

# **Sec 4 Physics**

Exam papers with worked solutions

## **SET B**

### **PAPER 1**

### **QUESTION**

Compiled by

**THE PHYSICS CAFE**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name and index number on the OTAS 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 answer sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each question carries one mark. No mark will be deducted for an incorrect answer.

Any rough working should be done in this question paper.

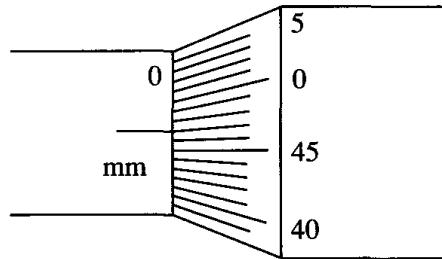
Hand in your OTAS at the end of the paper.

ThePhysicsCafe

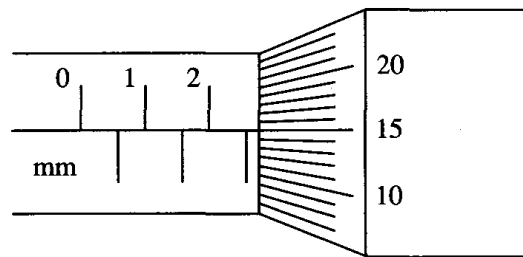
**Multiple Choice Questions (40 Marks)**

Answer all questions. Shade the correct answer for each question on the OTAS.

- Which of the following is a suitable estimate for the diameter of an atom?  
**A**  $5 \times 10^{-20}$  m      **B**  $1 \times 10^{-10}$  m      **C**  $3 \times 10^{-3}$  m      **D**  $1 \times 10^2$  m
- When the jaws of a micrometer screw gauge are fully closed, it shows the following reading:



The micrometer screw gauge is then used to measure the thickness of a copper plate and the following reading is obtained:



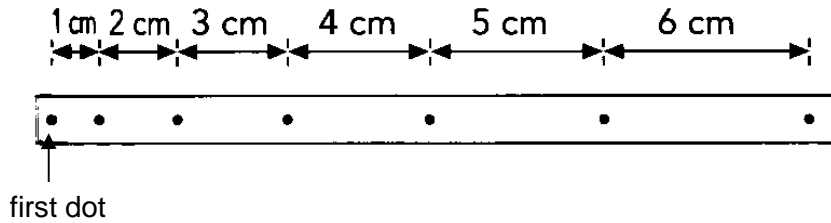
What is the actual thickness of the copper plate?

- A** 2.18 mm      **B** 2.62 mm      **C** 2.65 mm      **D** 2.68 mm
- A body **X** of mass  $m$  is dropped from a height  $h$ . At the same time, another body **Y** of mass  $3m$  is dropped from a height  $3h$ .

Which of the following statement is true?

- A** As both bodies fall, the distance between them decreases.  
**B** As both bodies fall, the distance between them remains constant.  
**C** Their velocities during the fall are constant.  
**D** **Y** will eventually overtake and pass **X**.

4. A ticker-tape vibrator makes 50 dots per second. The diagram below shows a ticker-tape produced by a trolley being pulled by a rubber band.

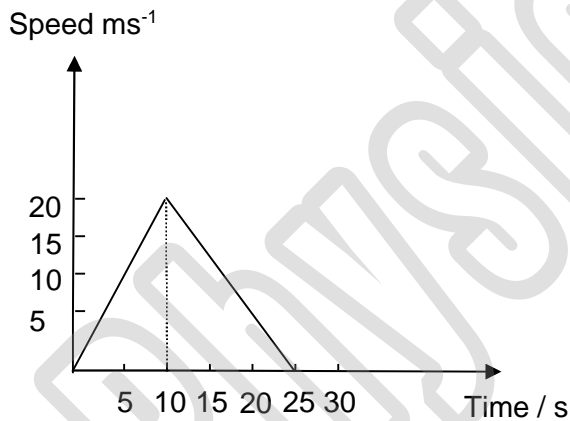


Which of the following statements about the trolley is/are true?

- I Its displacement increases uniformly with time.
- II Its velocity increases uniformly with time.
- III Its acceleration increases uniformly with time.

- A I only.
- B II only.
- C I and II only.
- D II and III only.

5. The speed-time graph for a motor vehicle is shown below.



What is the average speed of the vehicle?

