



YISHUN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2024

SECONDARY 4 EXPRESS

CANDIDATE
NAME

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CLASS

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INDEX
NUMBER

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PHYSICS

Paper 1 Multiple Choice

6091/01

20 August 2024

1 hour

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 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.

[Turn over

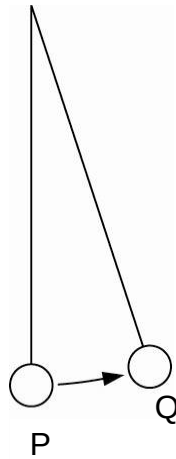
This document consists of **20 bn** printed pages.

- 1** A list of physical quantities is shown.

displacement of the school gate from the canteen
mass of your textbook
speed of a moving bullet
room temperature
resistance of a wire

How many of these quantities are derived quantities?

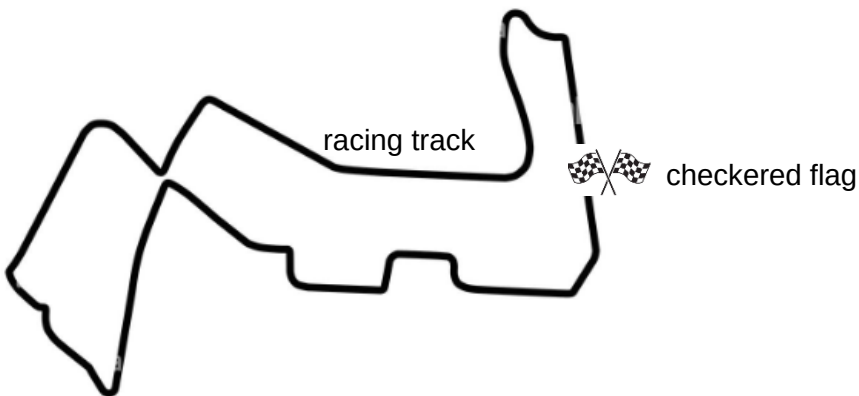
- A** 1
B 2
C 3
D 4
- 2** The time taken for a pendulum to swing from the lowest position P to its maximum displacement Q is 0.85 s.



What is the time taken for the pendulum to make 1.5 oscillations?

-
- A** 0.85 s
B 1.70 s
C 3.40 s
D 5.10 s

- 3 Which pair of measuring instruments are the most suitable to measure the external diameter and circumference of a test tube?
- A digital micrometer screw gauge and digital calipers
 - B digital micrometer screw gauge and 15.0 cm rule
 - C digital calipers and tape measure
 - D digital micrometer screw gauge and tape measure
- 4 An F1 car moves on the horizontal Singapore GP racing track.



If the speed of the car remains constant, which statement is true?

- A The acceleration of the car is always zero.
- B The velocity of the car is always constant.
- C In one complete round starting from the checkered flag, the displacement of the car from the checkered flag is zero.
- D The distance covered by the car in one second when it is going round a bend is lower than the distance covered by the car in one second when it is travelling on a straight portion of the track.

5 Four measurements are carried out in the school laboratory.

Which measurement will have the same value if it is carried out in a space laboratory?

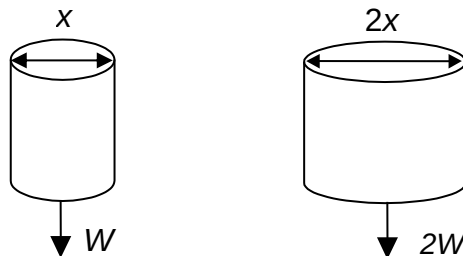
- A inertia of the object
- B period of a pendulum
- C pressure exerted by a mass on the bench
- D gain of energy in the potential store when an object is raised by 1.0 m

6 A mass of 5.0 kg is pulled by a spring balance along a surface. The mass moves at a constant speed of 8.0 m/s when the reading of the spring balance is 50 N.

What is the initial deceleration of the mass when the spring suddenly snaps?

- A 0 m/s²
- B 5.0 m/s²
- C 8.0 m/s²
- D 10.0 m/s²

7 The diagram below shows two solid cylinders made of two different materials. One cylinder has a diameter x while the other has diameter $2x$. The height of both cylinders is the same.



If the weight of the larger cylinder is twice that of the smaller cylinder, what is the ratio of the density of the larger cylinder to that of the smaller one?

