| Name: | | Index Number: | | Class: | |
|---|---|---|---|---|---|

# CATHOLIC HIGH SCHOOL
## Preliminary Examination
## Secondary 4 (O-Level Programme)

# PHYSICS 6091/01

Paper 1 Multiple Choice

16 September 2021
1 hour

Additional Materials: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, index number and class 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** 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.

For examiner's use only:

| Total Marks | / 40 |
|---|---|

| Paper | Type of Paper | Marks | Weighting |
|---|---|---|---|
| 1 | Multiple Choice | 40 | 30 % |
| 2 | Theory | 80 | 50 % |
| 3 | Practical | 40 | 20 % |

This document consists of 16 printed pages.

**1** Which one of the following base quantities is paired correctly?

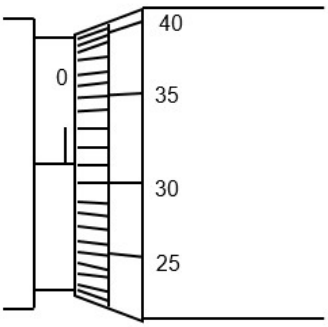
| | Physical Quantity | SI unit |
|---|---|---|
| **A** | electric current | A |
| **B** | length | cm |
| **C** | mass | g |
| **D** | temperature | °C |

**2** Which one of the following has the same value as 0.1 μm?

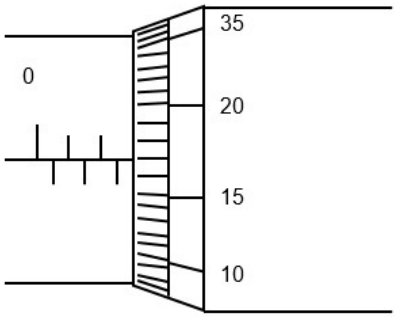
**A** 0.0001 nm **B** 100 nm **C** 0.0001 cm **D** 100 cm

**3** The diameter of a piece of wire is measured using a micrometer screw gauge.

A student takes an initial zero reading and then a reading of the diameter. The following figures show enlargements of the micrometer screw gauge readings.



**Zero reading**



**Diameter reading**

What is the diameter of the wire?

**A** 1.86 mm **B** 2.36 mm **C** 2.48 mm **D** 2.98 mm

**4** A student dropped a metal sphere and a ping-pong ball from a thirty-storey building. The balls have the same volume and there was significant air resistance as the objects were falling.

He made the following statements:

**I** Both objects will have the same initial acceleration.
**II** The metal sphere will have a greater final velocity than the ping-pong ball when it hits the ground.
**III** The metal sphere will reach the ground first.

Which of the statements are correct?

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

**5** A girl throws a ball vertically upwards. It takes a time of 3.20 s to return to her hand. Assume air resistance is negligible.

What is the initial speed with which the ball is thrown?

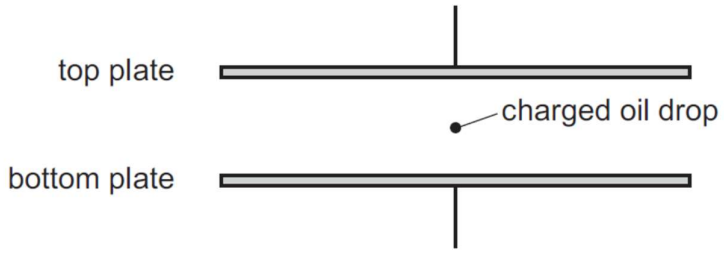
**A** 3.2 m/s **B** 6.4 m/s **C** 16.0 m/s **D** 32.0 m/s

**6** Two forces of equal magnitude are represented by two vectors on the same plane. One is directed towards the east and the other is directed towards the north.

What is the direction of a single force that will balance these two forces?

**A** towards the north-east
**B** towards the north-west
**C** towards the south-east
**D** towards the south-west

**7** A charged oil drop is at rest between two charged parallel plates as shown below.




Which forces act on the oil drop?

