Ω

34. The diagram shows an electric circuit.



What is the potential difference between P and Q?

(A) 1.5 V (C) 2.5 V

(B) 2.0 V (D) 3.0 V

$R_{eq} = (¼ + ¼)^{-1} + 4 = 6\ \Omega$ $V_{PQ} = 2/6 \times 6 = 2$ V $V_{PQ} = ¼ \times 2 = 1.5$ V

35 Which of the following best gives the reason why the earth wire is a necessity for many household appliances?

(A) To protect the fuse in the electric plug.

(B) To complete the circuit in order for the device to work.

(C) To protect the user against electrocution if the appliance becomes faulty.

(D) To protect the device against damage by preventing the excess current from flowing through the device

36 Which of the following observations confirms that an object is a magnet?

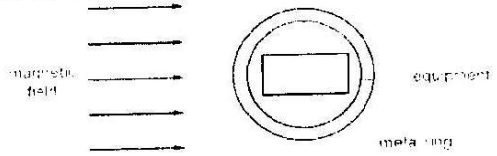
(A) The object is attracted by a strong bar magnet.

(B) The object causes a compass needle to move.

(C) The object rotates before being attracted to a bar magnet.

(D) The object is attracted to both poles of a horseshoe magnet.

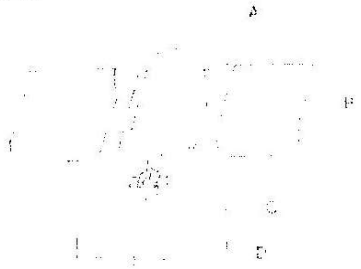
37. A metal ring shields a piece of equipment from a magnetic field.



Which metal should be used for the ring, and why?

	metal	reason
(A)	copper	The metal carries the field lines around the equipment
(B)	copper	The metal is non-magnetic.
(C)	iron	The metal carries the field lines around the equipment.
(D)	iron	The metal is non-magnetic.

38. The diagram shows a simple d.c. motor. Which part needs to be made of soft iron to increase the efficiency of the motor? A



39. Which diagram shows the direction of the force F that is produced by a current I in a magnetic field?

(A)



(C)



(B)



(D)



40. Two parallel wires each carry a current into the plane of the paper. Which diagram shows the magnetic field pattern due to the currents in the two wires?

(A)



(C)



(B)



(D)



*** END OF PAPER 1 ***

HILLGROVE

United We Soar

ANSWERS

PRELIMINARY EXAMINATION 2016

Secondary 4 Express

Physics **5059 / 2**

Paper 2

Date: 25 August 2016

Time: 1100 – 1245 hr Duration: 1 hour 45 minutes

INFORMATION TO CANDIDATES
Write your name, class and register number on the all the work you hand in.
Write in the dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not staples, paper clips, highlighters, glue or correction fluid.

SECTION A (Short Structured Questions)
Answer all questions.
Write your answers in the spaced provided on the question paper.

SECTION B (Long Structured Questions)
Answer all questions.
Question **12** has a choice of parts to answer

Candidates are reminded that all quantitative answers should include appropriate units.
The use of approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for the sound use of Physics than for correct answer.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Name of Student: _____ ( )

Class: Secondary 4-8

Parent's Signature: _____

Setter: Mrs Jennifer Peng

Section	Marks
A	/ 50
B	/ 30
Total	**/ 80**

This question paper consists of **17** printed pages, including cover page.

SECTION A [50 Marks]
SHORT STRUCTURED QUESTIONS
Answer all questions in the spaces provided on the question paper.

1. A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The velocity-time graph for the stone is shown in Fig. 1.2.

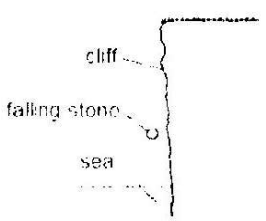


Fig. 1.1

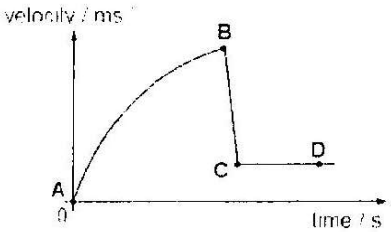


Fig. 1.2

(a) Describe the changes in motion of the stone between point A and D. [3]

A to B: speed increases at a decreasing rate / **decreasing acceleration** [B1]

B to C: speed decreases at a constant rate / **constant deceleration** [B1]

C to D: speed is constant / **acceleration is zero.** [B1]

(b) Explain, in terms of the forces acting, for your answer in (a). [3]

A to B: As the stone moves faster, **air resistance increases.** [a] Since resultant force = weight – air resistance, with weight remains constant thus **resultant force decreases**. [b] [B1: both a and b to get 1 mark]

B to C: **water resistance is greater than its weight** [c] and **resultant force is opposite to its motion**, thus the object slows down [d] [B1: both c and d]

C to D: **water resistance is equal to its weight** [e] and **resultant force is zero** [f], thus acceleration is zero [B1: both e and f]

2. A uniform rod AB of length 3 m weighs 10 N. It is suspended by two identical strings at points X and Y as shown in Fig. 2.1. T_1 and T_2 are the tension in the strings.

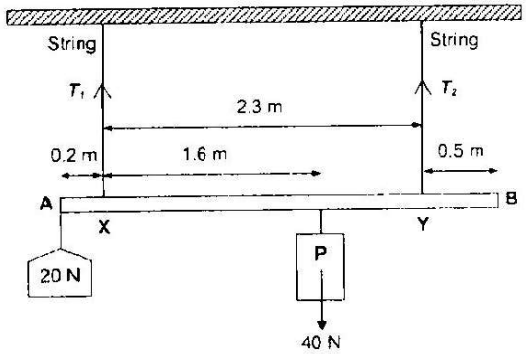


Fig. 2.1

Two weights, 20 N and **P**, are hung from the rod at point **A** and 1.6 m from **X** respectively

(a) Draw the weight of the rod in Fig. 2.1 and label it **W**.
Indicate clearly its distance from point A. [1]
Downward arrow drawn in the middle of the rod. W indicated for weight. Must indicate distance (e.g. 1.5 m from point A)

(b) Determine T_2, the tension of the string at **Y**.
Taking moments about X, at equilibrium
$(T_2 \times 2.3) + (20 \times 0.2) = (10 \times 1.3) + (40 \times 1.6)$
[M1: award 1 mark if there is 2 correct calculation of moments]
T_2 = 31.739 = **31.7 N** (3 sf) [A1: minus 1 mark for wrong or missing unit]

T_2 = [2]

(c) Hence, or otherwise, determine T_1, the tension of the string at **X**.
Total Upwards Force = Total Downwards Force
T_1 = 70 N – 31.7 N
= **38.3 N** [A1: minus 1 mark for wrong or missing unit]

T_1 = [1]

3. In an Olympic game, a man of mass 58 kg is trying to swing on a high bar as shown in Fig 3. He is momentarily at rest at the top of the swing. At this position, his centre of mass is at a height of 0.9 m above the bar as shown in the diagram.

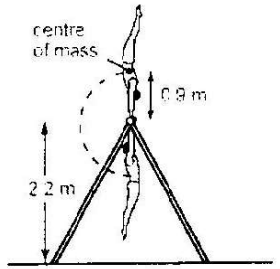


Fig 3

(a) Calculate his gravitational potential energy at the top of the swing.
GPE = mgh
= 58 × 10 × (2.2 + 0.9) [M1: correct distance of 3.1 m]
= 1798 J
= **1800 J** (3 sf or 2 sf) [A1: minus 1 mark for wrong or missing units]

gravitational potential energy = [2]

(b) Calculate his speed at the bottom of his swing.
Using conservation of energy,
Lost in GPE = Gain in KE
58 (10) (0.9 + 0.9) = ½ × 58 × v^2 [M1: difference in GPE]
v = **6 m/s** [A1: minus 1 mark for units]

speed = [2]

(c) State two assumptions that are made in (b). [2]

No work is done against friction between his hand and the bar [B1]

No energy is given to the surrounding to do work (sound and heat energy) against air resistance. [B1]

4. Fig. 4 shows two identical pots containing the same soup at different temperature, 90 °C and 75 °C. The mass of soup in both pots are the same and they are both left to cool under the same surrounding conditions.

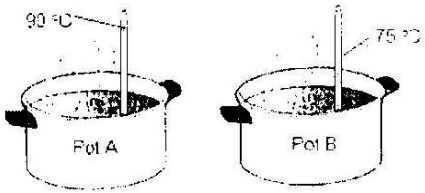


Fig 4

(a) Explain why the following features of a pot are advantageous to cooking:

(i) The pot is made of metal. [1]

Metal is a **good conductor of heat** and **heat** from the stove **can be quickly transferred** through the pot to the food. [B1]

(ii) The pot has low heat capacity. [1]

With low heat capacity, a **smaller amount of heat is required to raise the temperature of the pot by 1°C**. Hence, the **pot can heat up faster**. [B1]

(b) State and explain which pot will see a larger drop in temperature at the end of ten minutes. [2]

Pot A [B1] will see a larger drop in temperature as there is **greater difference in temperature** [a] **with the surroundings**. **More heat will be lost by radiation**. [b]

[B1: both a and b to be present to gain 1 mark]

(c) State and explain if your answer in (b) would differ if both pot A and pot B are painted black [2]

No [B1 awarded only is explanation is correct.]

Both pots will lose more heat as black is a good radiator of heat.

However, pot A will still have a larger drop in temperature compared to pot B. [B1]

5. A 2 kW heater is used to melt 1.5 kg of solid lead from a room temperature of 27 °C.

(a) The heater takes 29.25 s to heat the lead to its melting point of 327 °C. Calculate the specific heat capacity of lead.

Heat supplied by heater = Heat gained by lead
Pt = $mc\Delta\theta$
2000×29.25 = $1.5 \times c \times (327 - 27)$ [M1: 58500 J obtained]
58 500 = $1.5 \times c \times (300)$
c = $58500 / (1.5 \times 300)$
= **130 J/(kg K)** [A1: minus 1 mark for units]

specific heat capacity of lead = [2]

(b) Given that the specific latent heat of fusion of lead is 22.4 kJ/kg. Calculate the amount of time to further heat the lead until it is completely melted

Heat supplied by heater = Heat gained by lead
Pt = ml_f
$2000\ t$ = 1.5×22400 [M1: correct substitution of ml_f]
t = **16.8 s** [A1: minus 1 mark for units]

time = [2]

(c) Describe clearly the changes in kinetic energy and potential energy of the solid lead throughout the entire process. [4]

When the solid lead is heated from **27 °C to 327 °C**, the atoms vibrates [move is NOT accepted] much more vigorously and hence its **kinetic energy increases** [B1] **potential energy of the lead remains constant**. [B1]

At **melting point**, the temperature remains constant and hence the **kinetic energy remains constant** [B1]. However, the **energy supplied is used to overcome the intermolecular forces between the atoms and hence its potential energy increase** [B1]. Thus its internal energy increases.

6. Fig. 6.1 below shows a thin converging lens being used to produce an image X' of an object X. Show on Fig. 6.1 how the given light ray will travel after passing through the converging lens.

(a) Complete Fig. 6.1 with suitable light rays to locate the position of the principal focus F. [3]

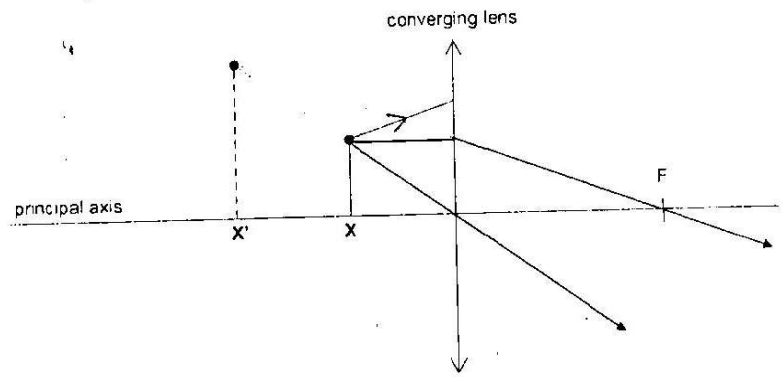


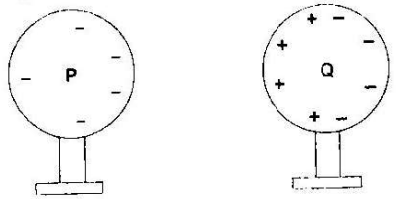
Fig. 6.1

	Completing the existing ray with correct dotted and solid portions and direction.
	Principal Focus F correctly positioned using two light rays with correct dotted and solid portions and directions, and labelled.

(b) Give one common application for the lens set-up in Fig. 6.1. [1]

Magnifying Glass

7. Two metal conductors **P** and **Q** are mounted on insulating stands. Conductor **P** is given a negative charge, which is initially spread uniformly over the surface of the conductor. Conductor **Q**, initially uncharged, is brought close to **P** as shown below. There is now more negative charge on the right-hand side of **P** than its left-hand side.



(a) On the diagram above, draw the induced charges on **Q**. [1]
A 1 - equal no. of positive charges and negative charges

(b) Explain how these charges are induced in **Q**. [2]

The negative charges in P **repel the negative charges in Q** to the **right-hand side of Q**, as **like charges repel**. [B1]

leaving behind positive charges in the **left-hand side of Q**. [B1]

(c) The conductors **P** and **Q** are brought closer and are in physical contact. State what happens to the charges on **P** and **Q**. [2]

Some of the **negative charges in P will move into Q**. [B1]

Both P and Q will be negatively charged. [B1]

8. In the circuit shown in Fig. 8.1, a 4 700 Ω resistor is connected in series with a light-dependent resistor (LDR), which has a resistance of 3300 Ω, and with a 12 V power supply.

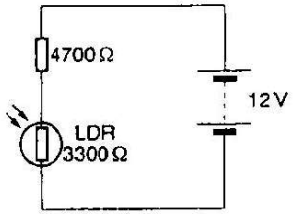


Figure 8.1

(a) Calculate the current through the LDR.

Current, I
= V / R
= 12 / (4700 + 3300) [C1: used total resistance]
= **0.0015 A** [A1: minus 1 mark for wrong or missing units]

current = [2]

(b) Calculate the voltage across the LDR.

Voltage, V
= IR
= 0.0015 x 3300
= **4.95 V** [A1: minus 1 mark for wrong or missing units]

OR

V = (R1 / RT) x E
= (3300 / 8000) x 12
= 4.95 V [A1]

voltage = [1]

(c) Describe how the resistance of the LDR changes as brighter light falls on it. [1]

Resistance of LDR drops [B1] when brighter light falls on it.

(d) A student claims that in theory if the resistor is replaced by a buzzer, it can function as a burglar alarm. Describe and explain how the student's setup will work when a burglar shines a very bright light on the LDR. [2]

When very bright light shines on the LDR, its voltage drops [B1] due to the drop in its resistance. **Voltage across the buzzer increases** OR **Current across the buzzer increases** [B1] and the buzzer will sound.

9. Fig. 9 below shows a science exhibit consisting of three vertical hollow tubes, T_1, T_2 and T_3, each about 2 m long. The tubes are identical in size. With the tubes are three identical small cylinders, one to each tube.

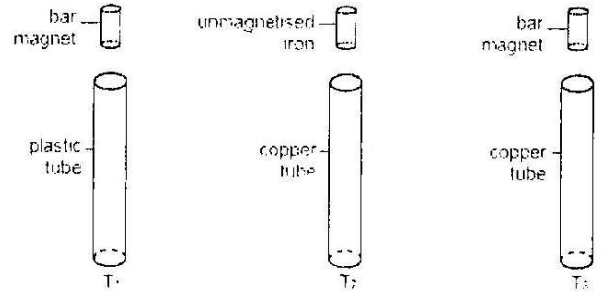


Fig. 9

The three cylinders are released from rest and dropped into the hollow tubes at the same time. When the cylinders are dropped down the hollow tubes, those in T_1 and T_2 reach the bottom in less than 1 second, while that in T_3 take a few seconds.

(a) Explain why the cylinder in T_3 takes longer to reach the bottom of the tube than the cylinder in T_1. [2]

As the bar magnet falls through the copper tube, there is a **change in magnetic flux cutting the copper conductor,inducing an e.m.f.** in the copper conductor. [B1]

By **Lenz's law** the **induced e.m.f. and hence the induced current flows to create magnetic field to oppose the change which produces it** [B1]

Hence the bar magnet in T_3 takes longer to reach the bottom of the tube.

(b) Explain why the cylinder in T_1 and the cylinder in T_2 takes the same time to reach the bottom. [3]

For T_2, since the unmagnetised iron does not have a magnetic field around it, **no e.m.f. is induced in the copper conductor** when the unmagnetised iron cylinder falls through the copper tube. [B1]

In T_1, the tube does not have any e.m.f. induced as it is made of plastic. [B1]

Hence, **no opposing magnetic field is set up to go against its motion** for both tubes thus they both fall with acceleration due to gravity. [B1]

SECTION B [30 Marks]

Answer Question 10 and 11 in the spaces provided.
Answer only one of the two alternative questions in Question 12

10 Many electrical devices, such as television and computers, have stand-by mode.

Fig 10.1 shows the 230 V mains supply connected to a television.



Fig. 10.1

When switch S is open, the television is in stand-by mode. No energy is supplied to the main television circuit. Some energy is supplied to the stand-by circuit.

When the television is in full use, switch S is closed and energy is supplied to both circuits. In the house of a student, the television is never unplugged. In one week, the television is in full use for 30 hours and in stand-by mode for 138 hours

Fig 10.2 shows the current in the two circuits when in full use and in stand-by mode.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main television circuit / mA	450	0
current in stand-by circuit / mA	34	34

Fig 10.2

(a) Calculate the total power supplied to the two circuits by the 230 V mains supply when the television is in full use.

P_{main} = VI_{main}
= 230 x 450 x 10^{-3}
= 103.5 W [M1]

$P_{stand\text{-}by}$ = $VI_{stand\text{-}by}$
= 230 x 34 x 10^{-3}
= 7.82 W [M1]

P_{total} = P_{main} + $P_{stand\text{-}by}$
= 103.5 + 7.82
= 111.32 W ≈ **111 W** (3 s.f.) [CAO1: correct answer with units]

power = [3]

(b) (i) Calculate the amount of energy supplied in one week by the mains supply to the television when in stand-by mode. Give your answers in joules.

Energy supplied.
E = VIt
= 230 x 34 x 10^{-3} x (60 x 60 x 138) [M1: convert time to seconds]
= 3 884 976 J ≈ **3 880 000 J** (3 sf) [CAO1: correct answer with units]

energy = [2]

(ii) The cost of 1 kWh of electrical energy is 25 cents. Calculate the cost of the energy in (b) (i)

E = VIt
= (230 x 34 x 10^{-3}) x 10^{3} x 138 [M1]
= 1.079 K Wh [M1]
Cost = 1.079 x 25
= 27 cents [CAO1: correct answer with units]

cost = [3]

(c) In the same house, there is a computer which is also never unplugged. This computer has a stand-by circuit and a switch similar to those in the television.

In one week, the computer is in full use for 50 hours and in stand-by mode for 118 hours.

Fig 10.3 gives data for the computer similar to the data in Fig 10.2.

	in full use (switch S closed)	in stand-by mode (switch S open)
current in main computer circuit / mA	270	0
current in stand-by circuit / mA	34	34

Fig 10.3

(i) To save energy, the student decides to unplug either the television or the computer when not in use.

Explain, in words, why unplugging the television saves more energy. [1]

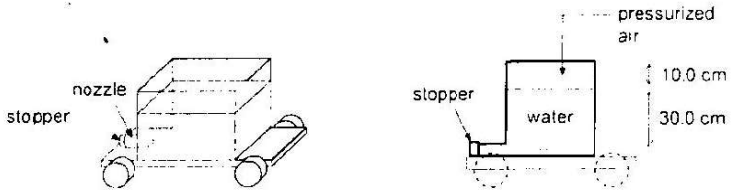
The television is in stand-by mode for 138 hours while the computer is in stand-by mode for 118 hours in a week. As the current in the stand-by circuit is the same for both, unplugging the television would save more energy as it is in the **stand-by mode for a longer duration**

(ii) Suggest one disadvantage in completely unplugging a computer when not in use. [1]

The computer needs more time to boot up if it is completely unplugged when not in use.

[Accept any reasonable answers]

11. Fig. 11.2 shows an experimental trolley which uses pressure to propel it forward. The trolley has an enclosed rectangular rigid tank filled with water and the air inside the tank is pressurised. There is a nozzle at the bottom of the tank which allows the water to rush out when the stopper is removed.



Perspective View Side View

Fig. 11.2

The following information is provided.

Initial height of the water in the tank	30.0 cm
Initial height of the air in the tank	10.0 cm
Initial air pressure in the tank	2.50×10^5 Pa
Cross-sectional area of the nozzle	4.00×10^{-4} m^2
Atmospheric pressure	1.00×10^5 Pa
Density of water in the tank	1000 kg/m^3

(a) Calculate the total pressure exerted on the stopper due to the air and water inside the tank.

hpg = 0.30 x 1000 x 10 = **3000 Pa** [M1]

total pressure = 3 000 + 250 000 Pa
= **253 000 Pa (to 3 s.f.)** [CAO1: correct answer with units]

total pressure = [2]

(b) The calculated pressure in part (a) is larger than the atmospheric pressure. Explain why the stopper is not forced out of the nozzle. [2]

There is **no resultant force** acting on the stopper. [B1]

The **friction between the stopper and the nozzle** prevents the stopper from coming off. [B1]

(c) When the stopper is removed, the water will be pushed out of the nozzle, causing a forward force which propels the trolley to move forward. Calculate the maximum forward force due to this propulsion.

F = P A
= (253 000 − 100 000) x (4.00×10^{-4}) [M1]
= **61.2 N (to 3 s.f.)** [CAO1: correct answer with units]

maximum forward force = [2]

(d) After a short period of time, the height of the water drops to 15.0 cm. Calculate the air pressure inside the tank.

$P_1 V_1 = P_2 V_2$
(2.50×10^5 x (10.0 x A)) = (P_2 x (25.0 x A)) [M1]
P_2 = **1.00×10^5 Pa (to 3 s.f.)** [CAO1: correct answer with units]

air pressure = [2]

(e) The cross-sectional area of the nozzle is enlarged. State two changes that will occur with reference to the trolley. [2]

The **forward force** on the trolley is **increased**. [B1]

The trolley will be in **motion for a shorter duration** etc. [B1]

12 EITHER

In an experiment to study sound waves, a tuning fork is struck and placed near a microphone.

(a) Explain how the sound waves are transmitted from the tuning fork to the microphone [2]

The vibrating tuning fork causes a series of **compressions and rarefactions** of the air particles. [B1]

The **air particles** themselves just **vibrate** back and forth about their original positions. **transferring energy** to the neighbouring particles [B1]

(b) The microphone converts the sound into electrical signal which is input into a cathode ray oscilloscope. Fig. 12.1 shows the trace obtained on the screen of the CRO when the input signal is applied to it. The time-base of the CRO is set at 2 ms/div.

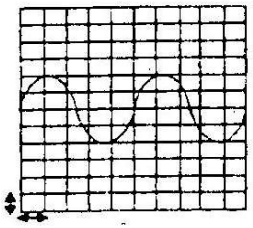


Fig. 12.1

(i) Calculate the frequency of the sound waves produced by the tuning fork.

$T = 5 \times 2 \times 10^{-3} = 10$ ms [M1]

$f = \frac{1}{T} = \frac{1}{10 \times 10^{-3}} = 100 Hz$ [CAO1: correct answer with units]

frequency = [2]

(ii) Calculate the wavelength of the sound waves, given that the speed of sound in air is 340 ms^{-1}

$v = f\lambda$

$340 = 100 \times \lambda$ [CAO1: correct answer with units]

$\lambda = 3.4m$

wavelength = [1]

(c) State and explain the effect on the trace on the screen when the tuning fork is moved further away from the microphone. [2]

The trace will have **smaller amplitude**. [B1]

As the sound waves travel through a longer distance. **energy is dispersed in all direction**. [B1]

(d) In a second experiment, the tuning fork is replaced by a device which emits an ultrasound.

(i) Explain the term *ultrasound*. [1]

Ultrasound are **sound waves that have a frequency of greater than 20 kHz** [B1]

(ii) State the effect on the trace on the screen when the ultrasound is input into the CRO [1]

The trace shown on the screen will have a **very small period of less than 0.05 ms**. [B1]

(e) State one practical application of ultrasound. [1]

- It can be used in ultrasound scanning to check the development of foetuses in pregnant women
- It can be used in ultrasound flow meter to measure the speed of blood flow in the body.
- It can be used in a technique known as shock wave lithotripsy to break kidney stones into small pieces.
- It can be used in sonar to locate underwater objects / determine the depth of the seabed.

[B1, accept any reasonable answer]

OR

The table contains data about a transformer. The turns ratio of primary coil to the secondary coil is 0.5. This is not an ideal transformer as seen from the data. The load resistance, connected to the secondary coil has been varied.

input voltage / V	output voltage / V	load resistance / Ω	input power / W
6.00	0.57	1.0	6.86
6.00	4.00	10.0	4.80
6.00	6.00	20.0	3.60
6.00	7.20	30.0	2.88
6.00	7.64	35.0	2.62

(a) State what is meant by an ideal transformer. [1]

An ideal transformer is one whose output power/energy is equal to the input power / energy

(b) Explain why the transformer under study is NOT ideal [1]

$\frac{N_s}{N_p} = 2$ but $\frac{I_s}{I_p} \neq 2$ [1] (OR $P_p \neq P_s$ using data from table)

(c) Use the table to calculate

(i) the current in the primary coil when the input power is 2.62 W.

P = IV
2.62 = I x 6.00 [C1]
I = 0.4367
= **0.437 A** [CAO1: correct answer with units]
current = [2]

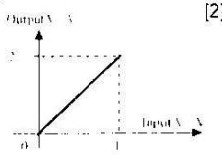
(ii) the corresponding current in the secondary coil.

V = IR
7.64 = I x 35.0 [C1]
I = 0.2183
= **0.218 A** [CAO1: correct answer with units]
current = [2]

(d) Determine the output power when the input power is 2.62 W.

P = IV
= 0.218 x 7.64 [C1]
= 1.668
= **1.67 W** [CAO1 correct answer with units]
power = [2]

(e) Sketch a graph of the output voltage against the input voltage if this transformer is ideal. [2]



Refer to diagram
Straight line [1]
Coordinates show that gradient equals 2. [1]
(Wrong graph, max 1m for straight line)

*** END OF PAPER 2 ***

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME _____ ( )

CLASS _____

PHYSICS **5059/01**

Paper 1 Multiple Choice **19 September, 2016**

Secondary 4 Express **1 hr**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, index number and class on the OTAS Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the one you consider correct and record your choice in soft pencil on the separate OTAS Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Where necessary, take acceleration due to gravity, g = 10 m/s^2

This document consists of **15** printed pages, including this cover page.

1 Pendulum A makes 20 complete oscillations in 10 s. Pendulum B makes 15 complete oscillations in 15 s. Both pendulums were displaced by a small angle before their oscillations.

Which of the following statements must be true?

A Pendulum B has a shorter period than pendulum A.

B The string of pendulum B is longer than that of pendulum A.

C The mass of the bob of pendulum B is smaller than that of pendulum A.

D The angle of swing of release for pendulum B is smaller than that of pendulum A.

2 A pair of vernier calipers is used to measure the thickness of a coin.

Diagram 1 shows the reading with the jaws closed. Diagram 2 shows the reading when the jaws are closed around the coin.

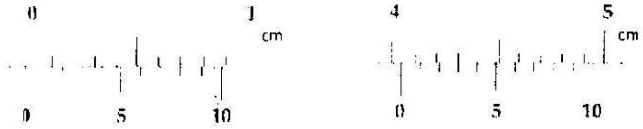


diagram 1 diagram 2

What is the zero error and the actual thickness of the coin?

	zero error / cm	corrected reading / cm
A	-0.02	4.05
B	-0.02	4.01
C	+0.08	3.95
D	+0.08	4.11

3 A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

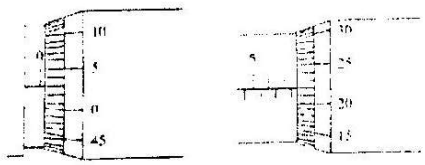


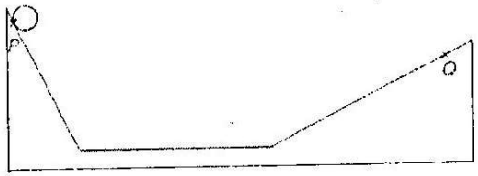
diagram 1

diagram 2

What is the true diameter of the ball bearing?

A 7.19 mm B 7.69 mm C 7.72 mm D 7.75 mm

4 A sphere runs along a smooth rail from **P** to **Q** as shown



Which of the following graphs best represents the variation of the distance *d* travelled by the sphere with time *t*?

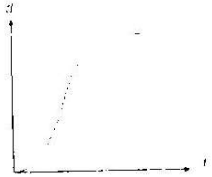
A



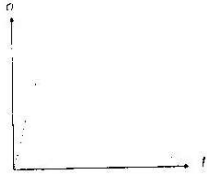
B



C



D



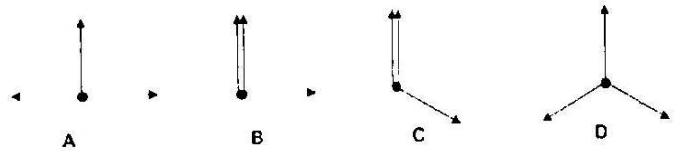
5 A bicycle accelerates from a speed of 2.0 m/s to 10 m/s in 8.0 s.

What is its average speed during the journey?

A 4.0 m/s B 5.0 m/s
C 6.0 m/s D 7.0 m/s

6 Three forces of the same magnitude act simultaneously on a small object.

Which one of the following combination of these three forces will give the greatest resultant force?

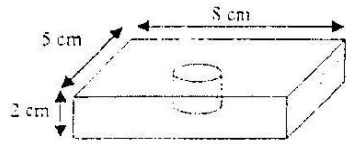


7 A 10.0 kg block of iron is brought from Earth to the surface of Planet Y.

Given that the gravitational field strength of Planet Y is 3.90 N/kg, how will the properties of the iron block change?

	inertia	density	weight
A	decreases	remains unchanged	increases
B	decreases	increases	increases
C	remains unchanged	decreases	decreases
D	remains unchanged	remains unchanged	decreases

8 A rectangular block of steel has a cylindrical hole bored through it as shown. The density of steel is 8.0 g/cm^3 and the mass of the block with the hole is 560 g.



What is the cross-sectional area of the hole?

A 3.5 cm^2 **B** 5.0 cm^2

C 2200 cm^2 **D** 4400 cm^2

9 An object is in static equilibrium. Which of the following statements about the object is true?

A It is moving in a straight line at uniform speed.

B It is rotating at a constant rate at a fixed point.

C It is rotating anti-clockwise and then clockwise in cycles.

D It is at rest and not rotating

10 A parachutist has opened his parachute and is falling to Earth at constant speed. What is the principal energy conversion taking place as he falls?

A kinetic energy → potential energy

B kinetic energy → thermal energy

C potential energy → kinetic energy

D potential energy → thermal energy

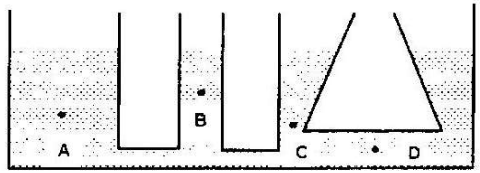
11 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power input by the motor? Take density of water to be 1000 kg m^{-3}.

A 12.5 W **B** 22.2 W

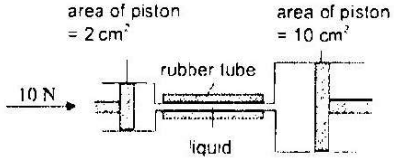
C 556 W **D** 1330 W

12 The diagram shows a container with openings of different shapes filled with a liquid.

Which of the points **A** to **D** has the greatest pressure?



13 The diagram shows two syringes connected by a rubber tube. The space between the two pistons is filled with a liquid. The areas of the small piston and the large piston are 2 cm^2 and 10 cm^2 respectively. A force of 10 N is applied to the small piston.



What is the ratio of the pressure acting on the small piston to the pressure acting on the large piston?

A 1 : 1 **B** 1 : 2

C 1 : 5 **D** 5 : 1

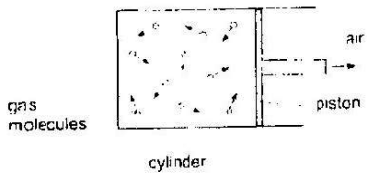
14 A resistance thermometer shows a resistance of 1.0 Ω and 4.0 Ω when placed in melting ice shavings and in a liquid at 60 °C respectively.

What is the thermometer reading when it is placed in a liquid at 80 °C?

A 1.5 Ω **B** 2.3 Ω

C 4.0 Ω **D** 5.0 Ω

15 Gas inside a cylinder is heated slowly to a higher temperature. The pressure inside the cylinder remains constant as the piston moves outwards.



How does the speed of the gas molecules and their rate of collision with the piston compare with their initial values at the lower temperature?

	speed of molecules	rate of collision
A	greater	greater
B	greater	reduced
C	greater	same
D	same	greater

16 A heated smooth metallic body is allowed to cool in air. Which of the following statements about its heat loss is incorrect?

A Convection currents in the air aid the process of heat loss.

B Conduction is the main mode of heat loss as the body is a good conductor of heat.

C The rate of heat loss by thermal radiation is increased due to its smooth metallic surface.

D The rate of heat loss decreases as the temperature of the body nears room temperature.

17 A person places his two feet on two separate surfaces, a woollen carpet and a marble tile. Both surfaces are initially at the same temperature.

Which statement best describes how the person will feel?

A Both surfaces feel the same since both are at the same temperature initially.

B The foot on the carpet feels warmer because the carpet transfers heat to the foot.

C The foot on the tile feels cooler because the tile transfers coldness to the foot.

D The foot on the carpet feels warmer because the rate of heat transfer is slower through the wool.

18 A piece of ordinary kitchen aluminium foil is used to wrap around food to be cooked in a barbecue fire. The foil has a shiny side and a dull side. Which side should be on the outside and why?

A The dull side should be on the outside because it is a better emitter of thermal radiation.

B The dull side should be on the outside because it absorbs thermal radiation better.

C The shiny side should be on the outside because it is a better thermal conductor.

D The shiny side should be on the outside because it is a better absorber of thermal radiation.

19 Object A is 2 kg. It has a temperature of 40 °C and has an internal energy of 500 kJ. Object B is 2 kg. It has temperature of 50 °C and has an internal energy of 400 kJ. Which of the following statement is correct?

A Heat flows from object A to object B.

B Heat flows from object B to object A.

C No heat flow between object A and object B.

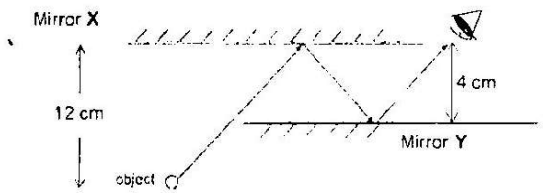
D There is not enough information to determine the direction of heat flow.

20 An ice tray contains 0.30 kg of water which has an initial temperature of 20°C. The ice tray and water are placed into a freezer that has a constant temperature of – 4.0°C. The specific heat capacity of water is 4180 J/(kg°C), the specific latent heat of fusion of water is 3.34×10^5 J/kg and the specific heat capacity of ice is 2100 J/(kg°C).

What is the energy that is needed to be removed in order to change the water into ice at – 4.0 °C?

A 18 kJ
B 25 kJ
C 125 kJ
D 128 kJ

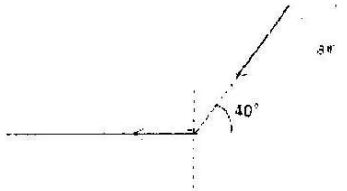
21 The figure below shows how a ray of light from an object enters the eye after being reflected twice.



What is the vertical distance (distance perpendicular to plane mirror) between the final virtual image of the object in mirror Y and the eye?

A 12 cm B 16 cm
C 20 cm D 32 cm

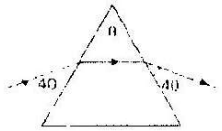
22 The following diagram shows a ray of light entering a transparent block from air



The speed of light in air is 3.0×10^8 m/s. Calculate the speed of light in the transparent block.

A 1.93×10^8 m/s B 2.30×10^8 m/s
C 1.14×10^8 m/s D 3.92×10^8 m/s

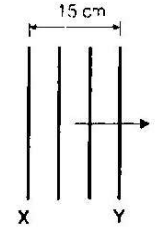
23 A light ray passes through a triangular glass prism of refractive index 1.5



What is angle θ?

A 51° B 53° C 61° D 65°

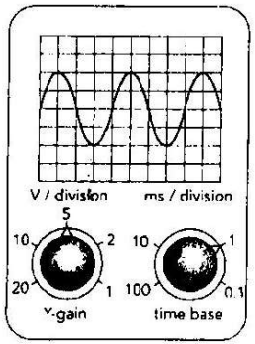
24 The figure below shows a water wave travelling in a ripple tank. The wavefront at **X** travels to **Y** in 5.0 s.



What is the frequency of the water wave?

A 0.60 Hz B 3.0 Hz C 15 Hz D 75 Hz

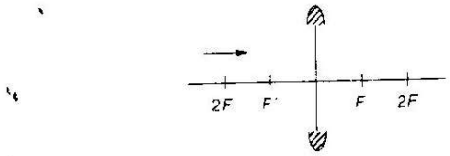
25 A wave is displayed on an oscilloscope with the settings as shown.



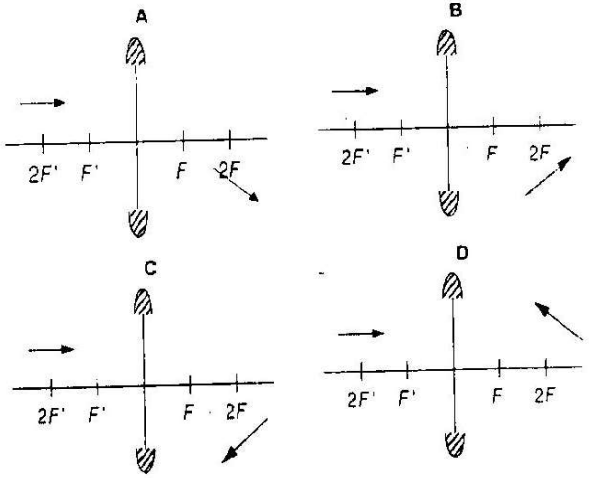
Which of the following shows the correct values for the peak voltage and frequency of the wave?

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

26 In the following diagram, F and F' are the focal points of a thin converging lens. An object represented by an arrow is placed in front of the lens.

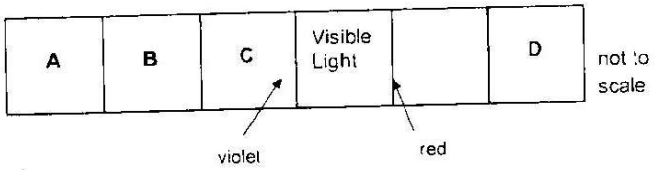


Which one of the following diagrams show the correct location and orientation of the image formed?

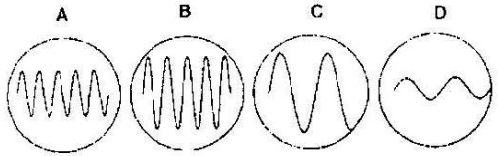


27 The following diagram shows an electromagnetic spectrum. The violet and red ends of the visible spectrum are marked. Which part of the spectrum can be used to detect counterfeit notes?

The Electromagnetic Spectrum

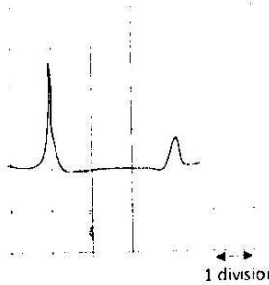


28 The diagram shows the waveforms produced by different sounds. Which diagram corresponds to the loudest sound with the lowest pitch?



29 A man shouts on a mountain and detects the echo from the nearest neighbouring mountain after using a microphone attached to a cathode ray oscilloscope (CRO). The following CRO screen shows the original sound and echo trace. Sound travels at 330 m/s in air.

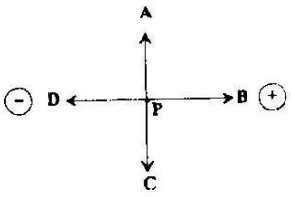
The time-based setting of the CRO is set to 10 s/div.



What is the distance between the man and the mountain?

A 30 m B 4950 m C 9900 m D 19800 m

30 The diagram below shows two electric charges. Which of the following shows the direction of the electric field at point P?

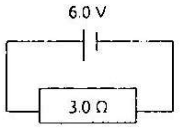


31 Wire X is 1.0 m long and has a diameter of 0.50 mm. It has a resistance of 5.0 Ω. Wire Y is made up of a material that has twice the resistivity of wire X's material. Wire Y is 2.0 m long but it has a diameter of 0.25 mm.

What is the resistance of Wire Y?

A 0.63 Ω **B** 5.0 Ω **C** 40 Ω **D** 80 Ω

32 A 3.0 Ω resistor is connected to a 6.0 V supply. How much charge flows through the resistor in 20 s?

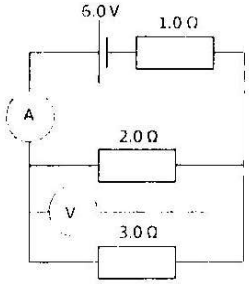


A 10 C **B** 40 C **C** 60 C **D** 120 C

33 Electromotive force is defined as the

A rate of flow of charge at a point
B the magnitude of force required to move a unit charge across the whole circuit
C the amount of energy required to move a unit mass of charge across the whole circuit
D the amount of energy converted per unit charge from non-electrical to electrical energy

34 The following diagram shows three fixed resistors connected to a 6.0 V supply



Which of the following show the voltmeter reading V and ammeter reading I?

	V/V	I/A
A	6.0	11
B	6.0	5.0
C	3.3	2.7
D	3.3	0.45

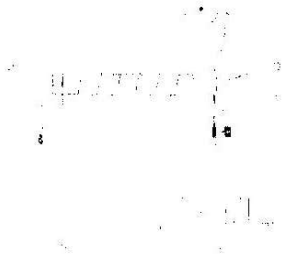
35 An electric iron is connected to the mains supply of 110 V by a cable. Which of the following shows a possible combination of the potential and current of the respective wires under normal operating conditions?

	live wire		neutral wire		earth wire	
	current/A	Potential	current/A	potential	current/A	potential
A	1.0	High	0.0	Low	0.0	Low
B	1.0	High	1.0	Low	0.0	Low
C	1.0	Low	1.0	High	1.0	High
D	0.0	Low	1.0	High	1.0	Low

36 An air-conditioner has a rating of 240 V, 1500 W. The cost of operating the air conditioner came up to $45 for a particular month. What is the duration of time that the air-conditioner was switched on for the month if one unit of electricity costs $0.20?

A 9 min **B** 150 hrs **C** 744 hrs **D** 938 hrs

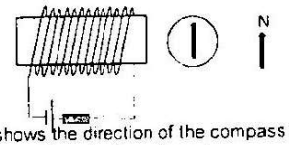
37 The following diagram shows an electric bell.



Which materials would be suited for the parts labelled P, Q and R?

	P	Q	R
A	soft iron	brass	soft iron
B	soft iron	soft iron	spring steel
C	soft iron	brass	brass
D	spring steel	soft iron	spring steel

38 The following diagram shows a solenoid connected to a DC supply and the direction of a compass near it before the switch is closed.



Which of the following shows the direction of the compass after the switch is closed? Assume that a small current flows in the solenoid.

A



B



C

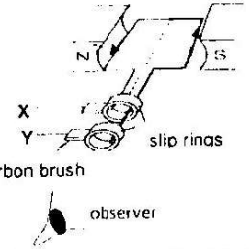


D



Refer to the following diagram for questions 39 and 40

The following diagram shows a representation of an AC generator connected to leads **X** and **Y**. At the instant shown, the current direction in the coil is as shown.



39 Which of the following shows the direction of rotation of the coil as seen by an observer and the rule used to obtain this direction of rotation?

	direction of rotation	rule used
A	clockwise	Fleming's Left Hand Rule
B	clockwise	Fleming's Right Hand Rule
C	anti-clockwise	Fleming's Left Hand Rule
D	anti- clockwise	Fleming's Right Hand Rule

40 Which of the following states the function of a slip ring in the AC generator?

A To prevent entanglement of the wire
B To ensure electrical contact between the coil and the external circuit
C To ensure the coil rotates continuously by changing the direction of the current in the coil every half a revolution
D To increase the magnetic field strength of the rotating coil

---------- END OF PAPER ----------

ZHONGHUA SECONDARY SCHOOL
Preliminary Examination 2016

CANDIDATE NAME ( )

CLASS

PHYSICS **5059/2**

Paper 2 Theory **30 August, 2016**

Secondary 4 Express **1 hr 45 minutes**

Set by: **Mr Lawrence Tang and Ms Chin Gui Jin**

Vetted by: **Mrs Ngiam Kar Yin and Mr Tan Jun Hong**

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B

Answer all **three** questions, the last question is in the form either/or.

Write your answers on the separate answer papers provided.

You are advised to spend no longer than one hour on **Section A** and no longer than 45 minutes on **Section B**.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

All essential working must be shown clearly.

Where necessary, take acceleration due to gravity, $g = 10\ m/s^2$.

For Examiner's Use	
Section A	
B 9	
B 10	
B 11	
Total	

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows a velocity-time graph for a ball bouncing vertically on a hard surface on an unknown planet. The ball was dropped at $t = 0$ s.