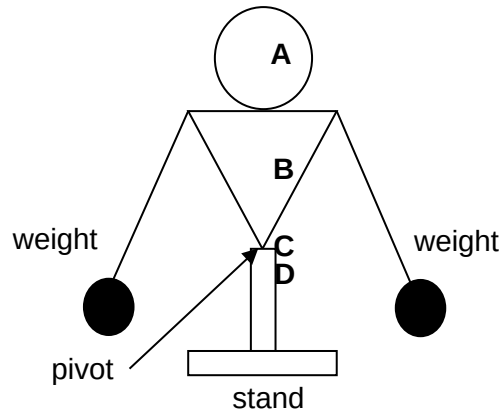
- A 0.5

B 1.0

C 2.0

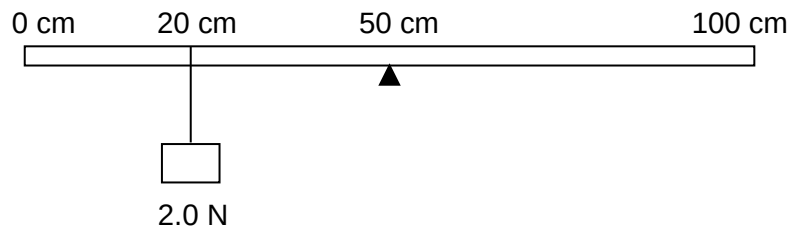
D 4.0

- 8** The diagram below shows a balancing toy pivoted on a stand. If the toy is tilted slightly, it remains at the same tilted position when the force is removed.



Which point **A**, **B**, **C** or **D** is the most likely position of the centre of gravity of the toy?

- 9** The diagram, not drawn to scale, shows a uniform metre rule of mass 500 g balanced at its centre of gravity. A load of 2.0 N is hung at the 20 cm mark.



At which position must a load of 5.0 N be hung in order to maintain equilibrium?

A 42 cm mark

B 58 cm mark

C 62 cm mark

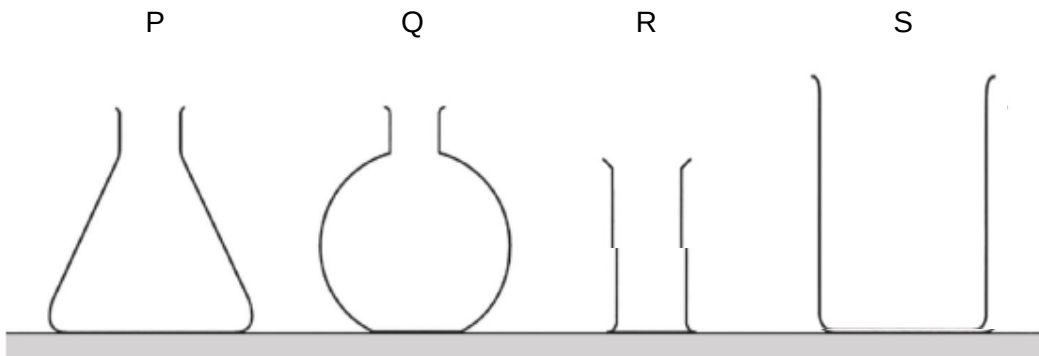
D 88 cm mark

- 10** An electric motor is used to lift a 12 kg box. The box is raised to a height of 20 m in 1 minute. The motor has an efficiency of 40 %.

What is the electrical power supplied to the motor?

- A** 600 W
- B** 100 W
- C** 40 W
- D** 10 W

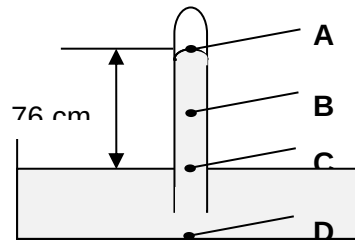
- 11** The diagram shows four containers.



If all the containers are completely filled with water, which statement about the pressure exerted by the water on the base of the containers is correct?

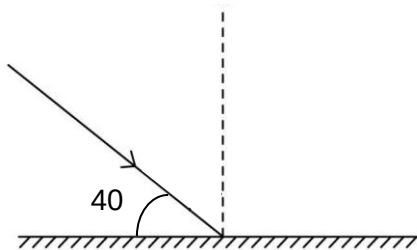
- A** The pressure is highest in container P and Q.
- B** The pressure is highest in container R.
- C** The pressure is highest in container S.
- D** The pressure is the same in all containers.

- 12 The diagram shows a simple mercury barometer at atmospheric pressure.



