# Anglican High School
# Secondary Four
# Preliminary Examination
# 2023

S4

CANDIDATE NAME

CLASS 4

INDEX NUMBER

## PHYSICS 6091/01

Paper 1 Multiple Choice

**13 Sep 2023**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet

**READ THESE INSTRUCTIONS FIRST**

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO DO SO.

Write in soft pencil.
Write your name, index number and class on all papers you hand in.
Do not use staples, paper clips, highlighters, glue or correction tape.

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.

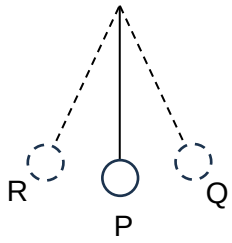
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages.

**1** A student writes down the order of magnitude of the diameter of the Earth, diameter of an atom and length of a football field. Which of the following is correct?

| | diameter of Earth | diameter of atom | length of football field |
|---|---|---|---|
| **A** | $1.0 \times 10^{4}$ km | $1.0 \times 10^{-1}$ nm | $10 \times 10^{0}$ m |
| **B** | $1.0 \times 10^{7}$ km | $1.0 \times 10^{-1}$ μm | $10 \times 10^{0}$ m |
| **C** | $1.0 \times 10^{4}$ km | $1.0 \times 10^{-1}$ nm | $10 \times 10^{1}$ m |
| **D** | $1.0 \times 10^{7}$ km | $1.0 \times 10^{-1}$ μm | $10 \times 10^{1}$ m |

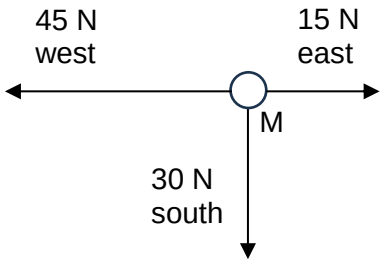
**2** The time taken for a pendulum to swing from position P to position Q and then to position R is 1.5 s.




How many complete periods of the pendulum are there in one minute?

**A** 15 **B** 30 **C** 40 **D** 60

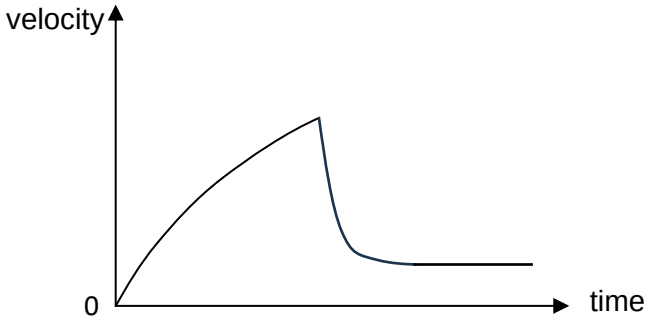
**3** Three forces act on a mass M as shown.




What is the approximate direction of the additional force required to keep the mass M stationary?

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

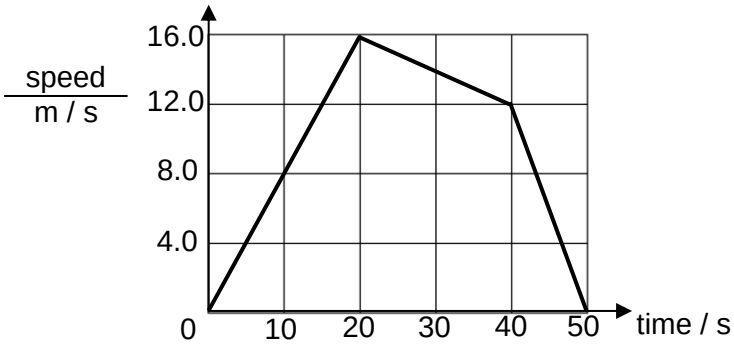
**4** The diagram shows a velocity-time graph.




Which of the following motion can be represented by the velocity-time graph shown above?