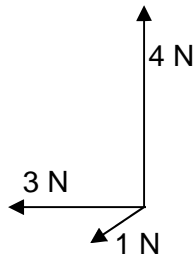
- A  $5 \text{ ms}^{-1}$       B  $10 \text{ ms}^{-1}$       C  $15 \text{ ms}^{-1}$       D  $20 \text{ ms}^{-1}$

6. A car was moving at a constant speed of  $15 \text{ ms}^{-1}$  before the driver stepped on the brakes. The average deceleration of the car was  $3 \text{ ms}^{-2}$ .

What was the stopping distance of the car?

- A 5 m      B 18 m      C 37.5 m      D 45 m

7. The diagram below shows three force vectors.



Which of the vectors below would most likely represent the direction of the resultant of the three forces?



8. The diagram below shows two blocks connected by a string and resting on a frictionless horizontal surface. Under the action of a constant force  $F$  N on the 3 kg block, they move with a uniform acceleration of  $3 \text{ m s}^{-2}$ .



What will be the acceleration of both blocks if the string suddenly breaks?

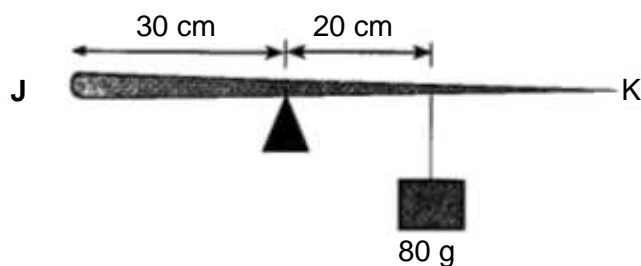
	acceleration of 1 kg block / $\text{ms}^{-2}$	acceleration of 3 kg block / $\text{ms}^{-2}$
<b>A</b>	0	0
<b>B</b>	0	4
<b>C</b>	1	3
<b>D</b>	3	3

9. A body of mass 500 g has a volume of  $100 \text{ cm}^3$ . A hole of  $20 \text{ cm}^3$  was drilled through the body.

What is the density of the body?

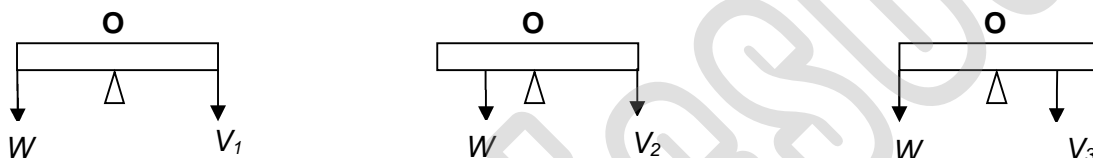
- A**  $0.20 \text{ gcm}^{-3}$       **B**  $5.00 \text{ gcm}^{-3}$       **C**  $6.25 \text{ gcm}^{-3}$       **D**  $25.0 \text{ gcm}^{-3}$

10. A non-uniform rod is balanced as shown in the diagram below. The centre of gravity of the rod is 14.0 cm from the end marked J.



What is the mass of the rod?

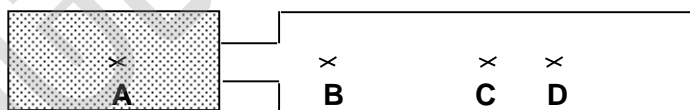
- A 53 g                      B 100 g                      C 120 g                      D 280 g
11. In the diagram below, the uniform metre ruler is pivoted at the middle O. In each case, a fixed weight  $W$  is loaded on one side and a variable weight  $V_1$  or  $V_2$  or  $V_3$  is loaded on the other side in order to balance the ruler horizontally.



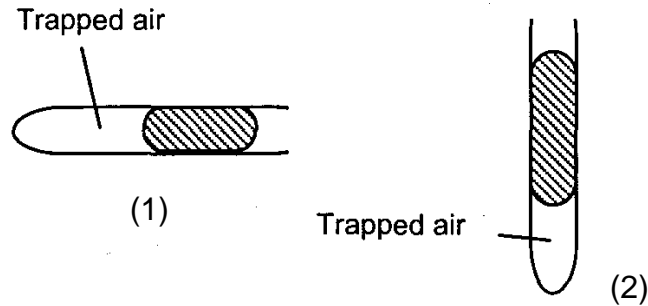
Which of the following correctly shows the magnitude of the variable weights  $V_1$ ,  $V_2$  and  $V_3$  in ascending order?