Which point shown in the diagram is at a higher pressure than atmospheric pressure?

- 13 The diagram shows a ray of light incident on a plane mirror.

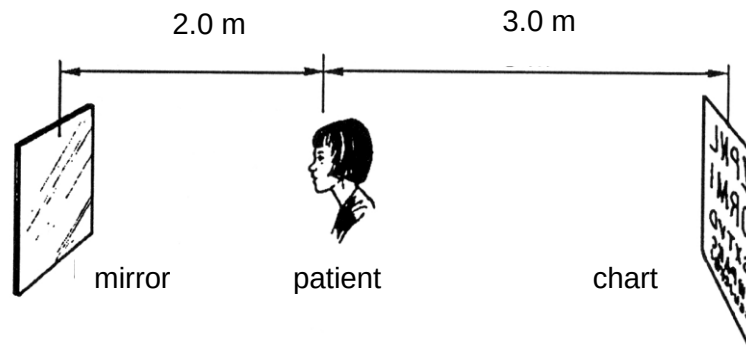


The angle the ray of light makes with the mirror is 40° .

What is the angle the ray of light is deviated (changed) due to the reflection in the mirror?

- A 40°
- B 50°
- C 80°
- D 100°

- 14 The diagram shows a patient having her eyes tested. A chart is placed behind her and she sees it reflected in a plane mirror.



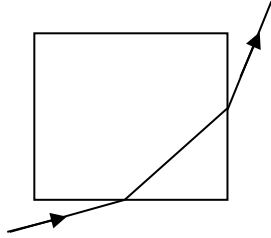
How far is the image of the chart from the patient?

- A 8.0 m
- B 7.0 m
- C 5.0 m
- D 3.0 m

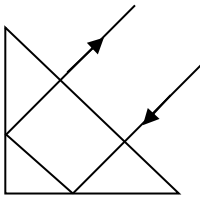
- 15 The diagrams **A**, **B**, **C** and **D** show rays of light travelling from air through glass.

Which diagram shows a path which is **not** possible?

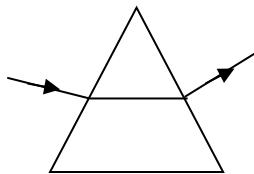
A



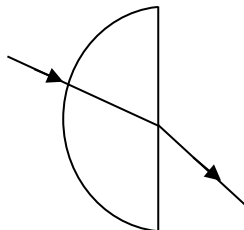
B



C

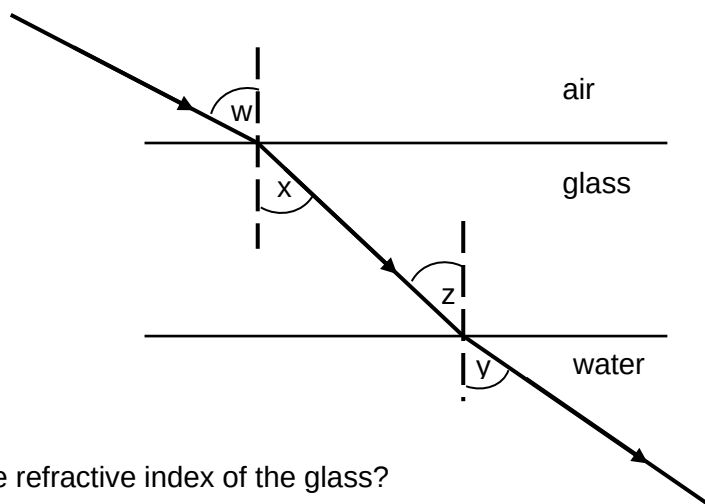


D



16

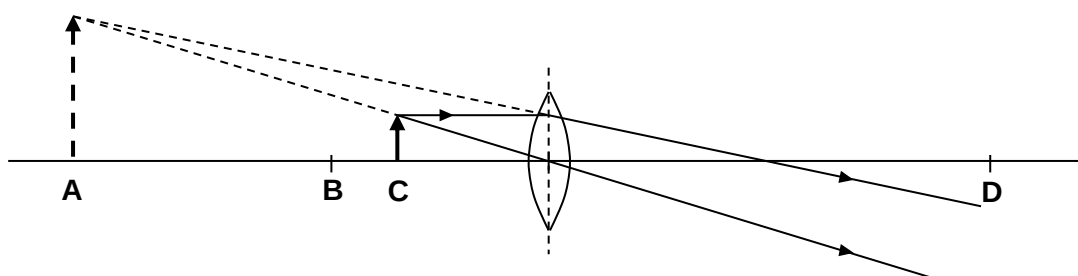
The diagram shows a ray of light travelling from air through a glass block and into water on the other side of the glass block.



