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4EX

Physics

Paper 1 [40 marks]

6091/01

PRELIMINARY EXAMINATION

August 2024

1 hour

Additional Materials: Electronic calculator

INSTRUCTIONS TO CANDIDATES:

Do not start reading the questions until you are told to do so.

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 provided.

INFORMATION FOR CANDIDATES

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 **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.

The use of an approved scientific calculator is expected, where appropriate.

Unless otherwise stated, take the gravitational field strength on earth g to be 10 N/kg.

This question paper consists of **18** printed pages.

Setter: Mr Johnson Tay

Vetter: Mrs Neo Peck Hoon

[Turn over

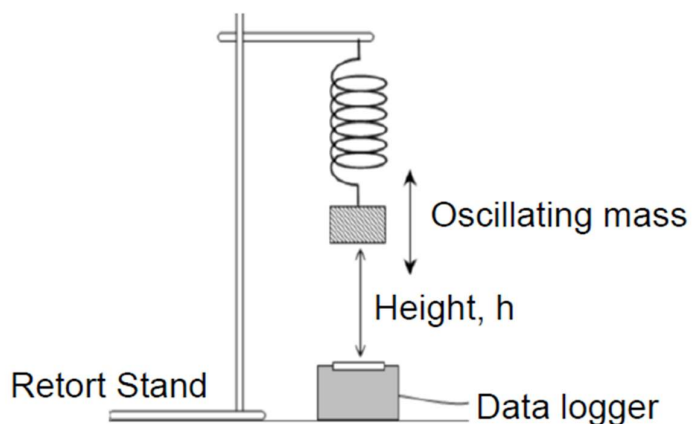
Answer **all** questions on the **OTAS** answer sheet provided.

- 1 A stone is dropped from the top of a building to the ground.

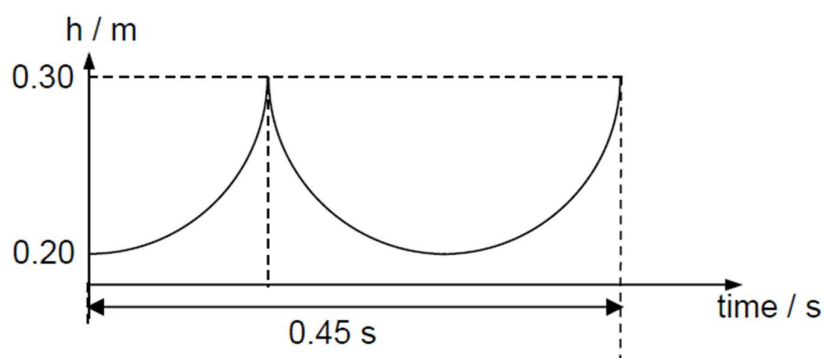
Which option describes a vector quantity?

- A Heat gained by the stone through its impact with the ground.
- B Kinetic energy of the stone as it reaches the ground.
- C Time taken for the stone to reach the ground.
- D Velocity of the stone when it is halfway to the ground.

- 2 The height, h , of an oscillating mass is measured by a data logger.



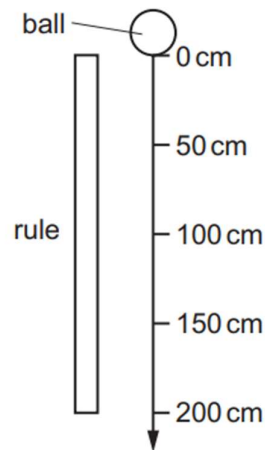
A graph of height, h , against time is shown below.



What is the period of the oscillation?

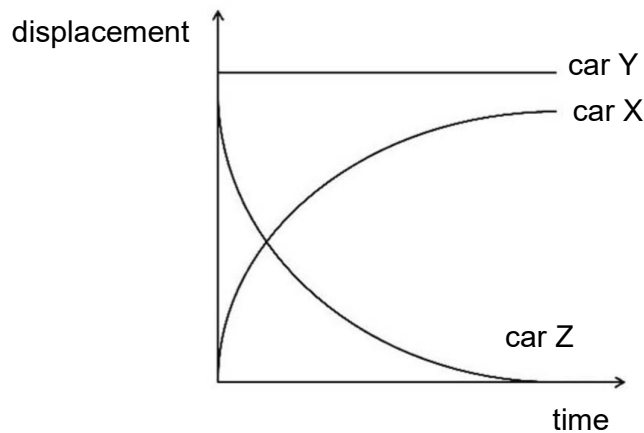
- A 0.15 s
- B 0.30 s
- C 0.45 s
- D 0.60 s

- 3 In a laboratory, a ball is dropped in a vacuum and falls 200 cm.



Which statement describes the acceleration of the ball?