- A  $V_1, V_2, V_3$   
 B  $V_1, V_3, V_2$   
 C  $V_2, V_1, V_3$   
 D  $V_3, V_2, V_1$
12. Two uniform lamina of equal density but different mass and shapes are joined together to form a new lamina as shown in the diagram.

Where is the centre of gravity of the new lamina most likely to be?



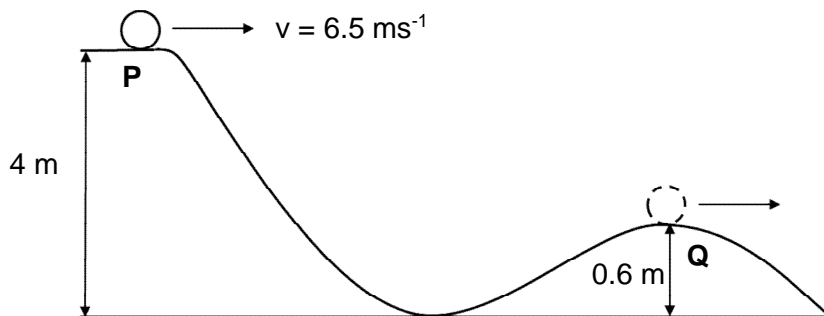
13. The diagram below shows air trapped in a capillary tube by a small mercury plug. The length of the mercury plug is 10 cm. The atmospheric pressure is 76 cm Hg.



What is the pressure of the trapped air column in the tube for both positions (1) and (2)?

	pressure of trapped air in position (1) / cm Hg	pressure of trapped air in position (2) / cm Hg
<b>A</b>	10	76
<b>B</b>	10	86
<b>C</b>	76	10
<b>D</b>	76	86

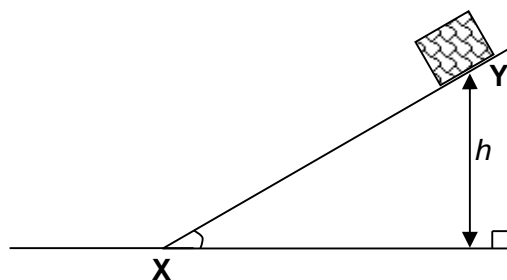
14. A sphere moving at  $6.5 \text{ ms}^{-1}$  passes point **P**, 4 m above the ground. It rolls down a frictionless slope before ascending a second, lower slope and passing point **Q**, which is 0.6 m above the ground. Take  $g = 10 \text{ N/kg}$ .



What is velocity of the sphere at point **Q**?

- A**  $5.50 \text{ ms}^{-1}$       **B**  $8.25 \text{ ms}^{-1}$       **C**  $10.5 \text{ ms}^{-1}$       **D**  $11.1 \text{ ms}^{-1}$

15. An object of mass  $m$  passes a point  $X$  with a velocity  $v$  and slides up a frictionless slope to stop at point  $Y$  which is at a height  $h$  above  $X$ .



A second object of mass  $0.5m$  passes  $X$  with a velocity of  $0.5v$ .

What is the height the second object will rise to?

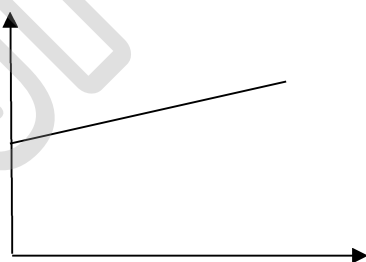
- A**  $0.0625h$       **B**  $0.125h$       **C**  $0.250h$       **D**  $0.500h$
16. A crate is pushed 10 m along a horizontal surface by a force of 80 N. The frictional force opposing the motion is 60 N.