What is the refractive index of the glass?

- A $\frac{\sin z}{\sin w}$
- B $\frac{\sin w}{\sin x}$
- C $\frac{\sin x}{\sin y}$
- D $\frac{\sin y}{\sin x}$

- 17 The diagram below shows a magnifying glass in action.

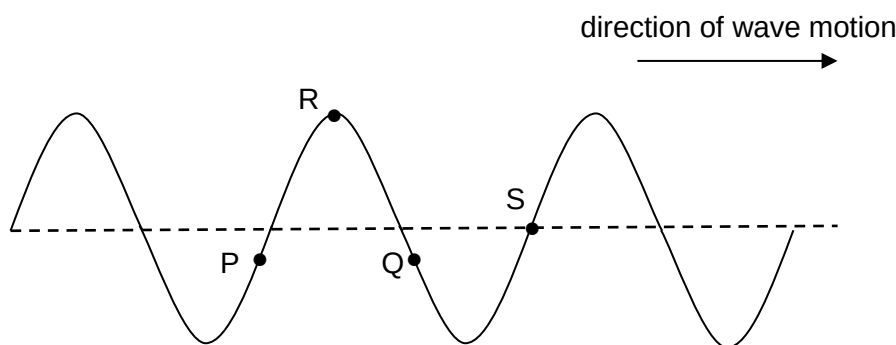


Which one of the points **A**, **B**, **C** or **D** is the principal focus of the lens?

- 18 Which component of the electromagnetic spectrum has the shortest wavelength?

- A** infra-red rays
- B** microwaves
- C** radiowaves
- D** X-ray

- 19 The diagram shows water waves travelling towards the right at a particular instance.



Which statement is true?

- A** Point P is moving downwards.
- B** Points P and Q are vibrating in phase.
- C** Point R is half a wavelength away from point S.
- D** Point S is momentarily at rest.

- 20** Sonar waves are emitted from a surface vessel to determine the depth of the sea. The time interval between the emitted signal and its reflection from the bottom of the sea is 5.0 s. The speed of sound in water is 1200 m/s.

What is the depth of the sea?

- A** 1200 m
- B** 3000 m
- C** 6000 m
- D** 12 000 m

- 21** In the Brownian motion experiment, the tiny smoke particles are observed to move in a random zig-zag manner.

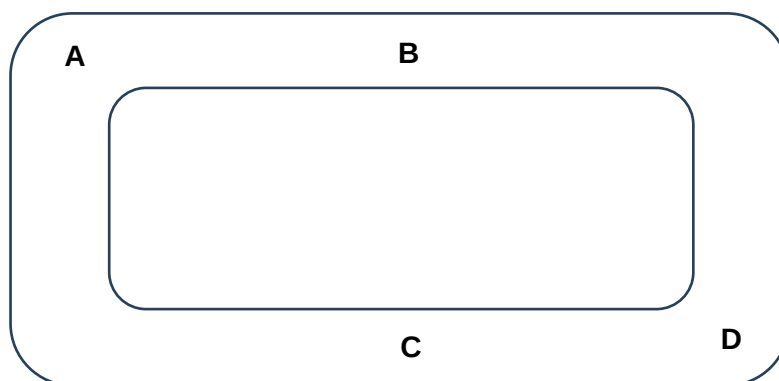
What could be the reason for this?

- A** the constantly changing average energy of the air molecules
- B** the smoke particles being too light
- C** the convection current of air
- D** uneven bombardment of air molecules on the smoke particles

- 22** Why does evaporation of a liquid produce cooling?