- A It is greater at 10 cm than at 200 cm.
 - B It is greatest at 200 cm.
 - C It is smaller at 50 cm than at 100 cm.
 - D It is the same value at 50 cm as at 150 cm.
- 4 The graph shows how displacement varies with time for three cars X, Y and Z.



Which row describes the motion of cars X, Y and Z correctly?

	car X	car Y	car Z
A	decreasing speed	constant speed	moving in the same direction as car X
B	decreasing speed	not moving	moving in the opposite direction to car X
C	increasing speed	constant speed	moving in the opposite direction to car X
D	increasing speed	not moving	moving in the same direction as car X

- 5 A stationary durian drops from a tree, and it takes 2.2 s to hit the ground.

What is the height that the durian is dropped from?

- A 22 m
- B 24.2 m
- C 44 m
- D 48.4 m

- 6 Which statement about the masses and weights of objects on the Earth is correct?

- A A balance can only be used to compare weights, not masses.
- B Heavy objects always have more mass than light ones.
- C Large objects always have more mass than small ones.
- D Mass is a force but weight is not.

- 7 A body of weight 600 N is tied to a rocket. The rocket takes off and rises vertically to a height of 30 km. During the process, the gravitational field strength changes from 9.81 N/kg (at ground level) to 9.79 N/kg (at 30 km above ground level). The body remains intact and was not damaged during the ascent.

What is the mass and weight of the body at 30 km above ground level?

	mass at 30 km / kg	weight at 30 km / N
A	61.2	599
B	61.2	600
C	61.3	599
D	61.3	600

- 8 Newton's third law describes a pair of forces.

Which row shows whether the two forces are of the same force type and whether they act on the same object?

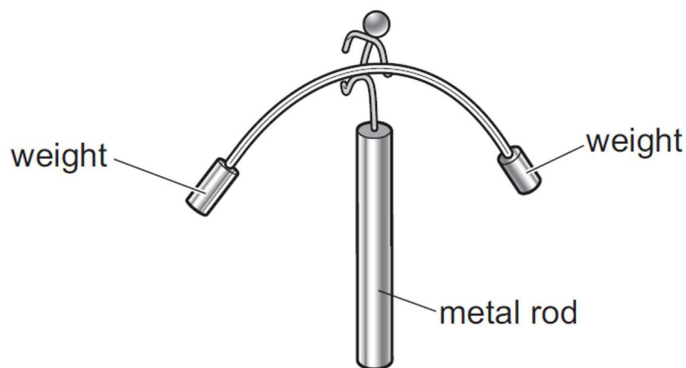
	the types of forces in the pair	the objects on which they act
A	different	different
B	different	same
C	same	different
D	same	same

- 9 A student drops, from rest, a light ball in air. The ball experiences some air resistance as it falls.

What happens to the velocity and to the acceleration of the ball during the first few seconds after release?

	velocity	acceleration
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

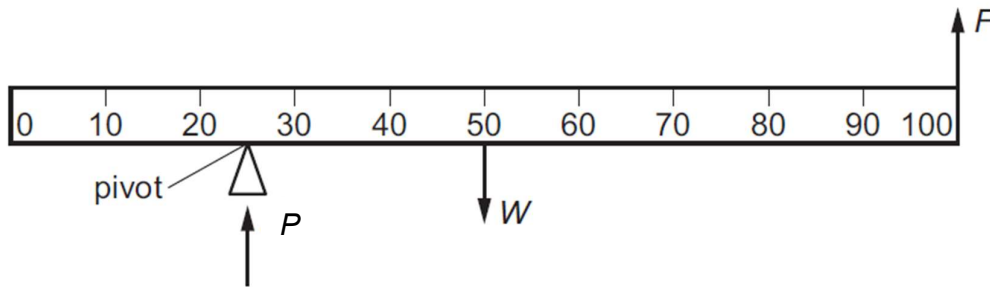
- 10 A student makes a model toy which balances on the end of a metal rod.



Why are the weights needed?

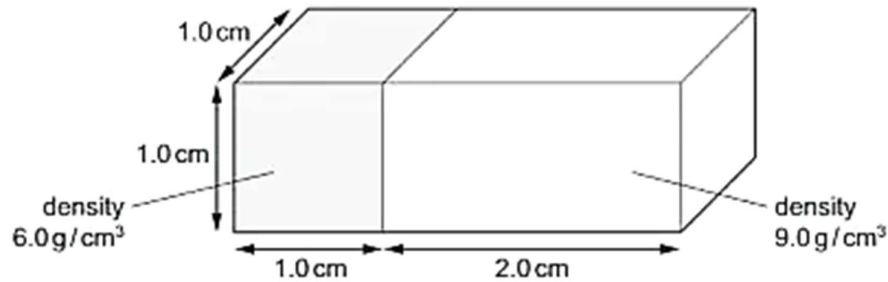
- A** They increase the pressure on the rod.
- B** They increase the weight of the model.
- C** They lower the centre of mass below the top of the rod.
- D** They raise the centre of mass above the top of the rod.