**A** A parachutist falling in air before opening his parachute.
**B** A high jump athlete jumping up vertically and landing on the crash mat.
**C** A child jumping up vertically and landing on a trampoline.
**D** A rock falling from the top of a mountain into seawater.

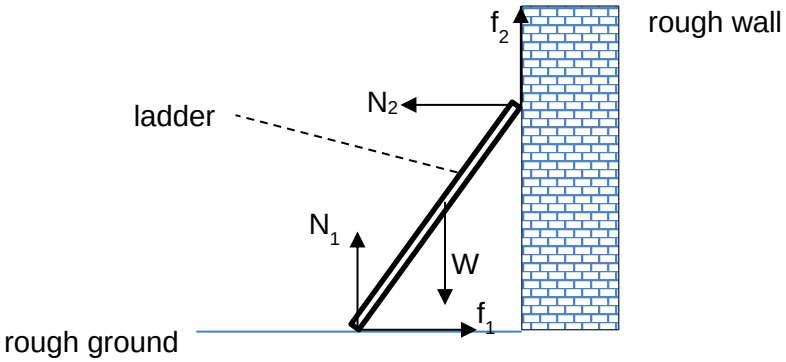
**5** The diagram shows the speed-time graph of a moving object over a period of 50 s.




What is the average speed of the object when it is decelerating?

**A** 10 m / s **B** 11 m / s **C** 12 m / s **D** 17 m / s

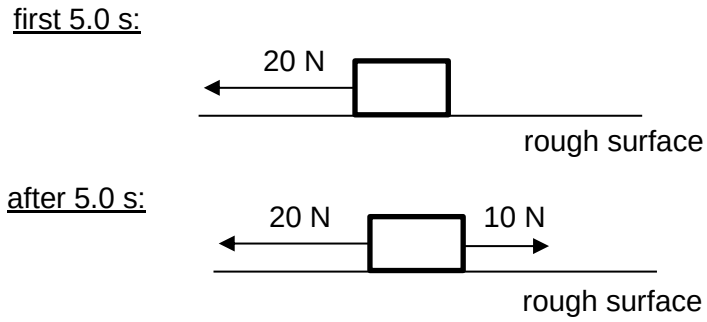
**6** The diagram below shows a ladder on the ground leaning against a wall and the forces acting on the ladder. The effect of friction **cannot** be ignored.




How many pairs of action-reaction forces are shown in the diagram above?

**A** 0 **B** 1 **C** 2 **D** 3

**7** A block is being pulled along a rough surface with a constant force of 20 N and it moves at a constant speed of 2.0 m / s. After 5.0 s, another constant force of 10 N is applied on the block in the opposite direction.




Which of the following describes the motion of the block after 5.0 s?

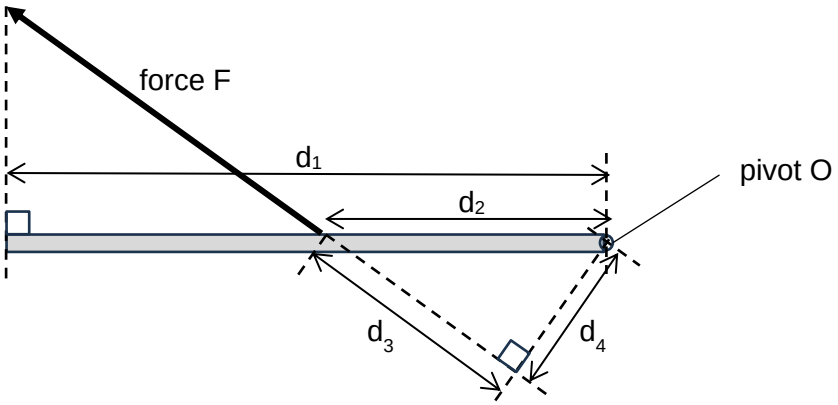
**A** accelerates uniformly
**B** travels at a constant speed of 2.0 m / s
**C** travels at a constant speed that is lower than 2.0 m / s
**D** decelerates uniformly

**8** Eight identical steel ball-bearings, each of mass 18 g, are immersed in a measuring cylinder containing 25 $cm^3$ of water. The density of each steel ball-bearing is 9.0 g / $cm^3$ and the density of water is 1.0 g / $cm^3$.