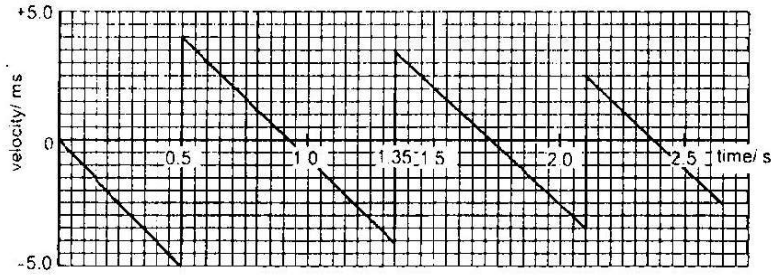


Fig. 1.1

(a) State the time at which the ball was just in contact with the ground for the first time.

[1]

(b) Calculate the height from which the ball was first dropped.

height = ... [2]

(c) State the acceleration of the ball at 0 s.

acceleration = ... [1]

Total marks: ____

[Turn over

(d) Sketch a displacement-time graph on Fig. 1.2 for the first 1.35 s of the motion.

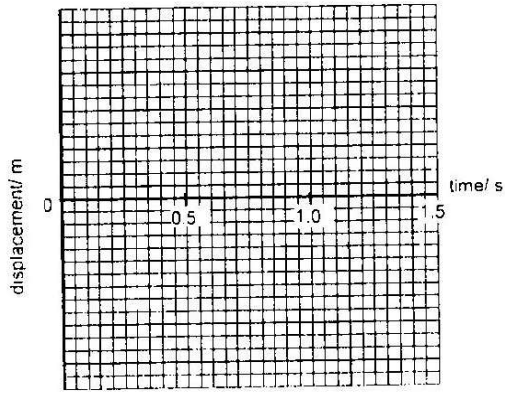


Fig. 1.2

[2]

Total marks:

[Turn over

2 Fig. 2.1 shows three cubes, **A**, **B** and **C**, of mass 35 kg, 5 kg and 20 kg respectively resting on a smooth horizontal surface initially. The cubes are in contact with each other as shown in Fig. 2.1. A horizontal force of 300 N is then exerted on cube **A**.

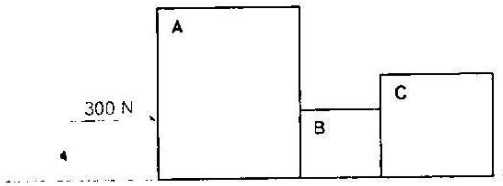


Fig. 2.1

(a) Calculate the acceleration of cube **B** and hence the resultant force acting on it.

acceleration = ...

force = ... [2]

(b) Calculate the force exerted on cube **A** by cube **B**.

force = [2]

(c) Draw all the pairs of action-reaction forces acting on cube **C** and label the forces clearly in Fig. 2.1. [2]

Total marks:

[Turn over

3 Fig. 3.1 shows an uniform gondola suspended in mid-air that is used to clean the window of buildings. A cleaner of mass 85 kg stands 2.0 m away from rope X inside the gondola. The mass of the gondola is 630 kg and the distance between the ropes is 6.0 m.

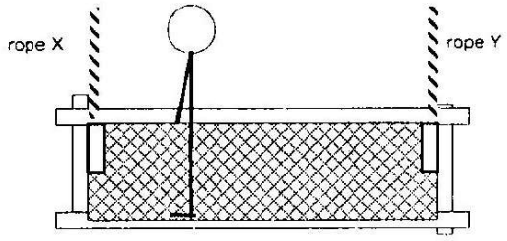


Fig. 3.1

(a) Draw and label all the vertical forces in Fig. 3.1 which are acting on the gondola.

[2]

(b) Calculate the force exerted by rope Y on the gondola.

force = [2]

(c) State and explain qualitatively how the force exerted by rope **Y** on the gondola will change as the cleaner moves towards rope **Y**.

[2]

Total marks:

[Turn over

4 Fig. 4.1 shows part of an experimental arrangement which is used to obtain a value for l_v, the specific latent heat of vaporisation of water.

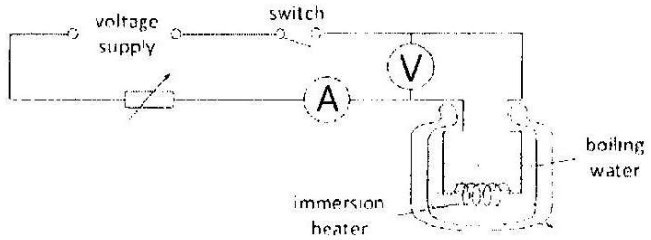


Fig. 4.1

(a) In a particular experiment using the apparatus in Fig 4.1, a student uses an immersion heater which supplies 300 J of energy per second. He closes the switch for 2 minutes, and 0.015 kg of boiling water is vaporised.

(i) Calculate a value for l_v.

l_v = [1]

(ii) State and explain whether you would expect the answer in **(a)(i)** to be larger or smaller than the true value of l_v.

[2]

Total marks:

[Turn over

(b) Another student doing the same experiment decides to insert a thermometer into the boiling water at the start of the experiment, as shown in Fig. 4.2, to ensure that the temperature remains at 100 °C throughout the experiment.

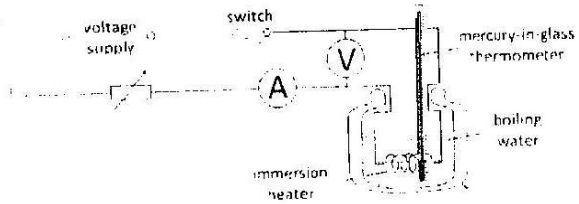


Fig. 4.2

(i) Suggest a reason why this student's concern may be invalid.

[1]

(ii) The student inserts the thermometer at 30 °C into the boiling water, right at the start of the experiment. Given that he uses the same immersion heater and keeps it on for the same 2 minutes, use your answer in **(a)(i)** to calculate the mass of boiling water that will be boiled off.

(You may take the average heat capacity of the mercury-in-glass thermometer to be 28.5 J K^{-1}, and assume that the thermometer reaches 100 °C before the end of the experiment.)

mass = [2]

(ii) Hence explain why thermometers cannot be made of thermometric substances with high heat capacities.

[1]

Total marks:

[Turn over

5 Fig 5.1 (an actual 1:1 scaled diagram) shows an object and its corresponding virtual image when the object is placed in front of a thin converging lens.

(a) Complete the diagram with two sets of rays to show how the image is formed. Mark the optical centre of the lens clearly with an X.



Fig 5.1

[2]

(b) State the magnification of this lens and its focal length.

magnification factor = ... [1]

focal length = ... [1]

6 Fig 6.1 shows a highly negatively-charged metallic ball on an insulated stand.

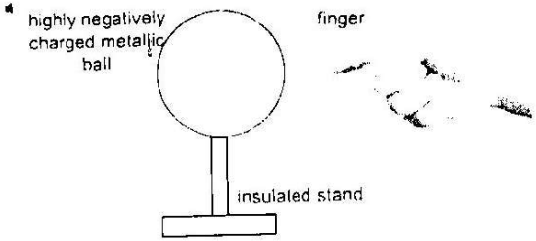


Fig 6.1

Describe and explain what happens to the charges in a person's finger when it approaches the ball without touching it. You may use the diagram to illustrate your answer. Include the idea of an electric field in your answer.

..... [2]

Total marks:

[Turn over

7 Seismic waves are generated by earthquakes. These waves start from the epicentre. Primary (P) waves travel in a direction parallel to the direction of the vibration of its particles. Secondary (S) waves travel in a direction perpendicular to the direction of vibration of its particles.

(a) State the type of wave that the P wave is.

.....[1]

(b) Fig 7.1 shows the time taken by the waves to travel different distances from the epi centre.

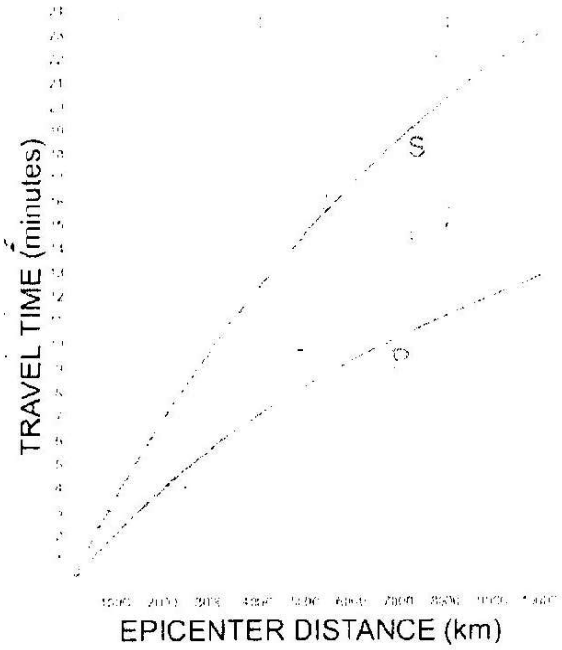


Fig 7.1

Calculate the average speed of the S wave that reached 10 000 km from the epi centre in m/s.

average speed = ...[2]

Total marks: [ ]

(c) A typical S wave has a frequency ranging from 0.50 to 1.0 Hz. Calculate the maximum possible wavelength of the S wave that reached 10 000 km from the epi centre.

wavelength = ...[2]

8 Fig 8.1 shows part of a circuit that is designed to switch on a LED when it is dark.

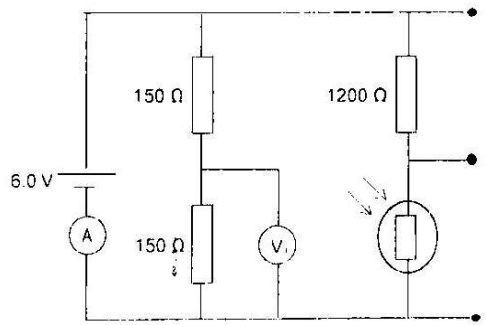


Fig 8.1

(a) Calculate voltmeter reading V_1.

V_1 = ...[1]

(b) State and explain if the LED should be placed across the 1200 Ω or LDR so that it can light up when the light intensity of the surroundings decreases.

.....

.....

.....

.....[2]

Total marks: [ ]

(c) Fig 8.2 shows how the current through a filament lamp changes as the potential difference (p.d) across it varies.

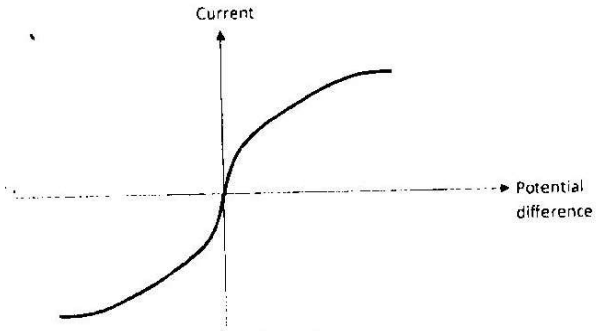


Fig 8.2

(i) Sketch on the same axis above how the current of an LED will change as the p.d across it changes. [2]

(ii) Hence or otherwise, explain the advantage of the LED over a filament lamp.

.....

..... [1]

9 Fig 9.1 shows part of a ring circuit in a phone shop. The ring circuit draws power from a 230 V supply.

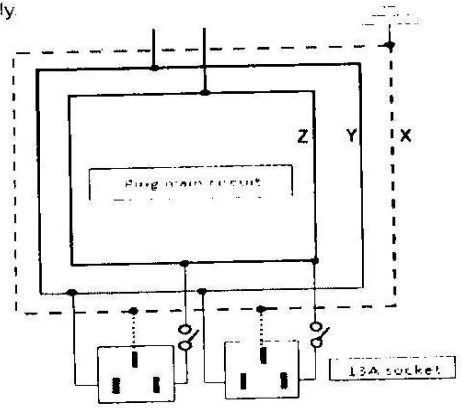


Fig 9.1

Total marks:

(a) Wire K is the earth wire. Label wires Y and Z.

Y: ..... Z : ..... [1]

(b) Fig 9.2 shows a 6 point multi plug adaptor that is connected to one of the 3 pin sockets in Fig 9.1.



Fig 9.2

The shop owner plugs 6 phone chargers into the multi plug adaptor. Each of the phone charger has an input rating of 230 V, 50 W.

The wires in the 3 pin plug are thin and can only withstand a maximum of 1.0 A. State and explain, with clear working shown, if the 13 A fuse of the 3 pin plug of the adaptor inserted into the socket is able to protect the circuit.

.....

..... [2]

(c) Fig 9.3 shows part of a 3 pin plug with a fuse missing.

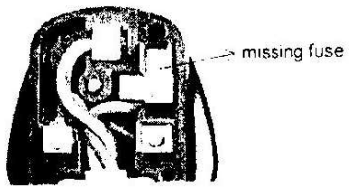


Fig 9.3

The shop owner claims that the missing fuse will not make any difference to the operation of the appliance. Explain if you agree with his statement.

.....

.....

..... [1]

Total marks:

10 Fig 10.1 shows a simple hand-wound AC generator. The generator consists of a rotating single coil of wire. The emf generated lights up a lamp.

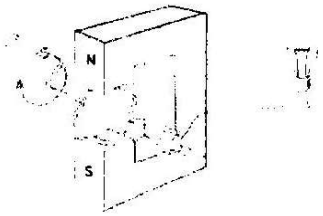


Fig 10.1

(a) Explain using Lenz's law, why the hand that is winding the generator coil experiences a resistive force when the lamp is lit.

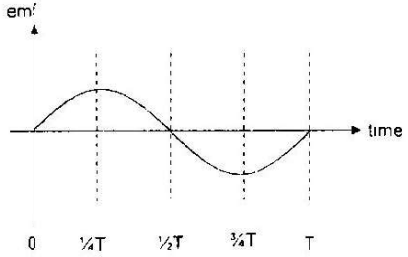
.....

.....

.....

..... [1]

(b) Fig 10.2 shows how the emf across the coil varies with time. Sketch on the same axis how the emf will change if the speed of rotation of the coil is doubled. A complete cycle of rotation of the coil takes a period T.



[2]

Fig 10.2

(c) Explain using Faraday's law, why increasing the number of turns of coil of wire increases the magnitude of the emf generated across the coil

.....

..... [1]

Total marks: [Turn over

Name: _____ ( )

Class: _____

Section B

Answer all **the** questions from this section.
Answer only one of the two alternative questions in **Question 13.**

11 Fig 11.1 shows a small water turbine that generates electricity from a reservoir of water located a height h above the turbine.

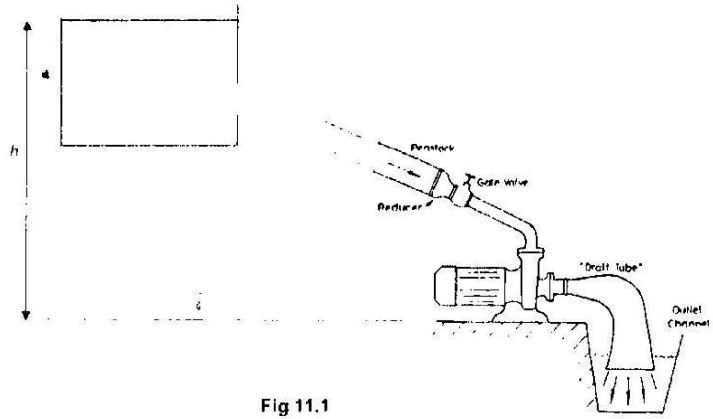


Fig 11.1

(a) Fig 11.2 shows the specifications of the water turbine.

power output (kW)	height h /m	flow rate (m^3/s)
5.0	20	0.035

Fig 11.2

Calculate the efficiency of the water turbine. Assume no frictional losses when the water flows from the reservoir to the water turbine. Take the density of water to be 1000 kg/m^3.

efficiency = ... [2]

Total marks: [Turn over

(b) Fig 11 3 shows the cross-section of the water turbine. The water flows into the turbine and turns the rotor blades.

Fig 11 4 shows the interior of the turbine. The rotor blade is wrapped by a coil of wire connected at a DC input. . An e.m.f. is generated across the coils of wire wrapped around a stator (stator coils) when the water flows.

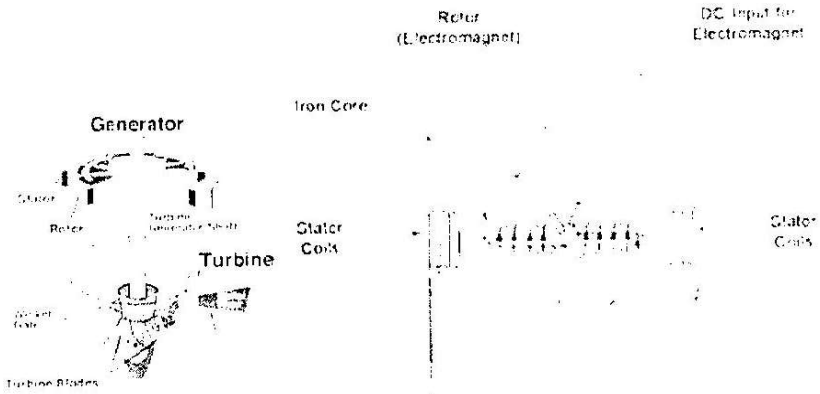


Fig 11.3

Fig 11.4

Explain how the flow of the water generales an e.m.f. across the stator coils

.....

.....

.....

.....

..... [3]

Total marks:

[Turn over

(c) Fig 11.5 shows the representation of how power is generated and transmitted from a hydroelectric plant to homes. Assume both the transformers are 100% efficient.

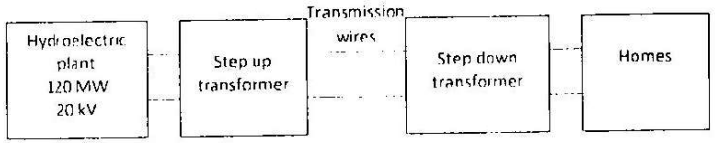


Fig 11.5

(i) Calculate the current generated by the hydroelectric plant.

current = ... [1]

(ii) The step-up transformer has a turns ratio of 40. Calculate the current output of the step-up transformer.

current = ... [1]

(iii) Assuming that each transmission wire has a resistance of 30 Ω, calculate the input voltage to the step-down transformer.

input voltage = ... [2]

(d) State an advantage and a disadvantage generating power using hydroelectric means instead of burning of fossil fuels.

advantage .....

.....

disadvantage .....

..... [1]

Total marks:

[Turn over

12 Fig 12.1 shows the DC motor of a fan. It consists of a single coil rotating in a clockwise manner about a pivot.

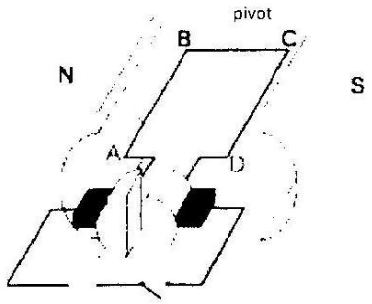


Fig 12.1

(a) (i) Draw the current direction in wire **AB** and **CD** so that the coil rotates in a clockwise manner. [1]

(ii) Complete Fig 12.1 to include a 12 V DC supply as well as a potentiometer that will allow the maximum potential difference across the motor to be 12 V [2]

(b) Fig 12.2 shows the front view of the wire **AB** between the two permanent magnets.



Fig 12.2

Explain, by completing the diagram above, how the magnetic fields interact to produce a force on wire AB.

.....

.....

.....

..... [3]

Total marks: [Turn over

(c) The magnetic field strength of the magnets is doubled.

(i) Explain why this would result in an increase in the rotation speed of the fan.

.....

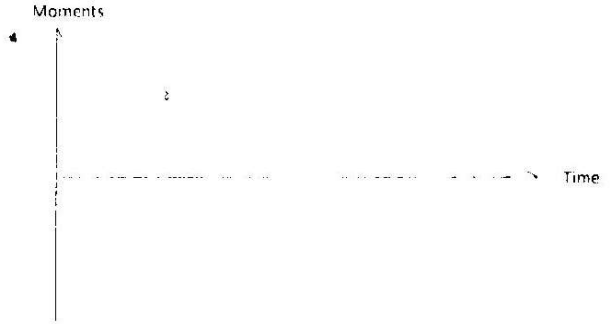
.....

.....

..... [2]

(ii) Sketch in the axis below how the moments about the pivot would vary with time for both the original weaker magnets as well as the stronger magnets. Label the curve due to the weaker magnets as 'W' and the curve due to the stronger magnets as 'S'. The time taken for a complete revolution for the coil with the weaker magnets is T

Draw the two curves from time 0 to T. Assume both coils are horizontal initially.



[2]

Total marks: [Turn over

13 EITHER

Fig. 13.1 shows the Griffon. II opened in August 2006 and is the world's tallest, floorless dive roller coaster. The ride features two nearly-vertical dives, one of which occurs at the start of the ride, subjecting the riders to large changes in speed and thrill of the ride.

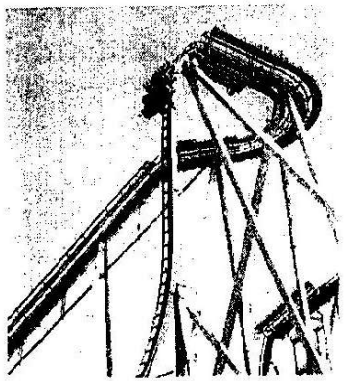


Fig. 13.1

Fig. 13.2 shows the simplified diagram of the first hill of the ride.

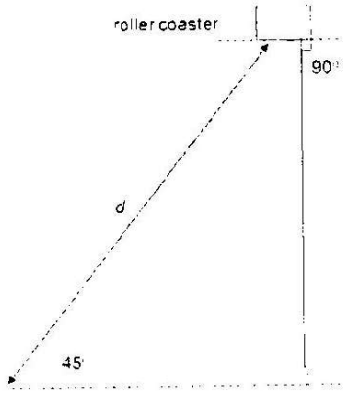


Fig. 13.2

At the start of the ride, the train of mass 3000 kg climbed a 45° lift hill at a constant

speed of 3.04 m/s. The train then pauses on a holding brake for five seconds before dropping 62.5m at 90° hitting a maximum speed of 31.7 m/s at the bottom of the hill.

(a) State the Principle of Conservation of Energy.

[2]

(b) In dropping from the top to the bottom of the first hill, determine the average friction between the tracks and the train.

mass = [3]

(c) Calculate the distance d and hence the time taken for the train to move up the first hill.

time taken = [2]

(d) The work done in pulling the train is converted to different forms of energy. Name these forms of energy

[1]

(e) Calculate the minimum power of the electric motor pulling the train up the first hill. Assume that friction is constant for the entire ride.

power = [2]

Total marks: [Turn over

OR The Hare's apparatus is a device used for comparing the densities of two different liquids. As shown in Fig. 13.3, the equipment consists of a three-limbed E-shaped glass tube. The two longer limbs at the side are dipped into the beakers containing the liquids, **X** and **Y**.

One of the liquids is chloroform and the other is methyl isobutyl ketone. The central limb has a tap which allows air to be pumped out. When the tap is closed after air is pumped out, the densities of the liquids can be compared by measuring and comparing the column heights in the two long limbs.

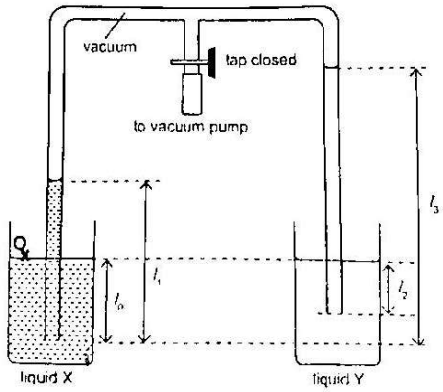


Fig. 13.3

The table below shows the densities of the two liquids.

liquid	density / kg m^{-3}
chloroform	1490
methy isobutyl ketone	801

(a) Explain, in terms of the air molecules inside and outside the Hare's apparatus, why the liquid levels in the two limbs increase after the air is pumped out.

[3]

(b) On Fig. 13.4, sketch a graph to show the relationship between the pressure and

Total marks: [Turn over

volume of gas in the Hare's apparatus.

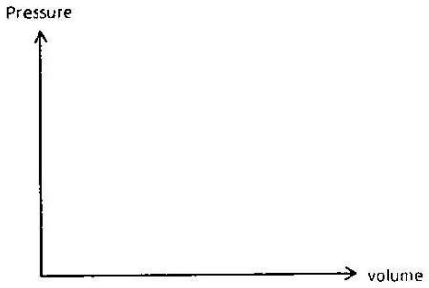


Fig. 13.4

[1]

(c) State which liquid (**X** or **Y**) is chloroform. Explain your answer.

[2]

(d) On Fig. 13.3, mark out a point **P** in liquid Y which has the same pressure as point **O**

[1]

(e) Given that l_0 = 5.0 cm, l_1 = 26.5 cm and l_2 = 3.0 cm, calculate l_3.

l_3 = [2]

Total marks:

(f) This experiment is repeated at a mountain top where the almospheric pressure is lower.

State and explain how your answer in **(e)** will be affected.

[1]

- End of Paper 2-

Total marks:

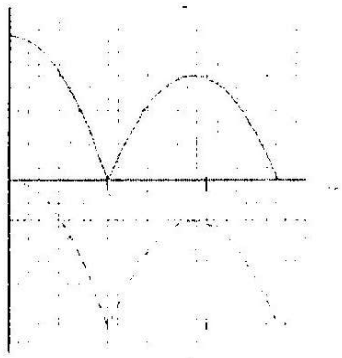
Zhonghua Secondary School

Preliminary Examinations 2016

5059 Physics Answer Scheme

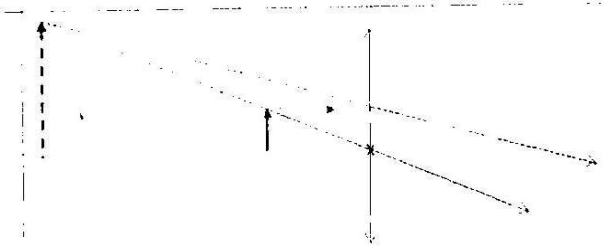
1	B	11	B	21	C	31	D
2	A	12	D	22	B	32	B
3	B	13	A	23	C	33	C
4	C	14	D	24	A	34	C
5	C	15	B	25	B	35	B
6	B	16	C	26	A	36	B
7	D	17	D	27	C	37	B
8	B	18	B	28	C	38	C
9	D	19	B	29	B	39	D
10	D	20	D	30	D	40	A

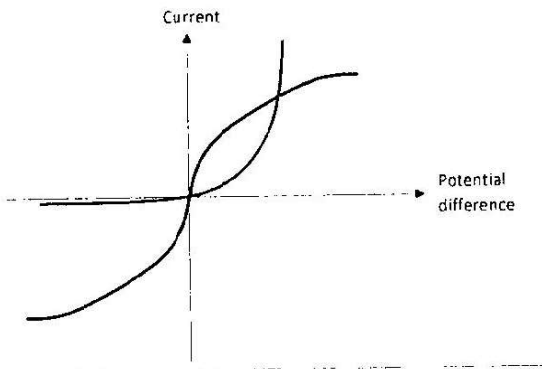
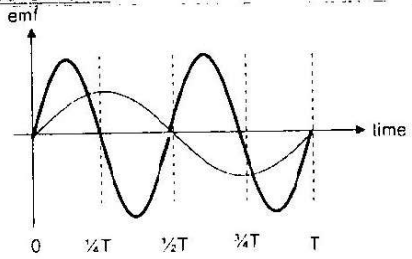
Paper 2

Qn		Mark
1a	0.50 s	1
1b	½ × 0.5 × 5 = 1.25 m	1 1
1c	10 or -10 m/s^2	1
1d		1 – shape from 0-0.5 s 2 m – 1.25 m and lower rebound height
2a	F_{net} on A, B and C = ma 300 = (35 + 5 + 20) a a = 5.0 m/s^2	1
	F_{net} = ma F_{net} on B = 5 × 5 F_{net} on B = 25 N	1
2b	F_{net} on A = 35 × 5 = 175 N	1

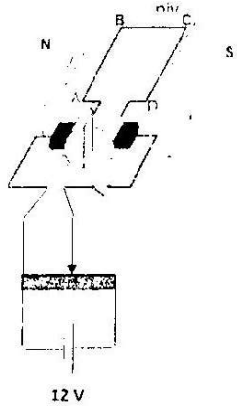
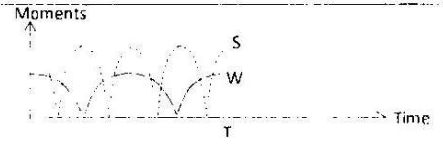
	300 – $F_{\text{on A by B}}$ = 175 $F_{\text{on A by B}}$ = 125 N	1

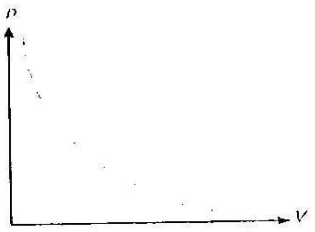
Question	Answer	Marks
2c	F on C by B and F on B by C F on C by surface and F on surface by C F on C by earth and F on earth by C	2
3a	Tension in X Tension in Y Force by cleaner on gondola (850 N) (W not accepted) Weight of gondola (6300 N)	2
3b	Taking X as the pivot: Y × 6 = (850 × 2) + (6300 × 3) Y = 3430 N (to 3sf)	 1 1
3c	Force exerted by rope Y will increase. As the cleaner moves from left to right, the perpendicular distance from the line of action of his weight and the pivot (X) increases. This increases the clockwise moment and hence the force exerted by Y has to increase to ensure the anticlockwise moment is equal to the clockwise moment.	1 1
4ai	$Pt = ml_v$ $(300\text{ W})(2 \times 60\text{ s}) = (0.015\text{ kg})l_v$ $l_v = \frac{(300\text{ W})(2 \times 60\text{ s})}{0.015\text{ kg}}$ $= 2.4 \times 10^6\text{ J kg}^{-1}$	 1
4aii	The answer in (b)(i) is larger than the true value, because in reality energy is lost to the surrounding, and the mass of water m vaporised is less. Since l_v = Pt / m, a lower mass m leads to a higher l_v.	1 1
4bi	The boiling point of water is exactly 100 °C and so when the water is boiling the temperature will be constant at 100 °C.	1
4bii	$Q_{supplied} = Q_{thermometer} + Q_{water}$ $Pt = C_{thermometer}\Delta\theta + m_w c_w \Delta\theta$ $(300\text{ W})(2 \times 60\text{ s}) = (28.5\text{ J K}^{-1})(120 - 20)\text{ K} + m_w (4.2 \times 10^3\text{ J kg}^{-1})$ $m_w = 0.0142\text{ kg}$	 1 1
4biii	If the thermometer has a large heat capacity C, it will take up a significant amount of energy per unit rise in temperature from the heat source and affect the accuracy of the measurements OR a thermometer with a high C is less responsive.	1

5a		1 m – correct X 1 m – all rays
5b	m = 2.8/0.9 = 2.9 to 3.3 f = 3.2 to 3.6 cm	1 1
6	The negative charges in a ball sets up an electric field (an equivalent diagram) which causes electrons t be repelled from the negative charges in the ball as like charges repel (The electric field set up between the finger and the ball eventually causes the electrons to move from the ball to the fingertip. A spark may be seen)	1 1
7a	Longitudinal waves	1
b	Average speed = 10 000 x 10^3 / (23X 60) = 7246 m/s = 7200 m/s	1 1
c	Maximum wave ength = Speed / minimum frequency = 7246 / 0.50 m = 14500 m (or 15000 m) (or 14.5 or 15 km)	1 1
8a	V_1 = ½ 6.0 = 3.0 V	1
b	When ligh. intensity decreases. R_{LDR} increases. Since $V_{LDR} = \frac{R_{LDR}}{R_{total}} \times emf$. LED should be placed across LDR	1 1

Question	Answer	Marks
8ci		1 m for curve, 1m for line
cii	If high p.d is high enough, the current of LED is higher than filament lamp for the same p.d, the LED will be brighter than lamp.	1
9a	Y: neutral wire Z: live wire	1
b	I = P/V = 50/230 = 0.217 A Total current flowing in fuse = 6(0.217) = 1.30 A There is no protection as 1.30 A > 1.0 A (or high current melt wire) and the 13 A will not blow to protect the fuse.	1 1
c	No, the appliance will not work as a missing fuse means the circuit is open and there will be no current.	1
10a	Lenz's Law states that the emf generated will produce a current which will flow in such a way to produce a magnetic field that opposes the motion of the coil.	1
b		1 – double amplitude 1 – double f
c	The rate of change of magnetic flux linking the coil and magnet increases. Since Faraday's Law depends on this rate of change, emf increases.	1

Question	Answer	Marks
11a)	Efficiency = (Po/Pi) X 100% = (5000/mgh) X 100% = (5000 / 0.035X1000X10X20) X 100% = (5/7) X 100% = 71%	 1 1
b)	The current carrying coils around rotor generate a magnetic field. when the coil rotates, the flux linking the rotating coil and stator coil changes (or flux cuts stator coil) and induces an emf across the stator coil	Idea of magnetisation of rotor coil -1 Cause of flux change - 1 Flux change - 1
c) ii)	I = P/V = 120 X10^{6} / 20 X 10^{3} = 6000 A Assuming no transformer power loss, $P_1 = P_2$ $V_1I_1 = V_2I_2$ $I_2 = (V_1/V_2)I_1$ But (V_1/V_2) = 1/40 Hence, I_2 = (1/40)(6000) = 150 A	1 1
iii)	Input V to step down transformer = Output V of step up transformer – V across 2 transmission wires = (Turns ratio)(Input V of step up transformer) – (Current)(R of 2 wires) Input V to step down transformer = = (40)(20 X 10^{3}) – 2(150)(30) =791,000 V	Either 2(150)(30) or (40)(20X10^{3}) – 1 m Ans-1 m
d)	Advantage : Energy is renewable Disadvantage : Have to clear forests to build dam	1

12a)i)	Using Fleming's Left Hand Rule: Current flows in direction BA Current flows in direction DC	**1**
ii)		1 m for terminal correct direction to achieve clockwise moment
b)	 Magnetic field of current and permanent magnet interact such that field is weakened above A and strengthened below A Force acts from region of high to low flux density (upwards)	Diagram-1 1 1
c)i)	The force on the coil is increased when the field strength increases This leads to a higher moment OR this is because there is a greater difference between the two interacting magnetic field densities	1 1
ii)		1 m only if cosine curve 1m for double f and amplitude No marks if sine curve

13Ea	Energy cannot be created nor destroyed. It can be converted from one form to another, or transferred from one body to another, but the total amount remains constant.	2
13Eb	Change in gravitational potential energy = (3000)(10)(62.5) = 1.875×10^6 J Increase in kinetic energy = ½·(3000)(31.7)^2 = 1.507×10^6 J Work done against friction = $1.875 \times 10^6 - 1.507 \times 10^6$ = 0.368×10^6 J Average friction = $0.368 \times 10^6 \div 62.5$ = 5880 N	3
13Ec	d = 62.5/sin 45 = 88.4 m t = 88.4 / 3.04 = 29.1 s	1 1
13Ed	Gravitational potential energy and thermal energy due to friction. (sound energy)	1
13Ee	Work done by motor against friction = 88.4 x 5880 = 5.23×10^5 J Total work done by motor = $5.23 \times 10^5 + 1.88 \times 10^6$ Power = $(5.23 \times 10^5 + 1.88 \times 10^6)/29.1$ = 8.26×10^4 W	1 1
13Oa	As the air is pumped out, the number of air molecules per unit volume decreases and becomes lesser than outside. The frequency of collision of the air molecules with the liquid decreases. The pressure inside becomes lower than outside and hence the liquid level increases.	1 1 1
13Ob	 	1

13Oc	X is chloroform. Chloroform has a higher density from table. h= P/pg. Since pressure on liquids X and Y is the same, the higher density (ρ) of chloroform will lead to a lower liquid level (h) (Liquid X)	1 1
13Od	Any point along the same level as point P in liquid Y	1
13Oe	$P_X = P_Y$ $\rho_x g h_x = \rho_y g h_y$ $(1490 \times 10 \times (l - l_0)) = (801 \times 10 \times (l - l_0))$ l = 45.0 cm (to 3sf)	1 1
13Of	Answer will not be affected The ratio of the densities of X and Y is related only to the ratio of their column heights. Since there is no change in the ratio of the densities of X and Y, the column height of X will still be lower than Y	1

Name : ( ) Class :

YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION II 2016

SEC 4 EXPRESS

PHYSICS

(5059/1)

Date : 31st Aug 2016 Day : Wednesday
Duration : 1 hour Marks : 40 marks

ADDITIONAL MATERIALS

Multiple choice answer sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name and class on the question booklet.

There are **forty** questions. Answer all questions. For each question, there are four possible answers, A, B, C and D.

Choose the one you consider correct and record your choice in soft pencil on the separate answer sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

1 Which one of the following physical quantities does not match with its approximate measurement?

	physical quantity	measurement / m
A	diameter of a hydrogen atom	1×10^{-10}
B	length of a bee	6×10^{-2}
C	height of Mount Everest	1×10^{4}
D	radius of Earth	6×10^{6}

2 Figure A shows the readings on a pair of vernier caliper when its jaws are closed and there is nothing clamped between its jaws. Figure B shows the length of a block being measured by the same pair of vernier caliper.

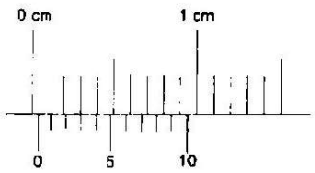


Figure A

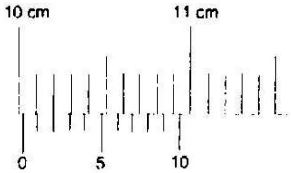


Figure B

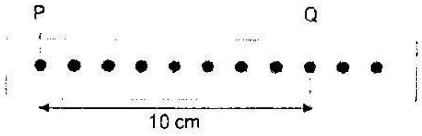
What is the actual length of this block?

A 9.98 cm B 9.99 cm C 10.02 cm D 10.05 cm

3 Which of the following is a scalar quantity?

A the braking force needed to stop a car
B the effort needed to hammer a nail into a wooden plank
C the heat needed to boil some water
D the thrust needed to lift a rocket off the ground

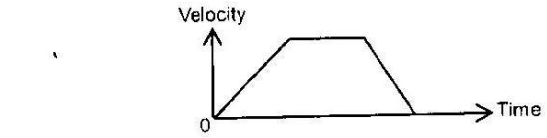
4 Aloysius uses a ticker tape timer to investigate the speed of a moving toy truck. The ticker tape timer is set to a frequency of 50 Hz and a portion of the tape obtained is shown below.



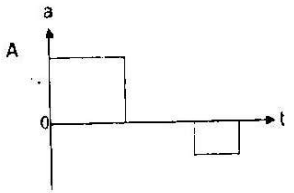
What is the average speed of the toy truck between point P and point Q?

A 0.016 cm / s B 55.6 cm / s C 62.5 cm / s D 500 cm / s

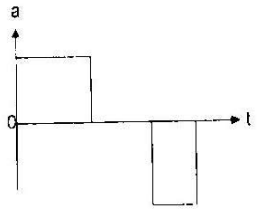
5 The velocity-time graph below represents a car moving along a straight road. Which of the following represents the corresponding acceleration-time (a-t) graph?



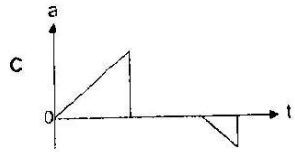
A



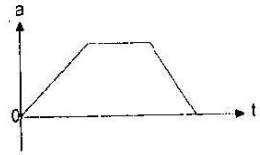
B



C



D

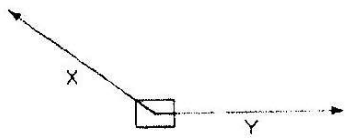


6 Beatrice takes a total of one and a half hours to make a journey of 12 km. During the journey, she takes a break of 15 minutes and spends another 30 minutes to stop for lunch.

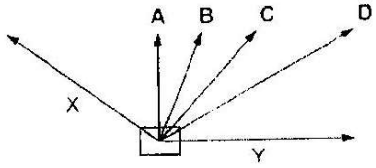
At what average speed must she travel during the rest of the time for the whole journey to take one and a half hours?

A 8 km/h B 10 km/h C 12 km/h D 16 km/h

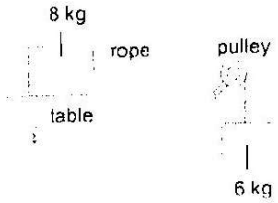
7 Forces **X** and **Y** act on a block in the directions shown on the scale diagram.



In which direction is the resultant force acting?



8 An 8 kg mass is connected to a 6 kg mass by a rope which passes over a smooth pulley.



If the friction between the 8 kg mass and the table is 10 N, find the acceleration of the 8 kg mass.

A 1.25 N B 3.57 N C 4.29 N D 10.0 N

9 Two spherical objects, **P** and **Q**, are dropped from the top of a skyscraper at the same time. **P** has a greater weight than **Q**, but both objects are identical in shape and volume.

Which of the following statements is correct?

A Both **P** and **Q** take the same amount of time to reach terminal velocity.
B **P** experiences a greater acceleration than **Q** upon release.
C **P** takes a longer time than **Q** to reach the ground.
D The terminal velocity of **P** is greater than that of **Q**.

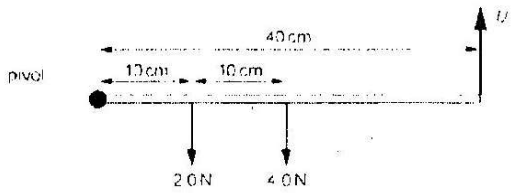
10 Gold has a density of 19.3 g/cm^3.

The volume occupied by a single atom of gold may be considered to be a cube with sides of length 2.6×10^{-8} cm.

What is the mass of a gold atom?

A 3.4×10^{-25} g
B 3.4×10^{-22} g
C 1.3×10^{-17} g
D 1.3×10^{-14} g

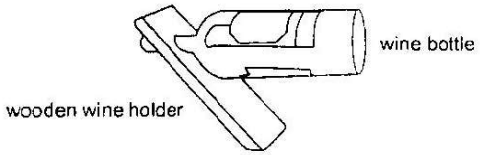
11 A beam of length 40 cm is pivoted at one end. The weight of the beam is 4.0 N and acts at a point 20 cm from the pivot. A weight of 2.0 N hangs 10 cm from the pivot.



An upward force **U** is needed to keep the beam horizontal. What is the magnitude of **U**?

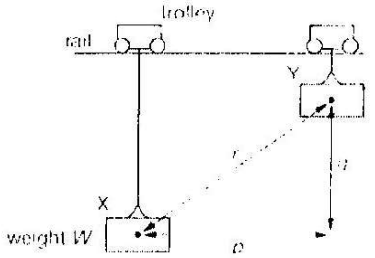
A 0.5 N **B** 1.5 N **C** 2.5 N **D** 6.0 N

12 The diagram below shows a wine bottle in a wooden wine holder in equilibrium. Which of the following statements is true?



A The C.G. of the bottle and the C.G. of the wooden holder are at the same point.
B The C.G. of the bottle and wooden holder together is directly above the base of the wooden holder.
C The C.G. of the bottle is directly above the base of the wooden holder.
D The C.G. of the wooden holder is directly above the base of the wooden holder.

13 A weight **W** hangs from a trolley that runs along a rail. The trolley moves horizontally through a distance p and simultaneously raises the weight through a height q.



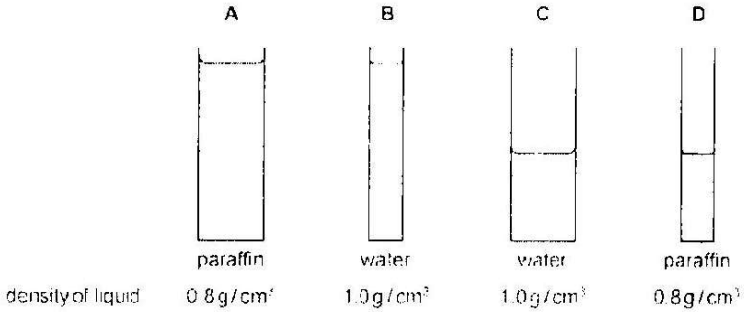
As a result, the weight moves through a distance r from **X** to **Y**. It starts and finishes at rest. How much work is done on the weight during this process?

A Wr **B** $W(p + q)$ **C** Wq **D** Wp

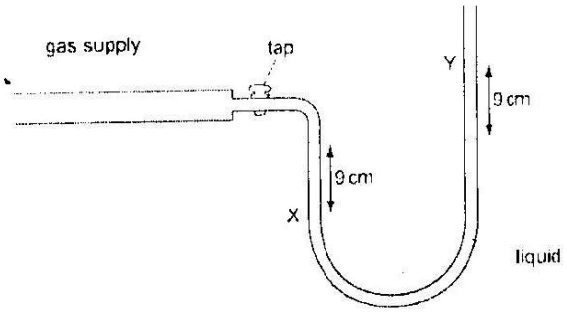
14 A builder lifts eight slabs from the ground onto the back of a lorry 1.5 m high. The total time taken is 48 s and each slab weighs 200 N. How much useful power does the builder produce?

A 50 W **B** 400 W **C** 2400 W **D** 3200 W

15 The diagrams show liquids in containers. Which column of liquid exerts the greatest pressure on the base of its container?



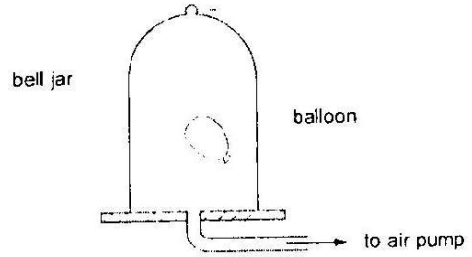
16 The diagram shows the levels **X** and **Y** in a liquid manometer with the gas tap open.



What is the pressure of the gas supply?