- 11 A uniform metre rule of weight W is pivoted at the 25 cm mark and held horizontal by a force F applied upwards at the 100 cm mark. The rule is supported by a vertical force P acting at the pivot.



What is the magnitude of P ?

- A $\frac{1}{3}W$
 - B $\frac{1}{2}W$
 - C $\frac{2}{3}W$
 - D $\frac{4}{3}W$
- 12 Two blocks are joined together.

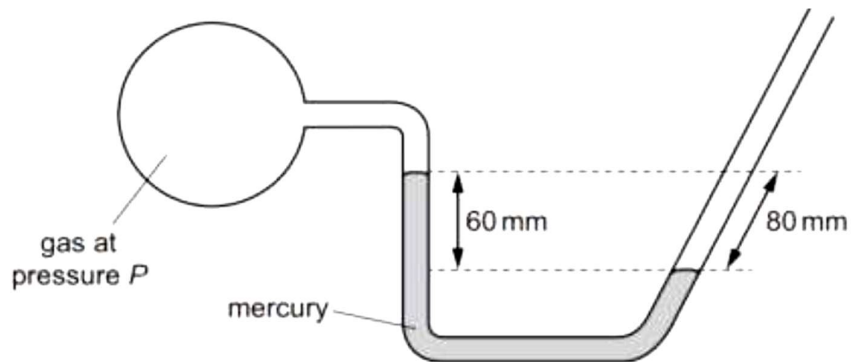


One block has a density of 6.0 g/cm^3 and the other has a density of 9.0 g/cm^3 .

What is the overall density of the two blocks joined together?

- A 7.0 g/cm^3
- B 7.5 g/cm^3
- C 8.0 g/cm^3
- D 10.0 g/cm^3

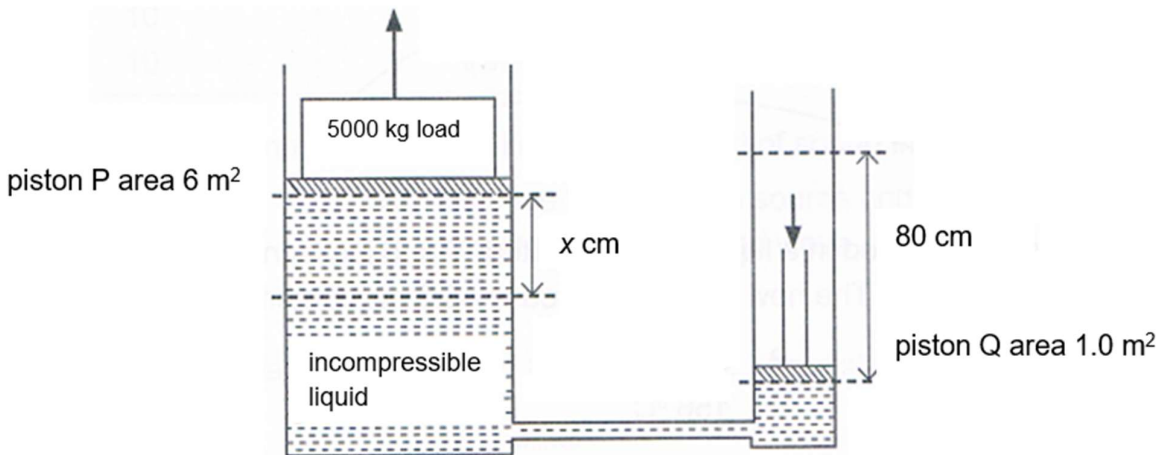
- 13** The diagram shows a mercury manometer. The tube is open to the atmosphere on the righthand side. The left-hand side is connected to a container containing a gas at pressure P .



Atmospheric pressure on its own supports a column of mercury of height 756 mm.

Which height of column does pressure P on its own support?

- A** 676 mm mercury
 - B** 696 mm mercury
 - C** 816 mm mercury
 - D** 836 mm mercury
- 14** In the hydraulic press shown below, when the small piston Q is pushed down by 80 cm, the large piston P, with load, moves up by x cm.



What is the distance x ?

- A** 0.13 cm
- B** 13.3 cm
- C** 4.8 cm
- D** 480 cm

- 15** A small motor has an input power rating of 10 W and is switched on for 5.0 minutes.

What is the electrical energy input to the motor in this time?

- A** 2.0 J
- B** 50 J
- C** 300 J
- D** 3000 J

- 16** Smoke particles in a transparent box are observed using a microscope. A shadow 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 more slowly when they are heated.
- D** They move because of collisions with smoke particles.