Assuming that all the steel ball-bearings are fully submerged under water, what is the water level reading on the measuring cylinder?

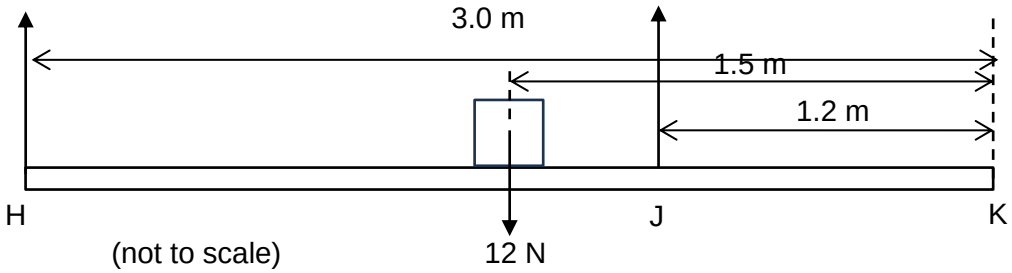
**A** 39 $cm^3$ **B** 40 $cm^3$ **C** 41 $cm^3$ **D** 43 $cm^3$

**9** What is the moment of the force, F, about pivot O?




**A** $Fd_1$ **B** $Fd_2$ **C** $Fd_3$ **D** $Fd_4$

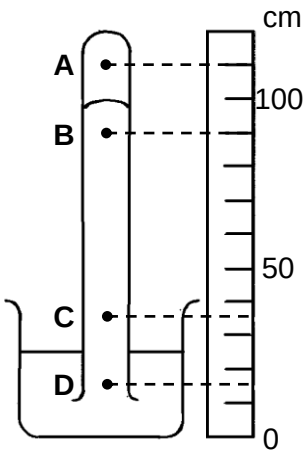
**10** A uniform plank weighing 10 N is supported by two ropes at points H and J. A box weighing 12 N is placed as shown with the centre of gravity (c.g.) of the box 1.5 m away from K. The box is then slowly shifted towards the left.



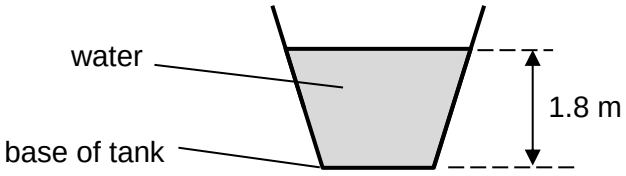

What is the distance of the c.g. of the box from position K when the plank is horizontal and the tension in each rope is 11 N?

**A** 1.4 m **B** 1.6 m **C** 2.1 m **D** 2.6 m

**11** The diagram below shows a simple mercury barometer that has been correctly constructed. At which point in the mercury column is the pressure equal to 10 cm Hg less than the atmospheric pressure?