A 18 cm of liquid below atmospheric pressure
B 9 cm of liquid below atmospheric pressure
C 9 cm of liquid above atmospheric pressure
D 18 cm of liquid above atmospheric pressure

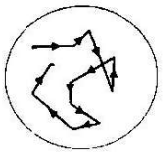
17 A partially-inflated balloon is placed inside a bell jar. The bell jar is connected to an air pump.



The air pump is switched on and air is removed from the bell jar. What happens to the pressure and volume of the gas inside the balloon?

	pressure	volume
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

18 Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



What does this experiment demonstrate about air molecules?

A They move because of collisions with smoke particles.
B They can be seen through a microscope.
C They are in continuous random motion.
D They move more quickly when they are heated.

19 A rod of metal is heated at one end. Which statement best describes the conduction of heat through the metal?

A Atoms move from the hot end and hit electrons at the cold end.
B Atoms vibrate and hit atoms at the cold end.
C Free electrons move from the hot end and hit atoms further along the rod.
D Free electrons vibrate and pass energy to free electrons further along the rod.

20 Fillings in teeth should be made from a material which

A does not expand when heated.
B expands by the same amount as the tooth when heated.
C expands less than the tooth when heated.
D expands more than the tooth when heated.

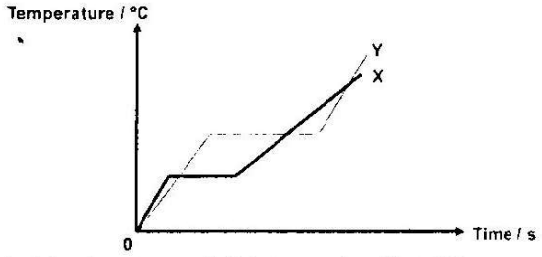
21 Four metal cans are identical except for the colour and texture of their outer surfaces. The same volume of water at 70°C is poured into each can. Which can cools most rapidly?

A black and rough surface
B black and shiny surface
C white and rough surface
D white and shiny surface

22 In calibrating a thermocouple thermometer, one of its junctions is kept in melting ice and the other in boiling water. The reading on the milli-voltmeter is 200 mV, and the pointer points to the right. If the "hot junction" is immersed in another substance and the reading is 20 mV with the pointer pointing to the left. What is the temperature of the substance?

A -20 °C B -10 °C C 10 °C D 20 °C

23 Equal masses of two solids **X** and **Y** are heated successively in a well-lagged calorimeter. Heat is supplied to each of them at the same rate. The diagram shows the temperature-time graph for the heating process.

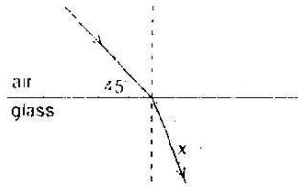


Which of the following statement(s) is/are true about **X** and **Y**?

I Solid **X** has a lower melting point than solid **Y**.
II Solid **X** has a higher specific heat capacity than solid **Y**.
III Solid **X** has a higher specific latent heat of fusion than solid **Y**.
IV Liquid **X** has a higher specific heat capacity than liquid **Y**.

A I and IV only **B** II and III only
C I, II and IV only **D** I, II, III and IV

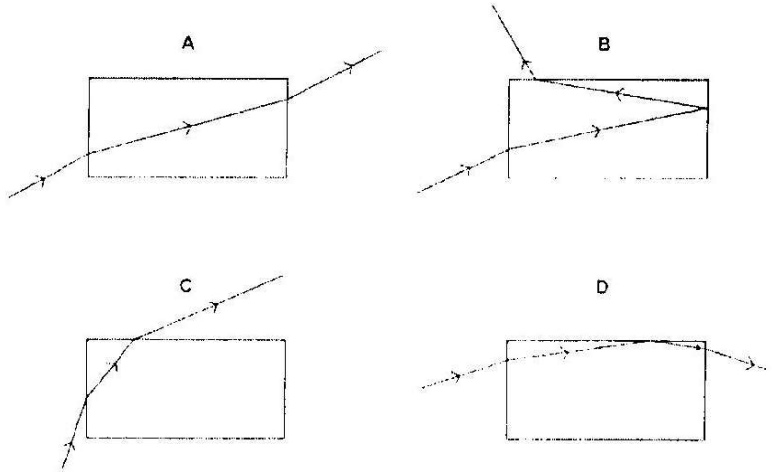
24 A ray of light is incident on the surface of a glass block, as shown in the diagram below.



The refractive index of the glass is 1.5. The light ray changes direction when entering the glass. What is the angle x through which the ray moves?

A 15° **B** 17° **C** 28° **D** 30°

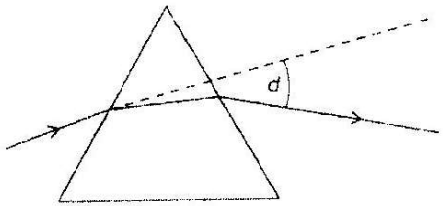
25 A ray of light is incident on one side of a rectangular glass block. Its path is plotted through the block and out through another side. Which path is not possible?



26 Which statement about the speed of sound is correct?

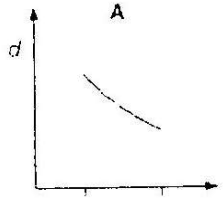
A Sound travels fastest in a vacuum.
B Sound travels fastest in gases.
C Sound travels fastest in liquids.
D Sound travels fastest in solids.

27 Light rays are deviated by a prism.

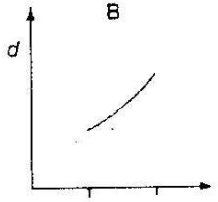


The deviation angle d is measured for light rays of different frequency, including blue light and red light. Which graph is correct?

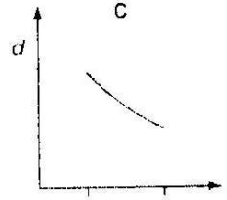
A



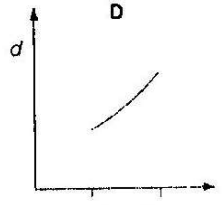
B



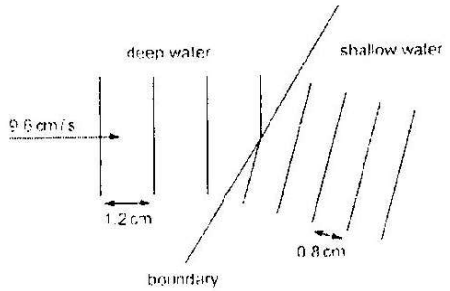
C



D



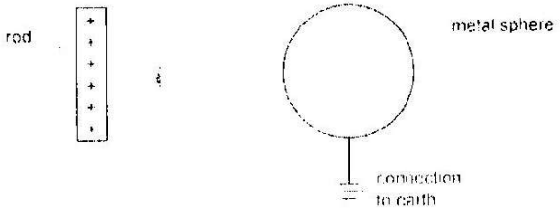
28 A ripple tank is used to demonstrate refraction of plane water waves.



Waves in deep water have a wavelength of 1.2 cm and a speed of 9.6 cm / s. The wavelength of the waves in shallow water is 0.8 cm. What is the speed of the waves in the shallow water?

A 6.4 cm / s B 8.0 cm / s C 9.6 cm / s D 14.4 cm / s

29 A metal sphere is connected to earth. A positively-charged rod approaches the sphere and stops before touching it.



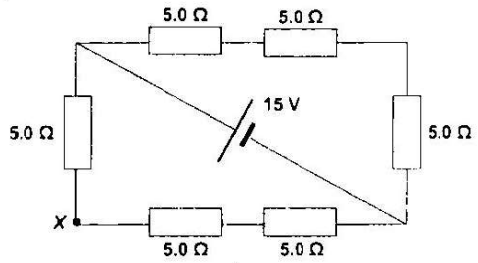
What is the movement of charge on the sphere and what is the final charge on the sphere?

	movement of charge	final charge on sphere
A	negative charge moves from earth to the sphere	negative
B	negative charge moves from earth to the sphere	neutral
C	positive charge moves from the sphere to earth	negative
D	positive charge moves from the sphere to earth	neutral

30 During a thunderstorm, lightning sends an electric charge of 90 C from a thundercloud to the earth. The potential difference between the thundercloud and the earth is 3×10^{10} V during the discharge. How much energy is produced during the lightning?

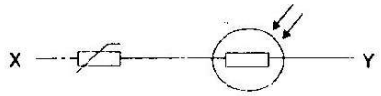
A 2.7×10^{10} J **B** 2.7×10^{12} J **C** 3.0×10^{12} J **D** 1.3×10^{13} J

31 The diagram shows six 5.0 Ω resistors connected to a 15 V cell. What is the current that flows through the point **X**?



A 0.50 A **B** 1.0 A **C** 2.0 A **D** 3.0 A

32 The diagram shows a thermistor and a light dependent resistor in series.



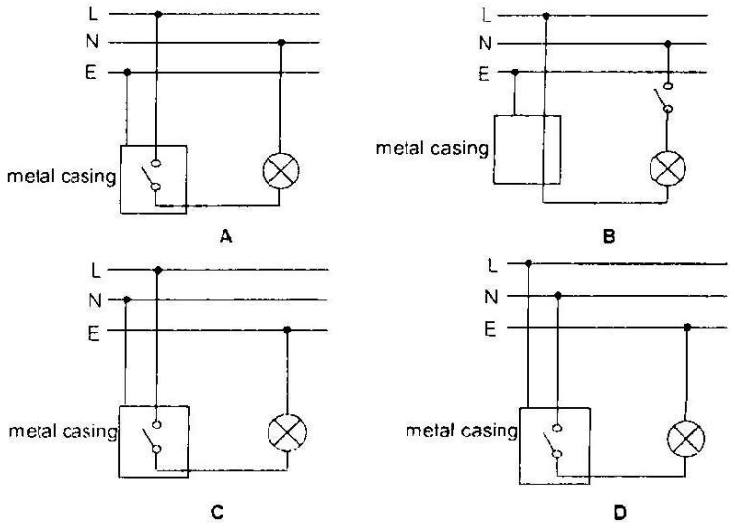
Which of the following conditions make the total resistance between **X** and **Y** the lowest?

	temperature	lighting
A	cold	bright
B	cold	dark
C	hot	bright
D	hot	dark

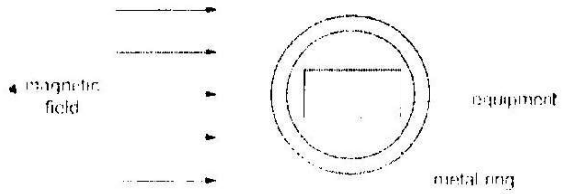
33 A kilowatt-hour of electrical energy is used when

A a 50 W lamp is used for 200 hours.
B a 3000 W heater is used for 20 minutes.
C a 100 W lamp is used for 1 hour.
D two 100 W lamps in parallel are used for half an hour.

34 Which diagram shows the correct connections for a switch, lamp and its metal casing in a lighting circuit?



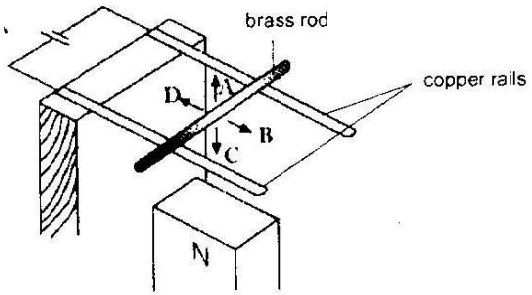
35 A metal ring screens a piece of equipment from a magnetic field.



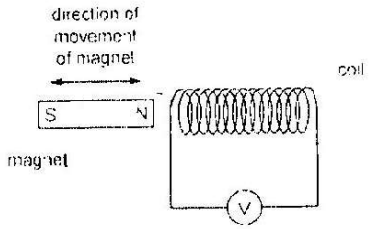
Which metal should be used for the ring, and why?

	metal	reason
A	copper	the metal carries the field lines around the equipment
B	copper	the metal is non-magnetic
C	iron	the metal carries the field lines around the equipment
D	iron	the metal is non-magnetic

36 The diagram below shows a brass rod supported on two copper rails, which are connected to a battery. The north pole of a magnet is placed beneath the rails. In which directions **A**, **B**, **C** and **D** does the brass rod experience a force?



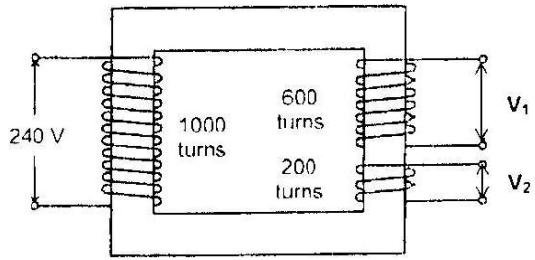
37 A teacher moves a magnet into and out of a coil of wire, as shown, in order to demonstrate electromagnetic induction.



Which statement is correct?

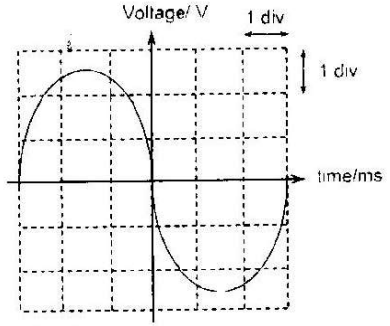
- **A** As the magnet is moved into the coil the left-hand end of the coil becomes a S-pole.
- **B** As the magnet is taken out of the coil the left-hand end of the coil becomes a N-pole.
- **C** Increasing the speed at which the magnet enters the coil increases the induced voltage.
- **D** Increasing the speed at which the magnet leaves the coil decreases the induced voltage.

38 The diagram shows a transformer with two outputs. Which of the following output voltages is correct?



	V_1 / V	V_2 / V
A	120	40
B	144	48
C	180	60
D	600	200

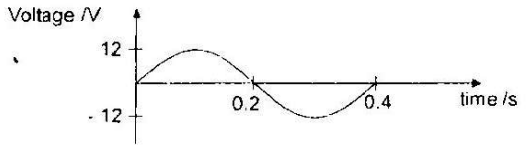
39 The following diagram shows a trace on the Cathode Ray Oscilloscope (CRO) when a source is connected to it. The amplitude of the input source is 5.0 V and the time-base of the CRO is 4.0 ms / div. Find the voltage gain of the CRO display and the frequency of the input source.



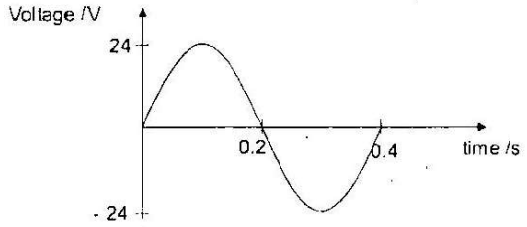
Find the voltage gain and time base of the trace.

	Voltage gain	Frequency
A	2.0 V/ div	24 Hz
B	2.0 V/ div	42 Hz
C	2.5 V/ div	24 Hz
D	2.5 V/ div	42 Hz

40 A simple alternating current (a.c.) generator initially produces a voltage which varies with time as shown below.



After a certain change was made to the a.c. generator, the voltage against time waveform is shown below.



What is the likely change that has been done to the generator?

A The speed of the coil rotation in the generator has doubled.
B The coil rotation in the generator has reduced to half the original speed.
C The strength of the magnet used in the generator has reduced to half its original value.
D The number of turns of the coil in the generator has doubled.

Name: _____ ( ) Class: _____

YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION II 2016

SEC 4 EXPRESS

PHYSICS

(5059/2)

Date : 31 August 2016 Day : Wednesday
Duration : 1 hour 45 minutes Marks : 80 marks

ADDITIONAL MATERIALS

Candidates answer on the Question Paper. No Additional Materials are required.

INSTRUCTIONS TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page and on any separate writing paper used.

Section A.
Answer **all** the questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that all quantitative answers should include **appropriate units and number of significant figures.**

Candidates are required to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

Take the value of g, acceleration due to gravity, to be 10 ms^{-2}

The number of marks is given in brackets [ ] at the end of each question or part question.

For Marker's Use	
Section A	
Section B	
TOTAL	

This question paper consists of **23** printed pages.

Section A

Answer **all** the questions in this section.

1. Fig 1.1 shows a firework rocket that contains a solid fuel inside a cardboard tube. The burning of the fuel creates a thrust to propel the rocket upwards.

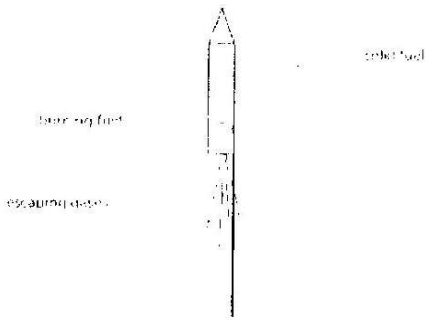


Fig 1.1

Before the fuel is lit, the total mass of the rocket including fuel is 0.07 kg.
There is a resultant force on the rocket of 0.50 N upwards when it takes off.

(a) Draw arrows on Fig 1.1 to show the size and direction of the forces acting on the rocket when it takes off. [2]

(b) Calculate the acceleration of the rocket when it takes off.

acceleration = ... [2]

2. Fig 2.1 shows the side view of a section of a vertical locker door with a horizontal hinge along its lower edge.

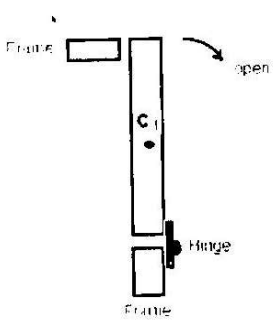


Fig 2.1

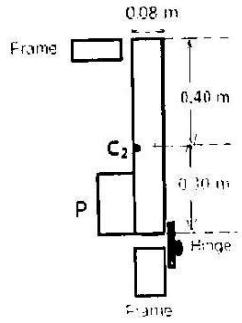


Fig 2.2

C_1 is the position of the centre of gravity of the door, and the door opens in the direction indicated.

Fig 2.2 shows the door with a piece of wood, P, attached to it so that the door is less likely to fall open; the position of the centre of gravity of the door and the wood is C_2.

(a) Explain why the door shown in Fig 2.2 is now less likely to fall open.

..... [2]

(b) The total mass of the door and the wood is 6.0 kg. Using the dimensions given in Fig 2.2, calculate the turning moment holding the door closed when it is in this vertical position.

moment = ... [2]

3. Fig 3.1 below represents a simple mercury barometer on a particular day. The scale alongside the barometer is marked in mm.

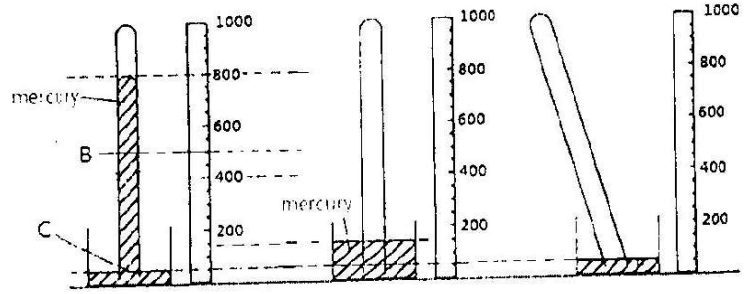


Fig 3.1 Fig 3.2 Fig 3.3

(a) What is the pressure inside the barometer tube in Fig 3.1

(i) at point C? .....

(ii) at point B? ..... [2]

(b) More mercury is poured into the reservoir until it reaches the level indicated by the dotted line in Fig 3.2. On Fig 3.2, show the correct level of mercury inside the tube now. [1]

(c) On Fig 3.3, show the correct level of mercury inside the tube after tilting the tube from the position shown in Fig 3.1 to the position shown in Fig 3.3. [1]

(d) **(i)** When air is introduced into the barometer tube in Fig 3.1, the difference between the mercury levels in the barometer tube and in the reservoir becomes 742 mm.

Deduce the pressure of the air above the mercury in the barometer tube. Write your answer in Pascal.
(Given that the density of mercury is 13600 kg/m^3)

pressure = ... [2]

(ii) After the air has been introduced, the barometer tube is lowered so that its lower end is immersed more deeply in the reservoir. By considering the air above the mercury in the barometer tube, would you expect the difference between the mercury levels in the tube and the reservoir to be **less** or **more** than 742 mm? Explain your answer.

..... [2]

4. John installs a solar water-heating unit on the roof of his house.

Fig 4.1 shows part of the unit.

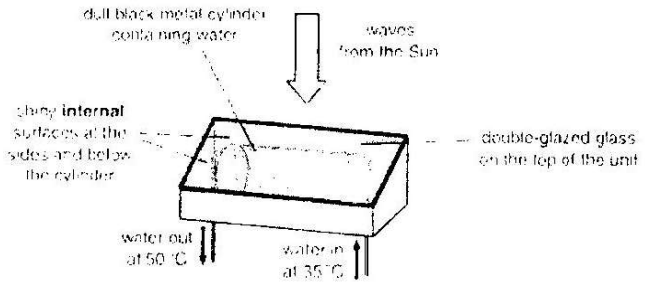


Fig 4.1

(a) Energy is transferred through parts of the unit by different methods.
What is the main method of energy transfer from a position above the glass to the surface of the cylinder?

..... [1]

(b) (i) These solar water-heating units have an efficiency of 85%.
Calculate the useful energy output for every 200 kJ of energy input.

energy output = ... [1]

(ii) Describe how **one** feature of the solar water-heating unit helps to produce this high level of energy efficiency.

..... [2]

(c) (i) Which type of electromagnetic radiation provides energy to the solar water-heating system?

.....[1]

(ii) The Sun emits all the waves in the electromagnetic spectrum. Explain why all these waves take the same time to travel to Earth from the Sun.

.....[1]

(iii) Name one of the electromagnetic radiations that has strong ionisation effect on living matter.

.....

.....[1]

5. Figure 5.1 shows the variation with time **t** of the displacement **x** of a particular particle in a water wave.

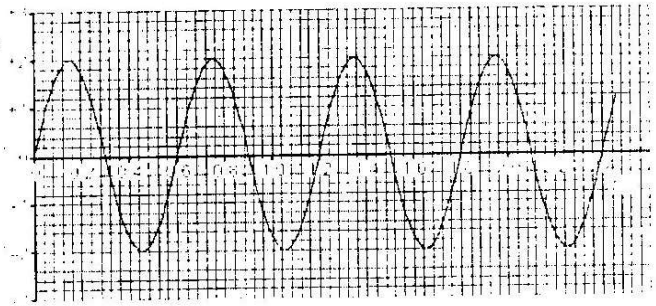


Fig 5.1

The distance **d** of the oscillating particles from the source of the waves is measured.

At a particular time, the variation of the displacement **x** with this distance **d** is shown in Fig 5.2.

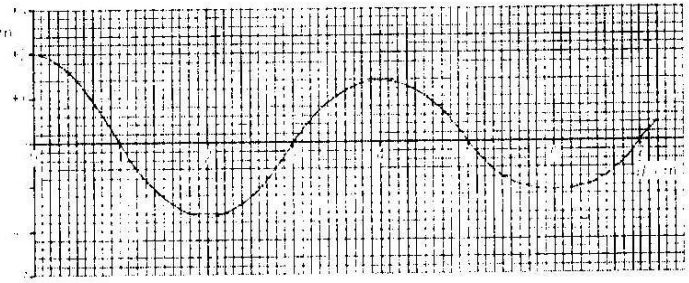


Fig 5.2

(a) For a wave, state what is meant by

(i) amplitude

.....[1]

(ii) wavelength

.....

.....[1]

(b) Use Fig 5.1 and 5.2 to determine, for the water wave,

(i) the frequency f of vibration.

frequency = ...[1]

(ii) the wavelength λ.

..... [1]

(iii) the speed v.

speed = ... [1]

(c) State and explain whether the wave is losing energy as it moves away from the source.

..... [1]

6. Fig 6.1 shows a thin converging lens forming an image I of a point object O.

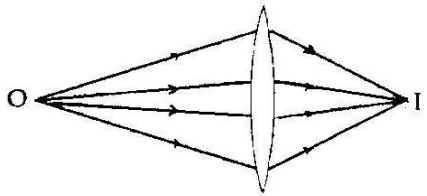


Fig 6.1

(a) (i) State clearly what happens to the path of a ray of light as it passes through each surface of the lens.

..... [2]

(ii) Explain why the lens has a bigger effect on the paths of rays passing near the edge than it does on the paths of rays near the centre.

..... [1]

(iii) State what happens to the speed, wavelength and frequency of the light ray as the light ray enters the glass block.

speed .....

wavelength .....

frequency ..... [2]

(b) This converging lens is used as a magnifying glass to view the caterpillar as shown in Fig 6.2.

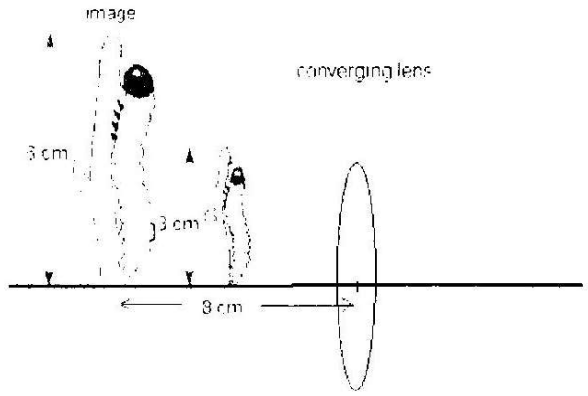


Fig 6.2

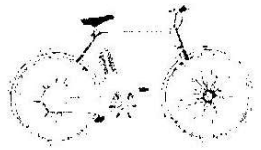
(i) By means of a scale diagram, determine the focal length of the lens.

focal length = ... [3]

(ii) Would it be possible to obtain this image on a white screen? Explain your answer.

..... [1]

7. The picture shows an electric bicycle. The bicycle is usually powered through a combination of the rider pedalling and an electric motor.



(a) A 36 V battery powers the electric motor. The battery is made using a number of individual 1.2 V cells.

(i) Explain how a 36 V battery can be produced using individual 1.2 V cells.

..... [1]

(ii) The battery supplies a direct current. What is the difference between a **direct current** and an **alternating current**?

..... [2]

(iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

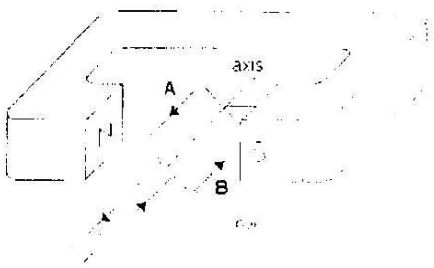
Calculate the maximum charge that the battery stores.

charge = ... [2]

(iv) Determine the energy delivered by the battery before the battery needs recharging.

energy = ... [1]

8. The diagram below shows the flow of current in a wire coil placed in a magnetic field.



(a) What happens to the coil in this situation, and why?

.....

.....

.....

.....[2]

(b) (i) Draw and label on the diagram the additions necessary to make the device useful as a d.c motor. [2]

(ii) Explain why the additions are able to make the device work as a d.c motor.

.....

.....

.....

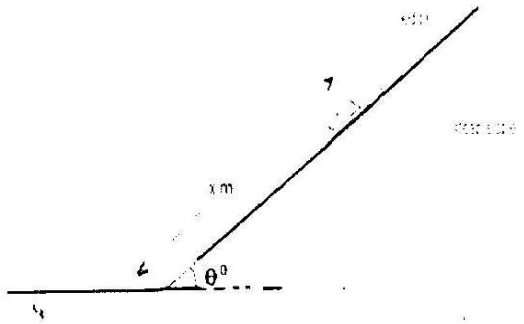
.....[2]

Section B

Answer **all** the questions in this section.

Answer only one of the two alternative questions in Question 11.

9. The figure below shows a boy sledging down a snowy hill.



The boy starts from different points on the slopes of different angles and his speed upon arrival at the bottom of the hill is recorded. The results are given in Table 9.1.

x/m	Speed / ms^{-1}	
	$\theta = 30^0$	$\theta = 40^0$
5	3.2	3.2
10	4.5	4.6
15	5.5	5.8
20	6.4	6.8
25	7.1	7.6
30	7.6	8.2

Table 9.1

(a) For the slope of different angles in table 9.1, state

(i) a similarity in the speeds for slope at 30^0 and slope at 40^0.

..... [1]

(ii) a difference between the speeds for slope at 30^0 and slope at 40^0.

.....

.....[1]

(iii) State how the speed will be affected if the sledge is made longer.

..... [1]

(b) Describe the energy changes as the boy slides down the hill.

.....

..... [2]

(c) (i) The total mass of the boy and the sledge is 80 kg. Calculate the approximate total kinetic energy when he arrives at the bottom of the hill from a starting point of x = 30 m for $\theta = 30^0$.

kinetic energy = ... [2]

(ii) Explain why the value calculated in c(i) is only approximate.

.....

.....[1]

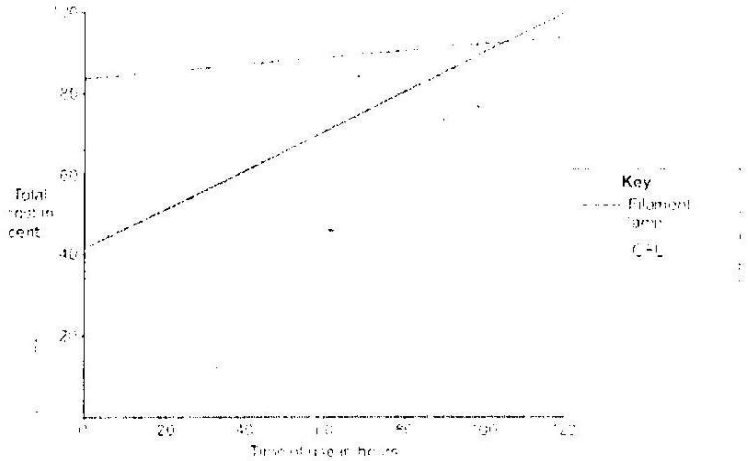
(d) When the boy reaches the bottom of the hill, the sledge continues to move through 15 m before it stops. Determine the average retarding force exerted by the ground on the sledge.

force = ... [2]

10. **(a)** Some information for two types of lamps is shown below.

Filament lamps	Compact Fluorescent lamp (CFL)
• Reach full brightness almost immediately • Efficiency of 0.1 • Expected life : 1000 h	• An 11 W lamp gives as much light as a 60 W filament lamp. • Takes a long time to warm up. • Efficiency of 0.8 • Expected life : 7000 h

The graph shows the total cost of buying and using each type of lamp.



(i) What is meant by ' the efficiency of filamant lamp is 0.1'?

.....

..... [1]

(ii) From the graph, compare the cost of buying a CFL with buying a filament lamp.

..... .[1]

(iii) When does a CFL become more economical than a filament lamp?

.....[1]

(iv) What is the cost of using a 60 W filament lamp during its expected life if the cost of electricity is 20 cents per unit?

cost = ... [1]

(v) Which type of lamp would you choose? State your reason.

.....

.....

..... .[1]

(vi) The heat capacity of the filament of the lamp is very small. State one reason why this is an advantage.

.....

..... .[1]

(b) Avan is learning about power transmission and the National Grid.
He first sets up a model system as shown in Fig 10.1 and the lamp glows dimly.

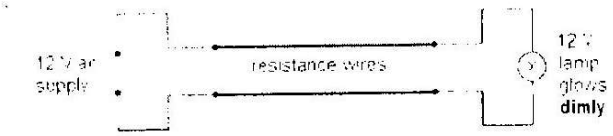


Fig 10.1

He then adds two transformers (TA and TB) before and after the resistance wires as shown in Fig 10.2. The lamp now glows brightly.

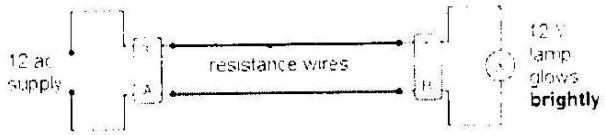


Fig 10.2

Explain these observations.

.....

.....

.....

.....

.....

.....[4]

11. EITHER

Students investigate the heating effect of an electric heater immersed in water. They measure the temperature of the water and use their measurements to determine the temperature of the water at 5.0 minute intervals after switching on the current.

In the first experiment, the current is kept at a constant value of 1.50 A.
In the second experiment, a fresh amount of water of the same mass is used and the current is kept at a constant value of 1.20 A.

(a) Fig 11.1 shows part of the experimental arrangement.

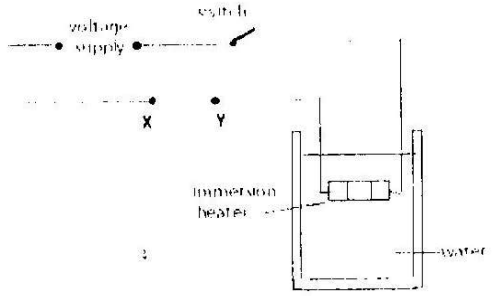


Fig 11.1

(i) Assuming that the voltage provided by the supply is fixed, add a suitable component between terminals X and Y which enables the power supplied to the heater to be varied. [1]

(ii) Show on Fig 11.1 how you would connect a voltmeter and an ammeter so that the power supplied to the heater can be determined. [1]

(b) If the resistance of the immersion heater is 12.0 Ω, calculate the power input to the water when the current is 1.50 A.

power = ... [2]

(c) Curve **P** in Fig 11.2 gives the variation of temperature θ with time **t** when the current is 1.50 A.

Curve **Q** gives the variation of temperature θ with time **t** when the current is 1.20 A.

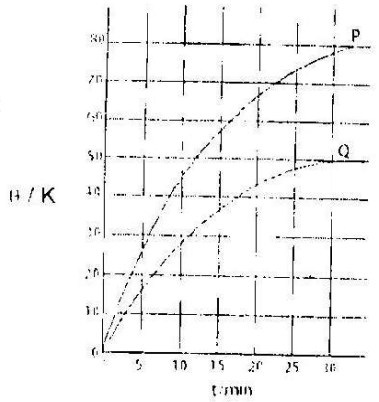


Fig 11.2

(i) Explain briefly why the temperature rises at a smaller rate in the second experiment (curve **Q**).

.....

..... [1]

(ii) Explain why the rate of temperature rise of water **decreases** with time in each case.

.....

.....

..... [2]

(d) In the first experiment (curve **P**), the initial rate of temperature rise is 0.100 K/s. Using this value and your answer to (b), obtain a value for the mass of water used in the experiment.

mass = ... [2]

(e) Suggest one modification to the experimental arrangement to improve the accuracy of the measurement.

.....

..... [1]

11. **OR**

(a) (i) Sketch the magnetic field pattern around a straight current-carrying wire.

[2]

(ii) Describe briefly, with the aid of a diagram, how you would use a plotting compass to show that your answer to **(i)** is correct.

.....

.....

.....

.....

.....

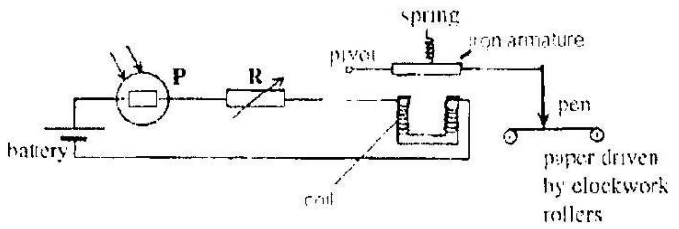
.....

.....

.....[3]

(b) The arrangement shown below is used to measure the length of the day, i.e. the length of time during which the daylight is above a certain brightness.

The circuit incorporates a device, **P**, which has a high resistance in the dark but it has almost no resistance when light falls on it.



(i) Explain why the pen begins to draw a trace on the paper when light starts to fall on **P** and stops when it becomes dark.

.....

.....

.....

.....

.....

.....[3]

(ii) Why does the use of a high resistance at **R** make the arrangement less sensitive to light?

.....

.....

.....

.....[2]

END OF PAPER 2

YISHUN TOWN SECONDARY SCHOOL
4E PHYSICS PRELIM 2 2016 ANSWERS

Answers

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	C	C	B	D	B	B	D	B
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	B	C	A	B	D	B	C	C	B
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
A	B	A	B	B	D	D	A	A	B
Q30	Q31	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
B	C	B	A	C	B	C	B	B	D

Section A

1 (a)

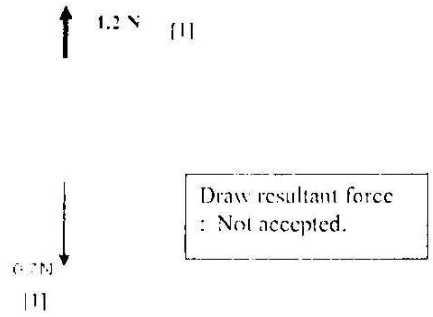


Fig 1.1

(b) $a = F / m = 0.5 / 0.07 = 7.1\ m/s^2$ [1]

2. (a) Wider and heavy base; low CG [1]

If tilted, line of action of the weight falls within the base; produces anticlockwise moment by addition of P to hold the door closed [1]

OR

Anticlockwise moment produced in Fig 2.2 is larger than in Fig 2.1.

(b) Anticlockwise moment about the hinge

[1] = 60 N x 0.08 m = 4.8 Nm [1]

*(* wrong unit -1/2)*

3.

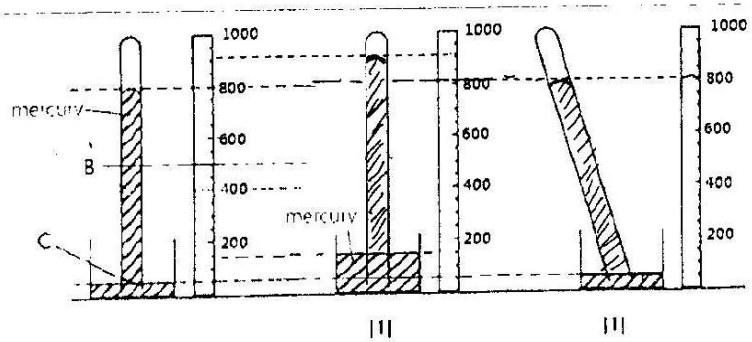


Fig 3.1 | Fig 3.2 | Fig 3.3

(a) (i) at point C 750 mm Hg [1]

(ii) at point B? 300 mm Hg [1]

(d) $P = (750 - 742)\,mmHg = 8\,mmHg$ [1/2] e.c.f

$P = h\rho g$ [1/2]

$= 8 \times 10^{-3}\,m \times 13600 \times 10$

$= 1088\ Pa$ [1]

(e) Less than. [1]

As the volume of air in the tube is compressed, pressure of the air increases provided the temperature remains constant. [1]

$P_{Hg} = P_{atm} - P_{air}$

4. **(a)** Radiation [1]

(b) (i) 200 kJ x 85% = 170 kJ [1] *(* wrong unit -1/2)*

(ii) Double glazed top traps air is a Good insulator of heat [1]
Reduces heat loss by conduction and convection. [1]

OR
Shiny surface is a good reflector of thermal energy; [1]
Reduces heat loss by radiation [1]

OR
Dull black metal is a good absorber of thermal energy [1]
More heat energy can be conducted to water. [1]

(c) (i) Infra red [1]

(ii) travel at same speed in free space, 3.0×10^{8} m/s [1]

(iii) UV or X-ray or Gamma ray [1]

5.

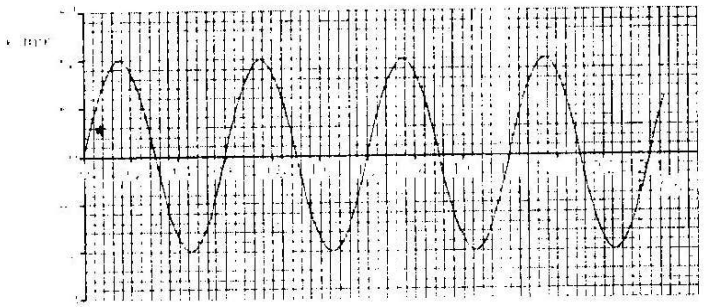


Fig 5.1

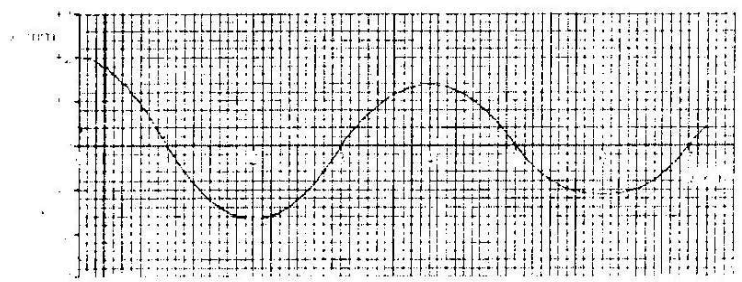


Fig 5.2

(a) (i) amplitude [1]

Maximum displacement of point on wave from rest position

(ii) wavelength [1]

The distance between two sucessive points with same phase.

OR minimum distance between two adjacent crests or troughs

(b) (i) the frequency f of vibration, [1]

$f = 1/0.6 = 1.67$ Hz

(ii) the wavelength λ, [1]

$\lambda = 4.0$ cm (4 cm -1/2)

(iii) the speed v. [1]

$v = f\lambda = 1.67 \times 4.0 = 6.68$ cm/s

(c) Refer to Fig 5.2.

Losing energy. [1/2]

Amplitude is decreasing [1/2]

OR Energy will be lost due to resistive force during transmittion

6. **(a) (i)** There are refraction of light at both surfaces. [1/2]

At the first surface, the light bends towards normal when travelling from optically less dense medium to denser medium [1/2]

At the second surface, the light bends away from the normal when travelling from optically denser medium to less dense medium. [1]

(ii) With different angles of incidence.

Larger angle of incidence at the edge compared to near the centre. [1/2]

Ray refracted more toward normal. [1/2]

(iii) speed decreases [1/2]

wavelength decreases [1/2]

frequency same [1]

(b)

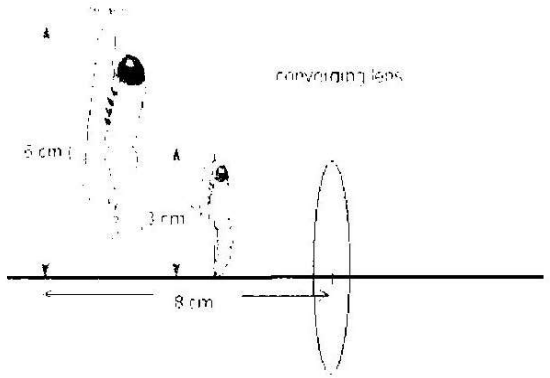
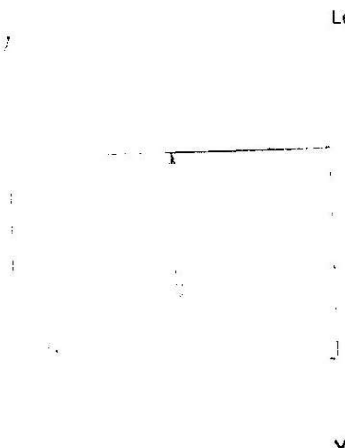


Fig 6.2

(i) By means of a scale diagram, determine the focal length of the lens. [3]

Scale 1 cm : 1 cm OR 1 cm : 2 cm [1/2]
(too small diagram -1/2)*



Two correct rays [1]

Direction [1/2] focal length = 8.0 cm [1]
(7.5 – 8.5 cm)

(ii) No. virtual image can't be formed on screen [1]
** accepted only with correct explanation*

OR

If object is placed between f and 2f, real image is obtained and can be formed on screen.

7. (a) (i) 30 cells of 1.5 V are connected in series [1]

(ii) Direct Current flows in one direction only [1]
(from positive terminal to negative terminal of the battery.

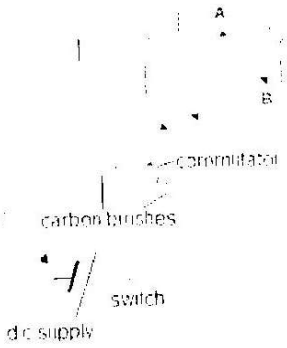
A.c alternates / reverses its direction of flow continously. [1]

(iii) $Q = I\,t$ [1/2]
$= 5 \times 2 \times 3600$ [1]
$= 36000$ C [1/2] ** Wrong unit - 1/2*

(iv) $E = VIt$ [1/2] OR $W = QV$
$= 36 \times 5 \times 2 \times 3600$ [1]
$= 1.30 \times 10^6$ J [1/2]
OR 1.29×10^6 J
OR 1296 kJ

8. (a) The coil rotates in a clockwise directions intially for 180^0 maximum.
Because there is upward force acting on side A and downward force on side B.
the coil will then rotates in an anticlockwise direction.
and oscillates until it comes to rest in a vertical position.

(b) (i) Commutator [1]
Carbon brushes [1]



b) (ii) When the split ring commutator is used, the direction of the flow of current relative to the coil is reversed every half turn.
The force acting on the sides of the coil will reverse directions as well.
The coil can then turns in same direction.
Carbon brushes act as contact to allow current to flow from supply to the coil: also to prevent tangling of wires when the coil rotates.

Section B

9.

x/m	Speed / ms^{-1}	
	Slope at 30^0	Slope at 40^0
5	3.2	3.2
10	4.5	4.6
15	5.5	5.8
20	6.4	6.8
25	7.1	7.6
30	7.6	8.2

Fig 9.1

(a) (i) At distance of 5 m, speeds are the same [1]

OR Both speeds increase after 5 m

(ii) Speed increases at a greater rate in slope at 40^0 compared to slope at 30^0.

(iii) Speed increases more. [1]
Longer sledge (larger area in contact with the slope; smaller pressure acting on the snow. Sledge won't sink deeper in snow, ie less frictional force.)

(b) Gavitational Potential Energy changes [1] partly to Kinetic Energy [1/2] and
partly wasted as heat and sound energy [1/2] due to work done against friction

(c) (i) KE = ½ m v^2 [1/2]
= ½ (80)(7.6)^2 [1]
= 2310 J [1/2]

(ii)
GPE ≠ KE at the bottom (shown by calculation of GPE)

OR any sensible answer related to sources of error in taking measurment.