**A** both electric and gravitational
**B** electric only
**C** gravitational only
**D** neither electric nor gravitational

**8** A steel pellet with a mass of 6.0 g is travelling on the ground to the right. It then collides head-on with the wall. It strikes the wall with a velocity of 5.0 m/s and rebounds to the left with a velocity of 4.0 m/s. The time of contact between the wall and the pellet is 0.10 s.

What is the average force exerted by the wall on the pellet?

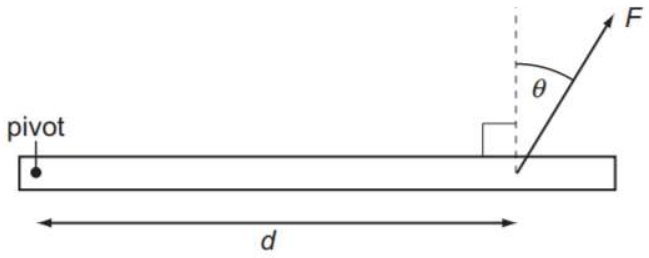
**A** 0.060 N **B** 0.54 N **C** 60 N **D** 540 N

**9** The density of paper is 800 kg/m$^3$. A typical sheet of paper has a width of 210 mm and a length of 300 mm. The thickness of a pack of 500 sheets of paper is 50 mm.

What is the mass of a single sheet of paper?

**A** 0.50 g **B** 5.0 g **C** 50 g **D** 500 g

**10** A force F is applied to a beam at a distance d from a pivot. The force acts at an angle $\theta$ to a line perpendicular to the beam.

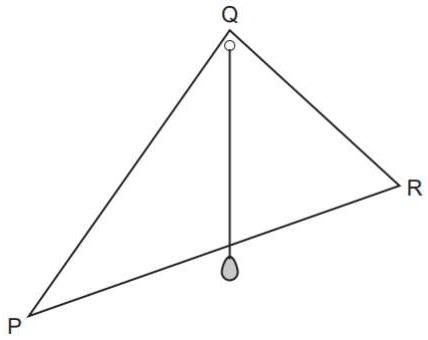



Which combination will cause the largest turning effect about the pivot?

| | *F* | *d* | $\theta$ |
|---|---|---|---|
| **A** | large | large | large |
| **B** | large | large | small |
| **C** | small | small | large |
| **D** | small | large | small |

**11** A student finds the centre of mass of a triangular lamina PQR. He drills a small hole at Q. He suspends the lamina from a pin through the hole at Q so that the lamina swings freely. He then hangs a plumb-line from the pin at Q, as shown. He marks the position of the plumb-line on the lamina.

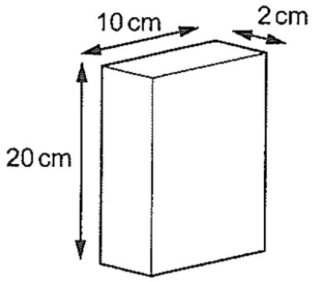
To determine the location of the centre of mass, the student then repeats the experiment but with one change.




What is the change?

**A** He suspends the lamina from the hole at Q, with R on the left and P on the right.
**B** He suspends the lamina from a pin through a hole at R.
**C** He uses a heavier weight on the plumb-line.
**D** He uses a longer plumb-line.

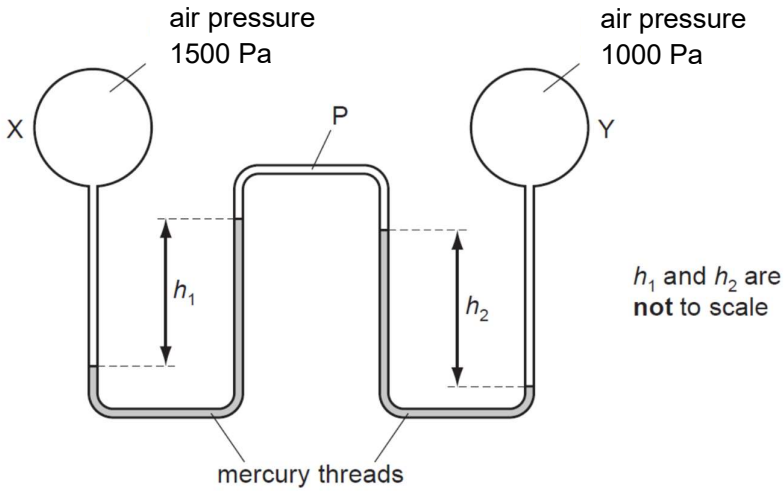
**12** A brick of mass 8.0 kg rests on one of its flat surfaces on the ground. The gravitational field strength g is 10 N/kg.