- 17** A beaker of water is heated up and its temperature increases from 30 °C to 54 °C.

Which statement correctly describes the changes at the molecular level when the temperature of the water is increased?

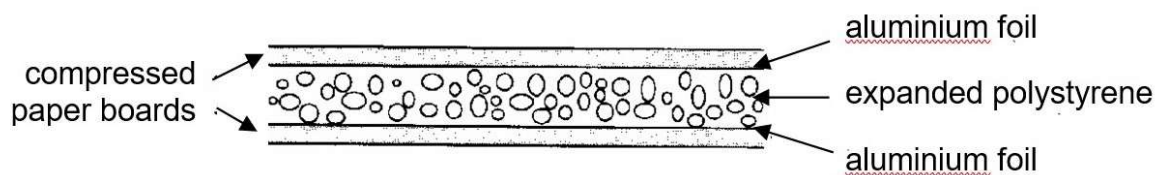
- A** Both the kinetic and potential energy of the water molecules increase at the same time.
- B** Only the kinetic energy of the water molecules has increased.
- C** Only the potential energy of the water molecules has increased.
- D** The kinetic energy of the water molecules increases initially until a certain temperature before the potential energy of the water molecules starts to increase.

- 18** A copper rod is heated at one end.

Which statement correctly 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.

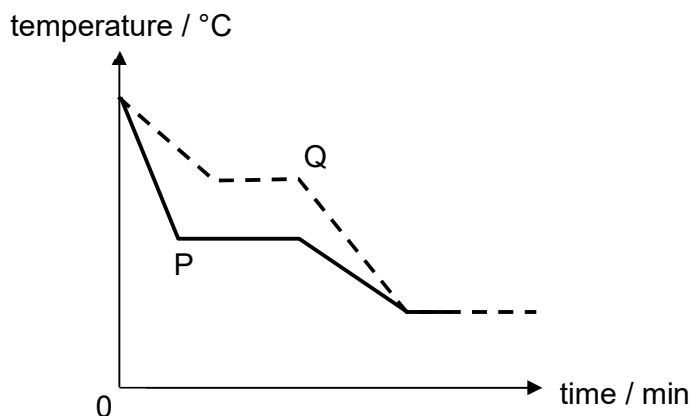
19 The diagram shows a section through a particular type of building board.



Which row correctly explains why such boards provide good heat insulation?

	aluminium foil	expanded polystyrene	compressed paper boards
A	is a good conductor	is a good reflector	has high thermal conductivity
B	is a good conductor	is a poor reflector	has high thermal conductivity
C	is a good reflector	is a good conductor	has low thermal conductivity
D	is a good reflector	is a poor conductor	has low thermal conductivity

20 Two liquids, P and Q, of the same masses are placed in a room for cooling. Their cooling curves are shown in the diagram below.



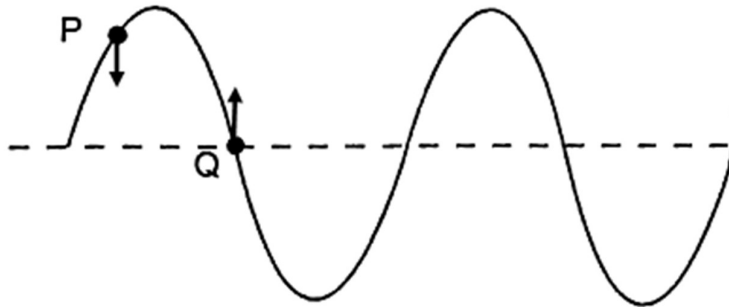
Which statement correctly describes the two liquids, P and Q?

- A** Both P and Q have the same specific latent heat of fusion.
- B** Both P and Q have the same freezing point.
- C** P has a higher specific latent heat of fusion than Q.
- D** Q has a lower freezing point than P.

21 What is the heat capacity of a body?

- A** the amount of thermal energy that the body can absorb without melting
- B** the amount of thermal energy required to raise the temperature of the body by 1.0°C
- C** the amount of thermal energy required to raise the temperature of 1.0 kg of the body by 1.0°C
- D** the amount of thermal energy required to raise the temperature of 1.0 m^3 of the body by 1.0°C

22 The diagram shows the direction of two particles on a wave at P and Q at this instant.



In which direction is the wave moving?

- A** downwards
- B** towards the left
- C** towards the right
- D** upwards

23 Sunlight enters the sea, lighting up the shallow waters of the coral reef.

Which row correctly state the changes in speed, frequency and wavelength (if any) when sunlight enters the shallow region of the water?

	wave speed	frequency	wavelength
A	slower	lower	smaller
B	slower	unchanged	smaller
C	unchanged	unchanged	unchanged
D	faster	higher	greater

- 24** A scientific research boat uses pulses of ultrasound to detect fish underneath it. A pulse of ultrasound is bounced from a group of fish 6000 m directly below the boat. The next pulse is sent out 2.0 s after the echo from the previous pulse has been received. The speed of ultrasound in water is 1500 m/s.