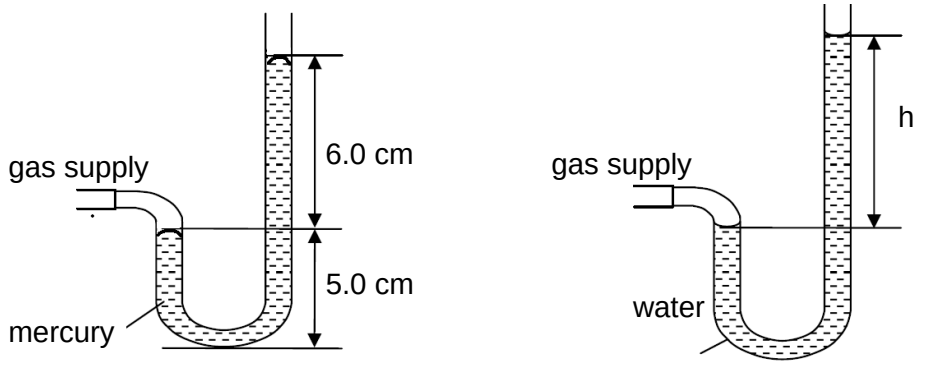

**12** The diagram shows a tank with sloping sides which contains water to a depth of 1.8 m. The density of water is 1000 kg / $m^3$. The gravitational field strength is 10 N / kg. The atmospheric pressure is 1.0 x $10^5$ Pa.




What is the pressure caused by the water on the base of the tank?

**A** less than (1.8 x 1000 x 10) Pa
**B** equal to (1.8 x 1000 x 10) Pa
**C** larger than (1.8 x 1000 x 10) Pa
**D** cannot be determined as there is not enough information given

**13** A gas supply is connected to a mercury barometer. The same gas supply is then connected to a water barometer.

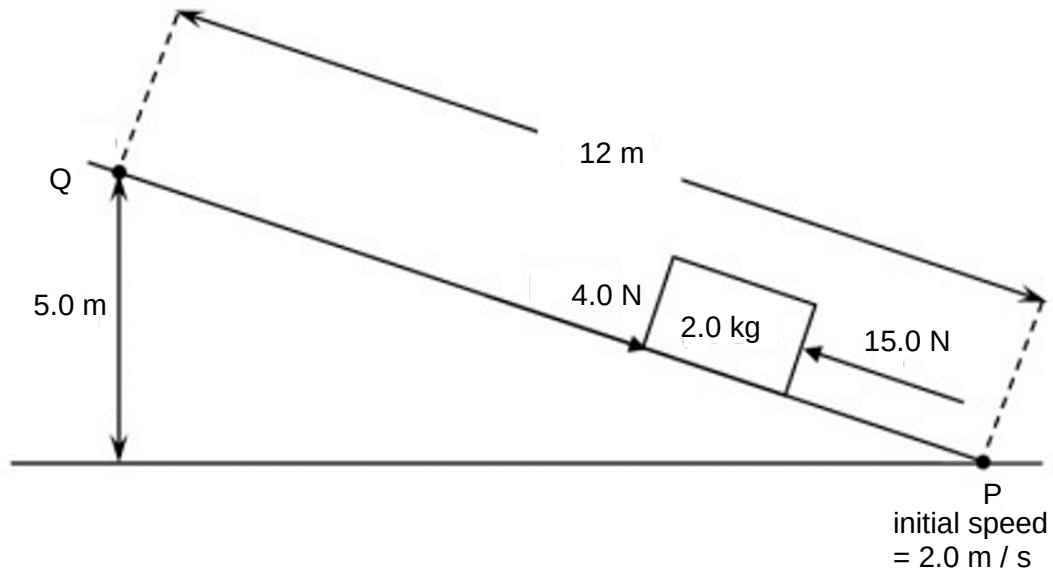



(not to scale)

The density of mercury is 13 600 kg / $m^3$ and the density of water is 1000 kg / $m^3$.
What is the value of h?

**A** 0.68 m **B** 0.82 m **C** 68 m **D** 82 m

**14** A box of mass 2.0 kg is pushed along a 12 m ramp with a force F of 15.0 N and accelerates from point P to point Q. The speed of the box is 2.0 m / s at P and the average frictional force acting on the box is 4.0 N throughout the motion.
The gravitational field strength is 10 N / kg.




What is the speed of the box at point Q?

**A** 5.7 m / s **B** 6.0 m / s **C** 8.0 m / s **D** 16 m / s

**15** Which of the following is equivalent to the unit of power?

**A** J / s **B** kg m / $s^2$ **C** N m **D** kW h

**16** A student writes down a list of energy: *chemical, light, thermal, elastic, gravitational, electric.* How many of the energies listed above are potential energies?