What is the amount of work done against friction and the kinetic energy gained by the crate?

	work done against friction/J	kinetic energy/J
<b>A</b>	200	800
<b>B</b>	200	600
<b>C</b>	400	200
<b>D</b>	600	200

17. The graph below shows the relationship between certain properties of a fixed mass of gas.

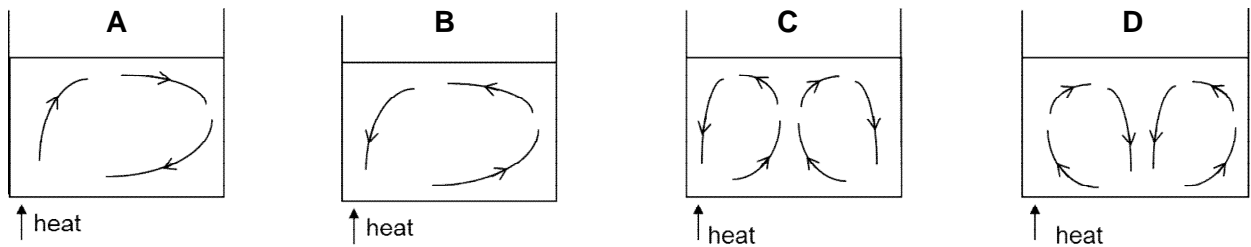


Which of the following could describe what is shown on the graph?

	vertical axis	horizontal axis	conditions
<b>A</b>	density	temperature	constant pressure
<b>B</b>	pressure	volume	constant temperature
<b>C</b>	volume	temperature	constant pressure
<b>D</b>	volume	pressure	constant temperature



18. Which of the following diagram shows the convection currents formed when a beaker of water is heated as shown?



19. A thermometer reads  $2\text{ }^{\circ}\text{C}$  in pure melting ice and  $102\text{ }^{\circ}\text{C}$  in steam above boiling water. It is used to measure the temperature of water before and after it is heated.

What is the error when the temperature rise is calculated?

- A  $2\text{ }^{\circ}\text{C}$  too low.  
 B  $2\text{ }^{\circ}\text{C}$  too high.  
 C Zero.  
 D None of the above.
20. When ice changes into water at  $0\text{ }^{\circ}\text{C}$ , which of the following statement(s) is/are true?

- I Energy is absorbed to raise the temperature.  
 II Energy is absorbed to overcome the forces of attraction between the molecules.  
 III The internal energy is increased.

- A I only.  
 B II only.  
 C II and III only.  
 D III only.
21. The resistance of a piece of platinum wire in pure melting ice is  $800\ \Omega$ . The resistance of the wire in steam is  $910\ \Omega$ .

What would be the temperature when the wire has a resistance of  $1000\ \Omega$ ?

- A  $55\text{ }^{\circ}\text{C}$                       B  $110\text{ }^{\circ}\text{C}$                       C  $182\text{ }^{\circ}\text{C}$                       D  $220\text{ }^{\circ}\text{C}$
22. **T**, **U**, **V** and **W** are four different liquids with the same mass. The table below shows the specific heat capacity and the boiling point for each liquid. All the liquids are at room temperature of  $30\text{ }^{\circ}\text{C}$  initially.

Which liquid will start to boil first if thermal energy is supplied at a constant rate to all the liquids at the same time?

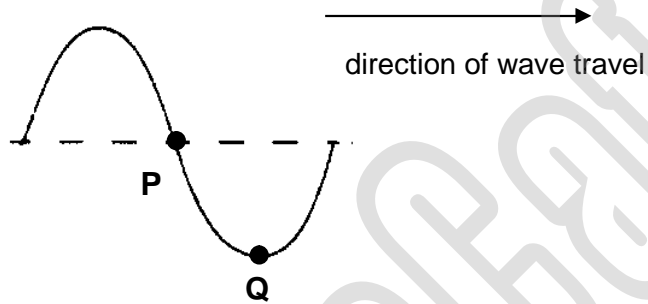
liquid	specific heat capacity / $\text{Jkg}^{-1}\text{K}^{-1}$	boiling point / $^{\circ}\text{C}$
<b>T</b>	4.0	50
<b>U</b>	3.0	50
<b>V</b>	4.2	100
<b>W</b>	0.2	200

- A Liquid **T**                      B Liquid **U**                      C Liquid **V**                      D Liquid **W**

23. Which one of the following is an example of a longitudinal wave?

- A light waves
- B radio waves
- C waves produced by a tuning fork
- D water waves