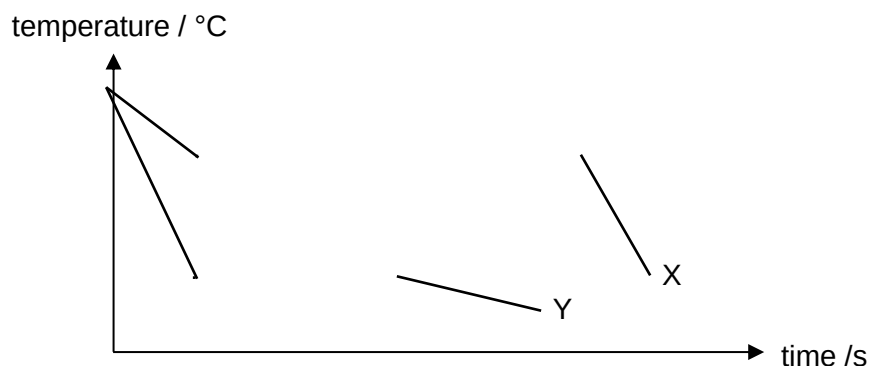
- A** There are lesser liquid molecules after evaporation.
- B** The liquid has less energy in the kinetic store and more energy in the potential store than before.
- C** The average energy in the kinetic store of the remaining molecules is reduced.
- D** Energy is transferred from the internal store of the surroundings to the kinetic store of the liquid.

- 23 A heating element is to be positioned in a narrow sealed tube of liquid.



At which position should the heating element be placed in order to obtain the best circulation of the liquid throughout the tube?

- 24 Two liquids, X and Y are cooled in air. Their cooling curves are shown below.



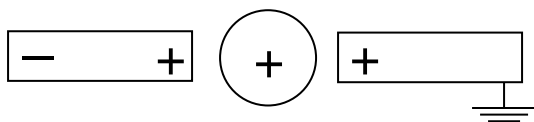
If X and Y have the same mass, which of the following statements is/are correct?

- 1 Liquid X has a higher melting point than liquid Y.
 - 2 Liquid X has a larger specific latent heat of fusion than liquid Y.
 - 3 Liquid X has a larger specific heat capacity than liquid Y.
- A** 1 only
- B** 2 only
- C** 1 and 2 only
- D** 1, 2 and 3

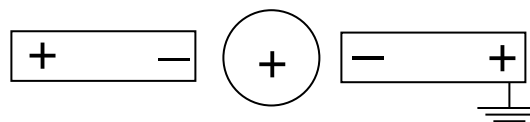
- 25** A positively charged metal sphere is placed halfway between previously uncharged metal rods, one of which is connected to earth.

Which diagram correctly shows how the charges are arranged on the rods?

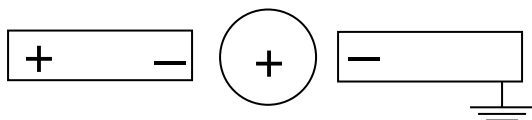
A



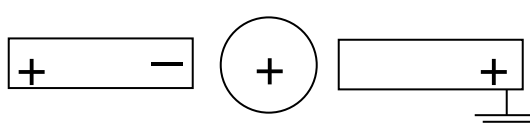
B



C



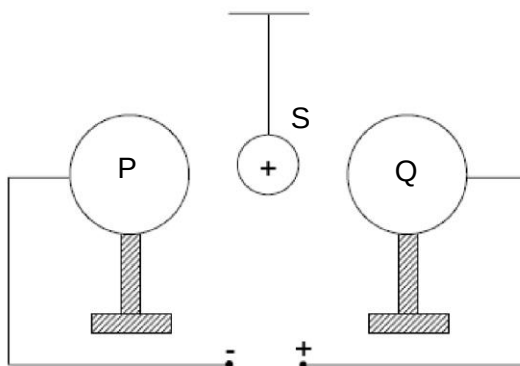
D



- 26** What could be done to remove excess positive charges from a plastic rod completely?

- A** passed to and fro over a Bunsen flame
- B** rubbed with one's hand to earth it
- C** placed in contact with a negatively-charged polythene rod
- D** placed back into contact with the charging duster

- 27 The diagram shows a light positively charged spherical conductor suspended precisely in between two insulated spheres P and Q. Both P and Q are connected to a high voltage direct current supply.



What will happen to the positively charged light spherical conductor S if it is given a small displacement from its original position?

- A S will move to touch Q and stay attracted to Q.
 - B S will move to touch P and stay attracted to P.
 - C S will move to touch P and start oscillating between Q and P.
 - D S will move to touch Q and start oscillating between P and Q.
- 28 A bulb is connected to a battery that transfers 600 J of energy to each coulomb of charge flowing through it. Every 10 minutes, there are 50 coulomb of charges flowing through the circuit.

What is the resistance of the bulb?