**A** one **B** two **C** three **D** four

**17** Two cuboids made of the same material are shown in the diagram below. X and Y are at the same temperature.


A student made some claims about X and Y.

*(i)* *They have the same density.*
*(ii)* *They have the same inertia.*
*(iii)* *They have the same heat capacity.*
*(iv)* *They have the same internal energy.*

Which of the above statement(s) is/are correct?

**A** *(i)* only **B** *(i)* and *(iv)* only
**C** *(ii)* and *(iii)* only **D** *(ii)* and *(iv)* only

**18** Susan is reading a horror story late at night. She covers herself totally under her thermal blanket and uses an LED torchlight to shine on the pages. After a while, she notices that there are some bright specks of light floating around her under the blanket.

What is a likely explanation for her observation?

**A** She sees air particles floating around as the air particles are colliding with dust particles.
**B** She sees air particles floating around as the air particles are colliding with each other.
**C** She sees dust particles floating around as the dust particles are colliding with each other.
**D** She sees dust particles floating around as the air particles are colliding with dust particles.

**19** A fixed mass of gas in a container is cooled slowly. The volume of the container decreases while the gas pressure remains constant.
How do the gas molecules now strike the walls of the container?

**A** less often and with a lower velocity than before
**B** less often and with a higher velocity than before
**C** more often and with a lower velocity than before
**D** more often and with a higher velocity than before

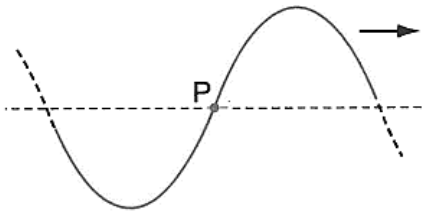
**20** In a certain thermocouple thermometer, a voltage reading of + 6.00 mV was obtained when the cold junction was placed in pure melting ice, and the hot junction in steam from water boiling at one atmosphere.

When the cold junction was taken out of the pure melting ice and placed in boiling propane, the voltage registered was 8.40 mV.

What is the temperature of boiling propane?

**A** - 140 °C **B** - 40 °C **C** 40 °C **D** 140 °C

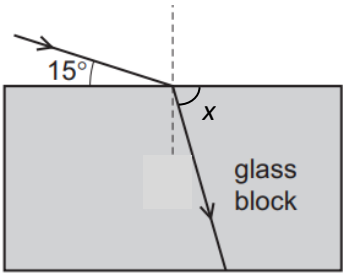
**21** The diagram shows part of a transverse wave travelling to the right along a string.
The horizontal dotted line shows the position of the string when there is no wave present.
P is a point on the string.




What is the direction of motion of P in the next instant?

**A** upwards
**B** downwards
**C** to the left
**D** to the right

**22** Light strikes the top surface of a glass block at an angle of 15° as shown.



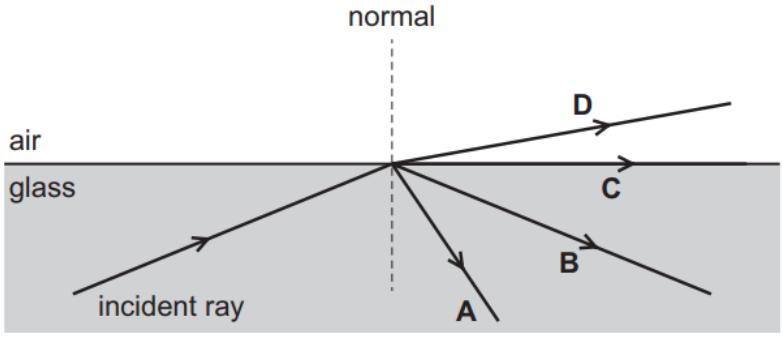

(not to scale)

The refractive index of glass is 1.5.

What is the value of angle *x*?