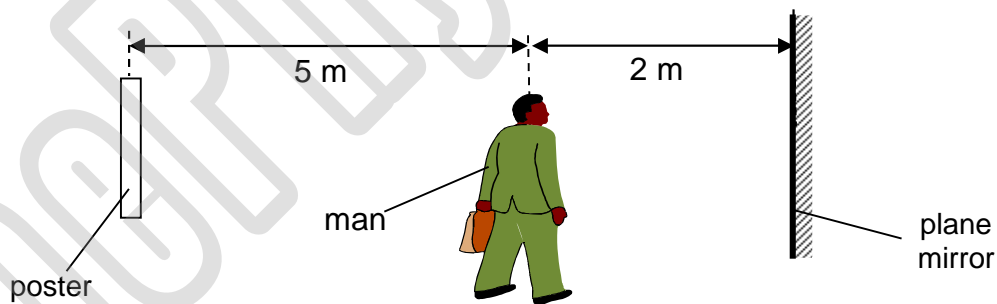
24. The diagram shows a transverse wave on a rope. The wave is travelling from left to right. At the instant shown, the points **P** and **Q** on the rope have zero displacement and maximum displacement respectively.



Which of the following describes the direction of motion, if any, of the points **P** and **Q** at this instant?

	Point P	Point Q
A	downwards	stationary
B	stationary	downwards
C	stationary	upwards
D	upwards	stationary

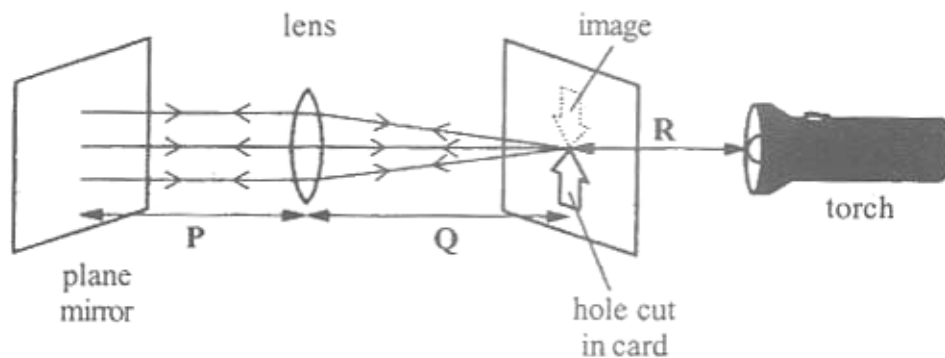
25. The diagram below shows a man standing in front of a plane mirror. A poster is placed behind him, which he sees reflected in the plane mirror.



What is the distance between the man and the image he sees of the poster in the mirror?

- A 5 m
- B 7 m
- C 9 m
- D 14 m

26. The diagram shows an experiment to measure the focal length of a lens.



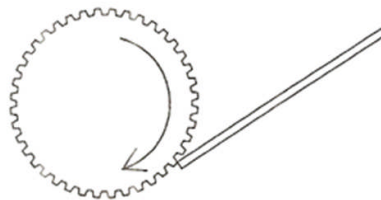
Which distance is the focal length of the lens?

- A** P                      **B** Q                      **C** R                      **D** P + Q
27. Which of the following statement is/are true of all electromagnetic waves?
- I They can be made to undergo total internal reflection.  
II They do not require energy to travel through a vacuum.  
III They travel at a speed of  $3 \times 10^8 \text{ ms}^{-1}$  in all mediums.

- A** I only.  
**B** I and II only.  
**C** II and III only.  
**D** III only.
28. In an experiment to measure the speed of sound, a boy stands 80 m from a wall and blows a whistle briefly. At the instant he hears the echo, he blows the whistle again. He does this 50 times. The time taken for 50 blows of the whistle is 23 s, and the frequency of the sound produced is 1.5 kHz.

What is the speed of the sound obtained in this experiment?