What is the interval between the two pulses?

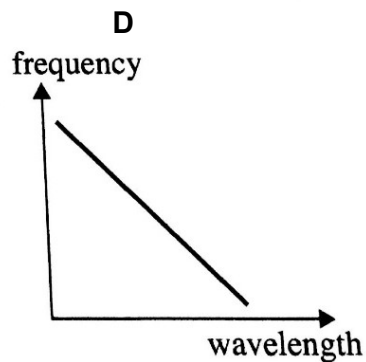
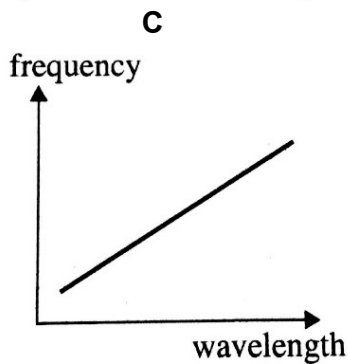
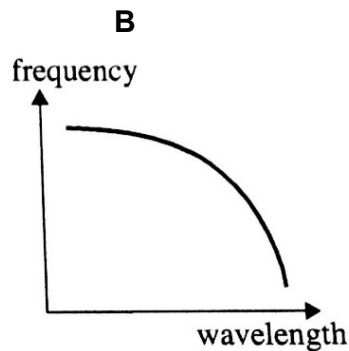
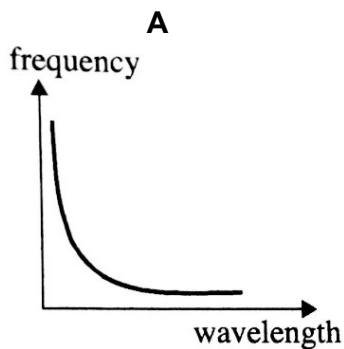
- A** 4.0 s
- B** 6.0 s
- C** 8.0 s
- D** 10.0 s

- 25** Ultrasound is used to clean jewellery in a liquid.

What is another use of ultrasound?

- A** optical fibre communication
- B** pre-natal scanning
- C** sunbeds
- D** telephone communications

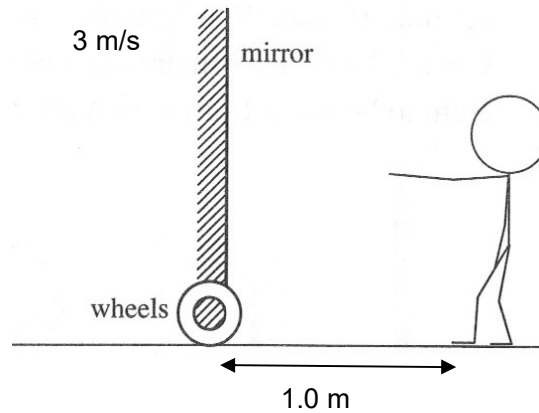
- 26** Which graph shows the relationship between the frequency and the wavelength of the electromagnetic waves?



27 Which type of electromagnetic waves is used for cancer treatment?

- A gamma rays
- B infra-red
- C microwaves
- D radio waves

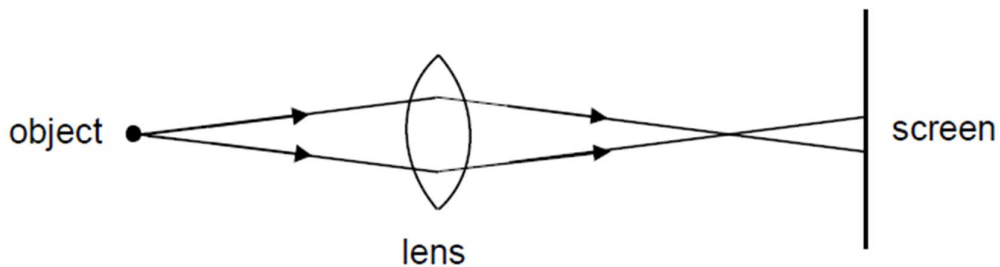
28 A man is standing still initially at a distance of 1.0 m from a plane mirror. The plane mirror is then moved away from him at a speed of 3 m/s.



How fast does he see his image moving away?

- A 2 m/s
- B 3 m/s
- C 5 m/s
- D 6 m/s

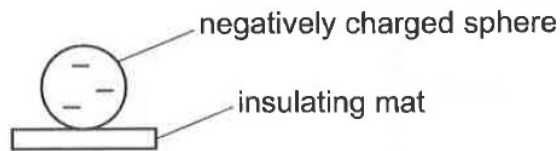
29 A lens forms a blurred image of an object on a screen as shown below.