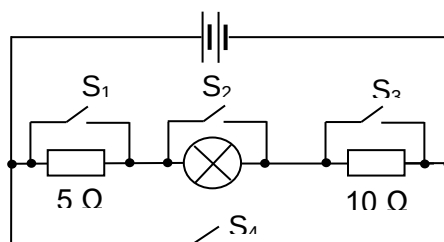
- A $1.4 \times 10^{-4} \Omega$
- B $7.2 \times 10^3 \Omega$
- C $3.0 \times 10^4 \Omega$
- D $1.4 \times 10^5 \Omega$

- 29** Two wires X and Y, each of the same length and the same material, are connected in parallel to a battery. The diameter of X is half that of Y.

What fraction of the total current passes through X?

- A** 0.15
- B** 0.20
- C** 0.25
- D** 0.33

- 30** The diagram shows a circuit.



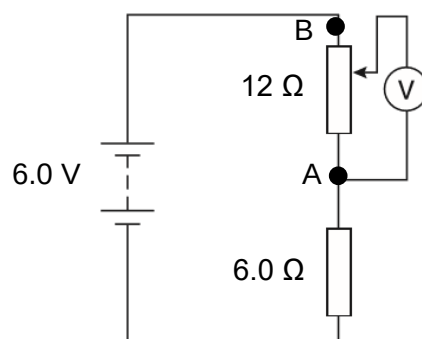
Which switch must be closed in order to have maximum brightness in the lamp?

- A** S₁
 - B** S₂
 - C** S₃
 - D** S₄
- 31** A bulb is labelled “240 V, 120 W”. Two of these bulbs are connected in series to the mains supply of 240 V.

What is the power of each bulb?

- A** 30 W
- B** 60 W
- C** 90 W
- D** 120 W

- 32 The diagram shows a circuit with a potential divider connected in series with a fixed resistor.



What are the minimum and maximum readings that can be obtained on the voltmeter when the contact of the potential divider moved from A to B?

	minimum / V	maximum / V
A	0	4.0
B	0	6.0
C	2.0	4.0
D	6.0	12.0

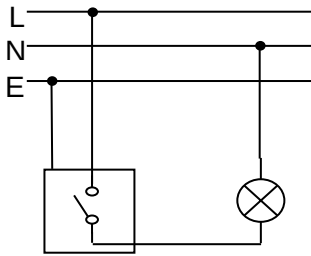
- 33 A 2.0 kW heater and a 1.0 kW fan are connected in parallel to a 240 V mains supply.

Which of the following fuse ratings should be installed in the household circuit?

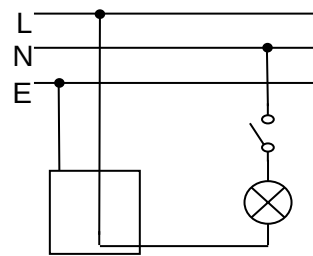
- A** 12 A
- B** 12.5 A
- C** 13 A
- D** 30 A

- 34 Which diagram shows the correct connections for a switch and lamp in a lighting circuit?

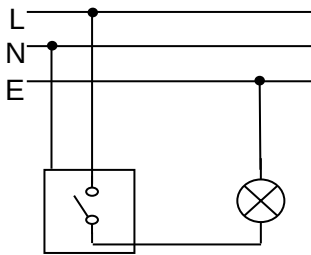
A



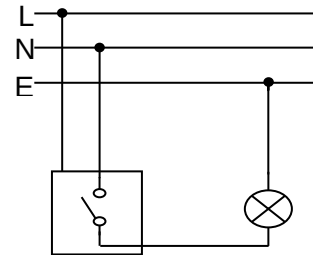
B



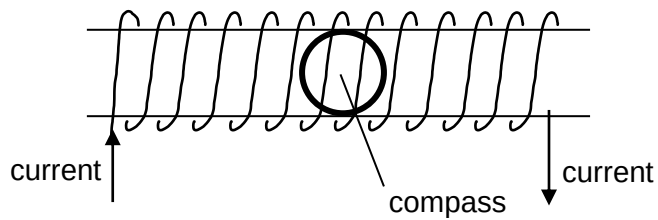
C



D



- 35 A compass is placed in the centre of a solenoid as shown in the diagram.



In which direction will the compass needle point?

A



B



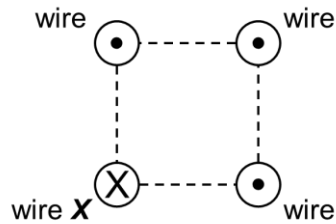
C



D



- 36 Four parallel wires each carrying the same current are arranged in a square formation. Wire X experiences a net electromagnetic force.