What is the minimum pressure it can exert on the ground?

**A** 0.40 Pa **B** 400 Pa **C** 4000 Pa **D** 40 000 Pa

**13** Two bulbs X and Y containing air at different pressures are connected by a tube P which contains two threads of liquid.




P contains some gas and the density of the liquid is 100 kg/m$^3$.
Which pair of values of $h_1$ and $h_2$ is possible?

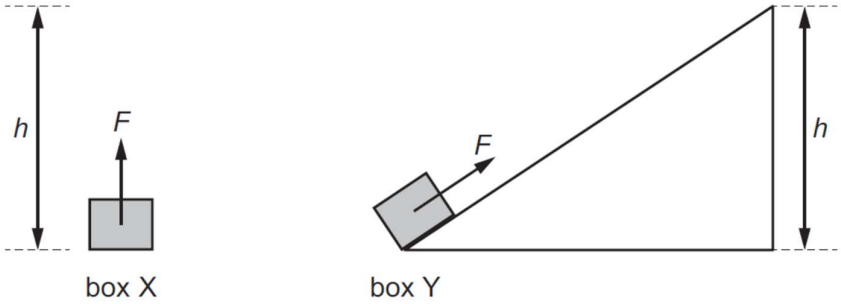
| | $h_1$/ cm | $h_2$/cm |
|---|---|---|
| **A** | 20 | 30 |
| **B** | 30 | 20 |
| **C** | 90 | 140 |
| **D** | 140 | 90 |

**14** A small diesel engine uses a volume of $1.5 \times 10^4$ cm$^3$ of fuel per hour to produce a useful power output of 40 kW. It may be assumed that 34 kJ of energy is transferred to the engine when it uses 1.0 cm$^3$ of fuel.

What is the rate of transfer from the engine of energy that is wasted?

**A** 102 kW **B** 142 kW **C** 182 kW **D** 470 kW

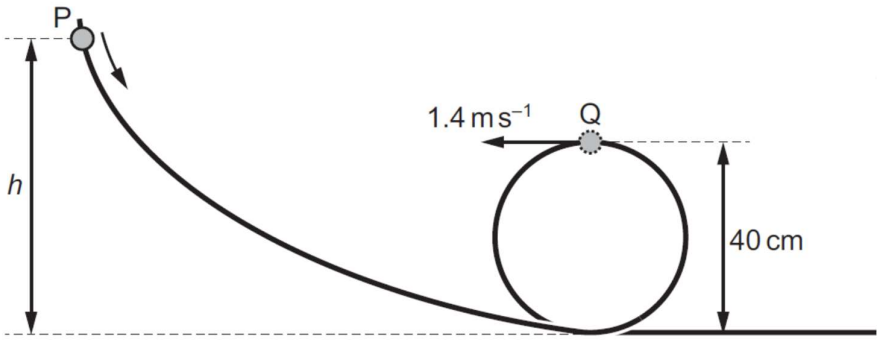
**15** Two boxes X and Y have the same mass. Box X is lifted vertically through a height h by a force of magnitude F.
Box Y is pulled along a slope by a force of the same magnitude to reach the same height, as shown.




Which statement is correct?

**A** Both boxes gain the same amount of gravitational potential energy and the same amount of work is done by the two forces.
**B** Both boxes gain the same amount of gravitational potential energy but more work is done by the force acting on box Y than by the force acting on box X.
**C** Box Y gains less gravitational potential energy than box X because the weight of box Y is less than the weight of box X.
**D** Box Y gains more gravitational potential energy than box X as more work is done by the force acting on box Y than by the force acting on box X.

**16** A bead is released from rest at point P and slides along a wire, as shown. The diagram is not drawn to scale.




The track loops around and forms a vertical circle of diameter 40 cm. At point Q, the bead has a speed of 1.4 m/s. Air resistance and friction between the wire and bead are negligible.