Which step will not allow the image of the object to be focused on the screen?

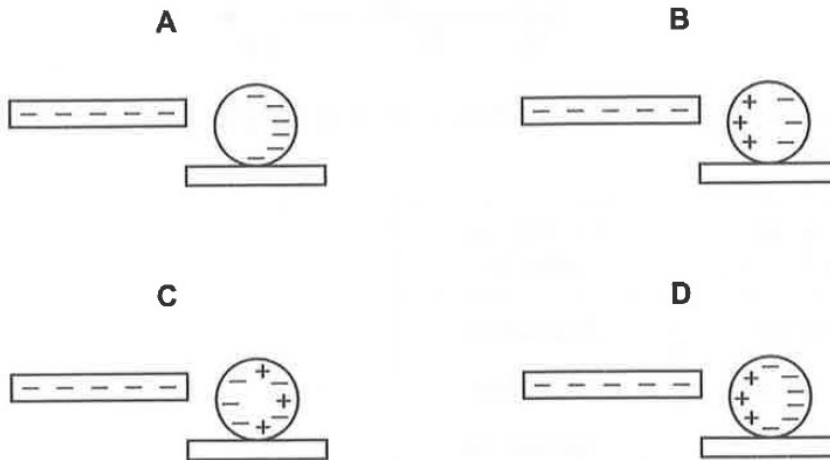
- A shift the screen closer towards the lens
- B shift the object nearer towards the lens
- C shift the lens nearer towards the object
- D use a lens of shorter focal length

- 30** A negatively charged copper sphere rests on an insulating mat.



A negatively charged polythene rod is brought near to the copper sphere.

Which diagram best shows the distribution of charge on the sphere?



- 31** Which statement correctly describes a current of 1.0 A?

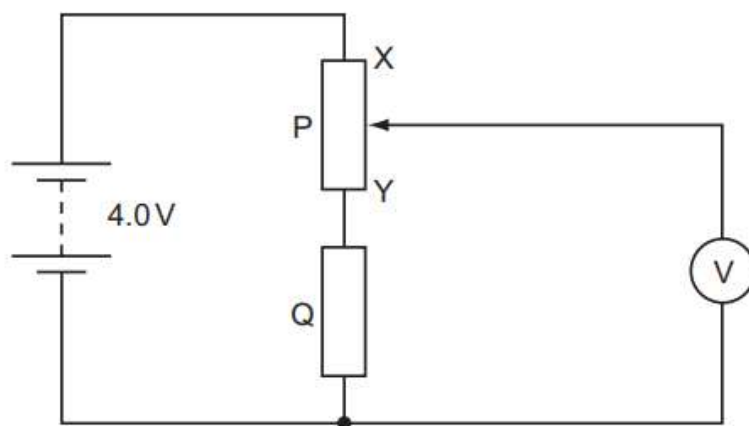
- A** A charge of 0.10 C passes through a resistor in 100 ms.
- B** A 10 V lamp with input power 0.10 W.
- C** A resistor of resistance 0.50 Ω with a potential difference of 2.0 V across it.
- D** Two resistors with a current of 0.50 A connected in series.

- 32** The potential difference between the clouds and the earth during a lightning strike is estimated to be 3.0×10^{10} V. The lightning transfers 90 C of charge from a cloud to the ground in 2.0 ms.

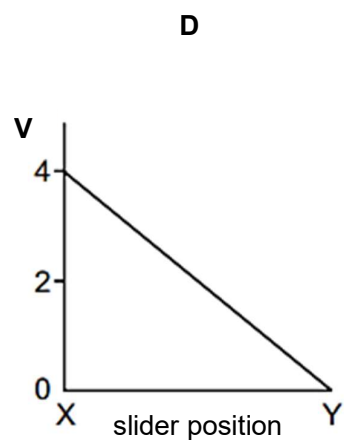
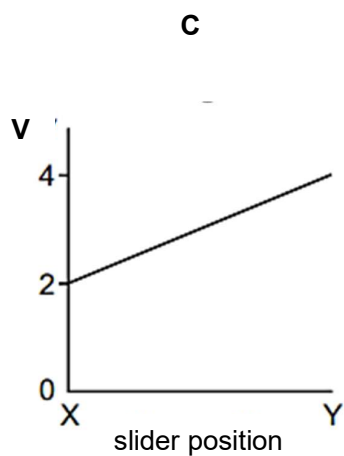
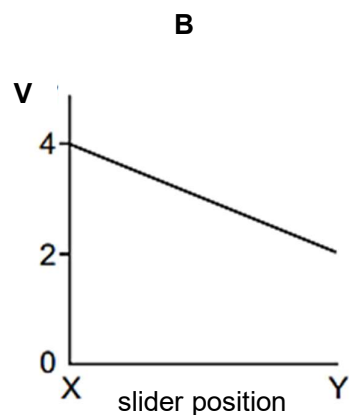
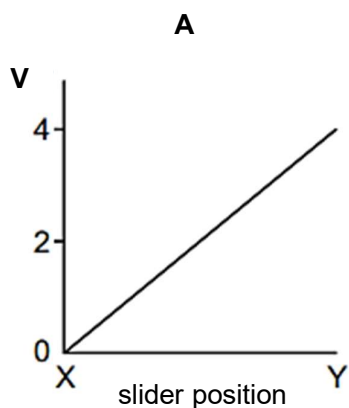
How much energy was produced during the lightning?