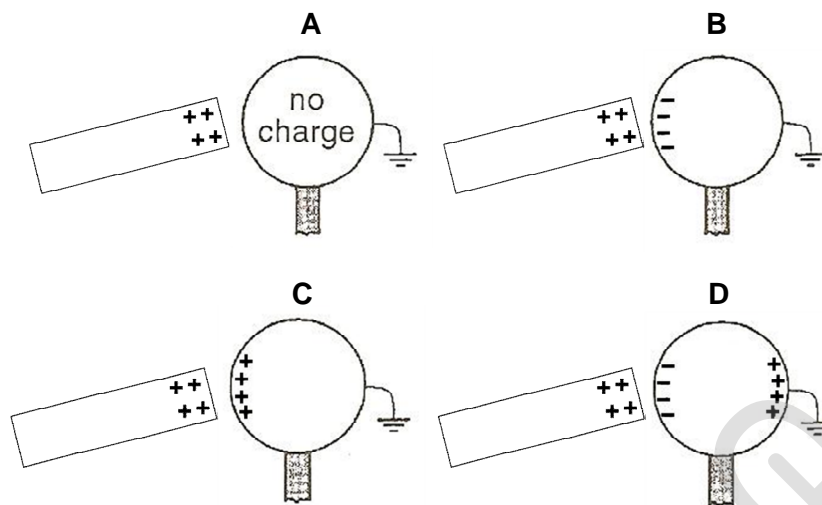
- A**  $174 \text{ ms}^{-1}$               **B**  $261 \text{ ms}^{-1}$               **C**  $330 \text{ ms}^{-1}$               **D**  $347 \text{ ms}^{-1}$
29. A thin card is held against a rotating toothed wheel as shown. As the wheel is turned quickly, a note is heard.



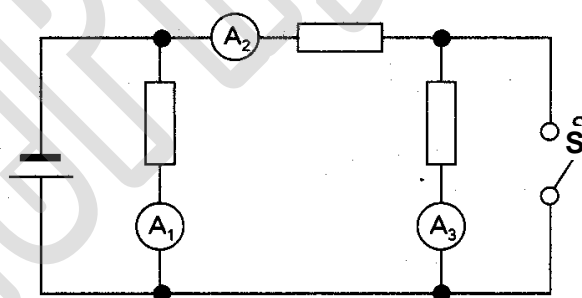
How can the pitch of the note be lowered?

- A** By pressing the card against the wheel with less force.  
**B** By turning the wheel more quickly.  
**C** By using a thicker card.  
**D** By using a wheel with fewer teeth.
30. A metal ball is to be charged by induction. A charged rod is held close to one side of the ball and the other side is earthed.

Which diagram shows the charged distribution at this stage of the experiment?



31. An electrostatically charged object will pick up small pieces of paper. Which of the following will not pick up pieces of paper?
- A** A copper rod rubbed with a duster.  
**B** A plastic comb pulled through dry hair.  
**C** A polythene rod rubbed with a woolen cloth.  
**D** A rubber balloon rubbed on a nylon shirt.
32. During a thunderstorm, a potential difference of 100 MV caused a bolt of lightning that carried 60 C of charge from a cloud to the ground in 3.2 ms. What was the power of the lightning strike?
- A**  $1.92 \times 10^4 \text{ W}$     **B**  $1.92 \times 10^7 \text{ W}$     **C**  $1.88 \times 10^9 \text{ W}$     **D**  $1.88 \times 10^{12} \text{ W}$
33. In the circuit below, **A**<sub>1</sub>, **A**<sub>2</sub> and **A**<sub>3</sub> are ammeters of negligible internal resistance.



What will happen to the readings of the ammeters when the switch **S** is closed?

	Reading of <b>A</b> <sub>1</sub>	Reading of <b>A</b> <sub>2</sub>	Reading of <b>A</b> <sub>3</sub>
<b>A</b>	Decreases	Increases	Becomes zero
<b>B</b>	Increases	Decreases	Decreases
<b>C</b>	Unchanged	Decreases	Increases
<b>D</b>	Unchanged	Increases	Becomes zero

34. When will the lamp in the circuit below light up?



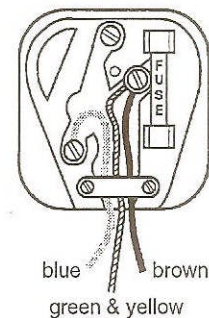
- A In a dark room
- B On a cold day
- C On a hot day
- D Under bright light

35. The two major electrical appliances in a certain household are a 4 kW electric oven, and a 450 W refrigerator. The cost per unit of electricity is \$0.22. The household sets a 30-day budget of \$100 for electricity consumption by these two appliances.

Which of the following daily usages would exceed the budget?