Which of the following shows the correct direction of the net electromagnetic force?

A



B



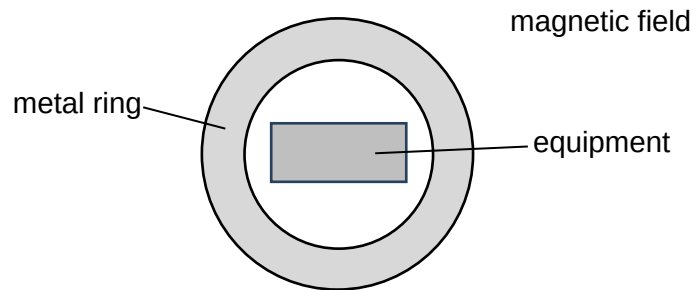
C



D



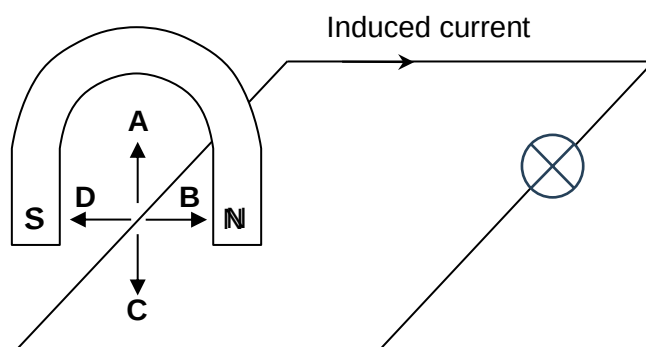
- 37 A metal ring shields a piece of equipment from a magnetic field.



Which row correctly describes the metal used for the ring?

	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 A wire, connected to a bulb, is placed between the poles of magnet.



Which direction should the wire move to induce the current shown above?

- 39 Which statement about nuclear fusion is correct?
- A Nuclear fusion occurs at low temperatures.
 - B Nuclear fusion occurs only between heavy nuclei.
 - C Nuclear fusion occurs in the formation of many stars.
 - D Nuclear fusion powers most electricity-generating stations.

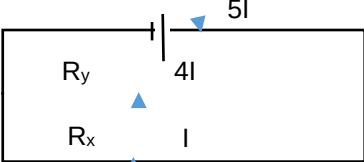
- 40 Which row shows the atomic structure of a neutral atom with a nucleon number of 9?

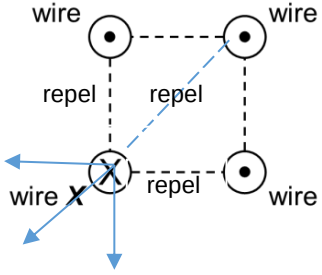
	number of neutrons	number of protons	number of electrons
A	4	5	4
B	4	5	5
C	5	4	5
D	5	5	4

End of Paper

Answers for Paper 1

1	B	Speed and resistance are derived quantity
2	D	time for $\frac{1}{4}$ oscillation = 0.85 s time for 1.5 oscillations = $0.85 \text{ s} \times 6 = 5.10 \text{ s}$
3	D	Digital micrometer screw gauge is used to measure the external diameter and tape measure is used to measure the circumference
4	C	Since the direction is changing, velocity is also changing and the car is said to be accelerating. The speed (distance covered in one second) is stated as constant. When it travels back to its starting point, the displacement is 0 m.
5	A	Inertia depends on mass. The other measurements are affected by the gravitational field strength which is not constant.
6	D	Opposing force = 50 N Initial deceleration = $50 \text{ N} / 5.0 \text{ kg} = 10.0 \text{ m/s}^2$
7	A	Let volume and mass of smaller cylinder be V and m . Volume of larger cylinder is $4V$. Mass of larger cylinder is $2m$. Density of larger cylinder = $2m / 4V = 0.5 \text{ m/V}$.
8	C	The CG is at the pivot. Thus, the weight does not have any resultant moment when the toy is tilted.
9	C	$5.0 \text{ N} \times x = 2.0 \text{ N} \times 30 \text{ cm}$ $x = 12 \text{ cm}$ position = 62 cm mark
10	B	Power used to lift the box = $120 \text{ N} \times 20 \text{ m} \div 60 \text{ s} = 40 \text{ W}$ Power of motor = $40 \text{ W} \div 0.4 = 100 \text{ W}$
11	C	The height of the water level in S is the highest. So the water pressure is the highest.
12	D	Pressure at C is the atmospheric pressure. Point D is lower than C in mercury and will have a higher pressure.
13	C	Angle between the reflected and incident ray is 100° . Thus, the ray of light is deviated by 80° .
14	B	Image is 5.0 m behind the mirror. Distance = $2.0 \text{ m} + 5.0 \text{ m} = 7.0 \text{ m}$
15	C	The emergent ray is air cannot be on the normal to the surface where the angle of refraction is 0° .
16	B	Refractive index = angle of incidence in air / angle of refraction in the medium
17	B	B is the same distance from the optical centre as the point of intersection of the refracted ray with the principal axis.
18	D	
19	A	By shifting the wave slightly to the right, the new position of P is lower. Points vibrating in phase must be at multiple wavelengths from each other. Similar to P, S is moving downwards.
20	B	Depth = $1200 \text{ m/s} \times 2.5 \text{ s} = 3000 \text{ m}$
21	D	The tiny smoke particles are bombarded by the constantly and randomly moving air molecules.
22	C	When evaporation occurs, the faster particles at the surface of the liquid have enough energy to break away from the other liquid particles to escape into the air. The particles left behind have lower energy in the kinetic store. Thus, temperature of the liquid becomes slightly lower.
23	D	It would allow the liquid that are heated at D to rise due to its lower density as they expand. The cooler liquid at C will fill in at D. Process repeats and sets up a convection current in an anti-clockwise direction.