- A** 2.7×10^{10} J
- B** 2.7×10^{12} J
- C** 3.0×10^{12} J
- D** 1.3×10^{13} J

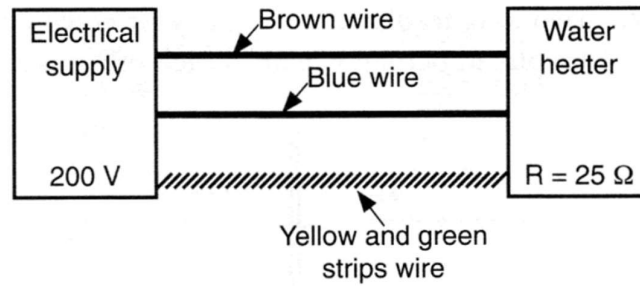
- 33** In the circuit below, P is a potentiometer of total resistance $10\ \Omega$ and Q is a fixed resistor of resistance $10\ \Omega$. The battery has an e.m.f. of $4.0\ \text{V}$. The voltmeter has a very high resistance. The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.



Which graph is obtained?



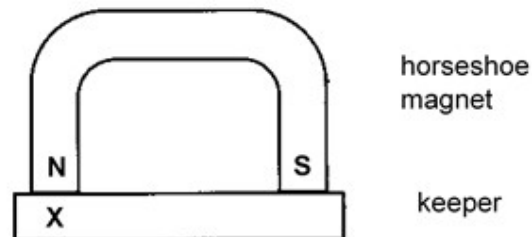
- 34 The diagram shows the three wires of an electrical supply connected to a water heater.



What is the amount of current that flows through each of the wires when the water heater is switched on?

	brown wire	blue wire	yellow and green striped wire
A	8 A	0 A	0 A
B	8 A	0 A	8 A
C	8 A	8 A	0 A
D	8 A	8 A	8 A

- 35 A permanent horseshoe magnet and soft magnetic keeper are arranged as shown.



Which row describes the materials used and polarity of end X correctly?

	magnet	keeper	polarity of X
A	iron	iron	north
B	iron	steel	south
C	steel	iron	south
D	steel	steel	south

36 A teacher wants to demagnetise a bar magnet and tries three different methods.

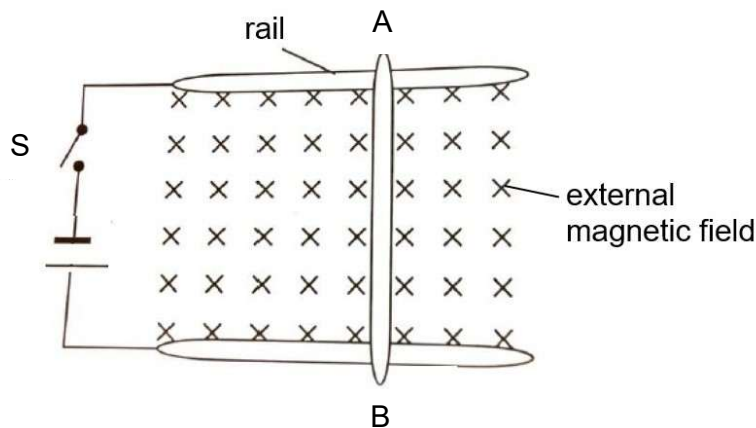
1. Heat the bar magnet to a high temperature and let it cool.
2. Place the bar magnet east to west and hammer it.
3. Place the bar magnet inside a coil that has a direct current in it and remove it from the coil slowly.

Which methods demagnetise the bar magnet?

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

37 A metal rod AB is placed on two smooth horizontal metal rails on the bench.

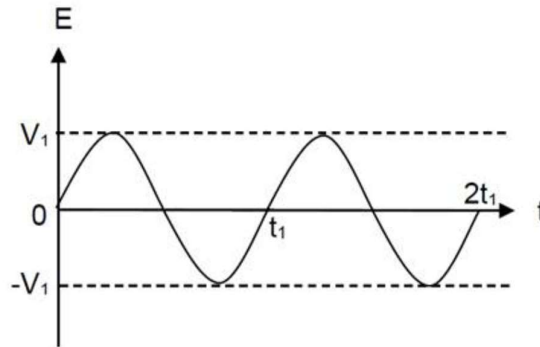
The rail and the rod are subjected to an external magnetic field. The top view of the setup is shown below.