(d)
Change in KE = WD against resistive force
2310 = F s [1]
F = 2310 / 15 [1/2]
= 154 N [1/2]

10. (a) (i) 90% of input energy is wasted. [1]
OR
Only 10% of input energy becomes light energy (useful energy)

(ii) Twice as much [1] (more costly ½ m)

(iii) after 105 h [1]

(iv) Cost = Pt x \$0.20 = 0.06 kW x 1000 h x \$0.20 = \$12.00 [1]

(v) CFL. On long run, it saves more than filament lamp.

OR

Less energy is wasted as heat.

* *Any sensible answer*

(vi) It takes small amount of heat to increase the temperature of the filament by 1 K. Hence, light is emitted in a short time once it is turned on. [1]

(b) In **Fig 10.1**, energy lost during transmission due to high current flows through resistance wire. Power loss is proportional to (current)^2. [1]

In Fig 10.2, TA is step-up and TB is step-down transformer. [1]

TA increases transmitted voltage to reduce current flowing through the resistance wire. Less energy is wasted as heat in resistance wires. [1]

TB lowers the high transmitted voltage to 12 V and thus increases current flows to lamp ie brighter than in Fig 10.1. [1]

11. EITHER

(a) Fig 11.1 shows part of the experimental arrangement.

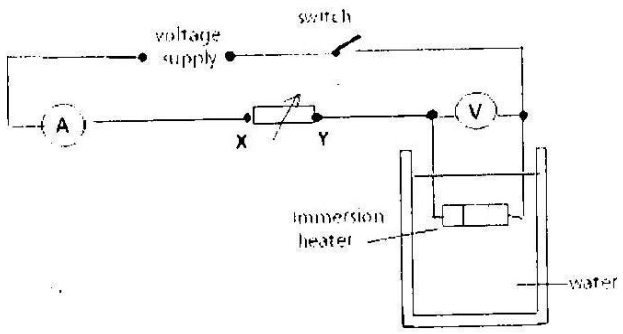


Fig 11.1

(i) variable resistor [1]

(ii) Ammeter in series [1/2]

Voltmeter in parallel to the heater [1/2]

(b) $P = I^2 R$ [1/2]

$= (1.50)^2 \times 12$ [1]

$= 27.0$ W [1/2] * *wrong unit – ½ m*

(c) (i) $Q = m c \Delta\theta$

$P = m c \Delta\theta / t$

Power is the rate of heat energy supplied.

Since current is lower, power supplied in second experiment is lower than in first experiment ($P \propto I^2$) [1/2]

rate of temperature rise is thus lower ($\Delta\theta \propto P$). [1/2]

(ii) The amount of heat loss by water to the surroundings is proportional to the temperature difference between hot water and surroundings. [1]

As water is heated, its temperature rises and the temperature difference increases. [1/2]

More heat energy provided by heater is lost to surroundings and less heat energy is used to increase temperature of water. [1/2]

(d) Energy provided by heater = thermal energy gained by water

$Q / t = m c \Delta\theta / t$ [1/2]

$27.0 = m \times 4200 \times 0.100$ [1]

$m = 0.064$ kg [1/2]

(e) Any one : [1]

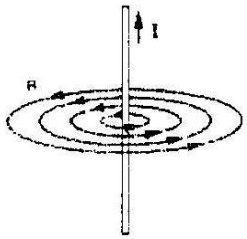
Lower the heater for better convection in water

Cover the container with lid to reduce heat lost by convection and evaporation.

Insulated the container to reduce heat lost by conduction.

11. **OR**

(a) (i) Sketch the magnetic field pattern around a straight current-carrying wire.



Concentric circles [1]

Direction of magnetic field [1]

Did not show the circles are closer near the wire but after that further apart -1/2

(ii) (Text book page page 407)

1. Thread the wire through a small hole in a sheet of cardboard. The wire should be perpendicular to the cardboard sheet.
2. Place a compass on the sheet.
3. Mark the positions of N and S ends of the compass needle with pencil dots X and Y respectively
4. Move the compass so that the S end of the needle is now at Y.
5. Mark the new position of the N end of a needle with a third dot Z.
6. Repeat steps 2 to 5, placing the compass at different distances from the wire until several field lines are drawn.

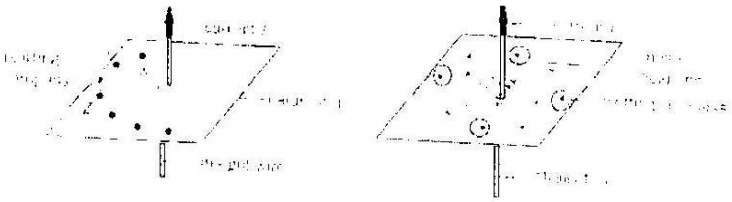


Diagram [1]

Description [2]

(b) (i) When light falls on to P, its resistance becomes so small and large current flows through the coils. [1]

The magnetic field produced by the coil magnetises the iron armature by magnetic induction; the pen is pulled downwards and drawing a trace on the moving paper. [1]

When no light falls on P, its resistance is very high and hence low /negligible current flows in the circuit. [1/2]
The small magnetic force produced is unable to pull the iron armature down. No trace is drawn. [1/2]

(ii) Effective resistance in the circuit
= Resistance of R + resistance of P [1/2]

The effect of change of effective ressistance due to resistance changes in P is reduced if resistance of R is very high. [1]

Since P does not affect the total resistance in a significant way, the entire arrangement is thus less sensitive to light. [1/2]

AHMAD IBRAHIM SECONDARY SCHOOL
GCE 'O' LEVEL PRELIMINARY EXAMINATION 2016

PHYSICS (SPA)

Sec 4 Express
5059 / 1

Date: 17 Aug 2016
Duration: 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.
Write your name and register number on the answer sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the one you consider to be correct and record your choice in soft pencil on the separate sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

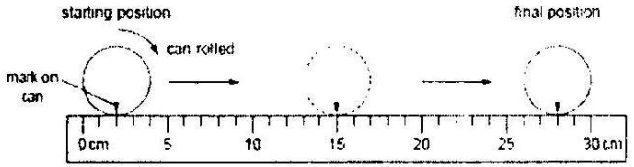
This question paper consists of 19 printed pages.

Answer **ALL** the questions in this section.

1 Which unit is equivalent to the coulomb?

A ampere per second
B joule per volt
C watt per ampere
D watt per volt

2 A cylindrical can is rolled along the ruler shown in the diagram.

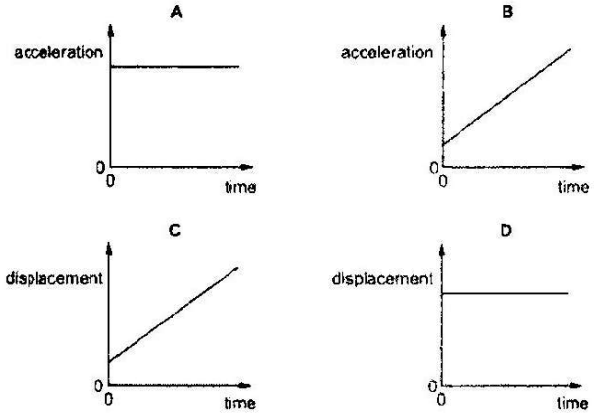


The can rolls over twice.

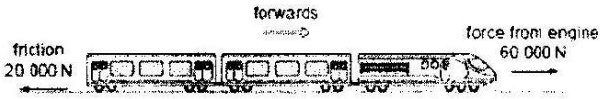
What is the circumference (distance all round) of the can?

A 13 cm **B** 14 cm **C** 26 cm **D** 28 cm

3 Which graph represents the motion of a car that is travelling along a straight road with a speed that increases uniformly with time?



4 A train is travelling along a horizontal track at constant speed. Two of the forces acting on the train are shown in the diagram.



A force of air resistance is also acting on the train.

What is this air resistance force?

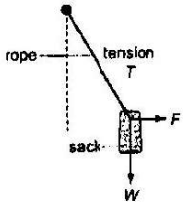
A 40 000 N backwards

B 80 000 N backwards

C 40 000 N forward

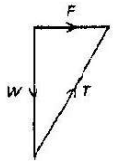
D 80 000 N forward

5 A heavy sack of weight *W* hangs from the end of a rope. The sack is pulled sideways by a horizontal force *F* and is held stationary. The tension in the rope is *T*.

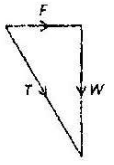


Which force diagram gives the correct value and direction for the tension T?

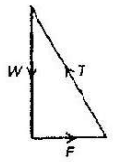
A



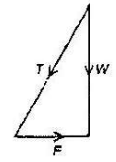
B



C



D



6 An airplane drops a 100 kg food package from a height of 400 m.
After falling for 2.0 s, the package reaches a terminal velocity and parachutes down at a steady speed, reaching the ground after falling for 30 s.

What is the net force on the package as it falls, just before it hits the ground?

A 0 N **B** 200 N **C** 2000 N **D** 20 000 N

7 An object is brought to planet P from planet Q. The gravitational field strength on the surface of planet P is twice of that on the surface of planet Q. No air resistance acts on the object at planet P and Q.

Which statement is incorrect?

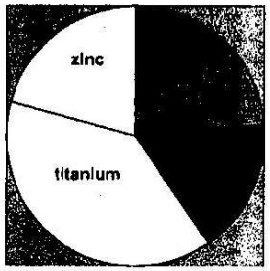
A The object's acceleration during free fall on planet P is twice of that on planet Q.

B The object's gravitational potential energy on planet P is twice of that on planet Q when the object is placed at the same height above ground.

C The object on planet P would have more reluctance to move from its original stationary position as compared to on planet Q.

D The object on Planet P would need twice the force to be lifted up as compared to on planet Q.

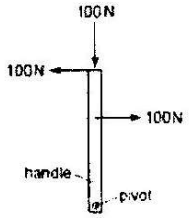
8 An equal mass of four different metals was mixed together to form an alloy. The chart shows the proportions by volume of each of these metals.



Which metal is the least dense?

A antimony **B** iron **C** titanium **D** zinc

9 The diagram shows a handle with three forces, each 100 N, applied to it. The handle is free to move.



What is the effect of the forces on the handle?

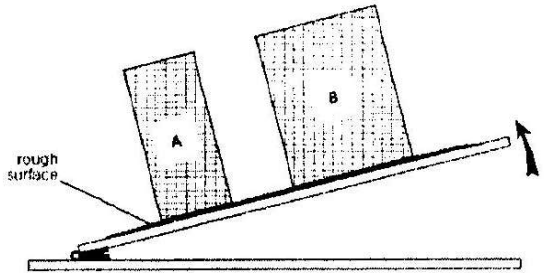
A The handle will move downwards.

B The handle will not move.

C The handle will turn anticlockwise (to the left).

D The handle will turn clockwise (to the right).

10 The diagram shows two wooden blocks standing on a hinged board with a rough surface.



The board is slowly tilted in anticlockwise direction. The blocks do not slip.
Which of the following statements is correct?

A A topples first because it is lighter than block B.

B B topples first because it is heavier than block A.

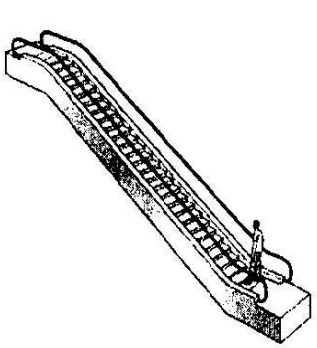
C A topples first because its weight acts outside its base with a smaller angle of tilt.

D B topples first because its weight acts outside its base with a smaller angle of tilt.

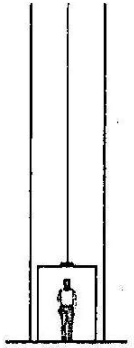
11 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power generated by the motor?
Take density of water to be 1000 kg/m^3.

A 12.5 W B 22.2 W C 556 W D 1330 W

12 An escalator (moving stairs) and a lift (elevator) are both used to carry passengers from the same underground railway platform up to street level.



escalator



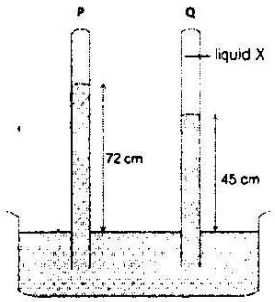
lift

The escalator takes 20 seconds to carry a man to street level.
The useful work done is *W*. The useful power developed is *P*.
The lift takes 30 seconds to carry the same man to street level.

How much useful work is done by the lift, and how much useful power is developed by the lift?

	useful work done by lift	useful power developed by lift
A	more than *W*	less than *P*
B	more than *W*	*P*
C	*W*	less than *P*
D	*W*	*P*

13 The diagram shows two vertical tubes **P** and **Q**, each closed at the upper end. The pressure in the space above the mercury meniscus in tube **P** is 5 cm Hg. The space above the mercury meniscus in tube **Q** is filled completely with a liquid X of unknown density.



Calculate the pressure due to liquid X in tube **Q**.

A 5 cm Hg **B** 10 cm Hg **C** 31 cm Hg **D** 32 cm Hg

14 The outlet on a bicycle pump is blocked.



The pump handle is pushed in slowly. The temperature remains constant.

Why does the pressure of the air in the pump increase?

A The air molecules have greater average speed.

B The air molecules all travel towards the outlet.

C The air molecules hit the walls of the pump more frequently.

D There are now more air molecules to hit the walls of the pump.

15 What surrounds the bulb of a thermometer when marking the upper and lower fixed points?

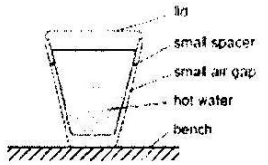
	upper fixed point	lower fixed point
A	boiling water	pure melting ice
B	boiling water	salt and ice
C	steam	pure melting ice
D	steam	salt and ice

16 The resistance of an alloy wire is 25 Ω when it is placed in a cup of melting ice. At room temperature of 28 °C, the resistance is 38 Ω.

If the wire is put in boiling water, what will be the resistance?

A 28 Ω **B** 46 Ω **C** 71 Ω **D** 152 Ω

17 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top, as shown.



Which statement is correct?

A Heat loss by radiation is prevented by the small air gap.

B No heat passes through the sides of either cup.

C The bench is heated by convection from the bottom of the outer cup.

D The lid is used to reduce heat loss by convection.

18 A heater supplies 80 J of energy to a block of metal. The temperature of the block rises by 20 °C.

What happens to the block of metal when its temperature falls by 10 °C?

A Its internal energy decreases by 40 J.

B Its internal energy decreases by 160 J.

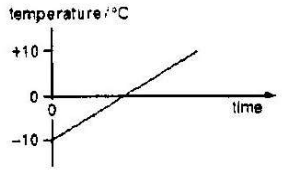
C Its internal energy increases by 40 J.

D Its internal energy increases by 160 J.

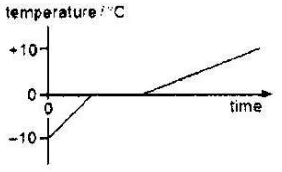
19 Ice at –10 °C is heated until it is water at +10 °C.

Which graph shows how the temperature changes with time?

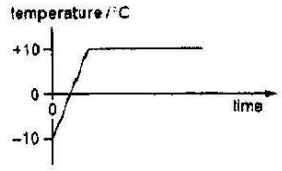
A



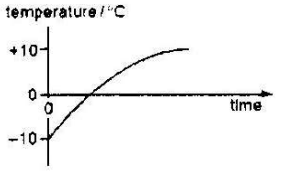
B



C

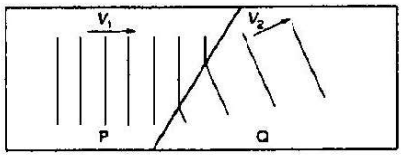


D



20 The diagram shows the waves in a ripple tank in which the water in parts P and Q is of different depths.

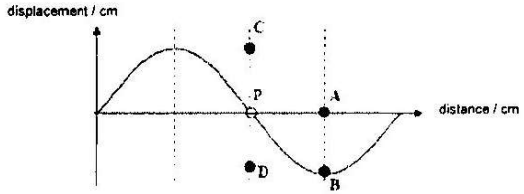
How do the depths and the speeds V_1 and V_2 of the waves compare in P and in Q?



	depth	speed
A	shallower in P	V_1 is smaller
B	shallower in P	V_2 is smaller
C	shallower in Q	V_1 is smaller
D	shallower in Q	V_2 is smaller

21 The following displacement–distance graph shows an instance of a transverse wave moving to the right.

Where will particle P be a quarter of a period after the instance shown?



22 Which of the following is **not** a property of microwaves?

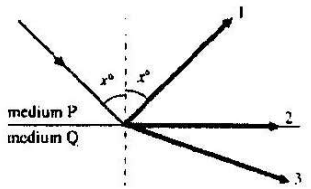
A They are used for radar communication.

B They are longitudinal waves with long wavelength.

C They can be absorbed by water in food.

D They have frequency lower than that of visible light.

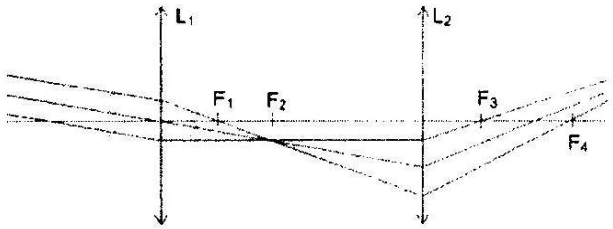
23 A light ray travels from a medium P to medium Q.
Given that medium P has a refractive index of 1.5 and medium Q has a refractive index of 1.2, which of the following rays is/are possible outcome(s)?



A 3 only **B** 1 and 3 only

C 2 and 3 only **D** 1, 2 and 3

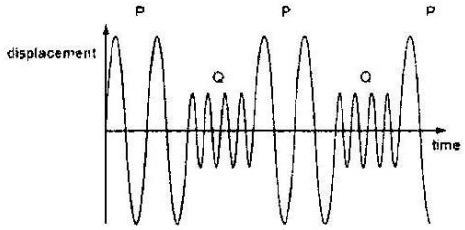
24 The figure below shows parallel rays from a distant object and passes through lens L_1 and L_2.



What are the principal foci of L_1 and L_2?

A F_2 for both lens
B F_1 and F_2
C F_2 and F_3
D F_1 and F_3

25 A police car siren emits two different sounds P and Q. These are produced alternately. The diagram represents the sounds emitted.



Which sound is the louder and which has the lower pitch?

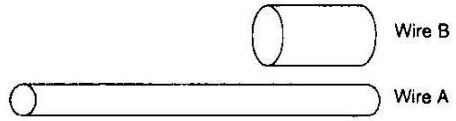
	louder	lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

26 A plastic rod and a dry cloth are uncharged. The rod is now rubbed with the cloth and they both become charged. The rod becomes negatively charged because some charged particles move from the cloth to the rod.

What is the charge on the cloth and which particles moved in the charging process?

	charge on cloth	particles that moved
A	negative	electrons
B	negative	neutrons
C	positive	electrons
D	positive	neutrons

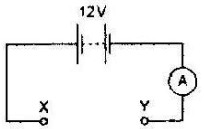
27 Two pieces of copper wire, A and B, have the same volume. The length of A is 3 times the length of B.



What is the value of $\frac{R_A}{R_B}$ where R_A and R_B are the resistances of wires A and B respectively?

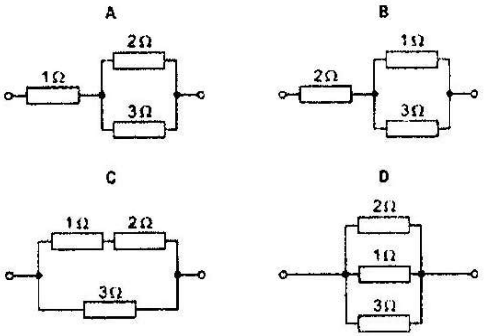
A 3.0 **B** 5.2 **C** 9.0 **D** 15.6

28 In the circuit shown, the battery and ammeter each has negligible resistance.

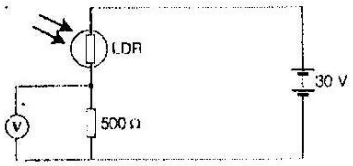


The following combinations of resistors are placed in turn, between the terminals X and Y of the circuit.

Which combination would give an ammeter reading of 8 A?



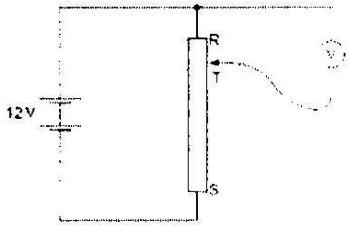
29 A light dependent resistor (LDR) and a 500 Ω resistor are connected across a 30 V source. The resistance of the LDR is 1000 Ω in the dark but drops to 100 Ω in bright light.



What is the voltmeter reading in the dark and in bright light respectively?

	in the dark	in bright light
A	10 V	25 V
B	15 V	15 V
C	20 V	5 V
D	25 V	10 V

30 A student connects a variable potential divider (potentiometer) circuit.



What happens to the reading on the voltmeter as the sliding terminal T is moved from R to S?

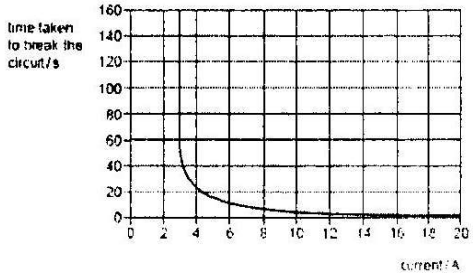
A It decreases from 12 V to 0 V.

B It increases from 0 V to 12 V.

C It remains at 0 V.

D It remains at 12 V.

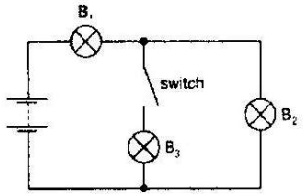
31 A circuit-breaker is designed to protect a circuit which usually carries a current of 2A. The time taken to break the circuit depends on the current, as shown in the graph.



What happens when the current in the circuit is 2 A and when the current is 18 A?

	when the current is 2 A	when the current is 18 A
A	the circuit breaks in less than 5 s	the circuit breaks in less than 5 s
B	the circuit breaks in less than 5 s	the circuit does not break
C	the circuit does not break	the circuit breaks in less than 5 s
D	the circuit does not break	the circuit does not break

32 B_1, B_2 and B_3 are three identical lamps. They are connected to a battery with zero internal resistance, as shown.



Initially the switch is closed. The switch is then opened and lamp B_3 goes out. What happens to the brightness of lamps B_1 and B_2 when the switch is opened?

	brightness of lamp B_1	brightness of lamp B_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

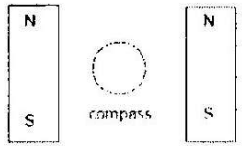
33 The duration of usage of several electrical appliances and their respective power ratings are shown in the table below.

appliance	**power rating / W**	**duration of usage / s**
electric iron	400	3600
rice cooker	5 000	1800
lamp	50	36 000

What is the cost of a unit (kWh) of electricity if the total cost of usage from the above table is $2.72?

A $0.01 **B** $0.08 **C** $0.80 **D** $9.25

34 Two equally strong bar magnets are placed side by side on a table. Their north poles point in the same direction, as shown in the diagram. A compass is placed exactly midway between them.



The north pole of the compass is shown by an arrow-head.

Which way will the compass point?

A 

B 

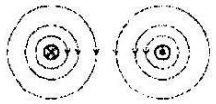
C 

D 

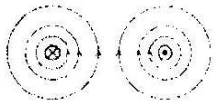
35 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

Which diagram shows the magnetic field around the two wires?

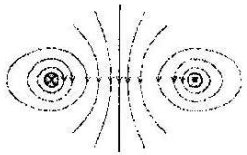
A



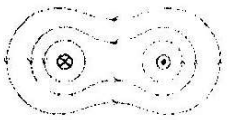
B



C



D

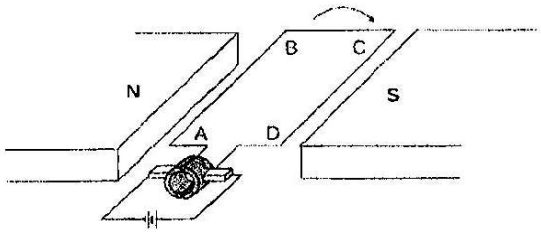


key

⊗ current into plane of paper

⊙ current out of plane of paper

36 The diagram shows a d.c. motor. The coil ABCD rotates in a clockwise direction.

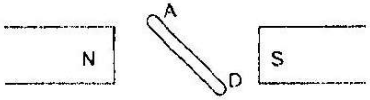


In which position will the coil experience zero turning effect from the interaction of the magnetic fields from both the current and the permanent magnet?

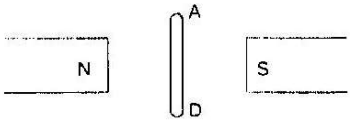
A



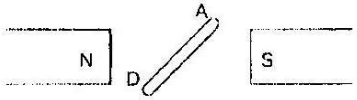
B



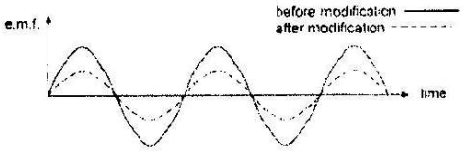
C



D



37 The variation of the e.m.f. produced by a simple a.c. generator against time, before and after modification, is shown below.



Which of the following could be the modification that was carried out?

A Weaker magnets were used.

B Speed of rotation was reduced.

C Direction of rotation of coil was reversed.

D Number of turns in the coil was increased.

38 A transformer has 15 000 turns on its primary coil and 750 turns on its secondary coil. Connected in this way, for what purpose could this transformer be used?

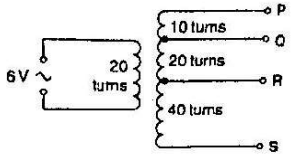
A to convert the 8000 V a.c. output of a power station to 160 000 V for long-distance power transmission

B to convert the 160 000 V d.c. supply from a power line to 8000 V for local power transmission

C to use a 12 V d.c. supply to operate a 240 V razor

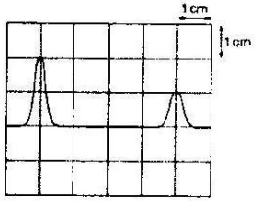
D to use a 240 V a.c. mains supply to operate a 12 V motor

39 The number of turns between each pair of output terminals of a transformer is shown in the diagram. Between which two terminals will the output be 12 V?



A P and Q **B** Q and R **C** R and S **D** P and R

40 A source of radio waves sends a pulse towards a reflector. The pulse returns from the reflector and is detected at the same point as the source. The emitted and reflected pulses are recorded on a cathode-ray oscilloscope (c.r.o.) as shown below.



The time base is set to 0.20 μs/cm.
Determine the distance between the source and the reflector.

A 120 m **B** 240 m **C** 120 km **D** 240 km

END OF PAPER

Setter: Mdm Latifah Noorahman

AHMAD IBRAHIM SECONDARY SCHOOL
GCE 'O' LEVEL PRELIMINARY EXAMINATION 2016

PHYSICS (SPA)

Sec 4 Express
5059 / 2

Date: 15 Aug 2016
Duration: 1 h 45 min

Name: .....( )

Class: .....

INSTRUCTIONS TO CANDIDATES

Do not turn over this paper until you are told to do so.
Write your name, class and register number in the spaces at the top of this page and on any writing papers used.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** three questions.
Write your answers in the spaces provided on the question paper.
Note that Question 12 has a choice of section to answer.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

Omission of working for any calculation in section A and B will result in deduction of marks.
The use of calculator is allowed in this examination.

FOR EXAMINER'S USE	
P 1 MCQ	/ 40
P 2 Section A	/ 50
P 2 Section B	/ 30
P2 Total	/ 80

This question paper consists of 21 printed pages.

Section A

Answer **ALL** the questions in this section.

1 A student carries out an experiment using a simple pendulum to determine how the period of a pendulum varies with its length. Fig. 1.1 shows the apparatus.

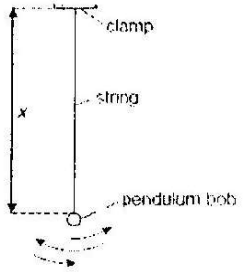


Fig 1.1

The student records the time *t* taken for 20 complete oscillations. She measured the *length x* for the length of the pendulum, as shown in the table below.

x / cm	t / s	T / s
90.0	38.5	

(a) Calculate the period T, of the pendulum.

period T =..... [2]

(b) Describe the mistake that the student made in determining the length of the pendulum.

.....

..... [1]

(c) The student was told that the period of the pendulum is independent of its mass. State what is meant by the *mass of the pendulum*.

.....

..... [1]

2 In Fig. 2.1, the sealed drum containing gas has a mercury manometer connected to it in order to indicate the gas pressure.

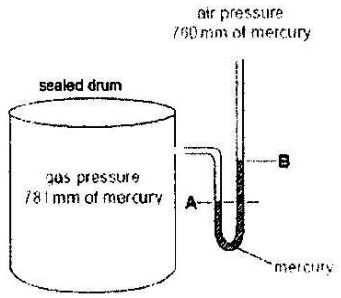


Fig. 2.1

For convenience, gas pressure is often expressed in mm of mercury.
The gas pressure is 781 mm of mercury and air pressure is 760 mm of mercury.

(a) State the difference in height between levels **A** and **B** on the manometer.

Difference in height = ... [1]

(b) The temperature of the gas rises.
State what happens to

(i) the gas pressure .....

(ii) the level A .....

(iii) the level B ..... [3]

(c) Explain our answers in (b), in terms of the gas molecules inside the drum and air molecules outside the drum.

.....

.....

.....

..... [2]

3 Fig. 3.1 shows steam passing into a jug to warm up some cold water. In this question, you may ignore any heating of the atmosphere.

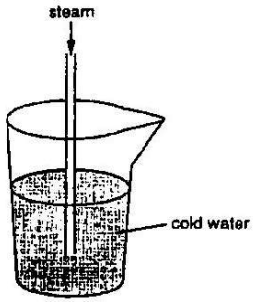


Fig. 3.1

Pure steam enters at 100 °C and the jug initially contains 500 g of water at 20 °C. Eventually, the water in the jug reaches a temperature of 100 °C.

The specific heat capacity of water is 4.20 J/(g°C) and the specific latent heat of vaporisation of water is 2250 J/g.

(a) State what is meant by *the specific latent heat of vaporisation of water is 2250 J/g.*

.....

..... [1]

(b) Explain why the mass of the water in the jug increases.

.....

..... [1]

(c) Calculate the energy needed to warm 500 g of water from 20 °C to 100 °C.

energy = ... [2]

(d) Calculate the final mass of water in the jug, when its temperature has reached 100°C.

mass = ... [2]

4 Fig. 4.1 shows an electrical circuit containing three resistors connected to a 10 V battery of negligible internal resistance.

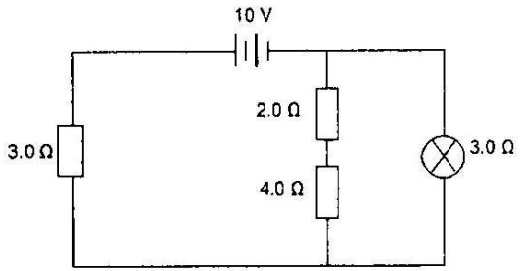


Fig. 4.1

(a) Calculate the effective resistance of the circuit.

effective resistance = ... [2]

(b) Calculate the current through the 3.0 Ω fixed resistor.

current = ... [1]

(c) Calculate the charge that flows through the battery in one minute.

charge = ... [2]

(d) Describe and explain the change on the brightness of the light bulb if the 3.0 Ω resistor is replaced with a 10.0 Ω resistor.

.....

.....

..... [2]

5 The diagram below shows a large conducting sphere **L** connected through a switch to the positive terminal of a supply of high voltage. A light conducting sphere **S** hangs from an insulating thread. Both spheres are initially uncharged.

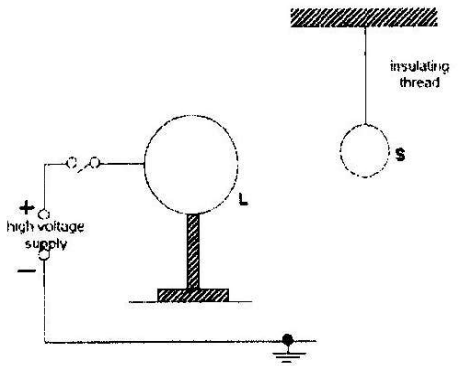


Fig. 5.1

(a) State the charge on sphere **L** when the switch is closed.

..... [1]

(b) On Fig. 5.1, draw the new position of sphere S on the insulating thread, and draw with labelled arrows, the forces acting on sphere S, when the switch is closed. [3]

(c) Explain the effect produced by sphere **L** on sphere **S** when the switch is closed.

.....

.....

.....

..... [2]

6 Fig. 6.1 represents the system used to transmit electricity from a power station to a factory.

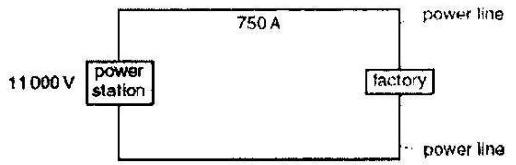


Fig. 6.1

The power station generates 11 000 V and supplies a current of 750 A. The total resistance of the power lines between the power station and the factory is 1.5 Ω.

(a) Calculate the power output of the power station.

power = ... [1]

(b) Determine the power loss at the transmission lines.

power loss = ... [2]

(c) Describe how the efficiency of the power transmission to the factory can be improved.

.....

.....

.....

..... [2]

7 The apparatus shown in Fig. 7.1 can be used to indicate when there is a force on the copper rod.

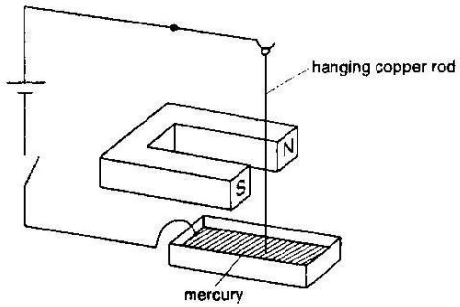


Fig. 7.1

(a) In the space below, draw the magnetic field pattern around the copper rod as seen from the top, when the switch is closed. [2]

(b) Suggest what is seen to happen to the hanging copper rod when the switch is closed. Explain your answer.

.....

.....

.....

..... [2]

(c) The cell is replaced with a low frequency a.c. supply and the switch closed. How does what is seen now differ from what you described in **(a)**?

.....

.....

..... [1]

8 Fig. 8.1 shows a drill that is being spun with a magnet attached to the drill bit. A coil of wire around a soft-iron core is placed above the rotating magnet. The ends of the coil are

connected to the Y-input of the cathode ray oscilloscope (CRO).

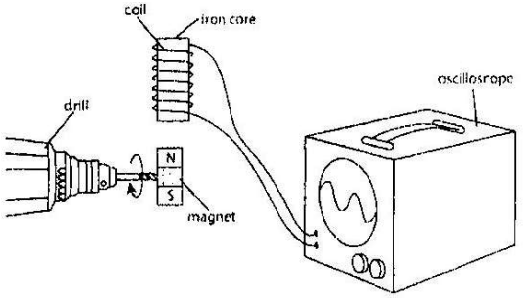


Fig 8.1

(a) Explain why there is current induced in the coil when the drill bit rotates.

.....

.....

.....

..... [2]

(b) On Fig. 8.1, draw the direction of the current in the coil as the North pole of the magnet approaches the coil. [1]

(c) Fig. 8.2 shows the display seen on the screen of the CRO as the magnet rotates [1]
On the figure, draw the display when the speed of the drill bit is halved.

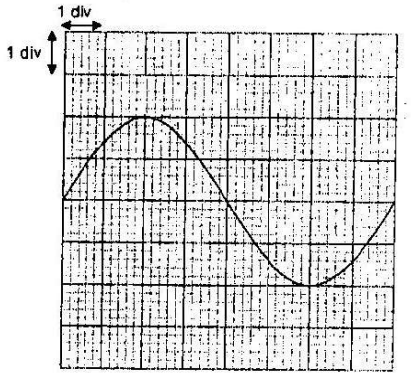


Fig. 8.2

(d) Describe the new trace on the screen if the soft-iron core is replaced by a copper core.

.....

..... [1]

(e) The drill rotates at a speed of 750 revolutions per minute.
Determine the time base frequency set on the CRO to produce the trace in Fig.8.2.

time base frequency = ... [2]

9 Fig. 9.1 shows ultrasound being used to study an unborn baby.

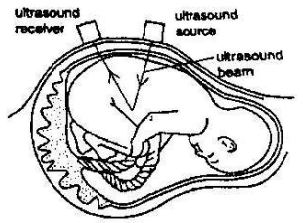


Fig. 9.1

(a) Explain how the vibration of the source produce waves of ultrasound and suggest how these waves are transmitted through the body tissue to the receiver.

.....

.....

.....

..... [2]

(b) Ultrasound used in medicine has a frequency which is about 100 times higher than the maximum frequency that can be heard by humans.

(i) Estimate the frequency that might be used for ultrasound in medicine.

frequency = ... [1]

(ii) The speed of ultrasound in the human body is 1500 m/s. Calculate its wavelength in the human body.

wavelength = ... [1]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in Question 12.

10 Two electrical components **X** and **Y** are each tested in turn, by connecting them to a variable voltage supply. The voltage V across and the current I through the components are measured as the voltage is increased. At each stage, the temperature of the components is allowed to reach steady value before the meter readings are recorded. The resulting variation of voltage with current is shown in the table in Fig. 10.1.

	Component X	Component Y
V / V	I / mA	I / mA
0	0	0
0.4	10	10
0.8	20	20
1.2	32	30
1.6	47	39
2.0	66	47
2.4	98	54

Fig. 10.1

(a) Compare the variation of current I with V for the components **X** and **Y**.

.....

.....

.....

..... [2]

(b) Calculate the resistance of component **X** when V is 2.0 V.

resistance of **X** = ... [1]

(c) Use the data to explain how the resistance of component **X** changes with increasing voltage.

.....

.....

..... [2]

(d) Suggest what is component **Y**.

..... [1]

(e) Component **X** is a thermistor. It is connected in a circuit as shown below.
The resistances P and Q are 2000 Ω and 5000 Ω respectively.
A voltmeter is connected in parallel with the 2000 Ω resistor and the thermistor is connected in parallel with the 5000 Ω resistor, as shown in Fig. 10.2.

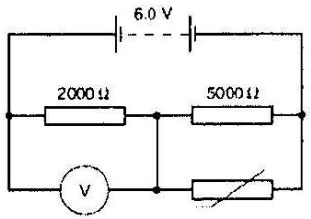


Fig 10.2

The battery has an e.m.f. of 6.0 V.

(i) State and explain qualitatively the change in the reading of the voltmeter as the temperature of the thermistor is raised.

.....

.....

..... [2]

(ii) The voltmeter reads 3.6 V when the temperature of the thermistor is 19 °C.
Calculate the resistance of the thermistor at 19 °C.

resistance = ... [2]

11 Fig. 11.1 shows a smooth metal block about to slide down BD, along DE and up EF. BD and DE are friction-free surfaces, but EF is rough. The block stops at F.

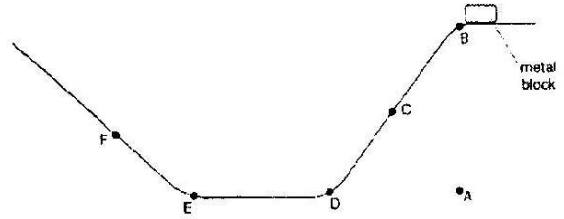


Fig 11.1

(a) The mass of the block is 0.2 kg. The vertical height of B above A is 0.6 m. The acceleration due to gravity is 10 m/s^2.

(i) Calculate the work done in lifting the block from A to B.

work done = ... [2]

(ii) At C, the block is moving at a speed of 2.5 m/s. Calculate its kinetic energy at C.

kinetic energy = ... [1]

(iii) Determine the vertical height of C above A.

height = ... [2]

(b) As it passes D, the speed of the block remains almost constant but the velocity changes. Using the terms *vector* and *scalar*, explain this statement.

.....

.....

..... [2]

(c) F is the point where the kinetic energy of the block is zero. In terms of energy changes, explain why F is lower than B.

.....

.....

.....

.....

..... [3]

12 **Either**

(a) An inventor is trying to make a device to enable him to see objects behind him. He cuts a square box in half diagonally and sticks two plane mirrors on the inside of the box.

A side view of the arrangement is shown in Fig. 12.1.

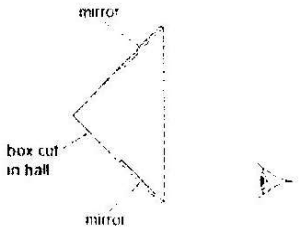


Fig. 12.1

Fig. 12.2 shows the arrangement, drawn larger.

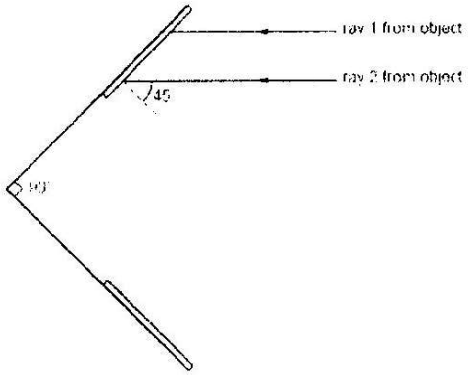


Fig. 12.2

Fig. 12.2 shows parallel rays from two different points on a distant object behind the man.

(i) Carefully continue the two rays until they reach the place where the inventor's eyes will be. [2]

(ii) Look at what has happened to the two rays.

Describe the image that the inventor sees.

.....

..... [1]

(iii) A rectangular glass block is placed between the mirrors as shown in Fig. 12.3.

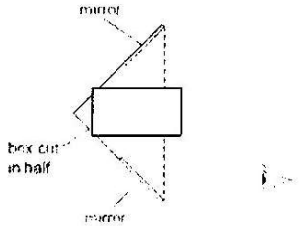


Fig. 12.3

Suggest changes to the image seen by the inventor, if any.

.....

..... [1]

(b) Figures 12.4 and 12.5 show a converging lens and a diverging lens respectively.

(i) Complete the figures to show the effect of each lens on the incident rays shown. [3]

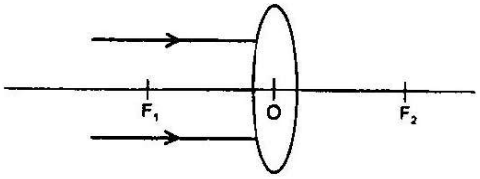


Fig. 12.4

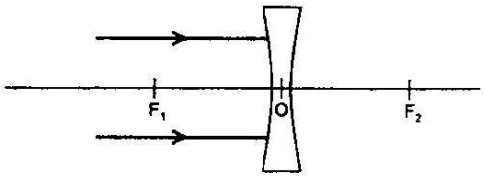


Fig. 12.5

(ii) A converging lens can form an image of an object when the distance of the object from the lens is greater or less than the focal length of the lens. Use the table below to compare the images formed under the two conditions. [3]

Description of image when the object distance is *greater* than the focal length	Description of image when the object distance is *less* than the focal length

12 **Or**

A trolley of mass 800 g is moving at a velocity u m/s to the right as it passes point P, as shown in Fig. 12.6.

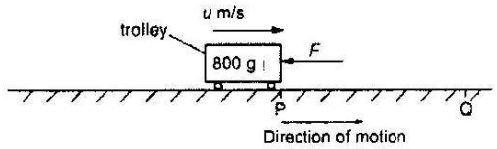


Fig. 12.6

A variable force F acts to the left on the trolley as it moves between points P and Q. Fig. 12.7 shows how F varies with time t.

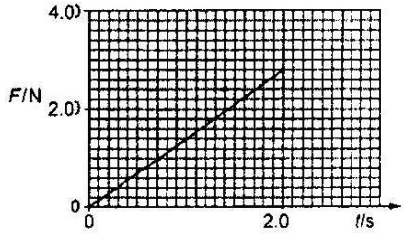


Fig. 12.7

The trolley comes to rest at point Q, 2.0 s later.

(a) State the resultant force on the trolley at P.

resultant force = ... [1]

(b) Using the graph on Fig. 12.7, describe how the resultant force on the trolley changes as it moves from P to Q.

.....

..... [2]

(c) Calculate the acceleration of the trolley at 2.0 s.

acceleration = ... [2]

(d) On Fig. 12.8, sketch the velocity-time graph for the motion of the trolley between P and Q. [2]

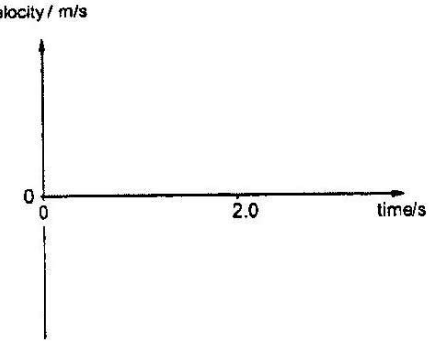


Fig. 12.8

(e) If the force F remains constant after 2.0 s,

(i) describe and explain the subsequent motion of the trolley,

.....

.....