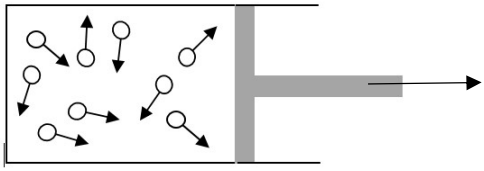
What is the height h from which the bead is released?

**A** 0.070 m **B** 0.098 m **C** 0.470 m **D** 0.498 m

**17** Which law or principle does Brownian Motion provide evidence for?

**A** kinetic theory of matter
**B** Newton's second law of motion
**C** Newton's third law of motion
**D** principle of conservation of energy

**18** There are gas molecules inside a cylinder. The piston of the cylinder is pulled outwards while the temperature of the gas inside does not change.



How do the average speed of the gas molecules and the pressure of the trapped gas change as the piston is moved outwards?

| | average speed of molecules | pressure of the trapped gas |
|---|---|---|
| **A** | decreases | remains the same |
| **B** | increases | remains the same |
| **C** | remains the same | increases |
| **D** | remains the same | reduces |

**19** Which statement about the transfer of thermal energy is correct?

**A** Transfer of thermal energy by radiation does not require a medium.
**B** Transfer of thermal energy occurs from a region of lower temperature to one of higher temperature.
**C** Transfer of thermal energy in fluids is mainly through the vibrations of neighbouring particles.
**D** Transfer of thermal energy in solids is mainly through density changes in the material.

**20** When calibrating a liquid-in glass thermometer, which of the following steps is **not** needed?

**A** Choosing two fixed points.
**B** Choosing a thermometric property that varies constantly.
**C** Ensuring that the room temperature is kept constant.
**D** Ensuring that the thermometer is calibrated at one atmospheric pressure.

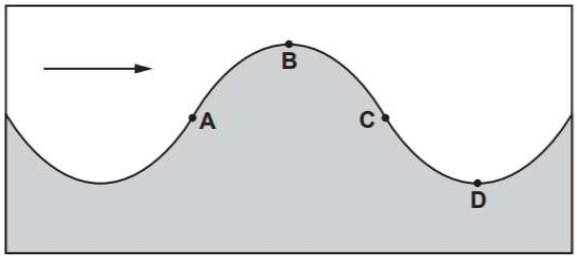
**21** 5 g of steam at 100 °C is passed into a beaker of 500 g of water at 10 °C.
(Specific heat capacity of water = 4.2 J /g K; specific latent heat of vaporisation of water = 2260 J/g)

What is the rise in temperature of the beaker of water if the heat capacity of the beaker is to be ignored?

**A** 6.2 °C **B** 16.2 °C **C** 22.6 °C **D** 77.4 °C

**22** The diagram shows a vertical cross-section through a water wave moving from left to right.

At which point is the water moving upwards with maximum speed?

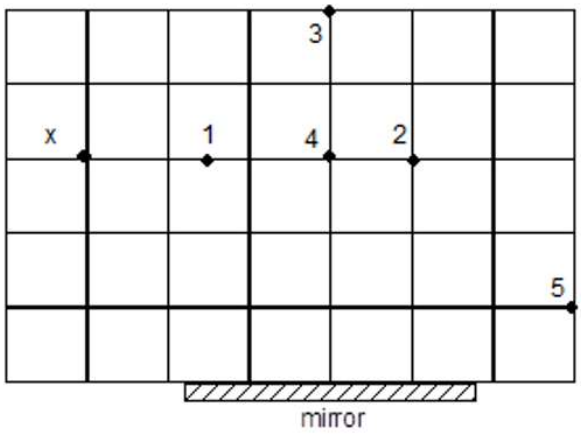



**23** What happens to light as it passes from glass into air?

**A** Its frequency decreases because its speed decreases.
**B** Its frequency increases because its speed increases.
**C** Its wavelength decreases because its speed decreases.
**D** Its wavelength increases because its speed increases.