24	D	The constant temperature represents melting point, which is higher for X. It also takes a longer time for liquid X to solidify, as larger specific latent heat of fusion than Y. As temperature decreases at a slower rate for liquid X, more amount of energy is needed per unit mass for each unit change in temperature.
25	C	For the metal rod on the left, electrons will be attracted by the positively charged sphere. Since there is no transfer of electrons, it remains net neutral. For the metal rod on the right, the right side of the rod is neutralised as electrons are transferred from the earth to the rod.
26	A	The air particles near the flame will be ionised, which then neutralised the excess positive charges on the plastic rod.
27	C	S is positively charged while P is negatively charged. S will move towards P as unlike charges attracts. When S touched P, electrons are transferred from P to S and S becomes negatively charged. Like charges repel and S moved towards Q and is attracted by Q as Q is positively charged as unlike charges attracts. When S touched Q, electrons are transferred from S to Q and S becomes positively charged. Like charges repel and S moved towards P and the cycle repeats itself.
28	B	$V = 600\text{J} / 1\text{C} = 600\text{ V}$ $I = Q/t = 50 / (10 \times 60) = 1/12$ $R = V/I = 7200\ \Omega$
29	B	$A_x = \frac{1}{4} A_y$ $R_x = 4 R_y$  Since R_x is 4 times larger than R_y, current flowing through x is 4 times lesser than y. Hence, if current flowing through x is I, current flowing through y will be 4I and thus total current is 5I. Fraction of total current = $I / 5I = 0.20$
30	C	When S_2/S_4 are closed, there is a short and current bypasses the bulb completely. The bulb will not light up. When S_1/S_3 are closed, there is also a short and current bypasses the resistor parallel to it. The one with the higher brightness will be the set up with the lower total resistance after the current bypass, which is S_3 (5 Ω) compared to S_1 (10 Ω).
31	A	$P = V^2 / R$ $R = 480\ \Omega$ When connected in series to the mains of 240 V, each bulb received 120 V. $P = V^2 / R$ $= 30\text{ W}$
32	A	When contact is at A, there is no potential difference across the voltmeter. Hence, reading is 0 V. When contact is at B, using potential divider rule to calculate, $V = (12 \div (12 + 6)) \times 6 = 4.0\text{ V}$.
33	C	Current = $(2000 / 240) + (1000 / 240) = 12.5\text{ A}$ Current rating = 13 A
34	A	Switch should be on the live wire. Earth wire should be connected to the metal casing.
35	A	Using right-hand grip rule, the left side of the solenoid is North pole. The magnetic field lines in the centre of the solenoid is pointing to the left.

36	D	
37	C	Metal has to be magnetic material for magnetic shielding.
38	C	Using Fleming Right hand rule, wire should move down.
39	C	Nuclear fusion requires very high temperature and pressure as two nuclei cannot come into close range of each other due to the repulsive forces. It takes places in stars such as the sun.
40	B	Protons and electrons must be equal to be neutral. Nucleon number is the sum of neutrons and protons ($5 + 4 = 9$)