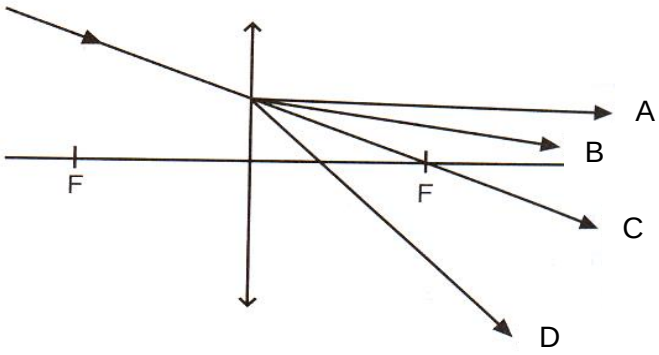
**A** 10° **B** 23° **C** 40° **D** 50°

**23** Light travelling in glass is incident on a glass-air boundary. The angle of incidence of the light is equal to the critical angle.
Which arrow shows the direction of the light after it is incident on the boundary?




**24** A ray of light falls on a converging lens as shown in the diagram. The principal foci of the lens are marked F.

In which direction does the light ray travel after passing through the lens?




**25** A wall poster showing the electromagnetic spectrum is displayed in a laboratory.


A section of the electromagnetic spectrum has been accidentally ripped from this wall poster.
Which of the following is the missing piece?

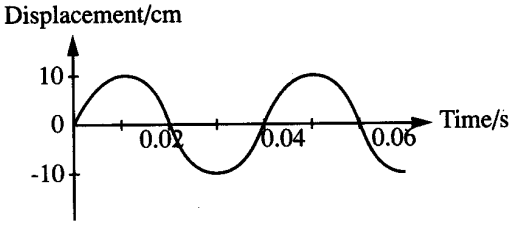
**A** infra-red visible light microwave

**B** microwave infra-red visible light

**C** visible light infra-red microwave

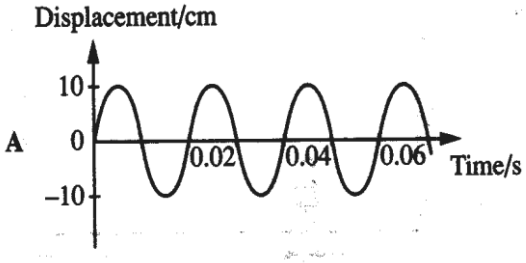
**D** visible light microwave infra-red

**26** The diagram below shows the displacement-time graph of a particle of a sound wave from an alarm.

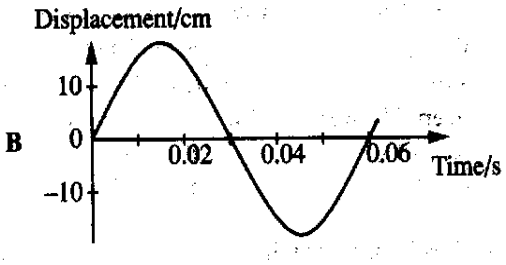



The alarm is then adjusted to give a higher-pitched sound of the same loudness.
Which of the following shows the displacement-time graph of a particle of the sound wave from the adjusted alarm?

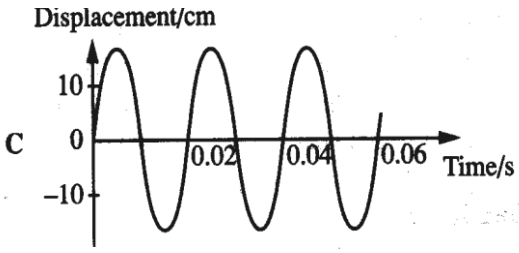
A



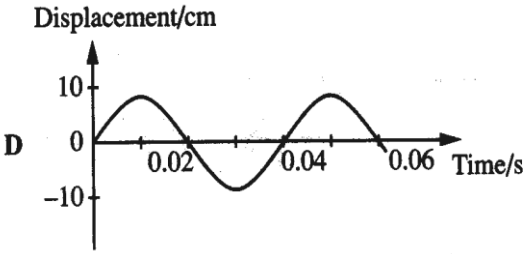

B




C




D




**27** A ship that is stationary on the surface of the sea sends pulses of sound vertically downwards towards the seabed.
Each pulse that reflects from the seabed is received 1.0 s after it is sent out.
A whale swims under the boat and a pulse is received 0.60 s after it is sent out.
The speed of sound in sea water is 1500 m / s.