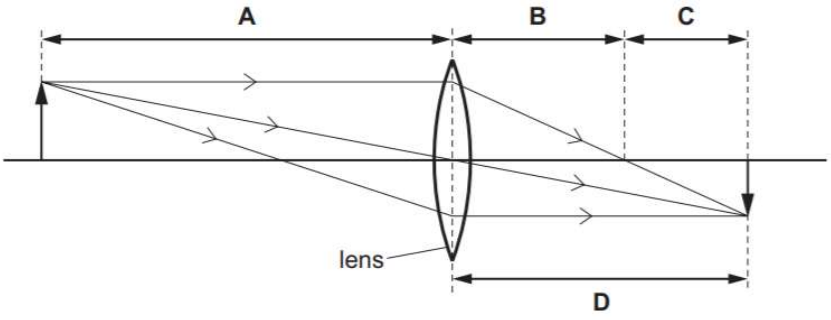
**24** A person stands at point X as shown in the figure below.

Which of the five pins, will the person be able to see in the mirror?




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

**25** Which distance represents the focal length of the lens shown in the diagram?




**26** Below are four statements about the use of electromagnetic radiation.

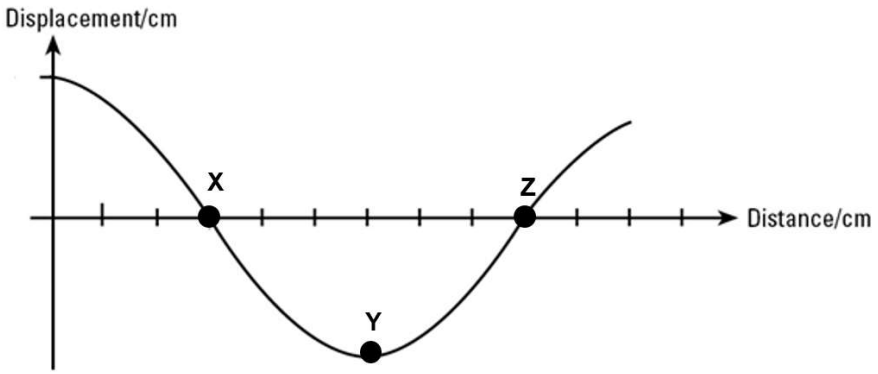
- Gamma rays are used in medical treatment.
- Ultra-violet radiation is used in sunbeds.
- Infra-red radiation is used in TV remote controls.
- X-rays are used in airports to scan luggage.

How many of the four statements are correct?

**A** 1 **B** 2 **C** 3 **D** 4

**27** The figure below shows the displacement-distance graph of a sound wave. The sound wave is travelling to the right.

Three particles X, Y and Z in the sound wave are marked below.
You may assume a displacement to the right as positive displacement and a displacement to the left as negative displacement.




Which particle(s) in the graph above is/are centre(s) of rarefaction?

**A** Particle X
**B** Particle Y
**C** Particle Z
**D** Particles X and Z

**28** Ships use sound waves to determine the vertical distance to the seabed. A pulse of sound waves is sent out and the echoes are detected.

A ship emits a pulse of waves lasting 0.50 s. The waves have a frequency of 3600 Hz.

How many complete wavelengths does the pulse contain?

**A** 1 800 **B** 3 600 **C** 7 200 **D** 18 000

**29** A light metal sphere is attracted by a negatively-charged rod.

What can be concluded about the light metal sphere?

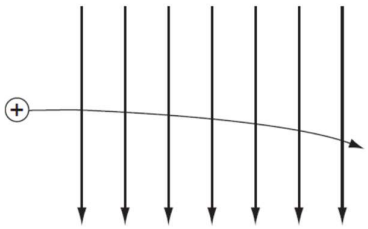
**A** It is electrically neutral.
**B** It is negatively charged.
**C** It is not possible to determine the charge of the sphere.
**D** It is positively charged.

**30** A positively-charged particle is projected into a uniform electric field.

Which diagram represents the path of the particle in the electric field?