..... [2]

(ii) sketch the velocity-time graph for the subsequent motion in Fig. 12.8 above. [1]

END OF PAPER

Setter: Mdm Latifah Noorahman

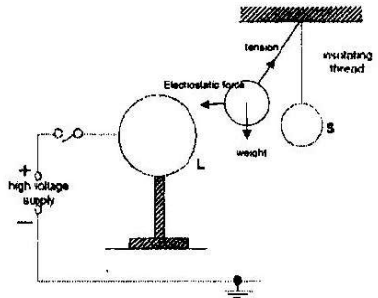
Ahmad Ibrahim Sec School
Preliminary Examination 2016
4E Physics 5059 Answers

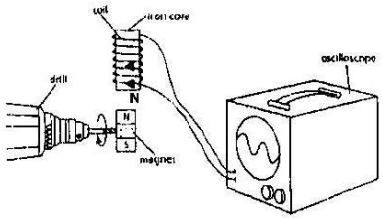
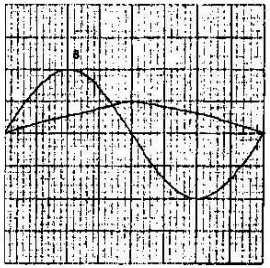
Paper 1

1	B	2	A	3	A	4	A	5	C	6	A	7	C	8	C	9	C	10	C
11	B	12	C	13	D	14	C	15	C	16	C	17	D	18	A	19	B	20	A
21	C	22	B	23	D	24	C	25	A	26	C	27	C	28	C	29	A	30	B
31	C	32	B	33	C	34	C	35	C	36	C	37	A	38	D	39	C	40	A

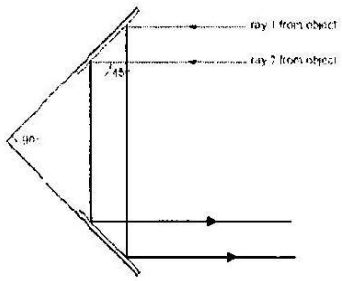
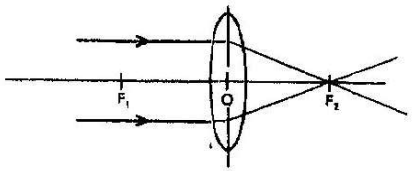
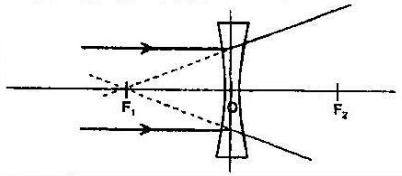
Paper 2

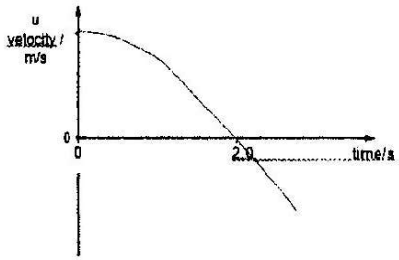
1(a)	T = 38.5 / 20 = 1.93 s
(b)	Length x is not the correct length of pendulum, the radius of the bob should be added (or length should be measured to the centre of the bob)
(c)	Mass of pendulum is the measure of the amount of substance in the pendulum.
2(a)	21 mm
(b)	(i) gas pressure increases (ii) the level A decreases (iii) the level B increases
(c)	When temperature rises, the gas molecules in the drum gain KE move faster, collide with more force or more frequently with the surface of mercury at A. No change in the rate of collision of the gas molecules outside on the surface of mercury at B. Since there is increase in pressure difference, mercury moves down from A and up at B.
3(a)	The amount of thermal energy needed to change the state of 1 g of water from liquid to gas without a change in temperature is 2250 J.
3(b)	The steam condenses into water at 100 deg Celsius and adds on to the mass of water in the jar
(c)	$Q = mc\Delta\theta = 500 \times 4.2 \times 80$ = 168 000 J
(d)	Heat absorbed by cold water = heat released by steam 168 000 = ml m = 168000 / 2250 = 74.7 g Final mass of water = 575 g

4(a)	$R_T = (1/6+1/3)^{-1} + 3$ = 5.0 Ω
(b)	I = V/R = 10 / 5.0 = 2.0 A
4(c)	Q = It = 2.0 x 60 = 120 C
4(d)	Dimmer. The p.d. across the bulb decreases, $P = V^2/R$ decreases OR The effective resistance of circuit increases, current in the circuit decreases, hence less current through the bulb.
5(a)	positive
5(b)	 B1 – pendulum at an angle towards L B2 – 3 labelled arrows correct directions
(c)	The electrons of S are attracted to / negative charge is induced on the left side of S, AND a positive charge is induced on the right side of S. [1] [Ecf from (a)] Attractive force is stronger than repulsive force as unlike charges are closer than like charges. [1]
6(a)	P = IV = 750 x 11000 = 8 250 000W
(b)	Power loss = $I^2 R = 750^2 \times 1.5$ = 843750 W = 844000 W
(c)	(1)Use a step-up transformer to reduce the current transmitted (2) Increase the cross-sectional area of transmission wires to reduce the resistance, so the power loss will be reduced useful power / input power x 100% increases

7(a)	Concentric circles (at least 3) with arrows pointing clockwise Increasing spacing away from centre
(b)	The copper rod moves (or swings) inwards / into the magnet / left **There is current in the rod, rod experiences a force in a magnetic field** / there is interaction between the magnetic field due to current in rod and the magnetic field of magnet Consider : Thumb to point to the force that results due to magnetic field indicated by the index (1st) finger, and the middle (2nd) finger to point in the direction of the current *at right angle to each other*
(c)	Moves in and out / oscillate due to current continually changing direction, force reverses in direction periodically
8(a)	As the drill bit rotates, the magnet rotates near the coil, there is a change in magnetic flux in the coil / the coil cuts the magnetic field lines, induces current in the coil
(b)	
(c)	
(d)	Amplitude of trace decreases but the number of cycles displayed on the screen remain the same.
(e)	f = 750 / 60 = 12.5 Hz T = 1 / f = 1/12.5 = 0.080 s Time base frequency = 0.080 s / 8 div = 0.010 s/div = 10 ms/div
9(a)	The source vibrates at a frequency higher than 20000 Hz. As the sound is transmitted into the body, it causes the particles of the skin and tissues to vibrate and transfer energy from one particle to another until they reach a boundary where some energy will be reflected back as echoes to the receiver.

(b)	(i) 100 x 20 kHz = 2 MHz or 2000000 Hz
	(ii) wavelength = speed / frequency = 1500 / 2×10^6 = 7.5×10^{-4} m
10(a)	for V = 0 to 0.8 V, current increases as V increases OR **I increases linearly with V** for V above 0.8 V, the increase in I per unit increase in V increases for X but decreases for Y.
(b)	resistance = V/I = 2.0 / 66 x 10^{-3} = 30.3 Ω
(c)	As V increases, current in X also increases, however, the increase in I per unit increase in V, increases. This means that the resistance of X, which is V/I is decreasing with increasing V OR Resistance of X decrease with increasing V. As shown in the table, R = V/I decreases from 40.0 ohm when V = 0.4V to 30.3 ohm when V = 2.0V to 24.5 ohm when V = 2.4V
(d)	Y is a filament lamp Should not be called light bulb.
(e)	(i) (as temperature rises), resistance of thermistor decreases ***either*** resistance of parallel combination decreases ***or*** p.d. across 5 kΩ resistor / thermistor decreases p.d. across 2000 Ω resistor / voltmeter reading increases (ii) if R is the resistance of the parallel combination, ***Either*** $3.6 = \frac{2000}{2000+R} \times 6$ R = 1330 Ω $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \rightarrow \frac{1}{1330} = \frac{1}{5000} + \frac{1}{T}$ T = 1.82 kΩ ***or*** current in 2 kΩ resistor = 1.8 mA current in 5 kΩ resistor = 0.48 mA current in thermistor = 1.32 mA T = 2.4 / 1.32 = 1.82 kΩ
11(a) (i)	Work done = (0.2 x 10) x 0.6 = 1.2 J
(ii)	KE = ½ mv^2 = ½ x 0.2 x 2.5^2 = 0.625 J
(iii)	GPE at C + KE at C = 1.2 J mgh + 0.625 = 1.2 h = (1.2 – 0.625) / (0.2 x 10) = 0.288 m
(b)	velocity is a vector quantity whereas speed is a scalar quantity **direction changes (as it passes D)**, so velocity changes
(c)	There is friction while moving on EF Work done against friction

	kinetic energy changes to thermal energy less kinetic energy at E changed to gravitational potential energy
12 E (a)(i)	one 90° deviation at 1st mirror, by eye two 90° deviations at 1st mirror, by eye emerging rays parallel to incident rays, by eye 
(ii)	upside down OR inverted OR same size OR virtual
(iii)	No change in the image seen, the rays incident on the surfaces of the prism are along the normal, the rays do not change direction.
(b)(i)	
	
(ii)	**Description of image when the object distance is *greater* than the focal length**: real, inverted **Description of image when the object distance is *less* than the focal length**: virtual, upright

	same size as object or magnified or diminished / magnified
12 Or (a)	0N
(b)	Resultant force increases at a constant rate in the negative direction OR Resultant force decreases at a constant rate from 0N to -2.8N
(c)	$a = F_{net} / m = - 2.8 / 0.8$ $= - 3.5\ m/s^2$
(d) (e)(ii)	
(e)	(i) The trolley moves in reverse direction with a constant acceleration because resultant force is now constant at – 2.8 N. (ii) see graph above

Answer **all** questions.

1 Fig. 1.1 and Fig. 1.2 show micrometer screw gauge readings with the jaws closed and when measuring a marble respectively.

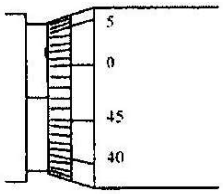


Fig. 1.1

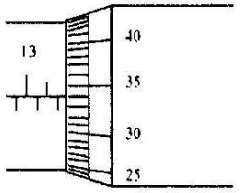


Fig. 1.2

What is the actual diameter of the marble?

A 15.31 mm
B 14.87 mm
C 14.81 mm
D 14.37 mm

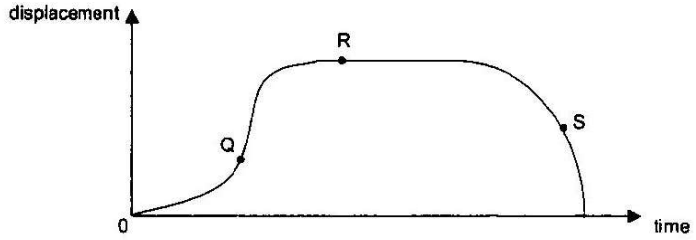
2 An astronaut has a mass of 60 kg on Earth. He can jump 2.0 m high on the surface of earth. Assume that the acceleration due to gravity on the Moon is 1.6 ms^{-2}. Which of the following statements regarding the distance he can jump on the Moon and the corresponding reason are correct?

	distance he can jump on the Moon	reason
A	lower than 2.0 m	his weight is more than on Earth
B	lower than 2.0 m	his mass is more than on Earth
C	higher than 2.0 m	his weight is less than on Earth
D	higher than 2.0 m	his mass is less than on Earth

3 Two objects X and Y are identical in size and shape but X has 3 times the mass of Y. When they are both released at the same time from the same height in a vacuum container, they reach the floor of the container at the same time. Which of the following statements is NOT correct?

A On reaching the floor, the speed of X is the same as the speed of Y.
B On reaching the floor, the kinetic energy of X is greater than that of Y.
C The size of the force acting on X is the same as the size of the force acting on Y.
D The rate of change of velocity is the same for X and Y.

4 The diagram shows a displacement-time graph of the journey of a car.



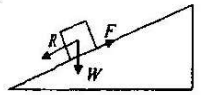
Which of the following statement(s) is/are true?

I At S, the car is travelling back to its start point.
II At Q, the car is travelling at a constant speed.
III At R, the car is travelling at a constant speed.

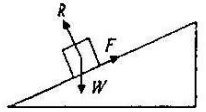
A I only
B I and II only
C I and III only
D I, II and III

5 A box of weight W is held stationary on a rough sloping surface. If F is the friction force and R the normal contact force, which of the diagrams below best represents the forces acting on the box?

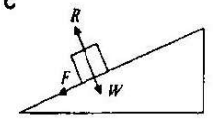
A



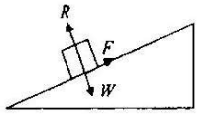
B



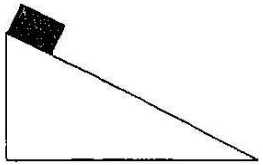
C



D



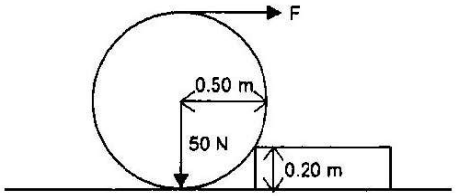
6 A box accelerates down a rough slope as shown.



What is the effect of friction on the motion of the box?

A The box slows down.
B The box moves with lower acceleration.
C The box moves with higher acceleration.
D The box continues to move with the same acceleration

7 A 50 N cylinder is pulled by a horizontal force F to climb a step 0.20 m high. The cylinder has a radius of 0.50 m.



What is the minimum value of force F required?

A 25 N
B 20 N
C 12.5 N
D 10 N

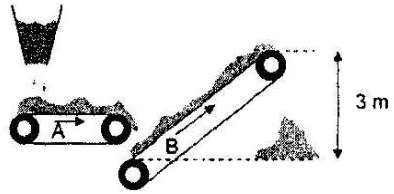
8 Which of the following objects, when displaced, is seen to be in neutral equilibrium?

A A heavy weight suspended on a string.
B A pencil balanced on its sharp tip.
C A cone resting on its slant edge.
D A pyramid resting on its base.

9 A ball is released from a height h above a table. Assuming that air resistance is negligible and 50% of its kinetic energy is lost at each bounce, what will be the height reached by the ball after the second bounce?

A h
B h/2
C h/4
D h/8

10 The diagram shows sand being dropped from conveyor belt A to conveyor belt B at a steady rate of 3.0 kg/s. Both conveyor belts move with a speed of 2.0 m/s.



What is the power supplied by the motor for belt B?

A 12 W
B 30 W
C 60 W
D 90 W

11 Fig. 11.1 and Fig. 11.2 show air trapped in a capillary tube by a small mercury plug. The length of the mercury plug is 10 cm. The atmospheric pressure is 76 cm Hg.

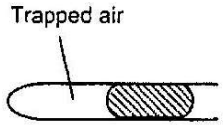


Fig. 11.1

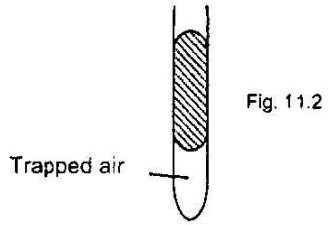
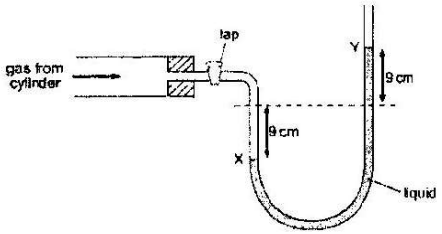


Fig. 11.2

Which of the following describes the pressure of the column of trapped air in Fig. 11.1 and Fig. 11.2?

	pressure in Fig. 11.1	pressure in Fig. 11.2
A	10 cm Hg	76 cm Hg
B	10 cm Hg	86 cm Hg
C	76 cm Hg	10 cm Hg
D	76 cm Hg	86 cm Hg

12 The diagram shows the levels X and Y in a liquid manometer when the gas tap is opened.



What is the pressure of the gas in the cylinder?

A 9 cm of liquid below atmospheric pressure.
B 9 cm of liquid above atmospheric pressure.
C 18 cm of liquid below atmospheric pressure.
D 18 cm of liquid above atmospheric pressure.

13 A partially inflated balloon is placed under a bell jar as shown in Fig. 13.1. A vacuum pump is turned on for several minutes and the volume of the balloon increases as shown in Fig. 13.2.

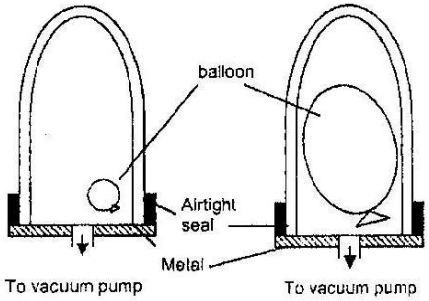


Fig. 13.1

Fig. 13.2

Which pressure changes occur within the bell jar and within the balloon?

	pressure change in bell jar	pressure change in balloon
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

14 In Brownian motion experiment involving smoke particles in the air, heavy particles settle quickly but very small particles remain suspended for a long periods of time. This is because

A very small particles have low inertia and therefore are easily affected by the bombardments of the air molecules.
B the Earth's gravitational field does not act on very small particles.
C the small smoke particles have the same density as air.
D air pressure has a greater effect on smaller particles.

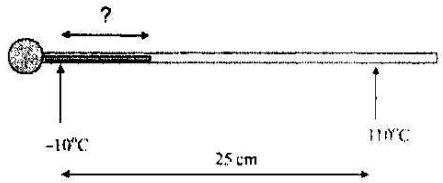
15 In a vacuum flask, which is the component that reduces radiation?

A the silvered wall
B the stopper
C the vacuum between the walls
D the foam supporting the walls

16 A thermocouple thermometer attached to a millivoltmeter reads 5.0 mV when the junctions are immersed in pure melting ice and in pure boiling water. When one of the junctions remains in pure melting ice and the other one in an unknown liquid, the reading is 2.0 mV. What is the temperature of the unknown liquid?

A 30 °C
B 40 °C
C 50 °C
D 60 °C

17 The diagram shows a mercury-in-glass thermometer. The distance between the -10 °C and the 110 °C markings is 25 cm.



At 38 °C marking, how long should the mercury thread be?

A 7.9 cm
B 10 cm
C 12 cm
D 14 cm

18 Latent heat of fusion is the energy required to change a solid into liquid. What does this energy do?

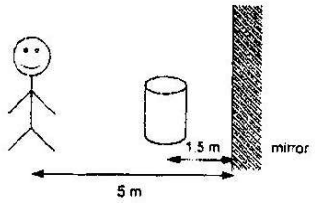
A It increases the average speed of the solid molecules.
B It increases the vibration between the solid molecules.
C It increases the average separation of the solid molecules.
D It increases the forces of attraction between the solid molecules.

19 An 80 g block of ice at -10 °C is placed on a hot plate heated rated at 5 A, 100 V. The specific latent heat of fusion of ice is 336 $kJkg^{-1}$ and the specific heat capacity of ice is 2.1 $kJkg^{-1}K^{-1}$ and the specific heat capacity of water is 4.2 $kJkg^{-1}K^{-1}$.

What is the total time taken for the ice to melt completely?

A 541 s
B 271 s
C 57 s
D 29 s

20 A man is standing 5 m away from a plane mirror and a cylindrical stool is placed in front of him as shown.



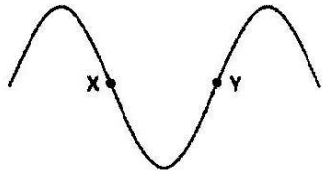
How far is the man's image in the mirror away from the stool?

A 3.0 m
B 3.5 m
C 6.5 m
D 8.5 m

21 When an object is placed 25 cm from a thin converging lens, a real image equal in size to the object is formed. The object is then moved 3 cm nearer to the lens. What will happen to the new image?

	image distance	image size
A	less than 25 cm from lens	magnified
B	more than 25 cm from lens	magnified
C	less than 25 cm from lens	diminished
D	more than 25 cm from lens	diminished

22 A transverse wave travels steadily from left to right as shown.



Which of the following concerning the directions of movement of the particles X and Y is true?

	X	Y
A	upward	downwards
B	downwards	downwards
C	downwards	upwards
D	to the right	to the right

23 A vibrator dipping into water in a ripple tank has period of $\frac{1}{6}$ s. The resulting wave has a wavelength of 0.02 m. What is the speed of the wave?

A 0.020 ms^{-1} **B** 0.12 ms^{-1} **C** 3.0 ms^{-1} **D** 6.0 ms^{-1}

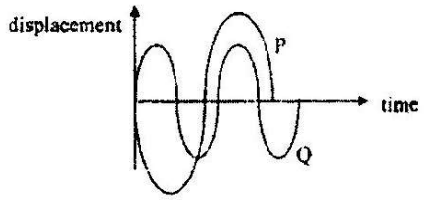
24 How do the wavelength, frequency and speed of ultraviolet light in vacuum compare with those of visible light?

	wavelength	**frequency**	**speed**
A	longer	higher	slower
B	longer	lower	same
C	same	lower	slower
D	shorter	higher	same

25 Which of the following does not make use of electromagnetic waves in its operation?

A a camera
B a radio set
C a microphone
D a television set

26 Two pure notes are produced and the resulting waveforms are superimposed on the same axes as shown below.

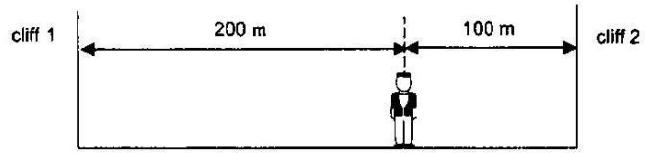


Which of the following statement(s) about P and Q is/are correct?

(1) P is louder than Q.
(2) P has a higher pitch than Q.
(3) P and Q have the same speed.
(4) Q has a lower frequency than P.

A (3) only
B (1) and (2) only
C (1) and (3) only
D (2) and (4) only

27 A man stands between 2 cliffs as shown in the diagram and claps his hands once.



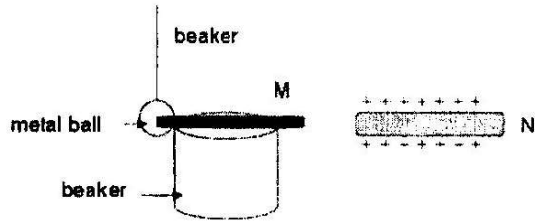
Assuming that the velocity of sound in air is 300 m/s, what will be the time interval between the first and second echoes?

A 2.00 s **B** 1.34 s **C** 0.66 s **D** 0.33 s

28 A rod which is an insulator carries a positive charge after it is rubbed with a woollen cloth. Which of the following explanation is correct?

A Electrons are transferred from the rod to the cloth.
B Electrons are transferred from the cloth to the rod.
C Positive charges are transferred from the cloth to the rod.
D Friction causes negative charges on the rod to become positive.

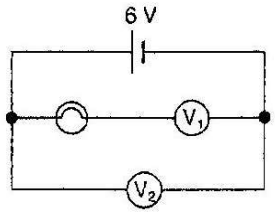
29 An uncharged conducting rod M is placed on top of a glass beaker. An uncharged metal coated ball hanging from an insulated string just touches one end of the rod. A charged metal rod N is brought to touch the other end of the rod M and then quickly removed.



What will happen to the metal coated ball?

A It remains still throughout.
B It moves away only when the two rods are touching.
C It swings back and forth while both rods are touching.
D It moves and stays away even after the rod N is removed.

30 In the given circuit, V_1 and V_2 are two identical voltmeters. What are the readings of the voltmeters and the brightness of the light bulb?

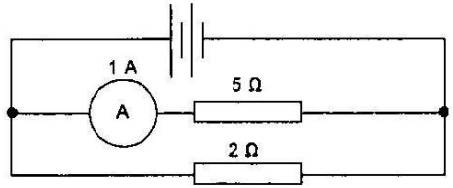


	reading of V_1	reading of V_2	light bulb
A	6 V	0 V	bright
B	6 V	6 V	dark
C	0 V	6 V	dark
D	3 V	6 V	bright

31 The resistance of an alloy wire is *R*. When the length and diameter of the alloy wire are both doubled, what is the resistance in terms of *R*?

A 8*R* **B** 4*R* **C** 2*R* **D** *R*/2

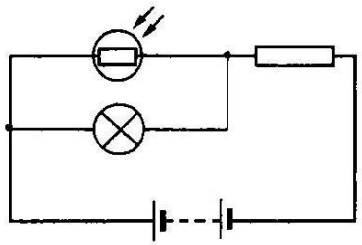
32 The following circuit is set up.



How much electrical energy is converted to other forms of energy in the 2 Ω resistor in 1 minute?

A 12.5 J
B 30 J
C 600 J
D 750 J

33 The diagram shows the connection of a fixed resistor, a bulb and a light dependent resistor (LDR). A weak light is falling on the LDR initially.



What happens to the brightness of the bulb when the brightness of the surrounding light increases?

A same brightness
B brightness increases
C brightness decreases
D bulb will not light up at all

34 The ratings of some electrical appliances are shown below.

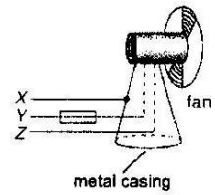
Electrical appliance	Rating
Television	135 W
Air conditioner	2.75 kW
Lamps	100 W

If the cost of 1 kWh electricity is 80 cents, what is the total cost of operating the following electrical appliances for 3 hours?

A $7.16
B $12.20
C $73.40
D $429.80

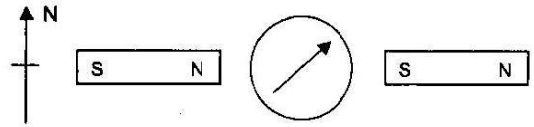
35 The diagram below shows the external wiring of an electric fan. Which of the following statements is/are correct?

I Wire *X* is always at a low potential
II The switch of the fan should be connected to wire *Y*.
III Wire *Z* is blue in colour.

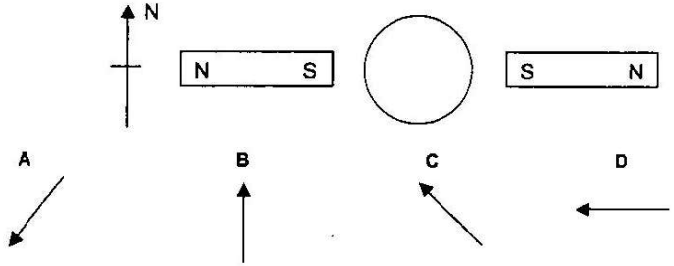


A I only
B I and II only
C II and III only
D I, II and III

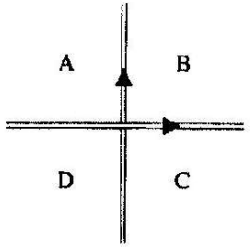
36 The diagram shows a compass placed between two identical magnets in the Earth's magnetic fields.



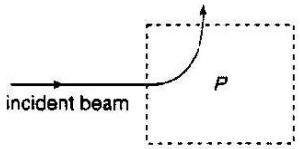
If one magnet is reversed as shown below, in which direction will the compass needle point?



37 Equal amount of current is flowing in two insulated wires perpendicular to each other as shown. Which segment **A**, **B**, **C** or **D** has the strongest magnetic field out of the paper?



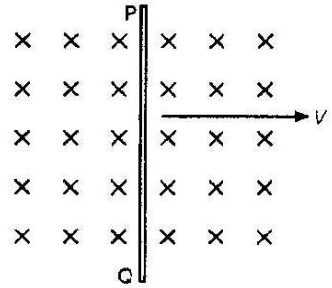
38 A beam of particles is directed towards a region *P* in which a magnetic field is applied. The beam is deflected as shown below.



What are the nature of the charged particles and the direction of the magnetic field?

	particles	direction of magnetic field
A	protons	into the page
B	protons	out of the page
C	electrons	into the page
D	neutron	out of the page

39 A rod is pulled to the right with velocity *v* through a magnetic field as shown.



Which of the following statements is/are correct?

I Q is at a higher potential than P.
II A current flows from Q to P in a rod if a wire is connected between P and Q.
III The induced e.m.f. increases when the velocity increases.

A III only
B I and II only
C II and III only
D I, II and III

40 The voltage of a 220 V a.c. supply is stepped down by a transformer if turn ratio is 1:18. When a portable CD player is connected to the transformer, it draws a current of 500 mA from the transformer. If the efficiency of the transformer is 80%, what is the power delivered by the power supply?

A 7.64 W
B 6.25 W
C 6.11 W
D 4.89 W

~ END OF PAPER ~

Section A
Answer **all** the questions in this section.

1 Fig. 1.1 shows a 400 g ball falling freely from rest.

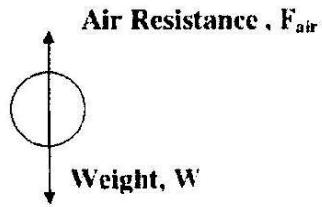


Fig. 1.1

(a) At a certain instant, the ball is accelerating downwards at 6.0 ms^{-2}. Calculate the air resistance acting on the ball.

air resistance = ...[2]

(b) The acceleration of the ball decreases while falling and eventually the ball reaches terminal velocity at t = 10 s. Sketch a velocity - time graph to show the motion of the ball. [2]

For Examiner's Use

(c) Explain, in terms of the forces acting, why the acceleration of the ball decreases and terminal velocity is reached.

.....

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.....[2]

For Examiner's Use

2 Fig 2.1 (*not drawn to scale*) shows the forces acting on an arrow by the string of a bow just before it is released.

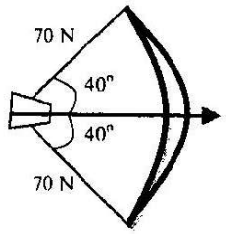


Fig. 2.1

Using a suitable labelled vector diagram, determine the magnitude and the direction of the resultant force exerted by the bowstring on the arrow. [3]

For Examiner's Use

3 **(a)** Fig. 3.1 shows a piece of glass being lifted by a suction cup. Some air inside the suction cup is removed by a vacuum pump. The atmospheric pressure outside the cup prevents the glass from dropping. The area of the glass covered by the cup is 0.0025 m^2. The pressure inside the cup is reduced to 60 kPa. The atmospheric pressure is 100 kPa.

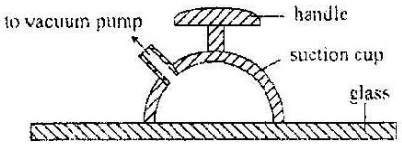


Fig. 3.1

(i) Calculate the maximum weight of a piece of glass that can be lifted with this cup.

Maximum weight = ...[1]

(ii) State one change that would allow the suction cup to lift a heavier piece of glass.

.....

.....[1]

(b) Fig. 3.2 shows a metal can with a tight fitting lid and the can is heated.

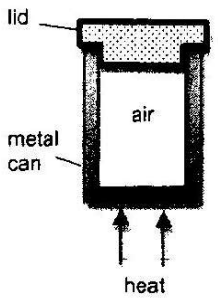


Fig. 3.2

For Examiner's Use

(i) Explain, in terms of the motion of molecules, why the pressure in the metal can increases when the can is heated.

.....

.....

.....

.....

.....[2]

(ii) If a little water is put in the bottom of the can before heating, explain how this would affect the pressure in the can when the temperature increases.

.....

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.....[2]

4 **(a)** Fig. 4.1 shows a filament lamp standing upright in air. The connections to the lamp are not shown. When switched on, the filament lamp loses energy by conduction, convection and radiation.

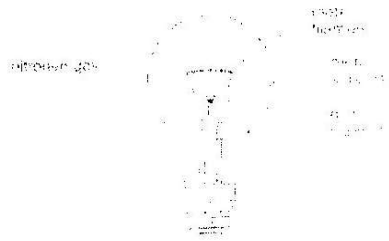


Fig. 4.1

Describe how energy is lost from the metal filament

(i) by conduction.

.....

.....

.....[1]

For Examiner's Use

(ii) by convection.

.....

.....

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.....[2]

(b) Fig. 4.2 shows an electric bulb painted matt black on one half and silver on the other.

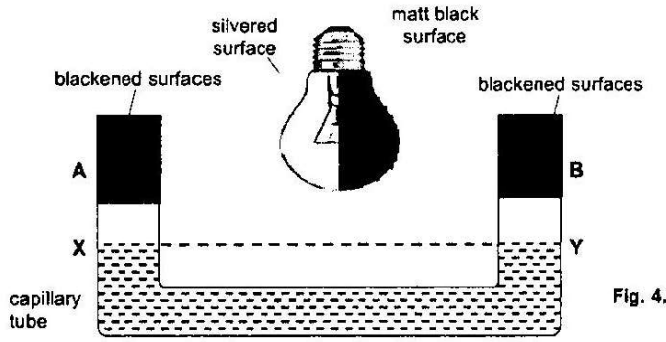


Fig. 4.2

(i) State which method(s) of heat transfer is/are involved in this setup.

.....[1]

(ii) A capillary tube containing water up to level **XY** is covered with blackened test tubes, **A** and **B**. The bulb is then switched on. Describe and explain what happens to the water level in the capillary tube.

.....

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.....

.....

.....[2]

For Examiner's Use

5 (a) A ray of light is incident on a right-angled prism of refractive index 1.5 as shown in Fig. 5.1.

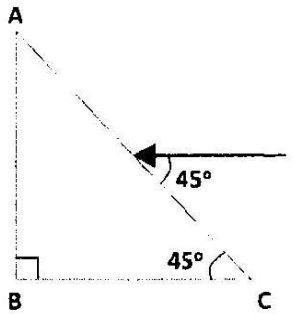


Fig. 5.1

(i) Calculate the angle of refraction of the ray.

angle of refraction = ...[1]

(ii) Explain whether this ray within the prism will undergo total internal reflection when it hits the face AB. Show all your workings clearly.

.....

.....

.....[3]

(iii) Hence, complete the light ray in the Fig. 5.1 to show how light travels when it strikes on the face AC. [1]

For Examiner's Use

(b) A parallel beam of light making an angle of 30° with the principal axis is incident on the lens as shown in the Fig. 5.2.

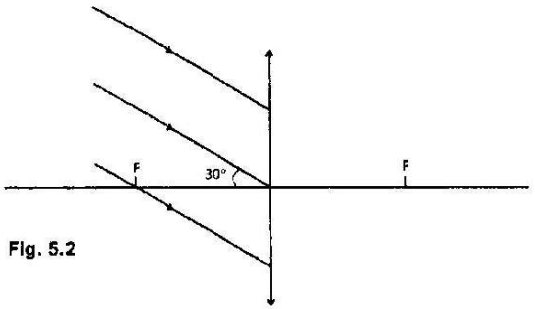


Fig. 5.2

(i) If the rays shown in Fig. 5.2 are from the top of a distant tree, complete the ray diagram to locate the image of the tree. [2]

(ii) Describe the characteristics of the tree image.

.....

.....[1]

6 Fig 6.1 shows a series of wavefronts of a water wave travelling through regions P and Q.

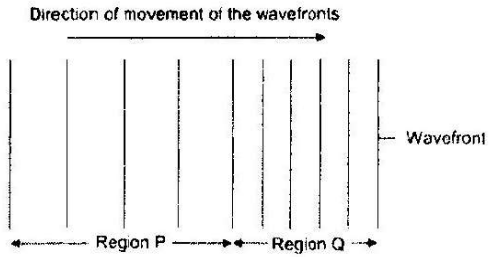


Fig. 6.1

(a) State and explain which region is deeper.

.....

.....

.....[2]

For Examiner's Use

(b) The distance between two successive wavefronts in region Q is 2.0 cm and each wavefront takes 4.0 s to travel through region Q.

(i) Determine the speed of the water wave in region Q.

speed = ...[2]

(ii) Hence, determine the frequency of the wave.

frequency= .....[1]

7 **(a)** Three uncharged metal spheres **A**, **B** and **C** mounted on insulating supports are positioned so that they touch. A rod carrying positive charge is brought near to them as shown in Fig. 7.1.

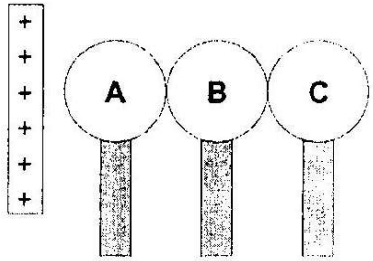


Fig. 7.1

The spheres are now moved slightly apart with the insulating supports and the charged rod is then removed.

(i) On Fig. 7.1, show the resulting charges on the spheres. [2]

(ii) Sphere **A** is moved until it touches sphere **C**. State the movement of the charges that occurs when they touch.

.....

.....[1]

For Examiner's Use

(b) Fig. 7.2 shows an electric motor which is rated 200 V, 900 W.

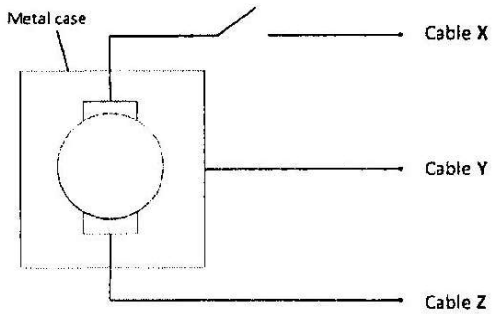


Fig. 7.2

(i) Calculate the current drawn by the motor when it is connected correctly.

current = ...[1]

(ii) Suggest a suitable rating for the fuse to be connected to the circuit.

.....

..... [1]

(iii) State and explain which cable (**X**, **Y** or **Z**) should the fuse be placed.

.....

.....

.....[1]

For Examiner's Use

8 A circuit is set up as shown in Fig. 8.1. The variable resistor XY varies between 0 Ω to 1.0 kΩ.

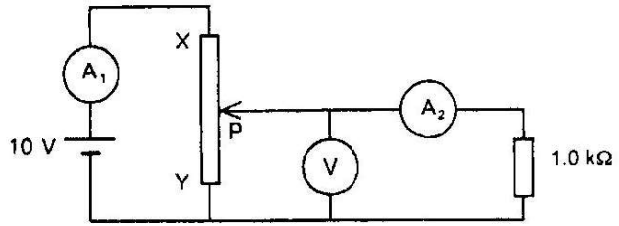


Fig. 8.1

State what happens to the readings of the three meters as P moves from Y to X. Give numerical values where possible.

Voltmeter: .....

.....

Ammeter A_1: .....

.....

Ammeter A_2: .....

.....

[5]

For Examiner's Use

9 Fig. 9.1 shows a simple magnetic relay, together with three contacts X, Y and Z, used to control the operation of two lamps L1 and L2 and a motor of a fan, M.

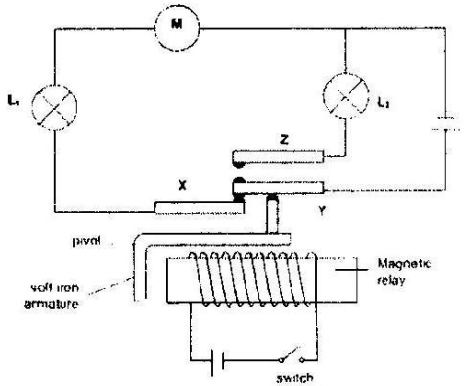


Fig. 9.1

(a) Suggest a suitable material for the magnetic relay. Explain why.

.....

.....

.....[2]

(b) Describe and explain the changes that occur when the switch is closed.

.....

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.....

.....

.....[3]

~ End of Section A ~

Section B

This section starts from Question 10.
Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 Fig. 10.1 shows the properties of three metals X, Y and Z.

For Examiner's Use

Metal	Density / gcm^{-3}	Specific heat capacity /Jg^{-1}°C^{-1}	Melting point / °C
X	2.7	0.90	700
Y	1.8	0.15	1800
Z	8.0	0.40	1600

Fig. 10.1

Three cooking pots of the same shape are made from the same volume of 800 cm^3 of each of the metals X, Y and Z.

(a) Which pot is the heaviest? Show your working clearly in the space provided.

.....

.....[3]

(b) Each pot contains equal volume of water and is heated by a hot plate that supplies thermal energy at the same rate. State and explain which pot of water will be the first to boil.

.....

.....

.....

.....

..... [2]

(c) After the water in each of the pots had boiled, the pots are removed from the hot plate and allowed to cool. Heat is lost from the pots at the same rate. After five minutes, state and explain which pot of water will be at the higher temperature.

For Examiner's Use

.....

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.....

.....[2]

(d) State and explain the advantage of using metal Y over the other two metals.

.....

.....

.....

.....

.....

.....[3]

11 Fig. 11.1 shows parts of a tall tower crane used on building sires. The trolley used to pick up loads can be moved along an iron jib of uniform density and a length of 80.0 m. The iron jib is pivoted at a point P, which is 20.0 m from one end. A concrete block A of weight 1.5 x 10^5 N helps to keep the iron jib horizontal at all times.

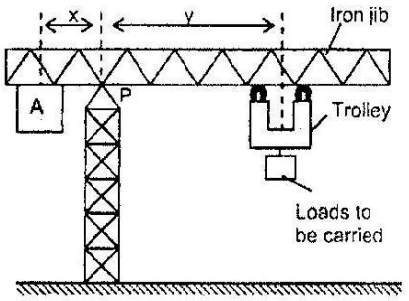


Fig. 11.1

For Examiner's Use

(a) (I) When the crane is used to lift a load of 4.0×10^4 N, the distance x and y must be kept at 6.0 m and 15.0 m respectively to ensure the iron jib does not topple. Keeping the distance x at 6.0 m, determine the load in which the crane can carry without toppling if the trolley is moved till y = 30.0 m.

load = ...[3]

(II) With y kept at 30.0 m, if the trolley is to lift a load heavier than the value calculated in (i), suggest and explain what changes must be made to the parts of the crane.

.....

.....

.....[2]

For Examiner's Use

(b) The tower crane can be modified to carry a load of fixed mass and the distance y can be varied without causing the iron jib to topple. This is done by attaching a cable as shown in Fig. 11.2.

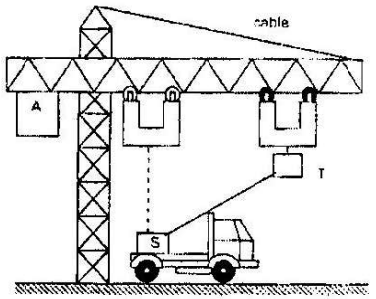


Fig. 11.2

The crane is used to lift a load of 1.5×10^5 N from a height of 1.0 m at S to a height of 25.0 m at T along the diagonal path ST in a time of 30.0 s.

(I) Calculate the gain in gravitational potential energy by the load as it lifted from S to T.

gain in gravitational potential energy = ...[1]

(II) If the electrical energy is supplied to the crane at a rate of 5.3×10^5 W, calculate the efficiency of the crane motor.

efficiency = ...[2]

(iii) At position T, the crane stops lifting the load. If the load is dropped from this height, calculate the speed of the load before it hits the ground.

For Examiner's Use

speed = ...[2]

For Examiner's Use

12 EITHER

(a) Describe an experiment to determine the speed of sound in air.
In your account
- list all the apparatus you would use,
- describe the procedure of the experiment with the aid of a diagram,
- state one way you would take to improve the accuracy of this experiment.

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[5]

For Examiner's Use

(b) Fig. 12.1 shows an experiment carried out by Naomi to measure the wind speed.

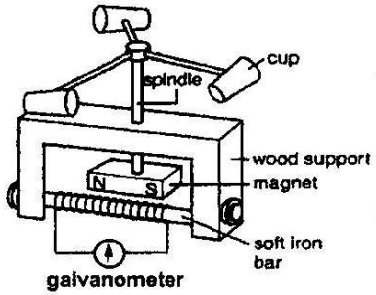


Fig. 12.1

(i) Explain how the wind causes the galvanometer to give a reading.

.....

.....

.....

.....

.....[2]

(ii) Why does the galvanometer reading increase as the wind speed increases?

.....

.....

.....

.....

.....[2]

(iii) The design shown in Fig. 12.1 is not sensitive enough to measure smaller winds. Give two ways that Naomi can modify the design to make the gauge more sensitive.

.....

.....[1]

For Examiner's Use

12 OR

(a) Ultrasound may be used to measure the depth of the sea. Fig. 12.2 shows a pulse of ultrasound sent down to the sea bed and the reflected pulse returning to the ship.

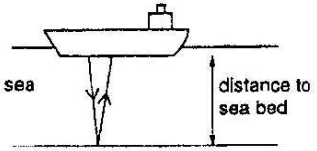


Fig. 12.2

(i) Describe what is meant by ultrasound.

.....

.....[1]

(ii) Fig. 12.3 is a cathode-ray oscilloscope (c.r.o.) trace of the pulses of ultrasound sent from the ship and the reflected pulses.

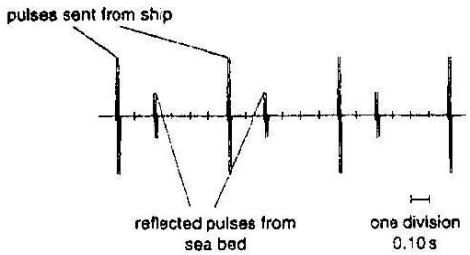


Fig. 12.3

The speed of ultrasound in water is 1500 m/s and the wavelength of the ultrasound wave is 0.030 m. The time-base setting for the x-axis on the c.r.o. is 0.10 s/division. Calculate the distance to the sea bed.

distance = ...[2]

(iii) The ship moves to a place where the sea is deeper. State and explain two changes that would occur to the reflected pulses on the c.r.o. trace.

For Examiner's Use

.....

.....

.....

.....

.....

.....[2]

(b) Fig. 12.4 shows two insulated copper coils, P and Q mounted close together on a wooden rod. Coil P is connected to switch S and a battery. Coil Q is connected to a sensitive voltmeter V.

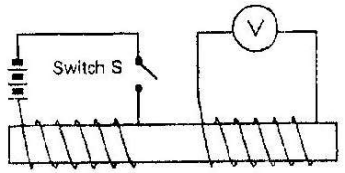


Fig. 12.4

When the switch S is closed, a deflection is seen on the voltmeter. This deflection lasts for a very short time.

(i) Explain whether the current flows through the meter from left to right or from right to left.

.....

.....

.....

.....

.....

.....[2]

For

(ii) Explain briefly how this effect is made use of in a transformer. Include in your answer a labelled diagram to illustrate the structure of a transformer.

Examiner's Use

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.....

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.....[3]

~ End of Section B ~

Section A
Answer **all** the questions in this section.