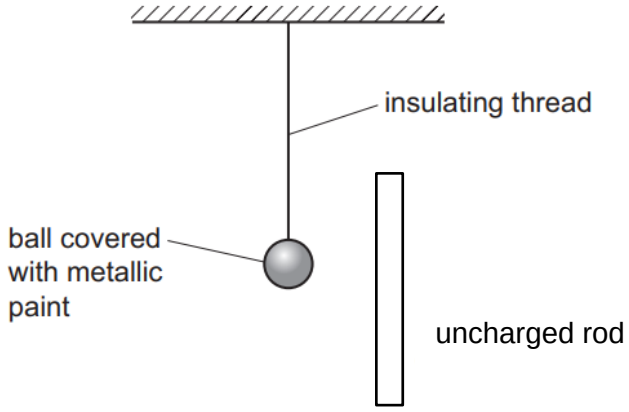
What is the distance of the whale above the seabed?

**A** 300 m **B** 450 m **C** 600 m **D** 750 m

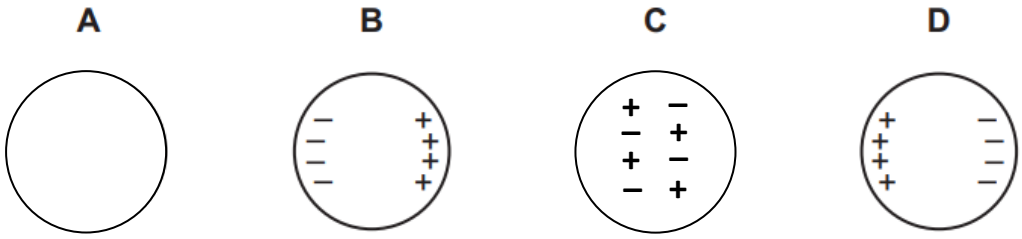
**28** A charged plastic ball is at rest near the surface of the Earth. The magnetic field of the Earth is negligible.
Which field(s) is/are found in the region surrounding the ball?

**A** electric only
**B** gravitational only
**C** electric and gravitational only
**D** electric, gravitational and magnetic

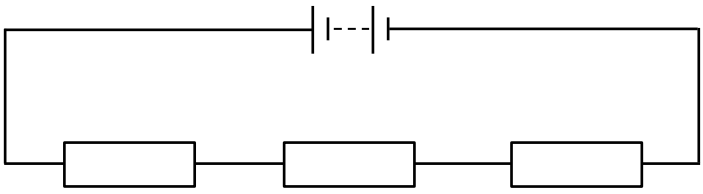
**29** The diagram shows an uncharged ball coated with metallic paint. The ball is suspended from an insulating thread. It is placed near an uncharged rod.




Which diagram represents the charge distribution on the ball?




**30** The diagram shows a circuit with a battery and three identical resistors connected in series.



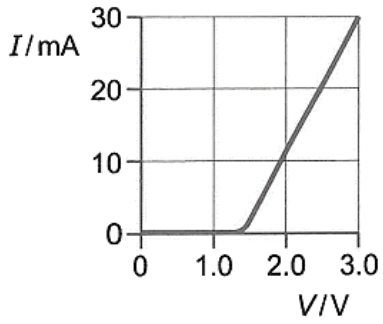
12 J of electrical energy is converted to other forms of energy when 4.0 C of charges flow across a resistor.
What is the e.m.f. of the battery?

**A** 1.0 V **B** 3.0 V **C** 6.0 V **D** 9.0 V

**31** The resistance of a piece of wire of length 1.0 m and diameter 0.30 mm is *R*.
Another piece of wire, made of the same material, is 2.0 m longer than the first wire. Its diameter is 50% of that of the first wire.
What is the resistance of the second piece of wire?