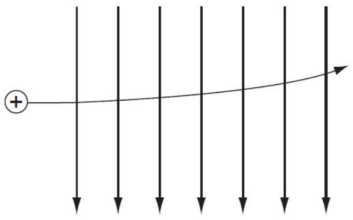
**A**

electric field in plane of the paper



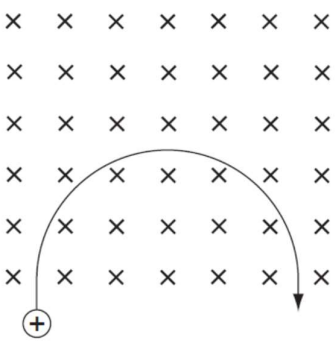
**B**

electric field in plane of the paper



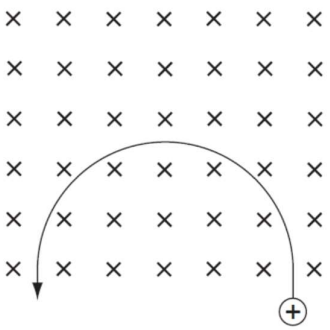
**C**

electric field into paper



**D**

electric field into paper

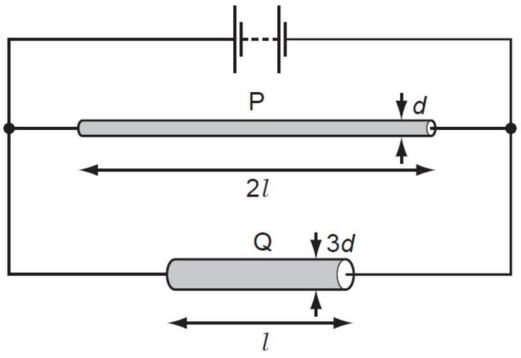


**31** An electrical quantity is defined as 'the energy converted by a source in driving a unit charge round a complete circuit.'

What is this quantity called?

**A** current
**B** electromotive force
**C** potential difference
**D** power

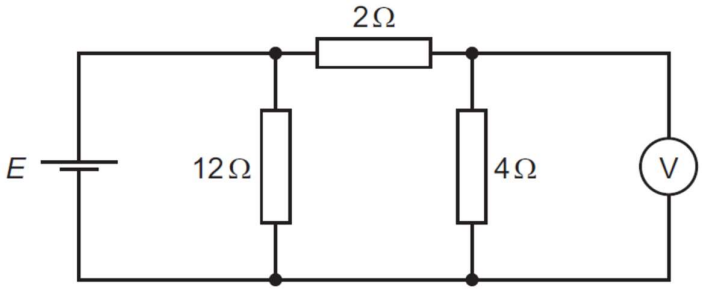
**32** Two wires P and Q made of the same material are connected to the same electrical supply. P has twice the length of Q and one-third of the diameter of Q, as shown in the diagram.




What is the ratio of $\frac{\text{current in P}}{\text{current in Q}}$ ?

**A** $\frac{1}{18}$ **B** $\frac{1}{6}$ **C** 6 **D** 18

**33** A cell of electromotive force (e.m.f.) E is connected into a circuit, as shown.




The voltmeter reads a potential difference $V_{out}$.

What is the ratio $\frac{V_{out}}{E}$ ?

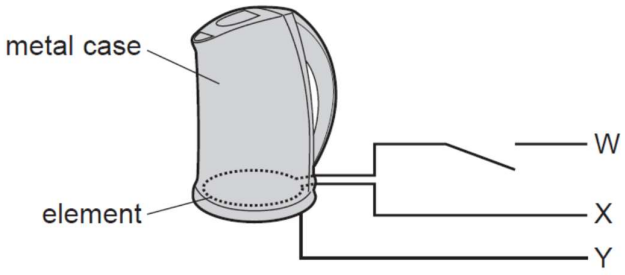
**A** $\frac{1}{6}$ **B** $\frac{1}{3}$ **C** $\frac{1}{2}$ **D** $\frac{2}{3}$

**34** An electric heater consists of a heating element mounted on a metal reflector. The reflector is connected to earth.

Where should the switch for the heating element be connected?

**A** between the earth wire and the reflector
**B** between the live wire and the heating element
**C** between the live wire and the neutral wire
**D** between the neutral wire and the heating element

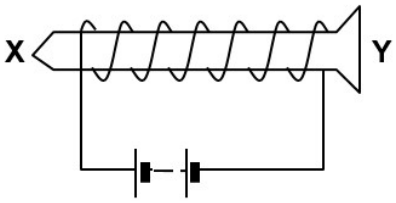
**35** The diagram represents part of a household circuit containing an electric kettle.