1 Fig. 1.1 shows a 400 g ball falling freely from rest.

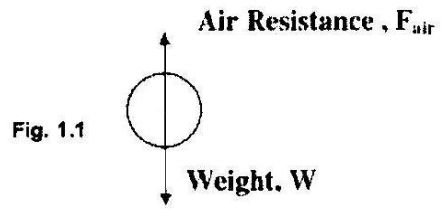
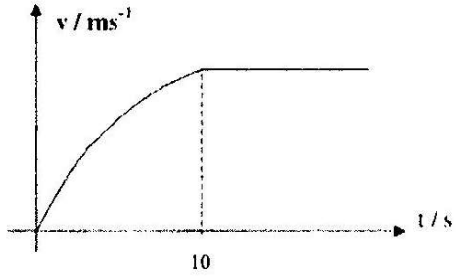


Fig. 1.1

(a) At a certain instant, the ball is accelerating downwards at 6.0 ms^{-2}. Calculate the air resistance acting on the ball. [2]

F = ma
W – F_{air} = 0.400 kg x 6.0ms^{-2}
F_{air} = (0.400 x10) – 2.4
F_{air} = 1.6 N

(b) The acceleration of the ball decreases while falling and eventually the ball reaches terminal velocity at t = 10 s. Sketch a velocity - time graph to show the motion of the ball. [2]



[1/2] label both axis
[1/2] dotted line and label t = 10s
[1/2] curve until t = 10 s
[1/2] horizontal straight line after t

(c) Explain, in terms of the forces acting, why the acceleration of the ball decreases and terminal velocity is reached. [2]

As the **velocity increases, upwards air resistance** (acting on the ball) **increases. Downwards resultant force acting on the ball decreases** as F = ma, therefore acceleration decreases as the ball is falling.
As acceleration decreases, upwards air resistance increases until **downwards weight is equal to upwards air resistance.** Therefore **resultant/ net force acting on the ball is zero** and F = ma, **acceleration is zero** so it moves with terminal velocity.

2 Fig 2.1 (*not drawn to scale*) shows the forces acting on an arrow by the string of a bow just before it is released.

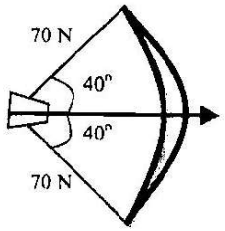
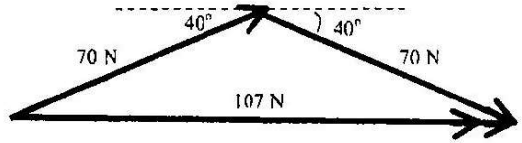


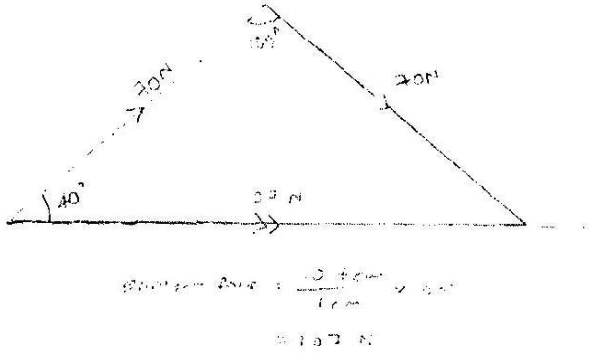
Fig. 2.1

Using a suitable labelled vector diagram, determine the magnitude and the direction of the resultant force exerted by the bowstring on the arrow. [3]



[1/2] appropriate scale: 1 cm rep10 N
[1/2] correct orientation
[1/2] correct diagram with labelled forces
[1/2] correct arrow direction, resultant force double arrows

Magnitude of the resultant force = 107 N (± 2 N) [1/2]
Direction of the resultant force = **horizontal to the right** or 40° to/from the 70 N force [½]



3 (a) Fig. 3.1 shows a piece of glass being lifted by a suction cup. Some air inside the suction cup is removed by a vacuum pump. The atmospheric pressure outside the cup prevents the glass from dropping. The area of the glass covered by the cup is 0.0025 m^2. The pressure inside the cup is reduced to 60 kPa. The atmospheric pressure is 100 kPa.

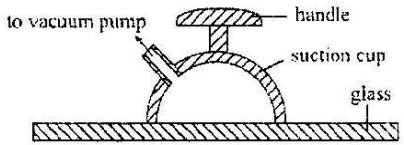


Fig. 3.1

(i) Calculate the maximum weight of a piece of glass that can be lifted with this cup. [1]

Pressure difference that prevents the glass from slipping = (100 – 60) kPa
= 40 kPa

P = F/A
F = 40 000 Pa × 0.0025 m^2
F = **100 N**

(ii) State one change that would allow the suction cup to lift a heavier piece of glass. [1]

Any one of the answers:

1) Suck out more air from inside of suction cup to increase the pressure difference.

2) Increase the surface area of the suction cup with the glass

(b) Fig. 3.2 shows a metal can with a tight fitting lid and the can is heated.

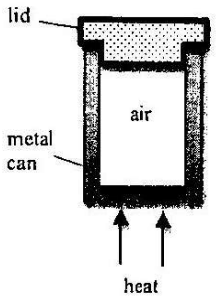


Fig. 3.2

(i) Explain, in terms of the motion of molecules, why the pressure in the metal can increases when the can is heated. [2]

As the temperature increases, the **average kinetic energy of the air molecules increases and air molecules move faster**. The **rate / frequency of collision of the air molecules with the walls of can increases.** The air molecules also collide with the walls of the can with **greater average force**. **Pressure is force per unit area (P = F/A)**.This causes the pressure to increase.

(ii) If a little water is put in the bottom of the can before heating, explain how this would affect the pressure in the can when the temperature increases. [2]

There will be **greater increase in pressure** as there will be **more (air) molecules due the vaporisation of water in the metal can**. Therefore, **frequency of collisions per unit area of the walls will increase**.

4 (a) Fig. 4.1 shows a filament lamp standing upright in air. The connections to the lamp are not shown. When switched on, the filament lamp loses energy by conduction, convection and radiation.

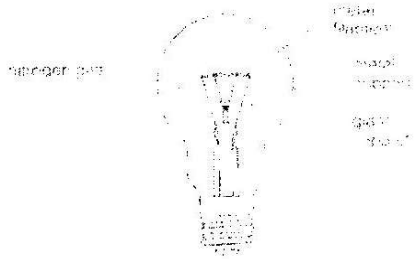


Fig. 4.1

Describe how energy is lost from the metal filament

(i) by conduction, [1]

Thermal energy is conducted down the **metal support** through the **glass support** and lost through the base of the filament lamp.

(ii) by convection. [2]

The metal filament **heated up the nitrogen gas near to the filament** and the gas expands, becomes less dense and rises. **(Minimal)**

The cooler gas being denser sinks. The **heated nitrogen gas transfers thermal energy to the surrounding air around the lamp by radiation or conduction.** The **air around the filament lamp is heated up expands, becomes less dense and rises.** The denser cooler surrounding air sinks. **Difference in densities set up convection current in the nitrogen gas inside the glass bulb and the air around the filament lamp** causing thermal energy to be lost to the surroundings.

(b) Fig. 4.2 shows an electric bulb painted matt black on one half and silver on the other.

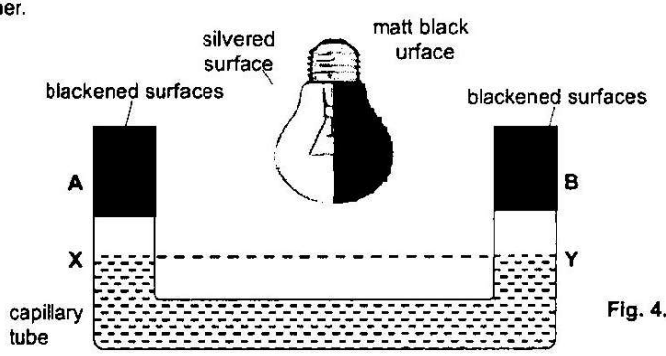


Fig. 4.2

(i) State which method(s) of heat transfer is/are involved in this setup. [1]

Radiation

(ii) A capillary tube containing water up to level **XY** is covered with blackened test tubes, **A** and **B**. The bulb is then switched on. Describe and explain what happens to the water level in the capillary tube. [2]

Black is a **good/better emitter of radiant heat** so rate of emission from the black surface of the bulb is greater.
Black is also a **good / better absorber of radiant heat.** Thus, the **rate of heat absorption** in blackened **test tube B will be greater** than A.
When heated, the **(air molecules in B will move faster)** and the pressure exerted **on water surface at Y will be greater.**
Thus, **X will have a higher water level than Y.**

5 (a) A ray of light is incident on a right-angled prism of refractive index 1.5 as shown in Fig. 5.1.

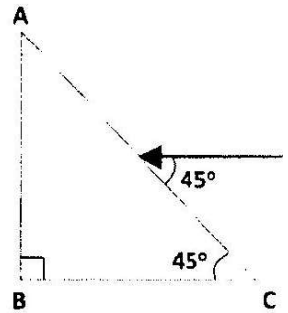


Fig. 5.1

(i) Calculate the angle of refraction of the ray. [1]

Let r be the angle of refraction,

$$n = \frac{\sin i}{\sin r}$$

$$1.5 = \frac{\sin 45^\circ}{\sin r}$$

$$r = 28^0$$

(ii) Explain whether this ray within the prism will undergo total internal reflection when it hits the face AB. Show all your workings clearly. [3]

Let c be the critical angle for the glass,

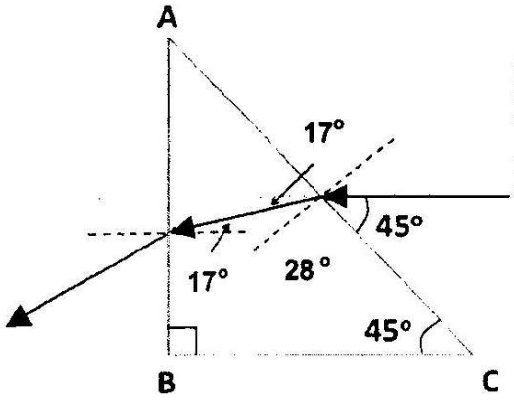
$$n = \frac{1}{\sin c}$$

$$1.5 = \frac{1}{\sin c}$$

$$c = 42^0$$

Using Geometry,
Angle of incidence of light ray at face AB, $i = 17^\circ$
The ray within the prism **will not undergo total internal reflection** since the **angle of incidence at face AB [1/2] is smaller than the critical angle**.

(iii) Hence, complete the light ray in the Fig. 5.1 to show how light travels when it strikes on the face AC. [1]



[1/2] correct light rays drawn with arrows

[1/2] angles clearly stated

(b) A parallel beam of light making an angle of 30° with the principal axis is incident on the lens as shown in the Fig. 5.2.

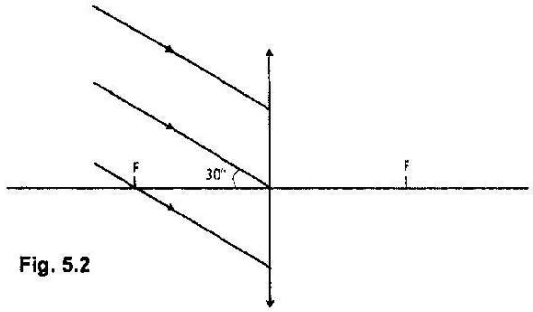
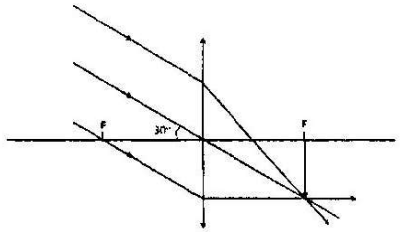


Fig. 5.2

(i) If the rays shown in Fig. 5.2 are from the top of a distant tree, complete the ray diagram to locate the image of the tree. [2]



½ mark for each correct ray drawn and ½ for the image drawn.

(ii) Describe the characteristics of the tree image. [1]

The tree image is real, inverted and diminished.

[1 marks for all 3 correct characteristics; 0.5 marks for 2; 0 mark for 1 and 0 for none.]

6 Fig 6.1 shows a series of wavefronts of a water wave travelling through regions P and Q.

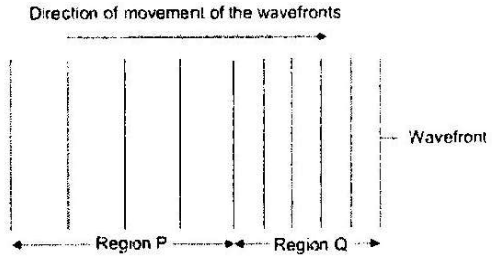


Fig. 6.1

(a) State and explain which region is deeper. [2]

Region P is deeper. It is because the **wavelength of P is longer than Q**, so **speed of the water wave is greater in region P** while **frequency of the wave remains unchanged**.

(b) The distance between two successive wavefronts in region Q is 2.0 cm and each wavefront takes 4.0 s to travel through region Q.

(*i*) Determine the speed of the water wave in region Q. [2]

Distance of region Q = 5 x 2.0 cm
= 10 cm

Distance = speed x time
Speed = 10 cm / 4.0 s
= 2.5 cm/s

(ii) Hence, determine the frequency of the wave. [1]

$v = f\lambda$

$f = 0.025\ ms^{-1} / 0.020\ m$ [1/2] with formula (accept if units in cm/s & cm)

= 1.25 Hz

7 (a) Three uncharged metal spheres **A**, **B** and **C** mounted on insulating supports are positioned so that they touch. A rod carrying positive charge is brought near to them as shown in Fig. 7.1.

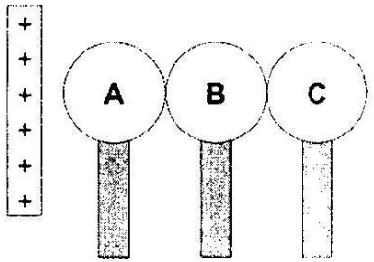
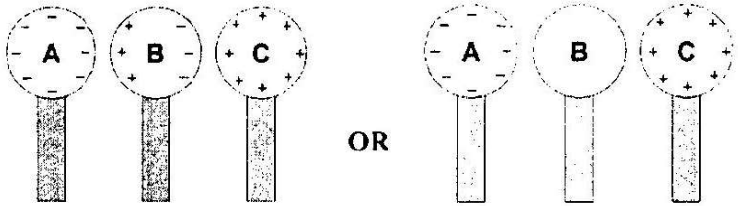


Fig. 7.1

The spheres are now moved slightly apart with the insulating supports and the charged rod is then removed.

(**i**) On Fig. 7.1, show the resulting charges on the spheres. [2]



[1] for showing the negative charges in sphere **A**

[1] for showing the positive charges in sphere **C**.

(**ii**) Sphere **A** is moved until it touches sphere **C**. State the movement of the charges that occurs when they touch. [1]

The negative charges in sphere **A** flows into sphere **C**.

(b) Fig. 7.2 shows an electric motor which is rated 200 V, 900 W.

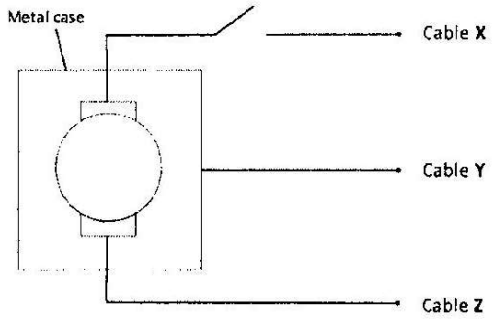


Fig. 7.2

(i) Calculate the current drawn by the motor when it is connected correctly. [1]

$I = P / V$

$= 900 / 200$

$= 4.5$ A

(ii) Suggest a suitable rating for the fuse to be connected to the circuit. [1]

5 A (accept 6 A or 7 A) or

Any value slightly greater than the answer in part (a) [e.c.f]

(iii) State and explain which cable (**X**, **Y** or **Z**) should the fuse be placed. [1]

The fuse should be placed along cable **X** as cable **X** is the live wire where switch is placed on the **live wire to disconnect the appliance from high voltage source**.

8 A circuit is set up as shown in Fig. 8.1. The variable resistor XY varies between 0 Ω to 1.0 kΩ.

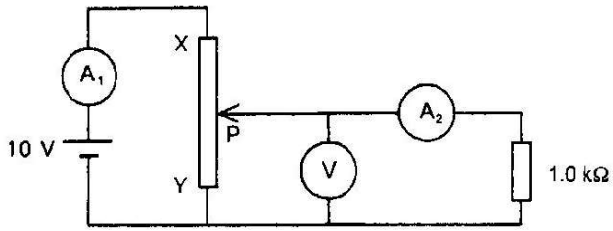


Fig. 8.1

State what happens to the readings of the three meters as P moves from Y to X. Give numerical values where possible. [5]

Voltmeter: The voltmeter reading will **increase** from **0 V to 10 V**.

Ammeter A_1: The ammeter reading will **increase** from **0.01 A** to **0.02 A**.

Ammeter A_2: The ammeter reading will **increase** from **0 A** to **0.01 A**.

9 Fig. 9.1 shows a simple magnetic relay, together with three contacts X, Y and Z, used to control the operation of two lamps L_1 and L_2 and a motor of a fan, M.

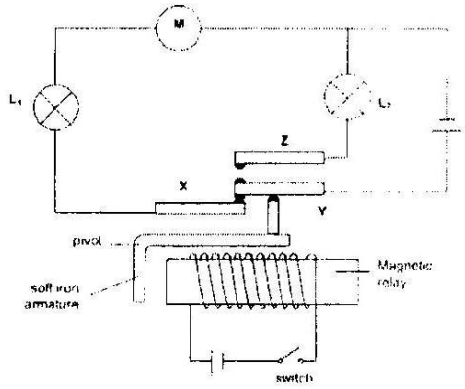


Fig. 9.1

(a) Suggest a suitable material for the magnetic relay. Explain why. [2]

(Soft) Iron.

Iron is a **soft magnetic material** which is **magnetised easily**, but it also **loses its magnetism easily**.

(b) Describe and explain the changes that occur when the switch is closed. [3]

When the switch is closed, **current flows through the solenoid** and magnetic field is produced at the solenoid. **Magnetic relay becomes magnetised / an electromagnet** and **attracts the soft iron armature** pushing the **contact Y upwards to be in contact with Z**. Therefore, **L_2 lights up** but **L_1 and motor of a fan are switched off.**

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 Fig. 10.1 shows the properties of three metals X, Y and Z.

Metal	Density / gcm^{-3}	Specific heat capacity /Jg^{-1}°C^{-1}	Melting point / °C
X	2.7	0.90	700
Y	1.8	0.15	1800
Z	8.0	0.40	1600

Fig. 10.1

Three cooking pots of the same shape are made from the same volume of 800 cm^3 of each of the metals X, Y and Z.

(a) Which pot is the heaviest? Show your working clearly in the space provided. [3]

Mass = Density x Volume
Mass for metal X = (2.7 × 800) g = 2160 g
Mass for metal Y = (1.8 × 800) g = 1440 g
Mass for metal Z = (8.0 × 800) g = 6400 g

Pot made of metal Z is the heaviest because the mass of metal Z is the largest.

(b) Each pot contains equal volume of water and is heated by a hot plate that supplies thermal energy at the same rate. State and explain which pot of water will be the first to boil. [2]

Water in pot Y will be the first to boil because the **heat capacity of metal Y (216 J°C^{-1}) is the lowest** which means that the **amount of thermal energy required to raise the temperature of metal Y by 1 °C is the smallest as compared to metal X (1944 J°C^{-1}) and Z (2560 J°C^{-1})** and with the same amount of thermal energy supplied by the hot plate, water in the pot Y will be heated up faster.

(c) After the water in each of the pots had boiled, the pots are removed from the hot plate and allowed to cool. Heat is lost from the pots at the same rate. After five minutes, state and explain which pot of water will be at the higher temperature. [2]

Water in pot X will be the at the higher temperature as compared to water in pot Y because it has the **higher heat capacity (1944 J°C^{-1} > 216 J°C^{-1})** so **more thermal energy will be needed for the temperature of metal X to drop 1 °C.**

Another acceptable answer (OR)

Water in pot Z will be the at the highest temperature because it has the **highest heat capacity** (2560 J°C^{-1} > 1944 J°C^{-1} & 216 J°C^{-1}) so the **thermal energy needed for the temperature of metal Z to drop 1 °C is the highest.**

(d) State and explain the advantage of using metal Y over the other two metals. [3]

Metal Y is the **lightest** as its **mass (1440 g) is the smallest** among the metals. Metal has the **lowest specific heat capacity**, which required the **least amount of thermal energy to raise the temperature of 1 g by 1°C.** It has also the **highest melting point** among the metals.

11 Fig. 11.1 shows parts of a tall tower crane used on building sires. The trolley used to pick up loads can be moved along an iron jib of uniform density and a length of 80.0 m. The iron jib is pivoted at a point P, which is 20.0 m from one end. A concrete block A of weight 1.5×10^5 N helps to keep the iron jib horizontal at all times.

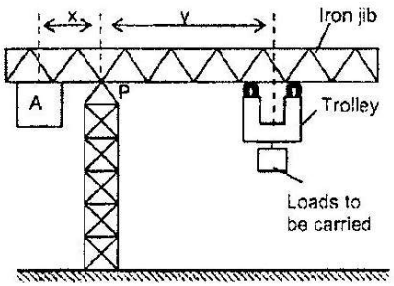


Fig. 11.1

(a) (i) When the crane is used to lift a load of 4.0×10^4 N, the distance x and y must be kept at 6.0 m and 15.0 m respectively to ensure the iron jib does not topple. Keeping the distance x at 6.0 m, determine the load in which the crane can carry without toppling if the trolley is moved till y = 30.0 m. [3]

Let W be the weight of iron jib.

For body to be equilibrium, taking moment about pivot P,

Sum of clockwise moments = Sum of anticlockwise moments

$(4.0 \times 10^4\ N)(15.0\ m) + (W \times 20.0\ m) = (1.5 \times 10^5\ N)(6.0\ m)$

$W = 15\,000$ N

Let L be the new load the crane can carry.

For body to be equilibrium, taking moment about pivot P,

Sum of clockwise moments = Sum of anticlockwise moments

$L \times 30.0\ m + (15\,000\ N \times 20.0\ m) = (1.5 \times 10^5\ N)(6.0\ m)$

$L = 20\,000$ N or 2.0×10^4 N

(ii) With y kept at 30.0 m, if the trolley is to lift a load heavier than the value calculated in (i), suggest and explain what changes must be made to the parts of the crane. [2]

Move the pivot nearer to the trolley / increase the distance x / use a heavier block A to increase the anticlockwise moment to balance the increased clockwise moment caused by the heavier load.

OR

Use a smaller mass of iron jib to reduce the clockwise moments to balance the **constant anticlockwise moment**.

(b) The tower crane can be modified to carry a load of fixed mass and the distance y can be varied without causing the iron jib to topple. This is done by attaching a cable as shown in Fig. 11.2.

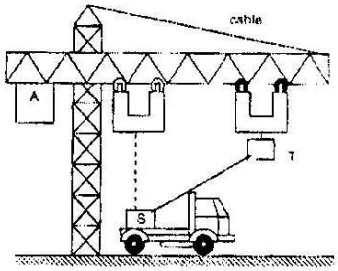


Fig. 11.2

The crane is used to lift a load of 1.5×10^5 N from a height of 1.0 m at S to a height of 25.0 m at T along the diagonal path ST in a time of 30.0 s.

(i) Calculate the gain in gravitational potential energy by the load as it lifted from S to T. [1]

Gain in G.P.E = mgh

$= 1.5 \times 10^5\ N \times 24.0\ m$

$= 3\,600\,000$ J or 3.6×10^6 J

(ii) If the electrical energy is supplied to the crane at a rate of 5.3×10^5 W, calculate the efficiency of the crane motor. [2]

Output power = E / t

$= 3\,600\,000\ J / 30.0\ s$

$= 120\,000$ W or 1.2×10^5 W

Efficiency = (Output Power / Input Power) x 100%

$= (1.2 \times 10^5\ W / 5.3 \times 10^5\ W) \times 100\%$

$= 22.6\%$ or 23%

(iii) At position T, the crane stops lifting the load. If the load is dropped from this height, calculate the speed of the load before it hits the ground. [2]

By Principle of Conservation of Energy,

Loss in G.P.E. = Gain in K.E.

$mgh = \frac{1}{2} mv^2$

$v^2 = 2 \times 10\ ms^{-2} \times 25.0\ m$

$v = 22.4\ ms^{-1}$ or $22\ ms^{-1}$

12 EITHER

(a) Describe an experiment to determine the speed of sound in air.

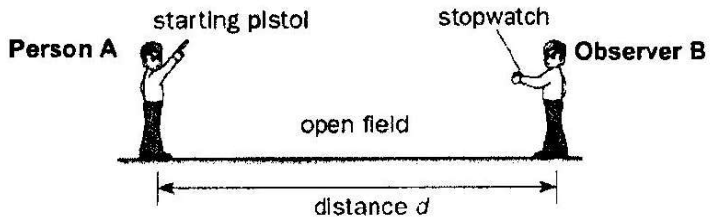
In your account

- list all the apparatus you would use,
- describe the procedure of the experiment with the aid of a diagram,
- state one way you would take to improve the accuracy of this experiment.

[5]

Apparatus: a pistol, a stopwatch, a measuring device such as measuring tape [1/2]

Diagram: [1/2] for drawing + [1/2] for labelling



Procedure:

The experiment is carried out with **two people are positioned at a known distance, d apart e.g. 1km in an open space.** When **person A holding the pistol fires the pistol, observer B upon seeing the smoke/flash from the pistol starts the stopwatch and stops timing on hearing the sound of the shot. The speed of the sound can be calculated using the distance, d divided by the time interval recorded on the stopwatch.**

Ways to reduce SOEs: (either one)

The experiment is repeated with person B firing and person A recording the time. An average time interval can then be calculated. This will reduce error due to the effect of wind.

The experiment can be repeated several / 2 or 3 times and an average timing is taken. This reduces the error due to human reaction time.

(b) Fig.12.1 shows an experiment carried out by Naomi to measure the wind speed.

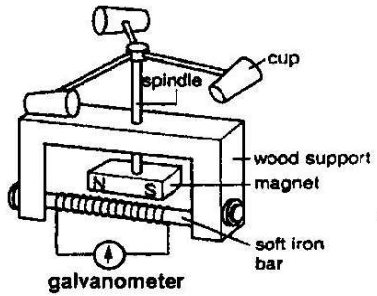


Fig. 12.1

(i) Explain how the wind causes the galvanometer to give a reading. [2]

The wind causes the plastic cups to turn. This causes the spindle and the **magnet to rotate**. The rotating magnet produces **changing magnetic field linking the coil / solenoid.** This **causes an e.m.f. / current to be induced across the coil / solenoid** and thus the galvanometer gives a reading.

(ii) Why does the galvanometer reading increase as the wind speed increases? [2]

As the **wind speed increases, the magnet rotates faster.** This **increases the rate at which its magnetic field lines linking the coil / greater rate of change of magnetic field lines linking the coil.** Thus the **induced e.m.f. / current increases.**

(iii) The design shown in Fig. 12.1 is not sensitive enough to measure smaller winds. Give two ways that Naomi can modify the design to make the gauge more sensitive. [1]

Any two of the following (:

- increase the number of turns of coil,
- use a stronger magnet,
- use larger cups,
- use more cups,
- use lighter cup

12 OR

(a) Ultrasound may be used to measure the depth of the sea. Fig. 12.2 shows a pulse of ultrasound sent down to the sea bed and the reflected pulse returning to the ship.

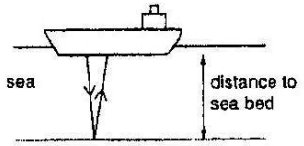


Fig. 12.2

(i) Describe what is meant by ultrasound. [1]

Ultrasound is **sound waves with frequency greater than 20 kHz**. It is beyond human audible range of hearing.

(ii) Fig. 12.3 is a cathode-ray oscilloscope (c.r.c.) trace of the pulses of ultrasound sent from the ship and the reflected pulses.

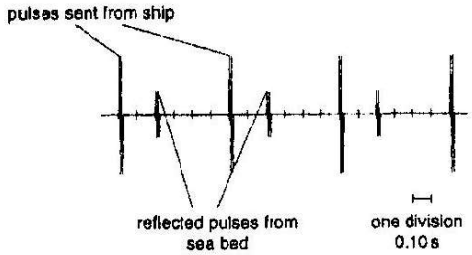


Fig. 12.3

The speed of ultrasound in water is 1500 m/s and the wavelength of the ultrasound wave is 0.030 m. The time-base setting for the x-axis on the c.r.o. is 0.10 s/division. Calculate the distance to the sea bed. [2]

Time for ultrasound pulse to reach sea bed = 0.10 s

Distance = speed × time

= 1500 m/s × 0.10 s

= 150 m

(iii) The ship moves to a place where the sea is deeper. State and explain two changes that would occur to the reflected pulses on the c.r.o. trace. [2]

With the same rate of transmission of the pulses sent from the ship, the number of cycles of waves displayed on the c.r.o. will be the same. **The horizontal separation between the transmitted pulse and the reflected pulse will be further in the c.r.o. as it will take a longer time for the reflected pulse to travel from sea bed to the ship.**

The **amplitude of the reflected pulses will be smaller as there is more energy loss** in a larger time interval. Some energy is absorbed by sea bed during reflection and surrounding water when sound waves propagate through the water.

(b) Fig. 12.4 shows two insulated copper coils, P and Q mounted close together on a wooden rod. Coil P is connected to switch S and a battery. Coil Q is connected to a sensitive voltmeter V.

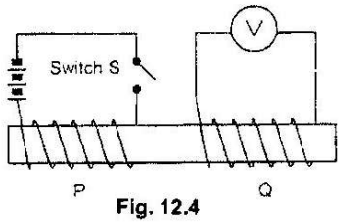


Fig. 12.4

When the switch S is closed, a deflection is seen on the voltmeter. This deflection lasts for a very short time.

(i) Explain whether the current flows through the meter from left to right or from right to left. [2]

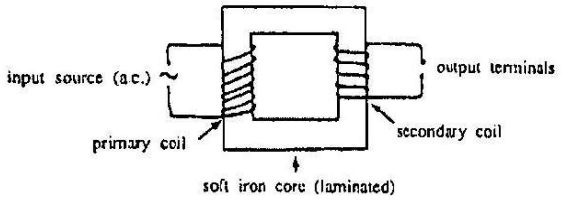
The **current flows through the meter from left to right**. According to **Lenz's Law of electromagnetic induction states that the direction of induced emf hence induced current is always such that its magnetic effect opposes the motion or change producing it**. Since the **current flows from the positive terminal and back to negative terminal of battery in coil P**, the **induced current flows in coil Q in the opposite direction** to oppose the increase in the magnetic flux linkage in coil P.

OR

The **current flows through the meter from left to right**. According to **Lenz's Law of electromagnetic induction states that the direction of induced emf hence induced current is always such that its magnetic effect opposes the change producing it**. Since **coil P magnetized with North pole facing coil Q**, it **induces North pole on the left of coil Q** and using right-hand grip rule, **an induced current flowing in the opposite direction** to oppose the change in the magnetic flux linkage in coil P.

(ii) Explain briefly how this effect is made use of in a transformer. Include in your answer a labelled diagram to illustrate the structure of a transformer. [3]

A transformer has a primary coil and a secondary coil wound around a soft iron core which is made of laminations of soft iron insulated from each other.



An alternating voltage has to be used in primary coil so that a **continuously / constantly changing magnetic field is produced in primary coil which is linked to the secondary coil through / via the soft iron core to induce an alternating e.m.f**.

[1] correct diagram with primary and secondary coils (both coils should have different no. of turns)
[1/2] for labelling

Paper 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	C	C	A	B	B	A	C	C	D	D	D	A	A	A	B	B	C	C	C
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
B	A	B	D	C	C	C	A	D	B	D	D	C	A	D	B	A	A	D	A

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2016

PHYSICS (5059/1)

PAPER 1

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

22 August 2016
1030 - 1130
1 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the OTAS.

Read very carefully the instructions on the OTAS.

INFORMATION FOR CANDIDATES

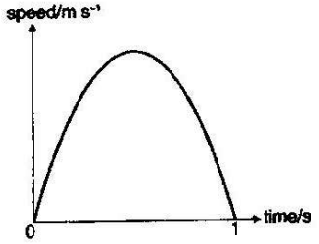
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Take the gravitational field strength on Earth, g to be 10 Nkg^{-1}.

Name of setter: Mdm Quek Lay Hong

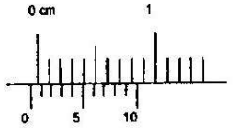
1 The graph shows the speed-time graph of a pendulum bob oscillating from a point.



What is the period of the oscillation of the pendulum bob?

A 5 s **B** 1.0 s **C** 1.5 s **D** 2.0 s

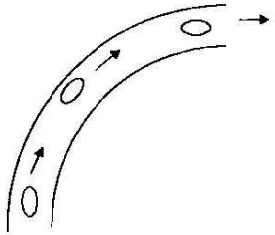
2 The diagram below shows part of a vernier scale when the jaws of the vernier calipers are closed.



What is the zero error of the vernier calipers shown?

A +0.04 cm **B** -0.04 cm **C** +0.06 cm **D** -0.06 cm

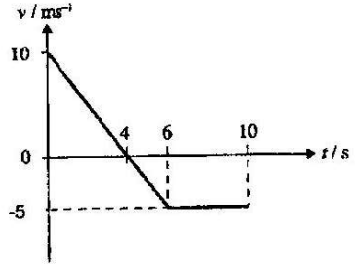
3 A car travels at *constant speed* round a bend.



Which of the following statements about the motion of the car is **not** correct?

A The car is accelerating.
B The velocity of the car is uniform.
C The displacement of the car increases.
D The distance covered per unit time by the car is constant.

4 The velocity-time graph below shows the motion of an object moving in a straight line.



Which of the following statements is/are true?

1. The object is stationary at 4 s.
2. The object is 5 m behind the starting point at t = 6 s.
3. The object is furthest away from its starting point at t = 10 s.

A 1 only
B 1 and 2 only
C 1 and 3 only
D All of the above

5 The engine of an 800 kg sports car exerts a constant forward force of 500 N on the car.

When the parachute is opened, the car decelerates at 2.5 ms^2 while the engine continues to provide the forward force of 500 N.

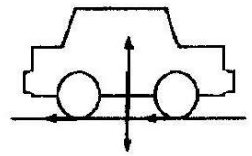


What is the tension in the cord at this instant? (Assuming that there is no other resistive force.)

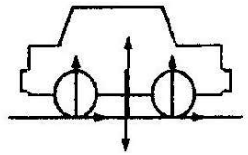
A 500 N
B 1500 N
C 2000 N
D 2500 N

6 A car starting from rest accelerates towards the right without skidding along a horizontal road. Which diagram below illustrates the forces acting on the car?

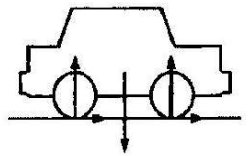
A



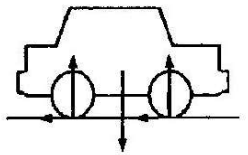
B



C



D

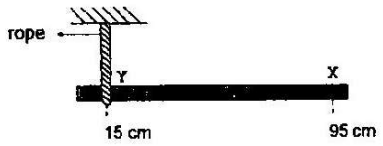


7 The gravitational field strength of a particular planet is 5 N/kg. On earth, the gravitational field strength is 10 N/kg. A rock weighs 80 N on that planet.

What would be its weight on earth?

A 10 N B 16 N C 80 N D 160 N

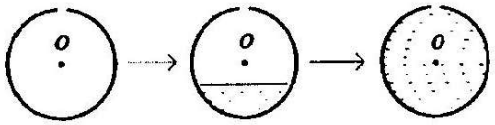
8 In the diagram below, the uniform metre rule is pivoted at X and held up at the point Y by a rope.



Given that the weight of the metre rule is 4.0 N, calculate the tension in the rope that is needed to ensure that the ruler stays horizontal.

A 1.8 N B 2.3 N C 3.1 N D 5.1 N

9

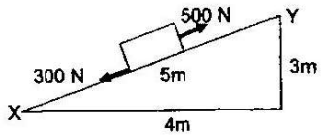


The above diagram shows a uniform hollow metal sphere with a small opening on top. *O* is the position of the centre of gravity of the hollow sphere.

What will happen to the position of the centre of gravity of the system as the sphere is being slowly filled with oil from the opening?

A It will remain unchanged throughout the process.
B It will fall gradually, and its final position will be below *O*.
C It will rise gradually and its final position will be above *O*.
D It will fall gradually at first and then rise to its original position.

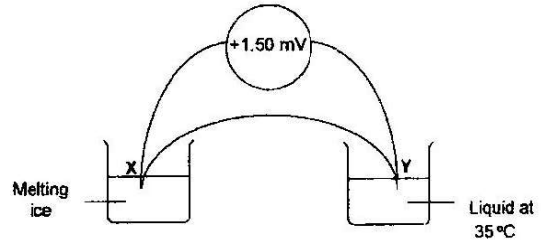
10 A force of 500 N is applied to a box to move it up the ramp as shown. The friction acting on the box is 300 N.



How much work is done against friction?

A 300 J B 1 200 J C 1 500 J D 3 000 J

11 The diagram shows a thermocouple thermometer when junctions X and Y are placed in melting ice and in a liquid at 35°C respectively.



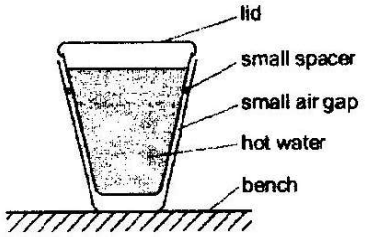
What is the voltmeter reading when junction X is removed and placed in boiling water instead?

A -2.79 mV B -1.92 mV
C +1.50 mV D +2.79 mV

12 Which of the following best explains steam point?

A The temperature of pure water when it boils at a pressure of 1 atm.
B The temperature of pure water just after it boils at a pressure of 1 atm.
C The temperature of steam from pure boiling water at a pressure of 1 atm.
D The temperature of the air above pure boiling water at a pressure of 1 atm.

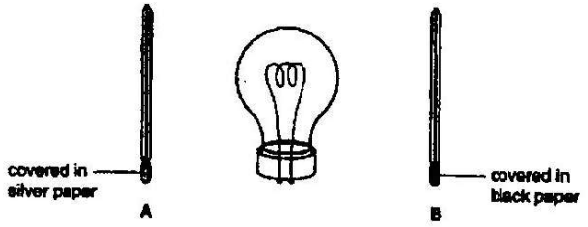
13 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top, as shown.



Which statement is correct?

A No heat passes through the sides of either cup.
B The lid is used to reduce heat loss by convection.
C Heat loss by radiation is prevented by the small air gap.
D The bench is heated by convection from the bottom of the outer cup.

14 The experiment is set up using a light bulb and two thermometers, **A** and **B**. The light bulb is switched on. After two minutes the thermometers show an increase in temperature. Thermometer **B** shows a greater increase in temperature.



Which of the following is/are **true** statements about this experiment?

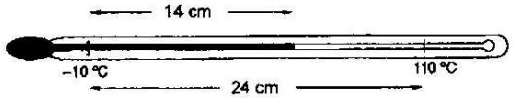
1. The silver paper is a better reflector of radiation.
2. The black paper is a better absorber of radiation
3. Heat is transferred to the thermometers mainly by radiation.

A 2 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

15 What happens when a liquid is being heated at its boiling point?

A An increase in molecular size
B An increase in molecular spacing
C An increase in the total number of molecules
D An increase in the average kinetic energy of the molecules

16 The figure below shows a mercury thermometer. The distance between the -10°C and 110°C markings is 24 cm.



What temperature does the thermometer read?

A 48 °C
B 58 °C
C 60 °C
D 70 °C

17 Which statement is true about water molecules at 70 °C?

A There are forces between the molecules and no molecules have enough energy to escape the liquid.
B There are forces between the molecules and some molecules have enough energy to escape the liquid.
C There are no forces between the molecules and no molecules have enough energy to escape the liquid.
D There are no forces between the molecules and some molecules have enough energy to escape the liquid.

18 The diagram below shows a frying pan.



The table shows three solid materials with their respective specific heat capacities.

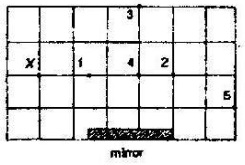
Solid Material	*Specific Heat Capacity (J/kg°C)*
K	440
L	920
M	4250

Assuming all these materials have reasonably high melting points, which materials are best suited to make the base and handle?

	Base	Handle
A	K	M
B	L	M
C	M	K
D	M	L

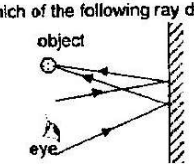
19 A person stands at point *X* as shown in the diagram.

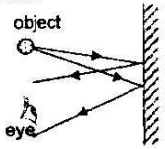
Which of the pins (1, 2, 3, 4 and 5) will the person be able to see in the mirror?

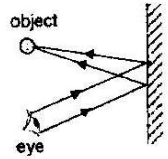


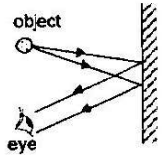
A 1, 3
B 2, 3 and 4
C 2, 4
D 2, 4 and 5

20 Which of the following ray diagrams is correct?

A


B


C


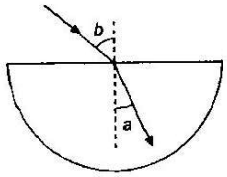
D


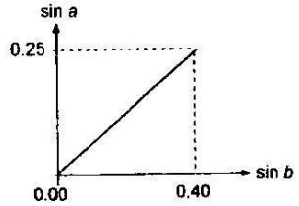
21 A ray of light travels with speed v_1 through medium 1 and then passes into another medium 2, where it travels at speed v_2. The refractive index for medium 1 and medium 2 are n_1 and n_2 respectively.

Which row in the following table correctly compares the speeds and refractive indices for each medium?

	Speed of light	Refractive index
A	v_2 is less than v_1	n_1 is less than n_2
B	v_2 is less than v_1	n_2 is same as n_1
C	v_2 is greater than v_1	n_2 is same as n_1
D	v_2 is greater than v_1	n_1 is less than n_2

22 A light beam is incident into a semi-circular glass block and refracted out as shown. A graph of sin *a* against sin *b* is plotted as shown.



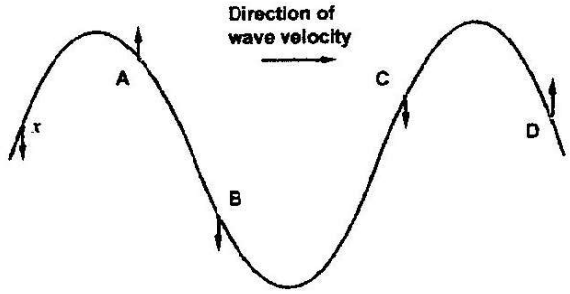


What is the critical angle of the glass?

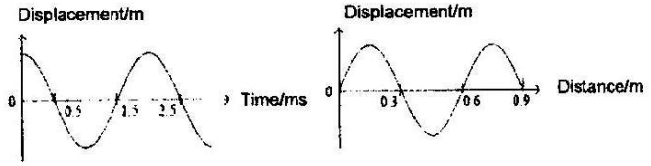
A 36.9°
B 38.7°
C 51.3°
D 53.1°

23 The diagram shows a section of a wave motion. The particle at position x moves in the direction of the arrow shown.

Which of the following particles at the labelled positions, A, B, C and D is incorrect?



24 The two graphs shown below refer to the same wave.

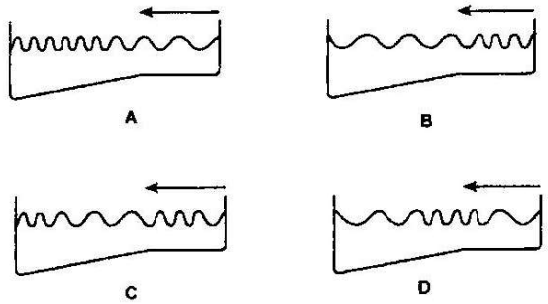


What is the speed of the wave?

A 0.3 ms^{-1}
B 1.2 ms^{-1}
C 150 ms^{-1}
D 300 ms^{-1}

25 A ripple tank contains water of varying depths.

Which diagram correctly represents the water waves as they travel from the shallow to the deep region?



26 Below are three statements about electromagnetic radiation.

- Microwaves may cause the ionisation of cells.
- Radio waves are use in cancer radiotherapy.
- Ultraviolet radiation is used in remote controls for television sets.

How many of the statements is/are correct?

A 0
B 1
C 2
D 3

27 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.

What is the correct order of increasing wavelength?

	shortest ⟶ longest		
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

28 The speed of a sound wave is reduced by half when it passes from medium A to medium B.

Which statement below describes the change in the sound wave correctly?

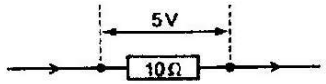
A The frequency is reduced by half.
B The wavelength is reduced by half.
C The frequency becomes twice its initial value.
D The wavelength becomes twice its initial value.

29 Sam plays a note on the guitar. He then plays a louder sound of the same pitch.

Which of the following correctly compares the speed and wavelength of the second note with the first note?

	Speed of second sound	Wavelength of second sound
A	Same	Same
B	Same	Different
C	Different	Same
D	Different	Different

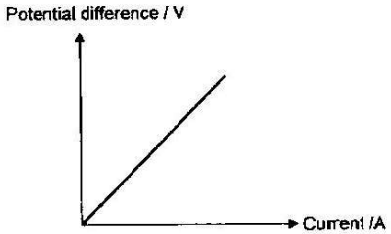
30 The potential difference across a 10 Ω resistor is 5 V.



How much charge passes through the 10 Ω resistor in 30 seconds?

A 2 C **B** 15 C **C** 60 C **D** 1500 C

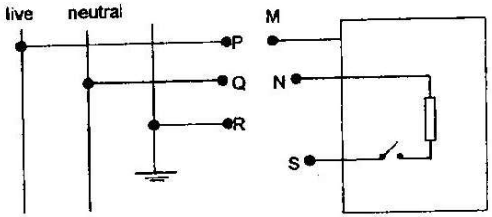
31 The graph below shows the variation of potential difference across a uniform resistance wire against the current in the wire.



Which of the following changes will make this graph steeper?

A A thinner wire is used.
B A shorter wire is used.
C The wire is made of a material of lower resistivity.
D A similar wire is connected in parallel to this wire.