	Oven	Refrigerator
A	60 min	24 h
B	90 min	20 h
C	120 min	16 h
D	140 min	12 h

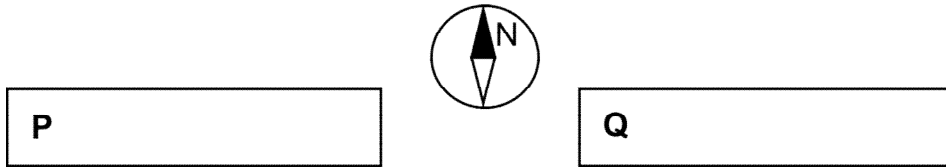
36. A plug is **wrongly** wired as shown in the diagram. It is connected to an old vacuum cleaner which has a metal case.



What would be the effect of using the plug wired this way?

- A The fuse in the plug would blow.
- B The metal case would be live.
- C The vacuum cleaner would catch fire.
- D The vacuum cleaner would not work.

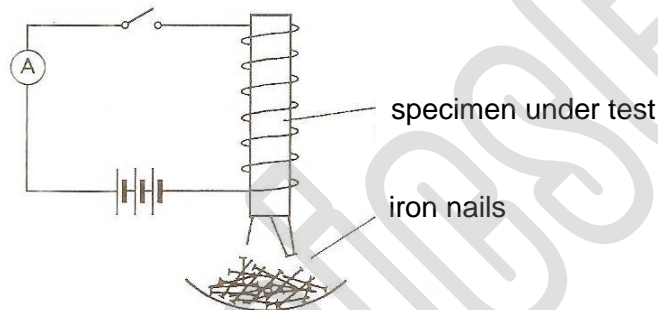
37. The diagram shows the position of a compass needle when the compass is placed between two magnets.



Which of the following combinations is likely to be the magnetic poles of **P** and **Q**?

	Pole of <b>P</b>	Pole of <b>Q</b>
<b>A</b>	N	N
<b>B</b>	S	S
<b>C</b>	N	S
<b>D</b>	S	N

38. Three specimens of magnetic materials were tested using the apparatus shown in the diagram.



When the switch is closed, the specimen picks up some of the iron nails but when the switch is opened, many or most of the nails fall off. The number of nails picked up and left on was counted for the three specimens. The table shows the results.

specimen	number of nails picked up	number of nails left on
<b>X</b>	35	4
<b>Y</b>	20	2
<b>Z</b>	40	3

What can be deduced from these results?

- A** X would make the best permanent magnet.
- B** Y would make the best electromagnet
- C** Y would make the best permanent magnet.
- D** Z would make the best electromagnet.

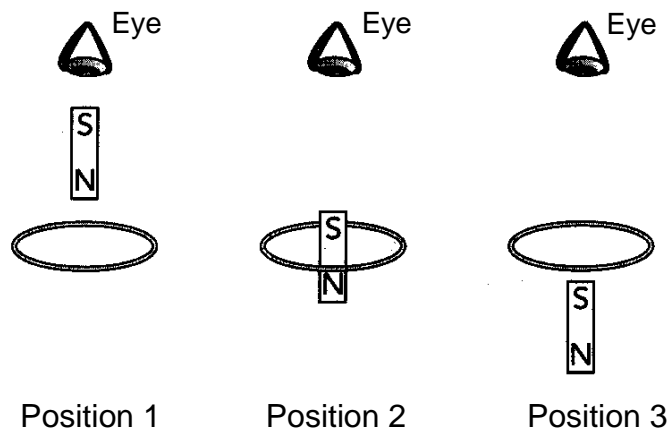
39. The diagram shows two parallel wires **S** and **T** placed in the plane of the paper. **S** is fixed and **T** is free to move. The same current,  $I$ , passes through each wire in the same direction.



In what direction will wire **T** move?

- A** Away from **S** in the plane of the paper.
- B** Downwards into the paper.
- C** Towards **S** in the plane of the paper.
- D** Upwards out of the paper.

40. A magnet is allowed to fall through a copper ring as shown.



What is the direction of the induced current in the ring (if any), relative to the eye, when the magnet is in the positions as shown in Position 1, 2 and 3?

	Position 1	Position 2	Position 3
<b>A</b>	Clockwise	No current	Anticlockwise
<b>B</b>	Clockwise	Clockwise	Anticlockwise
<b>C</b>	Anticlockwise	No current	Clockwise
<b>D</b>	Anticlockwise	Anticlockwise	Clockwise