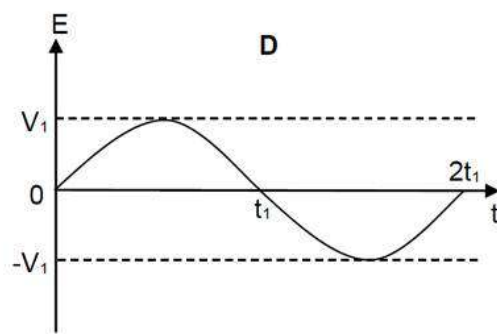
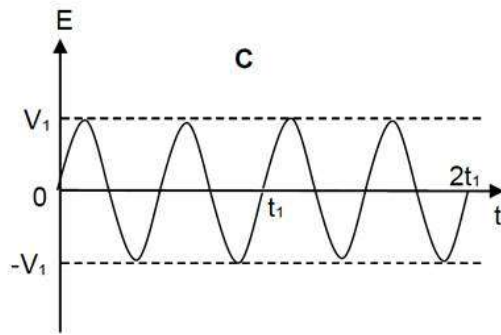
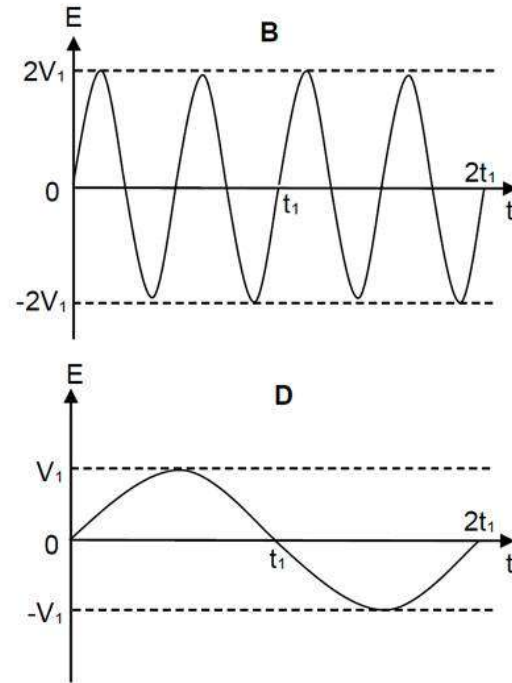
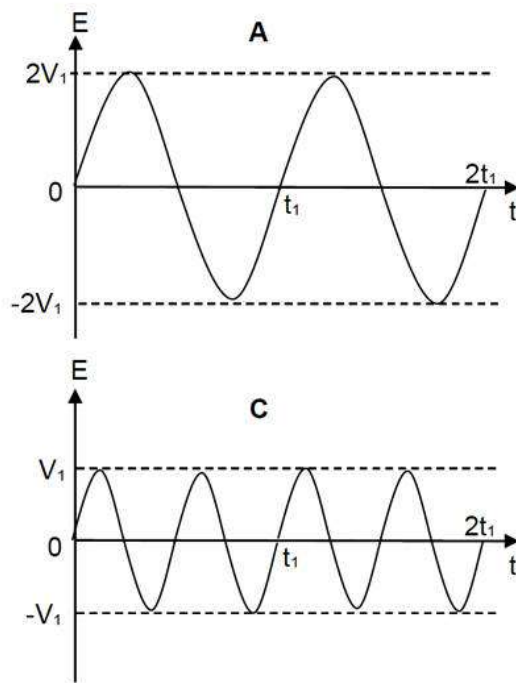
When switch S is closed, in which direction will rod AB move?

- A** into the page
- B** out the page
- C** to the right of the page
- D** to the left of the page

38 When a coil is rotated in a magnetic field, the induced e.m.f. E varies as shown.



Which graph would be obtained if the speed of rotation of the coil were doubled?



39 Why is electrical energy usually transmitted at high alternating voltages?

- A** The current in the transmission cables is as large as possible.
- B** The energy loss in the transmission cables is as little as possible.
- C** The resistance of the transmission cables is as small as possible.
- D** The transmission cables are safer to handle.

[Turn over

40 Alpha (α) particles and beta (β) particles are emitted during radioactive decay.

Which particle has the weaker ionising effect and which has the weaker penetrating power?

	weaker ionising effect	weaker penetrating power
A	α	α
B	α	β
C	β	α
D	β	β

-- END OF PAPER --