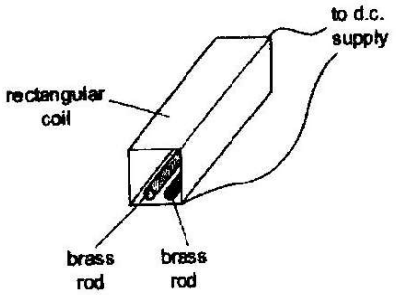
32 An electrical appliance with a metal case is to be connected to the mains supply as shown below.



Which of the following shows the correct connection of the wires from P, Q and R respectively?

	P	Q	R
A	S	M	N
B	S	N	M
C	N	M	S
D	N	S	M

33 The diagram shows two brass rods, side by side, at the bottom of a rectangular coil. The wires of the rectangular coil are insulated.

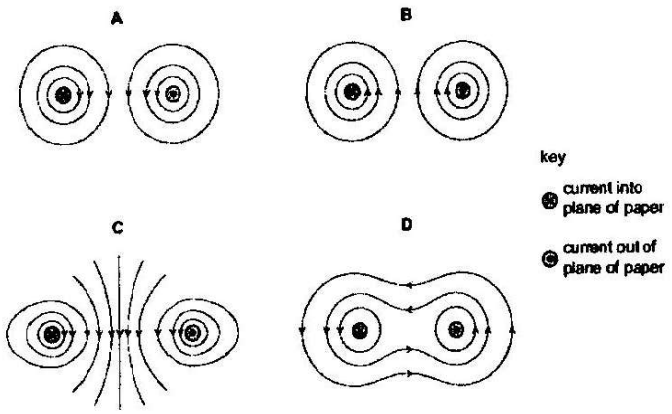


What happens when a direct current passes through the coil?

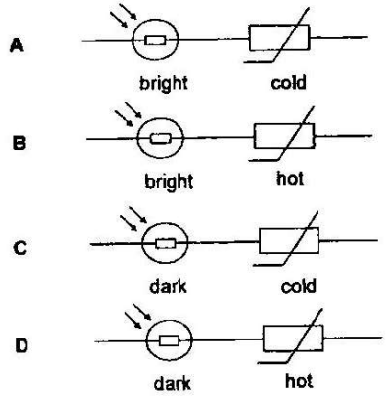
A Nothing happens.
B The two rods move towards each other.
C The two rods move away from each other.
D The two rods will move towards and then away from each other.

34 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

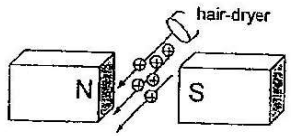
Which diagram shows the magnetic field around the two wires?



35 Given that the resistance of a thermistor decreases with increasing temperature, which of the following conditions will create the largest combined resistance in the circuit?



36 Hot air from a hair-dryer contains many positively charged ions.

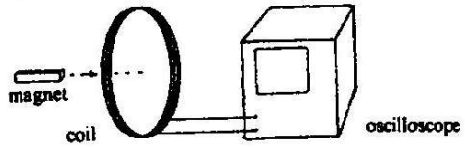


The hot air is directed between the poles of a strong magnet, as shown in the diagram above.

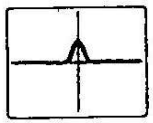
Which direction would the ions be defected?

A upwards.
B downwards.
C towards the north pole.
D towards the south pole.

37 A bar magnet is moved slowly into a coil of wire which is connected to an oscilloscope.

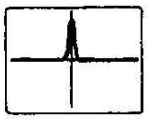


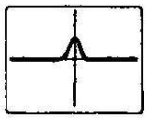
The trace on the oscilloscope is shown below:

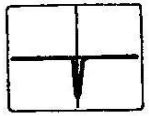


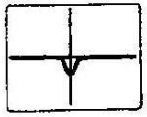
The magnet is then moved back from the coil at a greater speed.

Which trace shows this?

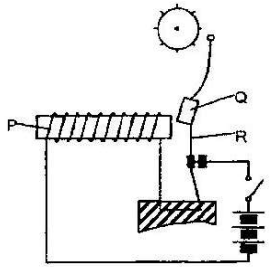
A 

B 

C 

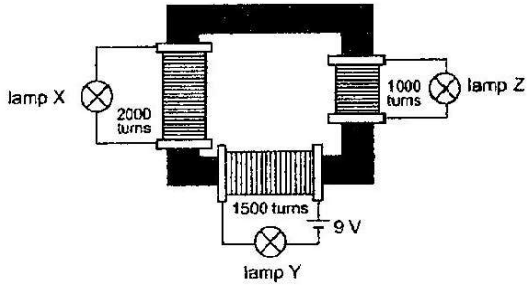
D 

38 In an electric bell, what are parts P, Q and R made of?



	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

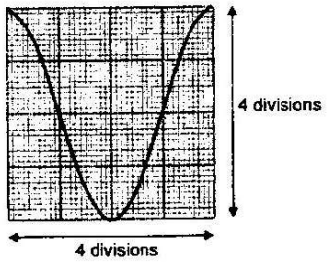
39 Three identical filament lamps, X, Y and Z, are connected to a transformer with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	Lamp X	Lamp Y	Lamp Z
A	Dimmer than normal	Normal brightness	Brighter than normal
B	Brighter than normal	Normal brightness	Dimmer than normal
C	Not lit	Normal brightness	Not lit
D	Not lit	Not lit	Not lit

40 The diagram illustrates the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.



The time-base is set to 2.0 ms/div and the voltage sensitivity is 2.0 V/div.

Which of the following correctly represents the peak voltage and frequency of the signal?

	Peak voltage	Frequency
A	4.0 V	83.3 Hz
B	4.0 V	125 Hz
C	8.0 V	83.3 Hz
D	8.0 V	125 Hz

COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2016

PHYSICS (5059/2)

PAPER 2

Name: _____ ( ) Class: _____

SECONDARY FOUR EXPRESS

18 August 2016
1115 - 1300
1 h and 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and any separate answer sheets used.
Write in dark blue or black pen.

Section A (50 marks)
Answer all questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer all three questions.
Question 12 has a choice of parts to answer.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

Take the gravitational field strength g on Earth to be 10 Nkg^{-1}.

At the end of the examination, ensure that you have submitted all your work.

For Examiner's Use	
Paper 1	40
Paper 2 Section A	50
Paper 2 Section B	30
Total	120
Parents'/Guardian's Signature	

Name of setter: Mdm Quek Lay Hong

This paper consists of **19** printed pages and 1 blank page.

[Turn over

SECTION A (50 marks)

Answer all questions. Write your answers in the spaces on the question paper.

1 Fig. 1.1 shows the velocity-time graph of a moving object.

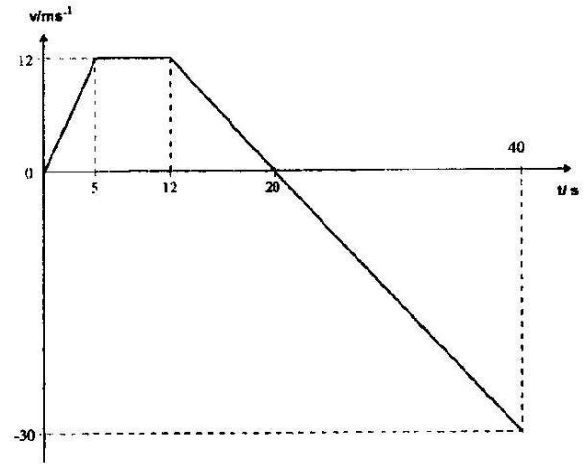


Fig. 1.1

(i) Calculate the acceleration of the object from t = 12 s to t = 20 s. [2]

Acceleration = ...

(ii) Describe the motion of the object from t = 12 s to t = 40 s. Indicate the direction of motion clearly throughout the entire duration. [2]

.....

.....

.....

2 A sky-diver jumps from a high-altitude helicopter as shown in Fig. 2.1.

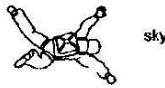


Fig. 2.1

(a) Explain why the acceleration of the sky-diver

(i) is 10.0 ms^{-2} at the start of the jump. [1]

.....

.....

(ii) decreases with time. [2]

.....

.....

.....

(b) At one point during the dive, the acceleration of the sky-diver was 7.5 ms^{-2}. The sky-diver and his equipment have a total mass of 90 kg.

Determine the total resistive force acting on the sky-diver at that point. [2]

total resistive force = ...

3 Two identical barometers **P** and **Q** containing mercury are set up at sea level as shown in Fig. 3.1.

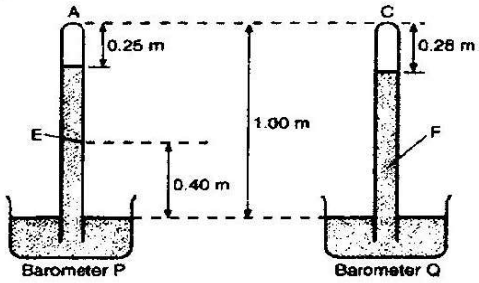


Fig. 3.1

The column of space A in barometer **P** is a perfect vacuum. The density of mercury is 13 600 kgm^{-3}.

(a) State the atmospheric pressure as measured by barometer **P**. [1]

.....

(b) Calculate the pressure at point E, giving your answer in Pascal. [2]

pressure = ...

(c) Suggest a possible reason why the column of space **C** is more than **A**. [1]

.....

(d) State the pressure within the space **C**. [1]

.....

4 The piston for the bicycle pump in Fig. 4.1 is pushed in slowly until the air pressure inside the pump in Fig.4.2 is three times greater. The air in the pump remains at a constant temperature of 20 °C.

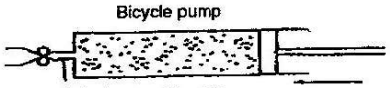


Fig. 4.1
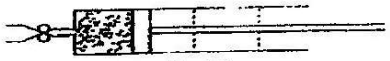


Fig. 4.2

(i) Explain in terms of molecular motion why the pressure in Fig. 4.2 should be three times greater than in Fig. 4.1. [2]

.....

.....

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(ii) If the piston had been pushed in quickly, the temperature of the air in the pump would have increased.

Explain in terms of molecular motion how this would affect the pressure in the pump. [3]

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5 Fig. 5.1 shows the path of a light ray through a converging lens.

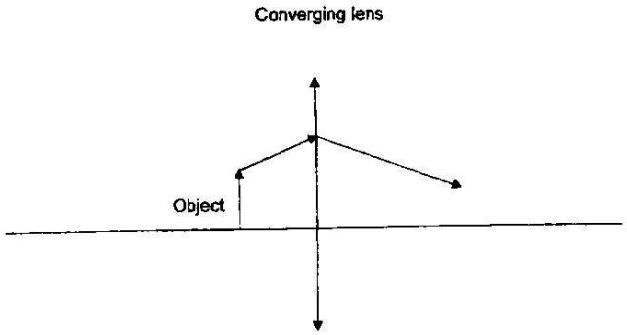


Fig. 5.1

(i) Complete the ray diagram in Fig. 5.1, locate and draw the image of the object. [2]

(ii) Explain how your diagram shows that the image is virtual. [1]

.....

.....

(iii) Complete the ray diagram in Fig. 5.1, locate the Principal Focus of the converging lens and label the point F. [2]

6 Fig. 6.1 shows wavefronts of a water wave in a ripple tank.

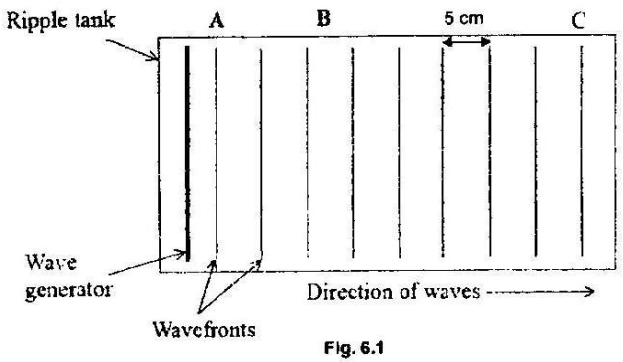


Fig. 6.1

(i) State the meaning of *'wavefront'*. [1]

.....

.....

(ii) Determine the wavelength of the wave. [1]

Wavelength = ...

(iii) A wavefront takes 1 second to travel from **A** to **C**. Determine the frequency of the wave. [1]

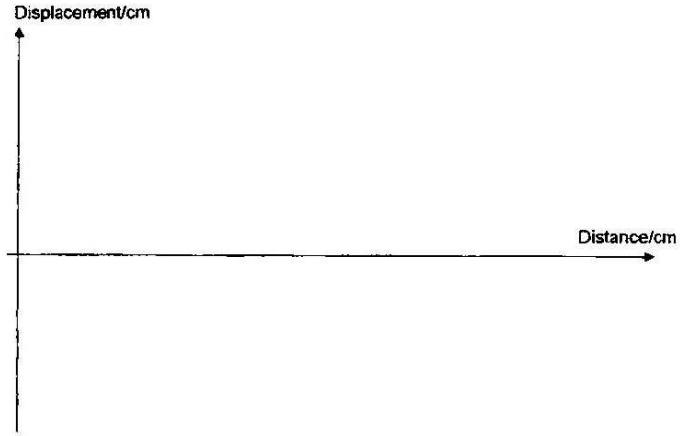
Frequency = ...

(iv) Calculate the speed of the wave. [2]

Speed = ...

(v) The wave generated has an amplitude 1.5 cm.

Sketch a displacement-distance graph. Indicate the position of **A** and **B** clearly in your graph. [2]



7 (a) The honey industry in Britain is under serious threat from a parasite that attacks bees. A company has developed a patented natural wax powder that keeps the parasites away from the bees. The formulated powder is added to a specially designed applicator placed in the doorway of the hive. Bees have specially modified hairs on their bodies that develop a static electricity charge.

Explain how the powder can adhere to the bodies the bees when they enter the hive. [2]

.....

.....

.....

(b) Large amounts of grains such as wheat can generate charges as they are poured from one storage bin to another. These organic materials are highly explosive when there is ample supply of oxygen.

State the method of charging of the grains during pouring and explain the main reason for the grains to be highly explosive. [3]

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8 Fig. 8.1 shows an electrical circuit with three identical lamps X, Y and Z, a switch, a 12 V battery, an ammeter, a voltmeter and a variable resistor.

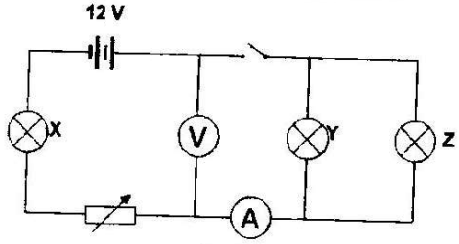


Fig. 8.1

(a) State the ammeter and voltmeter readings when the switch is opened. [2]

ammeter reading: .....

voltmeter reading: .....

(b) When the switch is closed, the ammeter reading is 1.50 A and the voltmeter reading is 3.00 V.

(i) Calculate the resistance of **each** lamp. [2]

resistance = ...

(ii) Calculate the power dissipated by Lamp **X**. [2]

power = ...

(iii) Calculate the potential difference across the variable resistor. [2]

potential difference = ...

(c) State what happens to the brightness of Lamp **Y** when the resistance of the variable resistor is increased. [1]

.....

9 Fossil fuels will eventually run out. This has led to scientists looking for alternative sources of energy. Tidal stream systems use the kinetic energy of seawater to generate electrical energy during the incoming and outgoing tides.

Fig. 9.1 below shows a twin-turbine system in which flowing seawater turns the turbine blades.

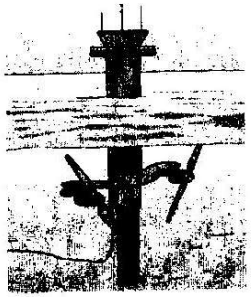


Fig. 9.1

When operating, 9.7×10^5 kg of seawater travelling at a speed of 3.0 ms^{-1} passes through each turbine every second. Each turbine generates 1.2×10^6 W of electrical energy.

(a) Define *power*. [1]

.....

(b) The input power to each turbine is the kinetic energy of the seawater that flows through each turbine in one second.

Calculate the input power of each turbine. [2]

Input power = ...

(c) Calculate the percentage efficiency of each turbine. [1]

Percentage efficiency =.....

(d) Suggest one advantage of tidal stream systems over conventional wind farms. [1]

.....

.....

SECTION B (30 marks)

Answer all the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 Four transformers, **A**, **B**, **C** and **D** are being investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs in Fig. 10.1.

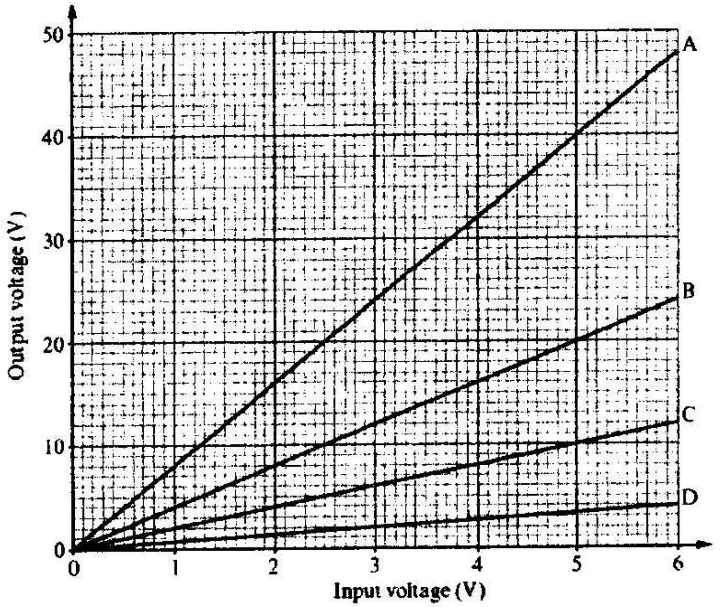


Fig. 10.1

One of the transformers is then used to light up a 12 V lamp from a 3 V power supply as shown in Fig. 10.2.

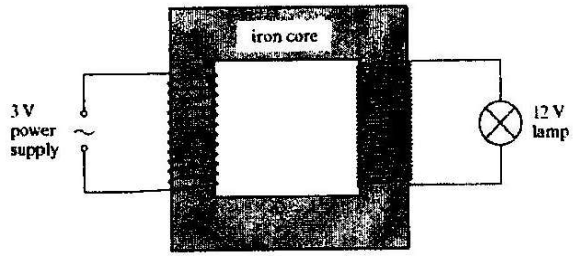


Fig. 10.2

(a) Explain how a current in the primary coil produces an output voltage in the secondary coil. [2]

.....

.....

.....

.....

(b) Describe the purpose of the iron core. [1]

.....

.....

(c) Using the data on the graphs in Fig. 10.1 to answer the following questions.

(i) State and explain which transformer, **A**, **B**, **C** or **D**, would be used to light the 12 V lamp to normal brightness, from a 3 V supply as shown in Fig. 10.2 [1]

.....

.....

(ii) Transformer **C** contains 50 turns on its primary coil. Calculate the number of turns on its secondary coil. [2]

Number of turns = ...

(iii) Transformer **A** has a current of 0.5 A in the primary coil. Calculate the current in the secondary coil. [2]

Current = ...

(iv) State and explain which transformer, **A**, **B**, **C** or **D**, is **not** suitable to be used for the transmission and distribution of energy from power stations to transmission cables. [2]

.....

.....

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11 A thermistor is placed in an environment where the surrounding temperature increases at constant rate of 1 °C/ minute. Fig. 11.1 shows how the resistance of a thermistor changes with its surrounding temperature.

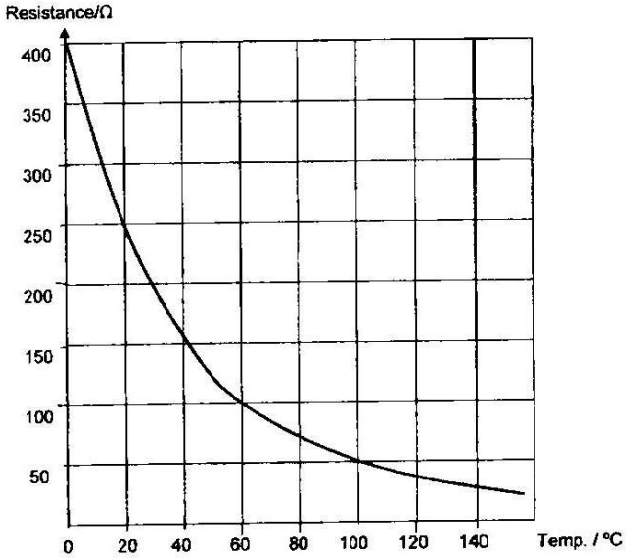


Fig. 11.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature. [1]

.....

.....

The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig. 11.2.

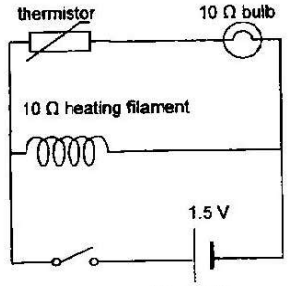


Fig. 11.2

Explain why the bulb

(i) fails to light up immediately when the switch is closed, [2]

.....

.....

.....

.....

(ii) lights up slowly after a while. [2]

.....

.....

.....

.....

(c) (i) Calculate the resistance of the thermistor when a current of 0.025 A flows through the light bulb [2]

Resistance = ...

(ii) Hence determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb [1]

Temperature = ...

(d) When the temperature of the thermistor is 100 °C, calculate the effective resistance of the whole circuit. [2]

Effective resistance = ...

12 EITHER

A pendulum consists of a metal sphere of mass 200 g attached to a thin thread as shown in Fig. 12.1. The length of the thread is 1.0 m.

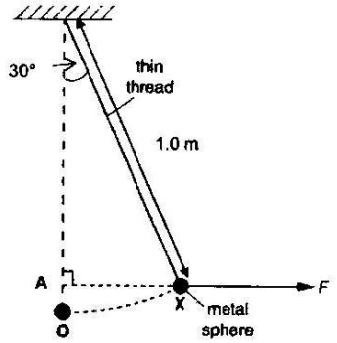


Fig. 12.1

When the thread is vertical, the metal sphere is at O. The metal sphere is moved from O to X and held in position by a horizontal force *F*. The angle between the thin thread and vertical is 30°.

(a) With an appropriate scale and drawing, determine *F* and the tension in the thread. [5]

Scale = ...

F = ...

Tension = ...

(b) Calculate the

(i) distance **OA**, which is the vertical displacement of the sphere from O to X. [1]

Distance **OA** =.....

(ii) work done to raise the sphere from O to X. [2]

Work done =.....

(iii) maximum speed of the sphere after it has been released. [2]

Maximum speed=.....

12 **OR**

A student poured 250 g of hot tea into a container. He placed a thermometer into the tea and started measuring the temperature with respect to time. After a while, he added *m* kg of ice cubes into the tea.

Fig. 12.2 below shows the temperature-time graph obtained.

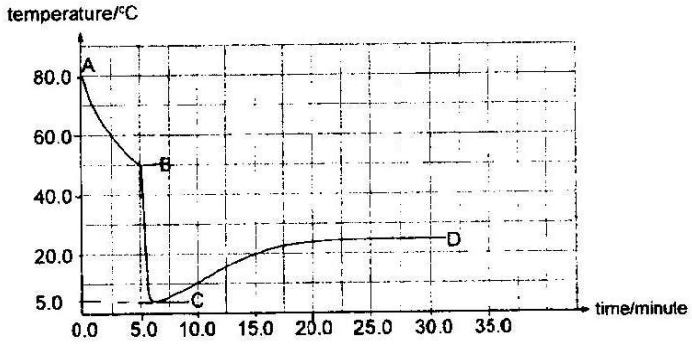


Fig. 12.2

The following information is provided :

specific heat capacity of ice = 2.10×10^3 J/kg°C
specific latent heat of fusion of ice = 3.36×10^5 J/kg
specific heat capacity of water or tea = 4.20×10^3 J/kg°C
specific latent heat of vaporisation of water or tea = 2.26×10^6 J/kg

The temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State and explain what time the student added the ice cubes into the tea. [1]

.....

.....

(b) Calculate the loss of thermal energy in the hot tea from B to C. [2]

loss of thermal energy = ...

(c) Calculate m. You may assume that there is no loss of thermal energy to the surrounding. [3]

m = ...

(d) Explain why the temperature of the tea increases from C to D. [2]

.....

.....

.....

(e) Estimate the temperature of the surrounding. [1]

.....

(f) In another experiment, the student placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

On Fig.12.2, draw the temperature-time graph for the second experiment. [1]

COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2016
SECONDARY FOUR EXPRESS PHYSICS
ANSWER KEY

Paper 1

1	D	11	A	21	A	31	A
2	D	12	C	22	B	32	B
3	B	13	B	23	B	33	A
4	A	14	D	24	D	34	C
5	D	15	B	25	B	35	C
6	C	16	C	26	A	36	A
7	D	17	B	27	D	37	C
8	B	18	A	28	B	38	A
9	D	19	D	29	A	39	C
10	C	20	B	30	B	40	B

COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS
PRELIMINARY EXAMINATION 2016
MARK SCHEME

Section A (50 marks)

1 (i) Acceleration = **(12 – 0)ms^{-1}/(12-20)s** [1]
= **-1.50 ms^{-2}** [1]

(ii) Object travel with **constant negative acceleration** [1]
Or: Decreasing velocity at a constant rate from 12 s to 20 s and increasing velocity at a constant rate from 20 s to 40 s.

The object **changes direction at t = 20s.** [1]
Or: The object moves in the positive direction from t = 12-20 s and it moves in the negative direction from t = 20-40 s.

To accept answer as long as student shows understanding that **the direction of motion is reversed at t = 20s.**

Total mark for Q 1 [4]

2 (a) (i) air resistance is **zero/negligible** [1]
or: weight / gravitational force is **only force**
Or: resultant force is the weight

(ii) **air resistance increases** as speed increases [1]
resultant force decreases [1]

2 (b) Resultant force = ma
= 90 kg x 7.5 ms^{-2}
= **675 N** [1]

Total resistive force = Weight – resultant force
= 900 N – 675 N
= **225 N** [1]

Total mark for Q 2 [5]

3 (a) Atmospheric Pressure: **0.75 mHg** or 75 cmHg or 750 mmHg [1]
Accept: 1.02 x 10^5 Pa

(b) identify h as **0.35 m** [1]

Pressure at E = 0.35 m x 13600 kg/m^3 x 10N/kg
= **47600 Pa** [1]

(c) There is **air** in C or C is not a perfect vacuum [1]

(d) P in C = **0.03 mHg** or 3 cmHg or 30 mmHg [1]
To accept answer in SI unit: 4080 Pa

Total mark for Q 3 [5]

Version 4 updated on 22 August 2016

4 (i) **The number of air molecules per unit volume is three times greater in Fig. 4.2.** [1]

Accept: Less space or distance deceases

As a result, the **frequency of collisions of the air molecules with the walls of the pump is three times greater.** [1]

Accept: 'three times' is mentioned once either in the first or second point.

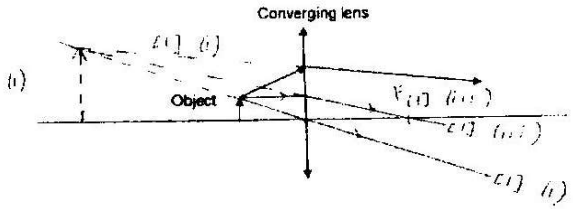
(ii) **Kinetic Energy** or **speed of air molecules increases** due to increase in temperature. [1]

The air molecules **collide more frequently and violently/forcefully with the walls** of the pump. [1]

Pressure increases [1]
Or: pressure is more than the previous se-up

Total mark for Q4 [5]

5



(i) A straight line passing through the tip of the object and Optical Centre and with extension. [1]

Extension of the given ray to intersect with the previous extension to form an upright image. Labelling of image is not required. Do not penalize if image is not dotted. [1]

(ii) The real rays do not intersect. [1]

(iii) A ray drawn parallel to Principal Axis, extended to tip of the image and passed through Principal Axis [1]

F correctly marked and labeled. [1]

To deduct a maximum of one mark for the following:
- missing arrows
- extension not in dotted lines
- arrows on extension
- arrows in wrong direction

Total mark for Q5 [5]

6 (i) A wavefront is an imaginary line **joining all the adjacent points in the same phase/adjacent crests/adjacent troughs.** [1]

(ii) Wavelength = **5 cm** [1]
Accept: 5.0 cm, 5.00 cm

(iii) Frequency = **8 Hz** [1]
Accept: 8.0 Hz, 8.00 Hz

(iv) Speed = frequency x wavelength
= **8 Hz x 5.0 cm** [1]
= **40 cms^{-1}** [1]
ecf from **(ii)** and **(iii)**

Accept: 0.4 ms^{-1}

(v) A sinusoidal wave with an amplitude of 1.5 cm [1]
B at the trough at 2.5 wavelength from **A.** [1]

Total mark for Q6 [7]

7 (a) By method of **induction** [1]
Or: a description of the induction process

The **charge of powder** nearer to the body of bee will be **opposite** to the **charge on the bee. Force of attraction is greater than the force of repulsion.** [1]

(b) Charging by **friction** or rubbing [1]

Large surface area of the grains and **charges accumulate fast** [1]
Or: large surface area of the grains and **large amount of charges accumulate** on the surface of the grains

Spark or **sudden discharge** might occur [1]
Or: high reaction/combustion rate

Total mark for Q7 [5]

Version 4 updated on 22 August 2016

8 (a) Ammeter reading = **0 A** [1]
voltmeter reading = **12 V** [1]

(b) (i) Since **Y** and **Z** are identical, current flowing through them = 1.50 A/2
= **0.75 A** [1]
R_Y = 3.00 V/0.75 A = **4.0 Ω** [1]
Hence resistance of each lamp = 4.0 Ω

(ii) P = I^2R = **(1.50 A)^2 x 4.0 Ω** [1]
= **9.0 W** [1]

(iii) p.d. across lamp X, V = IR = 1.50 A x 4.0 Ω
= **6.00 V** [1]

p.d. across the variable resistor = 12 V – 6.00 V– 3.00 V
= **3.00 V** [1]

(c) The brightness **decreases** [1]
Or: Lamp Y becomes dimmer.

Total mark for Q8 [9]

9 (a) **Rate of work done** [1]
Or: **Rate of energy conversion**
Accept: Formula expressed in words (work done divided by time taken)
Accept: Rate of energy generated/consumed

(b) **½ (9.7 X 10^3 kgs^{-1}) (3.0 ms^{-1})^2** [1]
= 4.37 X 10^4 J/s or W [1]

(c) (1.2 x 10^6 / 4.37 x 10^6) x 100%
= 27.5% [1]
e.c.f. from (b)

(d) Any of the following: [1]

- Tidal energy has **more** consistent **efficiency** as it is not dependent on climatic condition/wind condition and direction.
- **No noise pollution** for tidal energy.
- **Do not require large clearance of land space.**
- A tidal stream turbine system of identical size to a wind turbine system will **produce greater power** for the same water or wind speed
- Does not obstruct the flight path of birds

Total mark for Q9 [5]

10 (a) The **current** in the primary coil is **alternating**/changing [1]
Or: The magnetic field is changing

hence the **magnetic flux in the secondary coil is changing** continuously, hence induces an emf in the secondary coil. [1]
Or: The magnetic field linked to the secondary coil is changing

(b) To **concentrate the magnetic field lines** [1]
Or: to **link magnetic field to the secondary coil**

(c) (i) B because the **the output voltage is 12 V when the input voltage is 3V.** (as shown on the graph) [1]
Or: **the turns ratio is 4**
or **the output voltage is four times the input voltage**

(ii) **$N_s/50 = 12V/6V$** [1]
Or: The turns ratio is 2

N_s = **100** [1]

(iii) **48 V/ 6V = 0.5 A/I_s** [1]

I_s = **0.0625 A** [1]

(iv) D [1]

because it is a **step-down** transformer/current is stepped up hence the **power loss** in the cable is **higer** [1]

Total mark for Q10 [10]

11 (a) The resistance **decreases** as temperature **increases.** [1]

(b) (i) **Temperature is low** or the resistance of thermistor is high. [1]
Accept: Heating element has not been heated up
or the heating element takes time to get heated up

The p.d. across the thermistor is high hence **the p.d. across the bulb is low.** [1]
Or: No/low current through the bulb due to the high resistance in this path.

(ii) **Temperature of thermistor increases** due to the heat being transferred from the heating filament to the thermistor. [1]

The resistance and p.d of the thermistor decreases resulting in a **larger p.d. across the bulb.** [1]
Or: Current through the bulb increases due to the decrease in resistance in this path.

(c) (i) V = IR
1.5 V = 0.025 A (R_{th} + 10 Ω) [1]
Rth = 50 Ω [1]

Or:
P.d. across bulb = I x R = 0.025 x 10 = 0.25 V
P.d. across thermistor = 1.5 – 0.25 = **1.25 V** [1]
Resistance across thermistor = 1.25/0.025 = **50 Ω** [1]

(ii) Temperature = **100 °C** [1]
e.c.f. from (c) (i)
Accept: 80 °C to 100 °C for 60 Ω from (c) (i)

(d) R in series = 50 + 10 = 60 Ω
1/R = 1/60 + 1/10 [1]
R = 60/7 = 8.57 Ω [1]

Total mark for Q11 [10]

12 EITHER

(a) Accept either parallelogram or tip-to-tail method

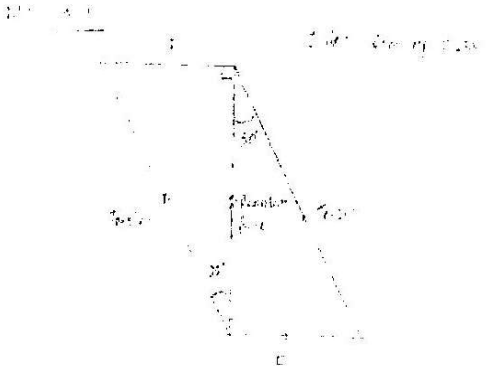
Vector diagram correctly constructed with **correct lengths for the 2.00 N vertical force** [1]

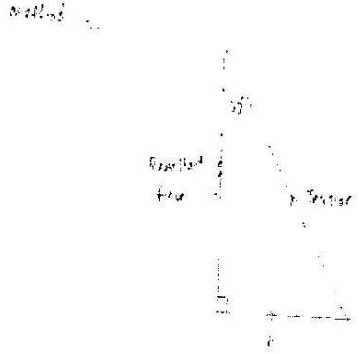
With an **enclosed angle of 30°** between vertical force and the tension [1]

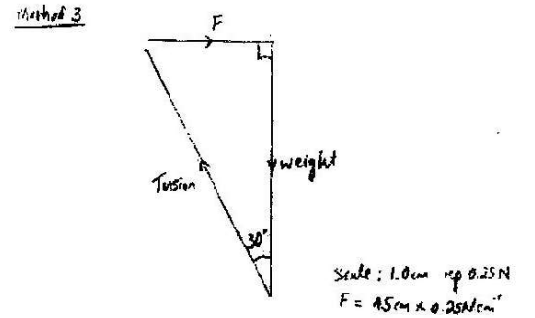
With **correct direction** of arrows for Tension, *F* and the 2.0 N vertical force. [1]

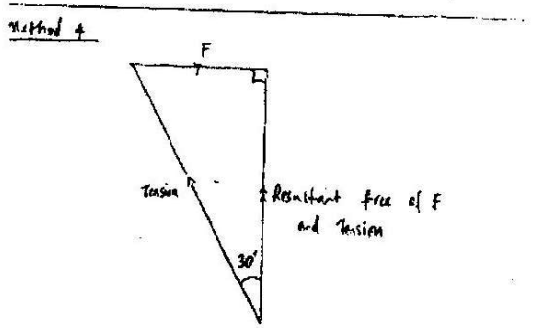
Values of *F* in the range from **1.02 N** to **1.25 N** [1]

Values of Tension in the range from **2.10 N** to **2.56 N** [1]









Method 5:
Similar to method 2 but with weight drawn with a single downward arrow

(b) **(i)** Distance OA = 1.0 m – (1.0 m cos 30°)
= **0.134 m** [1]

(ii) Work done = Gain in GPE
= mgh
= **0.200 kg x 10 Nkg^{-1} x 0.134 m** [1]
= **0.268 J** [1]
e.c.f. from (b) (i)

(iii) KE at O = GPE at X = 0.268 J
½ mv^2 = 0.268 J [1]
v = 1.64 ms^{-1} [1]
e.c.f. from (b) (ii)

Total mark for Q12 EITHER [10]

12 **OR**

(a) The student added the ice cubes at **5.0 minutes** (or at B). This is because there was a **sudden drop/decrease/change in temperature** from 5.0 minutes onwards. [1]

(b) Loss in thermal energy = $mc\theta$
= **0.250 kg x 4200 J /kg°C x (50.0 °C – 5.0°C)** [1]
= 47 250 J
= **47 300 J** (or 47 000 J) [1]

(c) Heat loss from tea = heat gained by ice cubes
47 300 = (m x 3.36 x 10^5) + (m x 4200 x 5.0)
= 336 000 m + 21 000 m
m = 47 250 / 357 000
= **0.132**

e.c.f. from (b)

Adding heat gained by ice in melting to heat gained by the melted ice in warming up: **(m x 3.36 x 10^5) + (m x 4200 x 5.0)** [1]
Equating heat gained by ice to answer in (b) [1]
Correct answer of 0.132 kg or 132 g [1]

(d) Since there is a **temperature difference** between the tea and the surrounding [1]

Or: the tea is at a lower temperature than the surrounding
Or: So to achieve equal temperature/equilibrium

thermal energy is transferred/gained/absorbed from the surrounding to the tea [1]
Or: heat flow from the surrounding to the tea

(e) **25.0 °C** (or 25 °C) [1]

(f) **Cooling curve** from 80°C to 25°C.
Final temperature of **25°C**
Takes a **longer time than 22.5 minutes** to reach 25°C

All three correct [1]

Total mark for Q12 OR [10]

Cat High

Section A

Answer all the questions in this section.

1 Fig. 1.1 shows a simple pendulum that oscillates between the points A and D with a period of 0.72 s.

Point B is the equilibrium position of the pendulum.

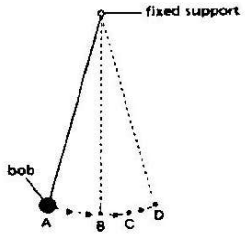


Fig. 1.1

(a) Explain what is meant by '*the period is 0.72 s*'.

.....

.....

[1]

(b) The bob is released from rest at point A. Determine the time required for it to reach point B.

time = ... [1]

(c) Explain why a student measuring the period should start timing when the pendulum bob is at point B, instead of point A or D.

.....

.....

.....

.....

[2]

(d) State and explain the effect on the period if the simple pendulum in Fig. 1.1 is replaced with a uniform iron rod of the same length.

.....

.....

[2]

2 A climber of weight 720 N is rappelling down a cliff. At the instant shown in Fig. 2.1, he is stationary and in a state of equilibrium.

The rope makes an angle of θ with the vertical, and the cliff exerts a force F of 300 N on the feet of the climber. This force F is directed at 22° above the horizontal.

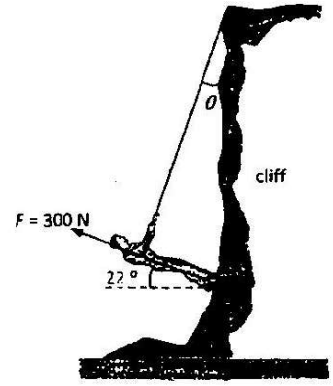


Fig. 2.1

(a) State the conditions for a body to be in equilibrium.

.....

.....

.....

.....

[2]

(b) In the space below, draw a scaled diagram to show the forces acting on the climber.

Determine the magnitude of the tension in the rope, and the angle θ it makes with the vertical.

tension = ...

θ = ...

[3]

(c) The force F can be said to be the resultant of two forces acting on the climber. One of them is the normal contact force by the cliff on him.

State the other force that acts on the climber, and state its direction.

.....

..... [2]

3 Fig. 3.1 shows a glass tube dipped into mercury. A vacuum pump is connected to the top of the tube and switched on. The mercury rises up the tube and stops.

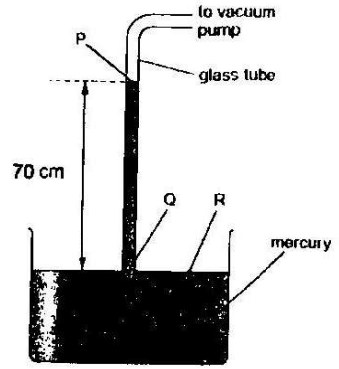


Fig. 3.1

(a) Three points on Fig. 3.1 are labelled P, Q and R.

State which of these point(s) is/are at atmospheric pressure.

..... [1]

(b) The density of mercury is 13 600 kg m^{-3} and the gravitational field strength is 10 N kg^{-1}.

Calculate the pressure due to the 70 cm long column of mercury.

pressure = ... [2]

(c) A student observes that the pressure calculated in (b) is lower than the atmospheric pressure. Suggest a reason for this.

..... [1]

(d) State and explain what happens if the mercury is replaced with water.

.....

.....

..... [2]

For Examiner's Use

4 Fig. 4.1 below shows the structure of a simple periscope used at sporting events to see over the heads of the crowd.

The critical angle of the material used in the prisms must be less than 45°.

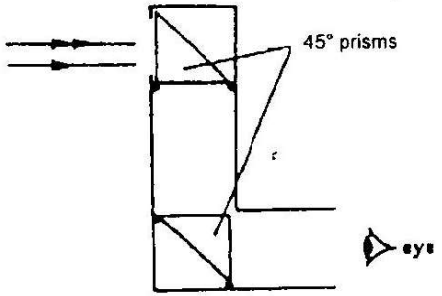


Fig. 4.1

(a) On Fig. 4.1, complete the paths of the two light rays through the periscope to the eye. [2]

(b) Given that dispersion of light can occur in a prism, explain why light of different colours will take the same paths through the prism.

.....

.....

..... [2]

(c) Is the image right way up or inverted? Explain your answer.

.....

.....

..... [2]

(d) Determine the smallest possible refractive index for the material of the prisms.

smallest refractive index = ... [2]

For Examiner's Use

5 Two identical large shallow dishes are filled with water at 30 °C as shown in Fig. 5.1.

Dish K is **covered** while dish L is not. A steady stream of air is blown over both dishes.

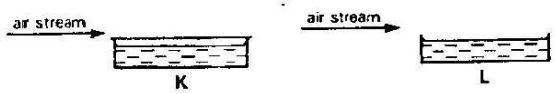


Fig. 5.1

(a) Using ideas about molecules, explain why

(i) the water in dish L cools down,

.....

.....

.....

..... [2]

(ii) the volume of water in dish L decreases more rapidly than that in dish K.

.....

.....

.....

..... [2]

For Examiner's Use

(b) The water in dish L reaches 25 °C and is found to have a mass of 1.5 kg. Dish L is then placed in the freezer.

(i) The water cools from 25 °C to 0 °C in a time of 60 minutes. The specific heat capacity of water is 4.2 J g^{-1} $°C^{-1}$.

Calculate the thermal energy removed from the water as it cools from 25 °C to 0 °C.

energy removed = ... [2]

(ii) After the water has reached 0 °C, thermal energy is removed from the water at the same rate in **(b)(i)**.

The specific latent heat of fusion of water is 3.3×10^5 J kg^{-1}.

Calculate the mass of water at 0 °C that becomes ice in 60 minutes.

mass = ... [2]

For Examiner's Use

6 Fig. 6.1 shows the wavefronts of a water wave in deep water in a ripple tank. The frequency of the water wave in deep water is 5.0 Hz.

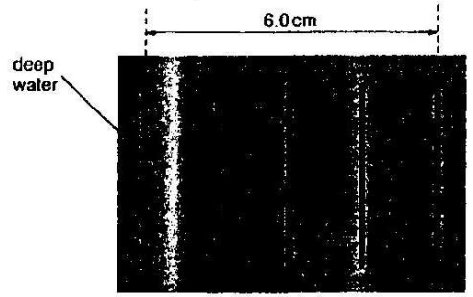


Fig. 6.1

(a) Explain what is meant by *wavefronts*.

..... [1]

(b) Calculate the speed of the wave in deep water.

speed = ... [3]

(c) The water wave passes from deep water into shallow water.

State and explain how this affects the wavelength of the wave.

..... [2]

7 Fig. 7.1 shows two horizontal plates X and Y connected to a high potential difference source. An uncharged conducting sphere is introduced into the region between the plates as shown.

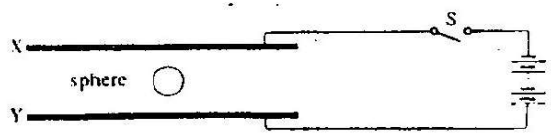


Fig. 7.1

(a) State the sign of the charges on each plate when the switch S is closed.

Plate X .....

Plate Y .....

[1]

(b) Indicate on Fig. 7.1 the charges induced on the conducting sphere.

[1]

(c) The sphere falls towards plate Y.

Explain why the fall takes place and state what happens to the charges on the sphere as it makes contact with plate Y.

.....

.....

.....

.....

..... [2]

8 Fig. 8.1 shows the variation of the output voltage of an ideal transformer with time. The transformer has 100 turns on the primary coil and 200 turns on the secondary coil.

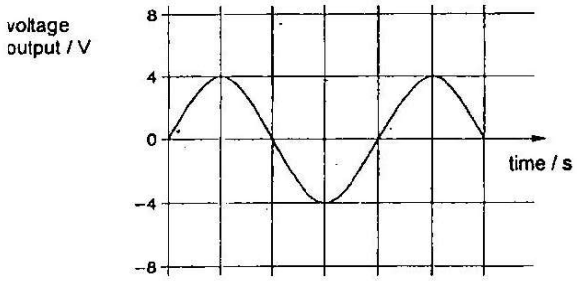


Fig. 8.1

(a) Explain what is meant by the transformer is *ideal*.