Which row correctly identifies the wires W, X and Y?

| | W | X | Y |
|---|---|---|---|
| **A** | earth | live | neutral |
| **B** | live | neutral | earth |
| **C** | live | earth | neutral |
| **D** | neutral | live | earth |

**36** An iron nail, XY, is placed within a current-carrying solenoid for a short while as shown below.




When the nail is removed from the solenoid, which of the following is true?

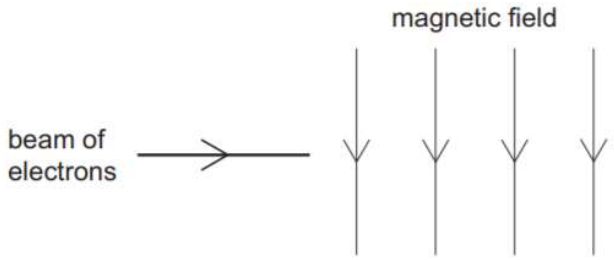
**A** End X will be able to repel a similar copper nail.
**B** End X will be attracted to the north-seeking pole of a bar magnet.
**C** End Y will be repelled by the south-seeking pole of a bar magnet.
**D** End Y will point to the North Pole of the earth when freely suspended.

**37** Delicate instruments are often placed in a box to screen them from stray magnetic fields.

What is the material used for the box and why is it chosen?

**A** Aluminium is used because it is a non-magnetic material.
**B** Copper is used because it has a low electrical resistance.
**C** Polythene is used because it is a good electrical insulator.
**D** Soft iron is used because it is a magnetic material.

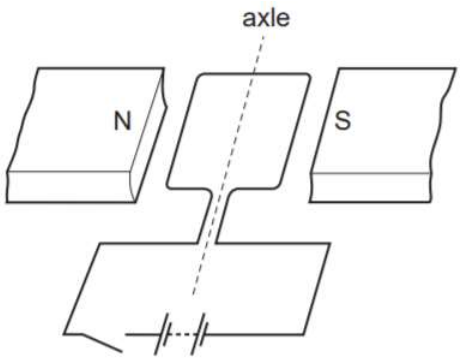
**38** The diagram shows a beam of electrons entering a magnetic field.




What is the effect of the magnetic field on the electrons?

**A** They are deflected into the plane of the diagram.
**B** They are deflected out of the plane of the diagram.
**C** They are deflected towards the bottom of the diagram.
**D** They are deflected towards the top of the diagram.

**39** A simple model of a d.c. motor is made. By mistake, the split-ring commutator is left out. The coil can turn, but is always connected to the battery in the same way.

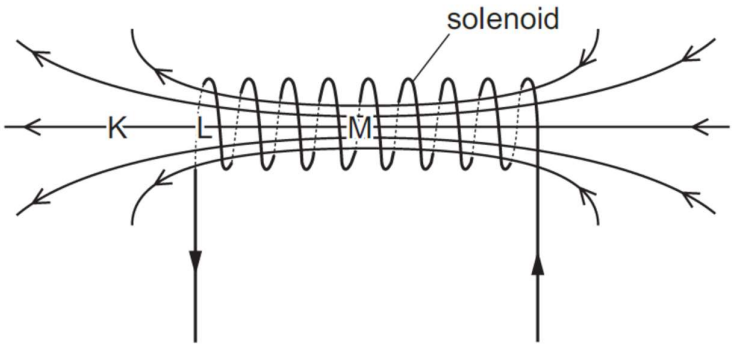



The coil starts in the horizontal position.

What happens to the coil when the circuit is switched on?

**A** It does not move at all.
**B** It moves upwards, out of the magnetic field.
**C** It turns to the vertical position and eventually stops there.
**D** It turns to the vertical position then comes back to the horizontal position.

**40** The diagram shows the magnetic field pattern of a current in a solenoid.




When the current in the solenoid is increased, at which location(s) does the magnetic field strength increase?

**A** K, L and M
**B** K and L only
**C** M and L only
**D** M only

End of Paper