.....

..... [1]

(b) Draw on Fig. 8.1 the new output voltage, if the number of turns on the secondary coil is increased to 300 while that of the primary coil remains unchanged.

[2]

(c) The transformer is used to step up the voltage at the power station before the electrical power is supplied to homes and factories.

Explain why electrical power is transmitted at high voltage.

.....

.....

.....

..... [2]

End of Section A

Section 2B	☐ s.f. ☐ formula	30

Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination 3
Secondary 4

PHYSICS **5059/02**

Paper 2 Theory **13 September 2016**

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

Section B

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 11**.

9 A bungee jumper falls from a bridge above a river, as shown in Fig. 9.1.

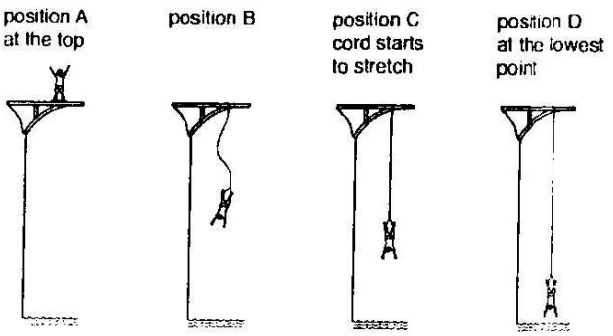


Fig. 9.1 (not drawn to scale)

The man starts from position A. The elastic cord starts to stretch at position C and he stops for the first time at position D. He continues to rise and fall after that.

Fig. 9.2 shows how the velocity of the man varies with time *t*.

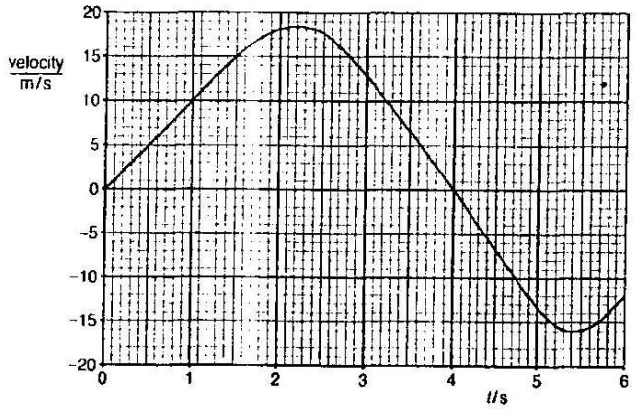


Fig. 9.2

(a) **(i)** State what is meant by ***velocity***.

.....

..... [1]

(ii) State the difference between a positive velocity and a negative velocity.

..... [1]

(b) **(i)** State the **first** time interval for which the acceleration is uniform.

..... [1]

(ii) Using values from Fig. 9.2, determine the acceleration of the man for the time interval mentioned in **(b)(i)**.

acceleration = ... [2]

(iii) Comment on your value of acceleration.

.....

..... [1]

(c) (i) State the value of t when the man is at position D.

..... [1]

(ii) State and explain, in terms of the forces acting, the direction which the man is accelerating at position D.

.....

.....

.....

..... [3]

10 (a) State the *Principle of Conservation of Energy*.

.....

.....

..... [2]

(b) A worker needs to move a box of mass 40 kg from the ground to the back of a truck as shown in Fig. 10.1.

The box moves 5.0 m along the ramp, which is inclined at an angle of 20 ° to the horizontal. The ramp is assumed to be frictionless.

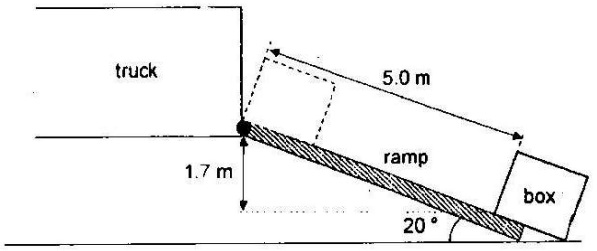


Fig. 10.1

(i) The worker gives a ***momentary*** push to the box to move it up the ramp.

Calculate the initial speed that the worker must impart to the box for it to reach the back of the truck. Take the gravitational field strength to be 10 N kg^{-1}.

speed = ... [3]

(ii) State the advantage of pushing the box up the ramp with a constant force, instead of lifting it up directly onto the truck.

.....

..... [1]

(iii) Another worker proposes using a longer ramp inclined at a smaller angle of 15 ° to the horizontal. He claims that less work need to be done to get the box into the truck.

Comment on his claim.

.....

.....

.....

..... [2]

(c) The truck in **(b)** accelerates uniformly, from a velocity of 2.0 m s^{-1} to 5.0 m s^{-1} in 3.0 s.

If the total mass of the truck and its contents is 2500 kg, calculate the additional work done by the engine in this time.

work done = ... [2]

11 EITHER

Fig. 11.1 shows an electromagnetic relay connected to a cell and a switch.

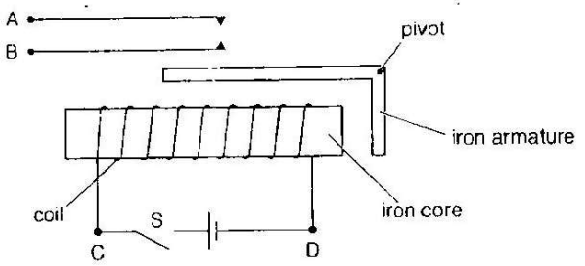


Fig. 11.1

(a) On Fig. 11.1, mark the north and south poles of the iron core when the switch S is closed. **[1]**

(b) Explain how the relay is used to close the contacts between A and B.

.....

.....

.....

..... [2]

(c) Explain why the core is made of iron and not steel.

.....

.....

..... [2]

(d) Fig. 11.2 shows the relay with its switch S and cell removed and connected to a circuit with a 12 V battery. The resistance of the thermistor, X decreases with temperature.

The coil has to close the contacts A and B for the bell to ring. The bell is not ringing at the instant shown.

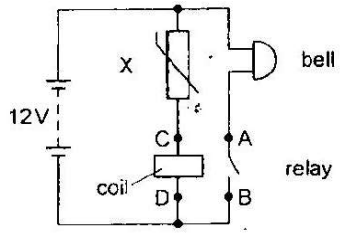


Fig. 11.2

(i) Explain why the bell rings when the temperature of the thermistor, X rises.

.....

.....

.....

..... [2]

(ii) When the resistance of X is 2000 Ω, the current flowing in the coil is 1.5 mA. This causes the contacts between A and B to close. The resistance of the bell is 200 Ω. Calculate

1. the potential difference across X,

potential difference = ... [2]

2. the current in the battery.

current = ... [1]

11 **OR**

The vibrations of a guitar string are picked up by a small coil of wire wound round a cylindrical magnet as shown in Fig. 11.3.

The string is made from steel. When it vibrates, an electrical signal is generated between the terminals of the coil.

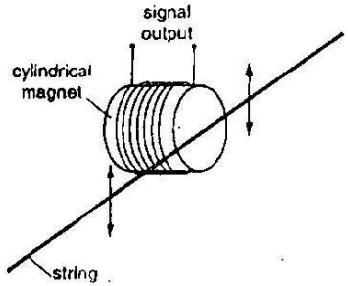


Fig. 11.3

(a) (i) State *Faraday's Law of Electromagnetic Induction.*

.....

.....

..... [2]

(ii) Use Faraday's Law to explain why an electrical signal is generated.

.....

.....

.....

..... [2]

(iii) Explain why no signal will be picked up if the guitar string is made from nylon.

.....

.....

..... [2]

(b) Fig. 11.4 shows the display on the C.R.O. screen when a signal from the guitar is fed into it. The time base on the screen is set to 2.0 ms/cm.

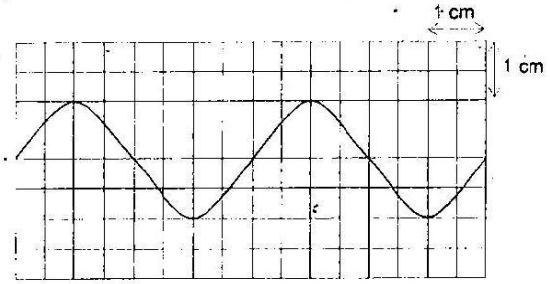


Fig. 11.4

(i) Calculate the frequency of the sound produced.

frequency = ... [2]

(ii) Draw on Fig. 11.4 the signal displayed on the C.R.O. screen when the frequency of the sound is doubled and its loudness is halved.

[2]

End of Section B

For Examiner's Use

ANSWERS

Catholic High 2016 – Physics Sec 4 Preliminary Examination 3

1	C	6	B	11	D	16	C	21	B	26	A	31	B	36	A
2	B	7	B	12	D	17	C	22	C	27	D	32	B	37	D
3	C	8	A	13	C	18	A	23	A	28	D	33	D	38	C
4	C	9	A	14	B	19	A	24	C	29	B	34	B	39	A
5	D	10	C	15	C	20	A	25	C	30	C	35	A	40	B

1 (a) The time for one complete oscillation is 0.72 s. [1]

(b) $\text{time} = \frac{0.72}{4} = 0.18\,\text{s}$ [1]

(c) The pendulum is momentarily at rest at points A and D. So the student will not know when exactly to start his stopwatch.
The pendulum bob moves with a non-zero speed at point B so the moment to start timing is more clearly defined. [2]

(d) The period will be shorter.
The mass distribution of the pendulum is changed with a uniform rod and its centre of gravity shifts nearer to the fixed support. [2]

2 (a) Resultant force on the body is zero.
Resultant moment about any point on the body is zero. [2]

(b)



[3]

(c) Friction between the climber's feet and the cliff.
It is acting in the direction up the cliff. [2]

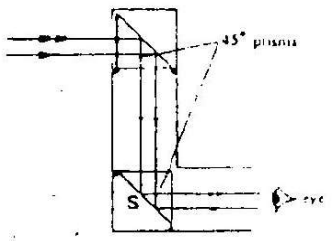
3 (a) Q and R [1]

(b) $P = h\rho g$
$= 0.70 \times 10 \times 13600$
$= 95200\,\text{Pa}$ [2]

(c) The vacuum pump cannot create a perfect vacuum in the glass tube. [1]

(d) The water column will be longer as water has a lower density so a longer column is required to exert the same pressure as mercury. [2]

4 (a)



[2]

(b) There is no refraction as the light enters and leaves each prism. At the surfaces where total internal reflection occurs, the angle of incidence equals angle of reflection for all colours of light. So there is no dispersion of light. [2]

(c) Right way up. The first prism inverts and the second prism reinverts the image. [2]

(d) c must be lesser than 45°. [2]

$n > \frac{1}{\sin 45°}$

$n > 1.41$

5 (a) (i) The more energetic water molecules are able to escape from the water surface into the atmosphere. This causes the average kinetic energy of the remaining water molecules to decrease, leading to a decrease in temperature. [2]

(ii) In dish K, some of the escaped water molecules return back to the water due to collision with air particles. For dish L, the escaped water molecules are quickly swept away by the air stream. [2]

(b) (i) $Q = mc\Delta\theta$ [2]
$= 1.5 \times 4200 \times (25 - 0)$
$= 15800\,\text{J}$

(ii) $Pt = ml_f$ [2]

$m = \frac{157500}{60 \times 60} \times \frac{60 \times 60}{330000}$

$= 0.477\,\text{kg}$

6 (a) Imaginary lines joining adjacent points on the wave with the same phase. [1]

(b) $\lambda = \frac{0.060}{4} = 0.015\,\text{m}$ [3]

$v = f\lambda$

$= 5.0 \times 0.015$

$= 0.075\,\text{m s}^{-1}$

(c) The wavelength decreases. The wave speed slows down in shallow water and since the frequency of the wave remains unchanged, the wavelength of the waves must have decreased (as $v = f\lambda$). [2]

7 (a) Plate X: Negative, Plate Y: Positive [1]

(b)

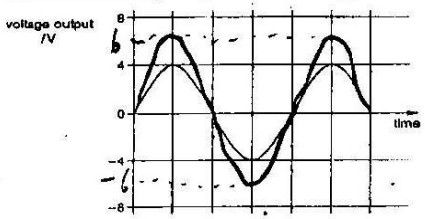


[1]

(c) The sum of the weight of the sphere and the downward electrostatic force on the negatively charged region of the sphere is greater than the upward force on the positively charged region of the sphere.
The negative charges will flow from the sphere to Y on contact. [2]

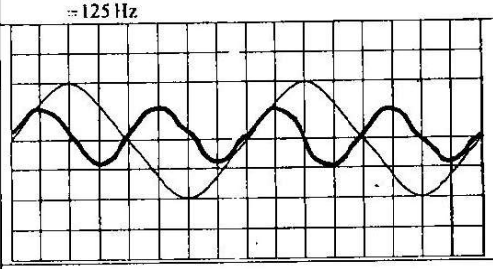
8 (a) No power loss between the primary and secondary coils of the transformer. [1]

(b)



[2]

	(c)		Transmitting at high voltage causes the current in the cables to be small (as $P = VI$). This reduces the power loss due to heating in the cables ($P_{loss} = I^2R$).	2
9	(a)	(i)	Rate of change of displacement.	1
		(ii)	They are in opposite directions.	1
	(b)	(i)	0 to 1.5 s	1
		(ii)	$a = \frac{v-u}{t}$ $= \frac{15-0}{1.5}$ $= 10\ \text{m s}^{-2}$	2
		(iii)	Equal to acceleration of free fall as the man's velocity is low so air resistance is negligible.	1
	(c)	(i)	4.0 s	1
		(ii)	The tension in the cord causes an upward force to act on him and this force increases as he is moving downwards. At D, this upward force is greater than his weight which is acting downwards, thus his acceleration is upwards.	3
10	(a)		Energy can neither be created nor destroyed. It can be transformed or transferred but the total amount in any (isolated) system must remain constant.	2
	(b)	(i)	By Principle of Conservation of Energy $\frac{1}{2}mv^2 = mgh$ $v = \sqrt{2gh}$ $= \sqrt{2 \times 10 \times 1.7}$ $= 5.8\ \text{m s}^{-1}$	3
		(ii)	Less force is required to push the box up the ramp.	1
		(iii)	Not true as the smaller force required to push the box up the ramp has to be applied over a larger distance (longer ramp). The work done should be the same by the principle of conservation of energy.	2
	(c)		$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$ $= \frac{1}{2}(2500)(5.0^2 - 2.0^2)$ $= 26300\ \text{J}$	2
11	Either			
	(a)		N S	1
	(b)		The iron core attracts the iron armature towards its S-pole when the switch is closed. This causes the armature to turn clockwise about its pivot and push the contacts A and B together.	2
	(c)		Iron retains its magnetism so the iron armature will still be attracted to the core even when the switch is opened. Thus the contacts A and B will not be apart.	2
	(d)	(i)	As the temperature of X (thermistor) rises, its resistance decreases, which causes the current through the coil to increase. This strongly magnetises the coil and closes the contacts A and B.	2
		(ii)	$V = IR$ $= 0.0015 \times 2000$ $= 3.0\ \text{V}$	2

		(iii)	I = sum of currents through the two branches $= 0.0015 + \frac{V}{R_{bell}}$ $= 0.0015 + \frac{12}{200} = 0.062\ \text{A}$	1
11	OR			
	(a)	(i)	The magnitude of the induced emf in a circuit is directly proportional to the rate of change of magnetic flux linkage in the circuit.	2
		(ii)	The cylindrical magnet magnetises the steel string. When the steel string vibrates, its magnetic field cuts the coil of wire, producing a continuously changing magnetic flux linkage in the coil. By Faraday's law, an emf which causes the signal is induced.	2
		(iii)	Nylon is not a magnetic material so it cannot be magnetised. There is no changing magnetic field to cause a change in magnetic flux linkage in the coil.	2
	(b)	(i)	Period $= 4 \times 0.002$ $= 0.0080\ \text{ms}$ $f = \frac{1}{T}$ $= \frac{1}{0.0080}$ $= 125\ \text{Hz}$	2
		(ii)		2

Section A

Answer **all** the questions in this section.

1 Fig. 1.1 shows a ship-to-ship cable used to transfer people and goods from one ship to another.

(a) A 500 N object is suspended at the mid-point of the cable ABC. By using a suitable scale drawing, find the tension present in the cable AB and BC.

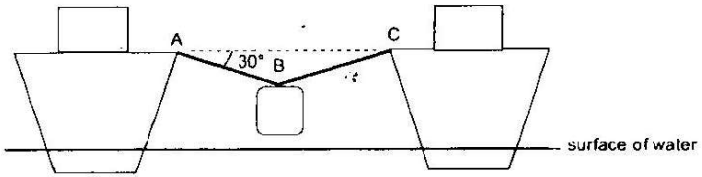


Fig. 1.1 (not drawn to scale)

tension in AB= .....

tension in BC = ... [4]

(b) When both ships are moving apart, the cable may break and cause severe injury. Suggest why an almost horizontal cable is more likely to break as compared to the cable in **(a)**.

.....

..... [1]

(c) Fig. 1.2 shows all the forces acting on one of the ship. The tension, T, of the cable is 100 kN. The centre of gravity is at point C. The weight of the ship, W, is 500 kN. The buoyant force, F_B, by the water acts at point D.

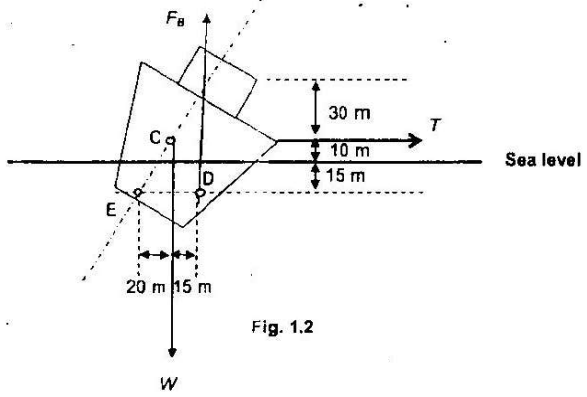


Fig. 1.2

(i) Calculate the sum of the clockwise moments due to the tension of the cable and the weight of the ship about point E. Leave your answer in kNm.

moment = ... [2]

(ii) Calculate the minimum buoyant force, F_B required to prevent the ship from toppling.

force = ... [2]

2 When large buildings are being erected, particularly on soft ground, piles are driven into the ground to provide a firm foundation. Fig. 2.1 shows a pile hammer in operation. The pile hammer has a mass of 5000 kg.

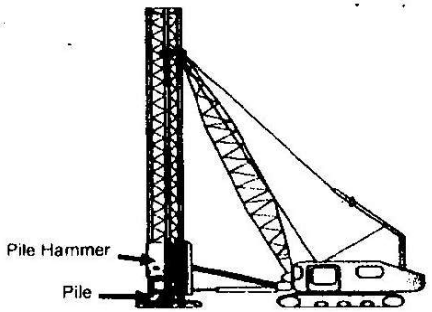


Fig. 2.1

(a) Calculate the loss of gravitational potential energy when the hammer falls 4.0 m to hit the pile.

loss of gravitational potential energy = ... [2]

(b) Assuming negligible air-resistance, calculate the speed of the hammer when it hits the pile.

speed = ... [2]

(c) Calculate the efficiency of the piling process given that 50 000 J of energy is converted sound and thermal energy.

efficiency = ... [2]

3 Fig. 3.1 shows a magnet picking up an iron coin.

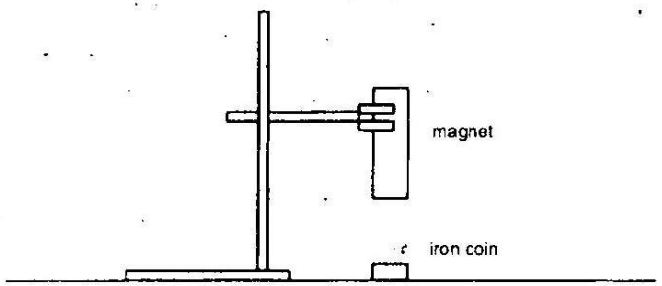


Fig. 3.1

The coin has a mass of 0.02 kg.
The initial attractive force on the iron coin by the magnet was 0.3 N.

(a) Explain why there is an attractive force on the iron coin by the magnet.

.....

.....

..... [2]

(b) Calculate

(i) the initial resultant force acting on the coin,

resultant force = ... [2]

(ii) the initial acceleration of the coin.

acceleration = ... [2]

4 Fig. 4.1 shows a long vertical glass tube with one end immersed in mercury and the other connected to a vacuum pump. The tube fits tightly into a bell jar. With tap B open, and air pumped out via A, the mercury rises to a maximum height of 76.0 cm above the dish.

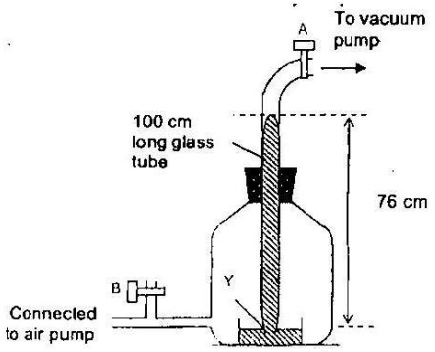


Fig. 4.1

(a) Explain why the mercury in the tube above Y can only rise to a maximum height of 76.0 cm.

.....

.....

..... [2]

(b) Given that the density of mercury is 13 600 kg/m^3, calculate the pressure at Y. Leave your answer in Pa.

pressure = ...Pa [2]

(c) Suggest how you can make the mercury column rise to a greater height.

.....

..... [1]

5 The piston for the bicycle pump in Fig. 5.1 is pushed in slowly until the piston comes to its positions shown in Fig 5.2. The air in the pump remains at a constant temperature throughout.

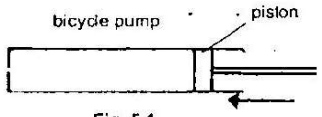


Fig. 5.1

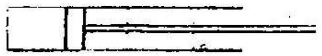


Fig. 5.2

(a) Describe the motion of the air molecules in the pump in Fig. 5.1.

.....

..... [1]

(b) Using ideas about molecules, explain why the pressure in Fig. 5.2 is greater than in Fig. 5.1.

.....

.....

.....

..... [3]

(c) If the piston was pushed in quickly instead, the temperature of the air in the pump would have increased. Using ideas about molecules, explain how this would affect the pressure in the pump as compared to your answer in **(b)**.

.....

.....

.....

..... [3]

6 Fig. 6.1 shows the screen of a cathode ray oscilloscope. The time-base is set at 0.4ms/mm and the length of the time-base sweep MN is 100mm.

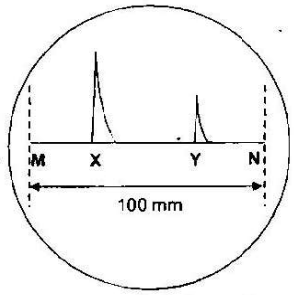


Fig. 6.1 (scaled diagram)

(a) Calculate the time represented by MN.

time = ... [1]

(b) A radar signal, sent from the radar station to a distant aircraft, is displayed on the CRO at X and the signal received back from the aircraft is displayed at Y. The speed of radio waves is 3.0×10^8 m/s. Calculate the distance of the aircraft from the radar station.

distance = ... [3]

(c) State why the signal displayed at Y is weaker than that at X.

.....

..... [1]

7 Fig. 7.1 shows a thin converging lens used to improve the efficiency of a solar cell.

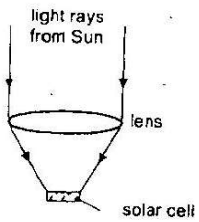


Fig. 7.1

Fig. 7.1 is drawn to scale.

(a) **(i)** State what is meant by the focal point of a lens.

.....

..... [1]

(ii) On Fig. 7.1, draw construction lines to determine the focal length of the lens.

focal length = ... [2]

(b) Explain how the lens affects the amount of electrical power generated by the solar cell.

..... [2]

(c) The lens is replaced with a replacement lens that has a longer focal length compared to the original lens.

State and explain whether the replacement lens has to be placed closer or further away from the solar cell in order for the efficiency of the solar cell to remain the same.

..... [1]

8 Fig. 8.1 shows a magnet being dropped vertically down through a solenoid. Fig. 8.2 shows how the induced current in the solenoid changes with time.

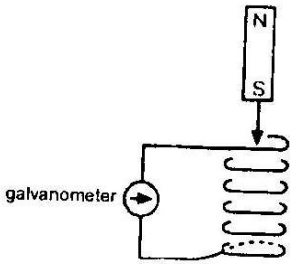


Fig. 8.1

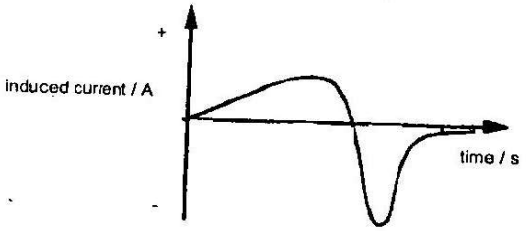


Fig. 8.2

(a) Explain why the second (negative) pulse of induced current is shorter in duration.

..... [1]

(b) Explain why the second pulse of current has a greater magnitude that the first (positive) pulse of induced current.

.....

.....

.....

..... [2]

(c) In the space below, sketch the graph, if the North end of the magnet was dropped first into the coil instead of the South end. [1]

(d) State two ways in which the magnitude of the induced current generated can be increased.

.....

.....

..... [2]

Section B

Answer all the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

9 In recycling plants, electromagnets are used to separate empty drink cans from the rest of the other materials. Fig. 9.1 shows an example of an electromagnet used to lift some cans.

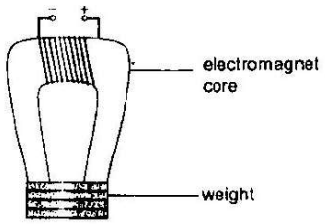


Fig. 9.1

Fig. 9.2 shows the data for four cores made from different materials.

Material	Density / gcm^{-3}	Relative Permeability	Resistivity / Ωm
H	7.87	5000	1×10^{-7}
I	7.85	1000	2.2×10^{-7}
J	8.90	600	6.84×10^{-8}
K	2.71	1	2.62×10^{-8}

Fig. 9.2

The relative permeability of a material is the ease at which the material can be magnetised. The strength of the magnet increases with the ease at which a material can be magnetised.

(a) Identify the best material to be used as an electromagnet core for lifting the most number of cans. Explain why.

.....

.....

..... [1]

(b) If material K is used for the manufacture of the drink cans, explain whether there is an increase or decrease in the number of drink cans that the electromagnet is able to lift compared to the other materials.

.....

.....

..... [1]

(c) The cans are attracted to the electromagnet through the process of induced magnetism. Describe what is induced magnetism.

.....

.....

..... [1]

(d) From Fig. 9.2, state and explain the relationship between hard magnetic materials and their electrical resistance.

.....

..... [2]

(e) Fig. 9.3 shows how the weight lifted by the electromagnet using material **H** core is dependent on the current in the coil.

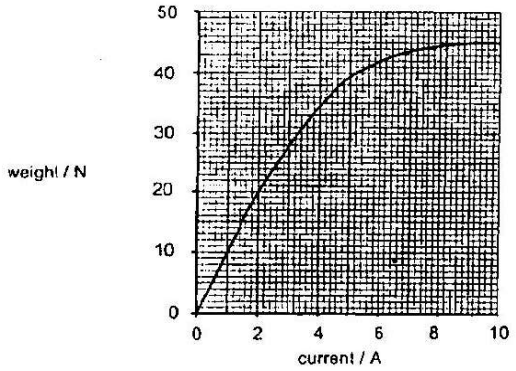


Fig. 9.3

(i) Suggest two methods to modify the electromagnet to lift a heavier load.

.....

.....

..... [2]

(ii) On Fig. 9.3, sketch the relationship between weight and current if material J is used for the core. [1]

(iii) The current is set so that the electromagnet can only lift the weight of 10 cans. One can weighs 2.5 N.

Using Fig. 9.3, explain if the electromagnet is able to lift 20 cans at the same time if the current is doubled.

.....

.....

.....

..... [2]

10 The brightness of the lamp inside a train is built in such a way that it becomes brighter as the external environment gets darker. The train enters a tunnel at t = 0 s.
Fig. 10.1 shows how the brightness of the lamp inside the train changes as it enters and moves through the tunnel at constant speed.

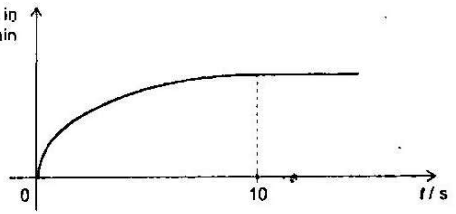


Fig. 10.1

(a) Suggest 2 possible reasons for the shape of the graph in Fig. 10.1 after t = 10 s.

1: .....

2: ..... [2]

(b) If the train were to move at twice the original speed, sketch on Fig. 10.1., how the brightness of the lamp inside the train will change as it moves through the same tunnel. [2]

(c) Fig. 10.2 shows the equipment that is connected in a circuit with the lamp in the train.

Equipment	Quantity
12 V dry cell	1
fixed resistor	1
light-dependent resistor (LDR)	1
lamp	1

Fig. 10.2

(i) In the space below, draw a circuit using the equipment from Fig. 10.2, which can be used for the lighting in the train [2]

(ii) Explain how the circuit in c(i) increases the brightness of the lamp in the train as it enters the tunnel.

.....

.....

.....

.....

.....

..... [2]

(d) (i) The lamp in the train is connected to a 12 V dry cell, which dissipates energy at a rate of 270 mW.

Calculate the current flowing through the lamp.

current = ... [1]

(ii) The lamp uses an input transducer to control the brightness of the lamp in the train.

Define the term input transducer.

.....

..... [1]

11 **EITHER**

A vacuum flask is a container that keeps a substance hot or cold by means of a double wall enclosing a vacuum. Fig. 11.1 shows a cross-sectional view of a vacuum flask.

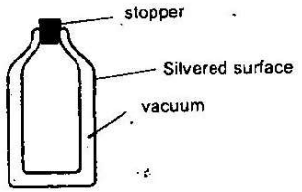


Fig 11.1

(a) Explain why it is not essential to close the top of the vacuum flask to keep water cold for a period of time.

.....

..... [1]

(b) Explain how a silvered surface is able to keep water in the flask cold.

.....

..... [1]

(c) Explain the ways in which a vacuum flask keeps hot liquid warm for a long time.

.....

.....

..... [2]

(d) When a flask was filled with hot water, it felt warm.

Identify and explain the fault(s) present in the flask.

.....

.....

..... [3]

(e) An immersion heater producing 300 W of power is placed in a vacuum flask containing ice at -5 °C.

Calculate the time taken to melt 0.2 kg of ice completely, assuming that all the energy dissipated by the heater is absorbed by the ice.

Specific latent heat of ice = 330 000 J/kg
Specific heat capacity of ice = 2000 J/kg°C

time taken for ice to melt = ... [4]

11 OR

Fig 11.2 shows a part of the main electrical circuit in a house.

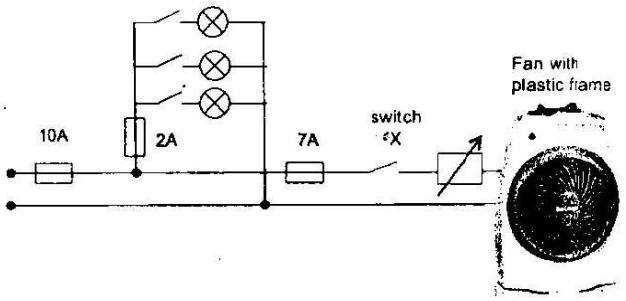


Fig. 11.2

Three lamps, each rated 60 W, 960 Ω are connected to the live wire through a 2 A fuse. An electrical fan rated at 1200 W, 240 V is connected to the live wire through a 7 A fuse. There is a 10 A fuse protecting the whole circuit. The mains supply is 240 V.

(a) State the function of the neutral wire in a circuit.

.....

..... [1]

(b) Explain if it is dangerous to connect only the live and neutral wire to the fan

.....

.....

..... [1]

(c) Describe how the speed of the rotation of the fan blades can be increased.

.....

.....

.....

..... [2]

(d) Determine the current in each of the fuses when all the appliances are switched on.

current in 2 A fuse = ...

current in 7 A fuse = ...

current in 10 A fuse = ... [3]

(e) With all the appliances being switched on, the live wire touches the neutral wire at switch X.

(i) Describe and explain the effect on the lamps, fan and fuses when this fault happens.

.....

.....

.....

.....

..... [2]

(ii) Suggest another device that can replace the fuse in the circuit. State the advantage of using the device instead of the fuse.

.....

.....

..... [1]

End of Paper

Anglo Chinese School (Barker Road)
2016 Sec 4 5059 Prelim

1	D	21	D
2	A	22	D
3	C	23	B
4	C	24	C
5	A	25	B
6	C	26	A
7	A	27	C
8	B	28	D
9	D	29	D
10	B	30	C
11	B	31	B
12	B	32	B
13	D	33	D
14	B	34	A
15	C	35	C
16	B	36	B
17	B	37	A
18	B	38	C
19	B	39	C
20	B	40	D

Qn.		Answers	Marks	Markers' Comments
1	(a)	Scale: 1 cm : 50N (490N – 510N) or 1cm: 100N (480N to 520N) Correct shape Correct direction of arrows Tension = 500 N Comments: Scale must be mentioned and not inferred from the vector diagram.	B1 B1 B1 B1	Students made common mistakes in the identification of the direction of the tensional forces. Most students make the mistake of pointing the tensional forces towards the weight. Most students have trouble in identifying that the two tensional forces will act to have a resultant upwards force. Students could properly identify a proper scale.
	(b)	As the angle between the ropes increase, tension in the rope increases, causing it to break.	A1	Generally well done although a few students made the mistake of using moments to answer the question.
	(c)	(i) Total clockwise moments =T(25) + W(20) = 100(25)+500(20) = 2500 + 10000 = 12,500 kNm	M1 A1	Many students had trouble identifying the correct perpendicular distances to calculate the momehts cause by each force.
		(ii) Take moments about E, T(25) + W(20) = F_B(35) 12500 = F_B(35) F_B = 357 kN	M1 A1	Most students got this question correct due to ecf. Students were able to identify the correct perpendicular distance.

2	(a)	GPE = mgh = 5000 x 10 x 4 = 200, 000 J	M1 A1	
	(b)	Loss in GPE = Gain in KE 200,000 = 0.5 x 5000 x v^2 v = 8.94m/s	M1 A1	Most students were able to equate the GPE to KE.
	(c)	Efficiency = (Output / Input) x 100% = (150 000 / 200 000) x 100 = 75%	M1 A1	Most students were able to use the correct values to calculate the efficiency. Some students showed lack of understanding and used 200 000 / 250 000 to calculate

3	(a)	Iron is a magnetic material. The coin becomes a induced magnet which cause an attraction between the coin and the magnet. Comments: Accept magnetic object (given BOD), magnetic conductor is not accepted. An explanation involving magnetic poles being induced and therefore attracting each other because unlike poles attract.	M1 A1	Most students were able to correctly use the term magnetic material. Some students use magnetic object and were given BOD marks. Students were unable to adequately explain the second point on the induction of magnetic properties/polarity on the coin.
	(b)	(i) F = 0.3 – (0.02 x 10) = 0.1 N	M1 A1	Some students were unable to identify that the attractive force and weight acted in opposite direction.
		(ii) F = ma = 0.1 / 0.02 = 5m/s^2	M1 A1	Most were able to get this question correct due to ecf
4	(a)	Atmospheric pressure of 76 cmHg, acts on the surface of mercury reservoir. The pressure at Y will only be due to the mercury acting above it, so the mercury will rise to a height of 76cm Hg.	M1 A1	Most were able to get answer that atmospheric pressure acted on the surface of the mercury but only a small percentage of students were able to identify that the pressure at Y was due to the height of mercury above it.
	(b)	Pressure = density x g x h = 13 600 x 10 x (76/100) = 1.03 x 10^5 Pa	M1 A1	
	(c)	Pump more air into the bell jar through tap B. Or any logical answer Comment: Accept 1) increase temperature in the jar 2) bring to lower elevation	A1	Most students were able to give sound and logical answers.

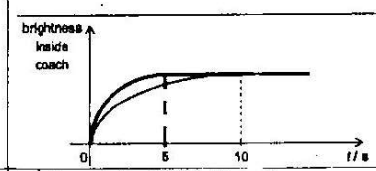
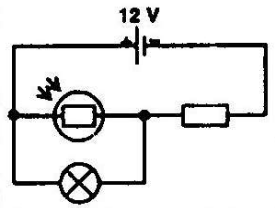
5	(a)	Air molecules are in **continuous random motion** and moving at **high speeds**. Comment: Kinetic energy may be accepted in exchange for speed.	A1	Some of students were unable to give both portions of the answers in the description of the motion.
	(b)	Because the pump is pushed in, the **number of molecule per unit volume is greater.** The **frequency of collision** of the molecules with walls of the pump **increases**, therefore causing a force to be exerted on the piston to be higher. Since pressure is **force per unit area**, pressure is higher Comment: Accept 'space' in exchange for 'volume'	M1 M1 A1	Most of the students had trouble obtaining full credit for this question. They failed to give the following 1) Correct description of no. of molecules per unit volume 2) Identifying the increase in frequency as the cause of the increase in force on the walls 3) Staling that the increase in force per unit area as pressure
	(c)	**Kinetic energy of the molecules increase due** to increase in temperature. Pressure would increase even more than in (b). As molecules will collide **more frequently** and with **greater force** on the walls of the pump. Comment: Accept the use of the word 'speed' instead of 'kinetic energy'	M1 B1 A1	Most students were unable to state that the increase in KE of the molecules results in a increase in frequency of collision and the force of collision.
6	(a)	Time = 100 x 0.4ms = 40 ms or 4 x 10^{-2}s or 0.04s	A1	Some students incorrectly used 100/0.4 to calculate the answer.
	(b)	Time taken = [(2.2/5) x 100] x 0.4 =17.6 ms 2d = speed x time d = [(3x10^8) x (17.6 X 10^-3)]/2 d = 2 640 000 m Comment: Accept range of measurement between 5.1cm to 5cm Range for time taken = 17.2 ms or 17.6ms Range for d = 2 580 000m or 2 640 000m	M1 M1 A1	Most students were unable to calculate the time taken from X to Y. Most students incorrectly used speed x time to calculate the distance when they should have divided that value by 2 to calculate due to the echo.
	(C)	Energy is absorbed by the surrounding air. Thus less energy is received by the radar.	A1	Generally well done although a handful of students were unable to adequately describe energy loss.

7	(a)i	It is the point at which all light rays that travel parallel to the principal axis converge on	1	Most students were unable to correctly define this.
	(a)ii	Correct drawing to extend the light rays to converge at a point 2cm (accept 1.9 to 2.1)	[B1] [B1]	Most students were able to draw the path of the light ray however some students made the error in measuring the focal length from the top part or bottom part of the lens instead of the center.
	(b)	The lens converges the light rays, Allowing more **solar energy** to reach the solar cell **per unit time** which will allow the solar cell to increase the amount of electrical power generated. Comment: Accept as long as the idea of convergence is shown	[M1] [A1]	Most students were able to identify the convergence as a lens for the reason for an increase in solar energy hitting the surface of the solar cell but were unable to relate the quantity energy and power.
	(c)	The lens will have to be positioned further away from the cell. With a larger focal length, light rays will need to travel a longer distance to converge on the same area Comment: Accept as long as the idea of the point of convergence is at a point that that is a longer distance away from the lens is shown	[M1]	*Question Voided* Most students were unable to adequately explain that the longer focal length results in the light rays converging at a distance that is greater.

8	a	The magnet is travelling faster and therefore takes a shorter time to leave the solenoid Comment: Accept – accelerating, speed increasing. Do not accept – Faster velocity/speed	A1	Most students were able to answer the question although a small amount of students used faster velocity instead of greater or larger velocity.
	b	The magnitude of the induced emf and the current is proportional to the rate of change of magnetic flux linkage with coil. Since the magnet is moving faster through the coil as it exits, there is a higher rate of change of magnetic flux linkage with coil. Comment: Accept (BOD) if 'with coil' is not present	[M1] [A1]	Most students could identify the 'rate of change of magnetic flux linkage with coil' as the reason for the greater current. However, most students used the term 'rate of change of magnetic flux'. Most students did not explain why the increase in rate of change of magnetic flux linkage with coil would result in a greater magnitude of current.
	c	The first pulse of the induced current will be negative and the second pulse will be positive	[A1]	

	d	Use a stronger magnet Increase the amount of coils in the solenoid. Comment: Do not accept the use of a soft iron core. Accept - throw the magnet in at a higher speed.	A1 A1	Some students incorrectly used soft iron core. Context of problem makes this method to increase the current impossible.

9	(a)	Material H Its high relative permeability allows the material to be magnetized easily	[A1]	Some students incorrectly identified K as the best material due to the lower density. The permeability is 5000 times greater in H compared to K, while the density is 3 times greater. The effect of the increase in permeability outweighs the increase in density
	(b)	Number of drink cans are reduced. Material K is difficult to magnetize compared to material H, I, J	[A1]	
	(c)	Induced magnetism is the process in which an object made of a magnetic material becomes a magnet when it is near or in contact with a magnet. Comment: Accept if 'magnetic material' is replaced with 'magnetic object'	A1	Most students had trouble defining induced magnetism adequately.
	(d)	Hard magnetic material corresponds to low resistivity. Since resistance is proportional to resistivity, hard magnetic materials corresponds to low resistance.	[A1] A1	Very few students were able to use the data to correctly identify the relationship between hard magnetic materials and resistivity. An even smaller amount of students were able to relate the quantities resistivity and resistance
	(e)	i Increase current in the coil. Increase the number of turns in the coil	[A1] [A1]	
		ii A curve below curve for material H	[A1]	
		iii The current required to lift ten can of 25 N is 2.6 A. When the current is doubled to 5.2 A it can only lift up to 40 N. The electromagnet is unable to lift 20 cans which weigh 50N	[M1] [A1]	

10	(a)	1: There is no change in the surrounding light intensity 2: The lamps are already operating at its maximum power / brightness Comment: Accept if the idea of light intensity is not changing is shown.	[A1] [A1]	Most students were able to identify that no change in external light condition as a reason but were unable to identify that the lamp has reached the maximum brightness as a reason.
	(b)	Steeper Value of brightness reach the same max level  	[A1] [A1]	
	(c)	Correct circuit symbols used Correct connection with LDR in parallel with lamp  	[A1] [A1]	Most students incorrectly drew LDR. A large number of student were unable to draw a correct circuit.
		ii As the train enters the tunnel, the intensity of the surrounding light decreases, the resistance of the LDR increases. The higher the resistance, the higher the voltage across lamp, therefore increasing the brightness of the lamp.	[M1] [A1]	Most students incorrectly identified the relationship between the brightness of external condition and resistance of LDR. Most students were unable to identify the effect of increasing the resistance of the LDR.
	(d)	i $I = P / V$ $= (270 \times 10^{-3}) / 12$ $= 0.0225$ A	[A1]	Some students were unable to change milliwatt to watt.
		ii Input transducer is an electronic device that converts non-electrical energy to electrical energy.	[A1]	Definition was poorly done

11 E	(a)	Cold air sinks as it is denser, hence heat loss via convection cannot effectively occur.	A1	Very few students are able to answer correctly. Most students were not able to identify effective convection cannot occur.
	(b)	Silver surfaces are good reflectors/poor absorbers of thermal energy and reduce heat gain from the surrounding via radiation	[A1]	Very few students are able to answer correctly. Most students were unable to adequately state that silver are poor absorbers of thermal energy and instead only state that silver reflects thermal energy.
	(c)	Surfaces of the walls are silver surfaces reduces heat loss by radiation. OR Vacuum layer reduces heat loss by conduction or convection OR Stopper prevents heat loss via convection and evaporation	M1 [A1]	Most students could only identify one proper way in which thermal energy is kept in the flask.
	(d)	The inner lining would have been damaged Therefore, air replaces the vacuum, hence heat can be lost through conduction. OR The surface maybe black due to accumulation of dirt or wear and tear. Therefore since black are better radiators of thermal energy, the bottle feels warm to the touch.	A1 A1	Most students did not understand the question. They were unable to identify possible faults and what form of transfer of thermal energy was involved to make the flask feel warm.
	(e)	Q = mc(Δθ) = (0.2) (2000) (5) = 2000 J Q = ml = (0.2) (330 000) = 66 000J t = E / P = (66 000 + 2000) / 300 = 227 s	B1 B1 [M1] [A1]	Most students are able to answer correctly.

11 O	(a)	The neutral wire allows current to return from the appliance to the power supply. Comment: Accept 'to complete the circuit'	[B1]	Most students are able to answer correctly
	(b)	No. The fan has a plastic casing and is doubly insulated. As such, the casing can never be live even when there is a fault Comment: Accept if the idea of current not being able to flow through is shown	[1]	Most students could not adequately explain that the plastic frame protects the user since current cannot flow through an insulator.
	(c)	When **resistance of the rheostat is reduced**, the current running through the fan will increase and increase the speed of rotation of the fan	[1] [1]	Most students could not link the information given in 11.2 to solve the question. Some incorrectly identified the rheostat as a thermistor and hence gave weird answers.
	(d)	P = I^2 x R 60 = I^2 x 960 I = 0.25 A I(in 2A fuse) = 0.25A x 3 = 0.75A P=IV 1200 = I x 240 I = 5A Current (10A) = 5 + (0.25x3) = 5.75 A	[1] [1] [1]	Most students had trouble using the correct formula to identify the current running through each of the fuses.
	e	i Short circuit will occur and the lamps and fans will not light up. A large current flows in the circuit and the 7A and 10A fuse will blow	M1 [A1]	Most students could identify that a short circuit will occur but were unable to identify that the 2A fuse will not blow.
		ii Circuit breaker. It can be reset conveniently after the fault is corrected.	[A1]	