**A** 4 *R* **B** 6 *R* **C** 8 *R* **D** 12 *R*

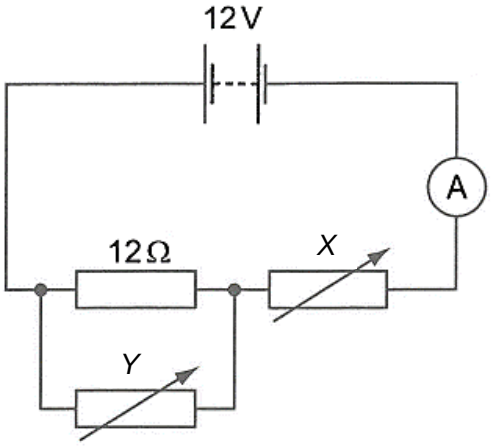
**32** The diagram shows the $I$-$V$ characteristic of a semiconductor diode.




Which statement about the resistance of the diode is correct?

**A** It has a value of 0 Ω at $V$ = 1.0 V.
**B** It has a value of 100 Ω at $V$ = 3.0 V.
**C** It is constant for values of $V$ above 1.4 V.
**D** It increases for values of $V$ above 1.4 V.

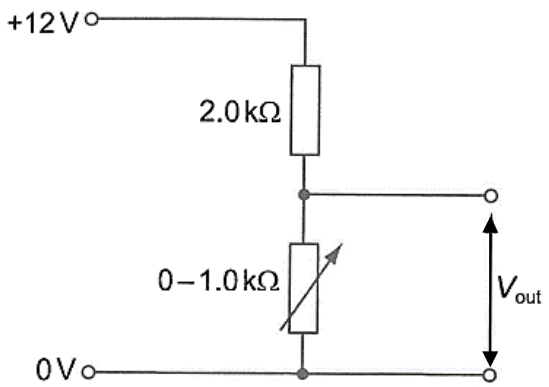
**33** The diagram shows a circuit containing a battery of e.m.f. 12 V, a fixed resistor of resistance 12 Ω, two variable resistors of resistances $X$ and $Y$, and an ammeter.




Which values of $X$ and $Y$ will give a current of 0.50 A in the ammeter?

| | $X$ / Ω | $Y$ / Ω |
|---|---|---|
| **A** | 16 | 14 |
| **B** | 18 | 12 |
| **C** | 20 | 10 |
| **D** | 22 | 8 |

**34** A potential divider circuit is set up across a 12 V d.c. power supply with a fixed 2.0 kΩ resistor and a variable 0 – 1.0 kΩ resistor.




Which of the following shows the range of the output voltage $V_{out}$?

**A** 0 to 4.0 V
**B** 0 to 8.0 V
**C** 4.0 V to 12 V
**D** 8.0 V to 12 V

**35** The metal casing of an electric heater is earthed. The plug to the heater contains a 5 A fuse. There is a current of 4 A when the heater works normally.

The cable to the heater becomes so worn out that the live wire makes electrical contact with the metal casing.

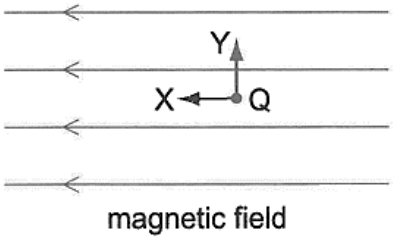
What will happen?

**A** The current flows to earth and the fuse is not affected.
**B** The fuse melts and switches off the circuit.
**C** The metal casing becomes live and dangerous.
**D** The metal casing becomes very hot.

**36** A metal bar PQ hangs from a thin thread and always comes to rest with end P pointing north. Another bar XY made of the same metal as bar PQ settles in no definite direction when it hangs from a thin thread. What happens if the two bars are brought near one another?

**A** End P and end Q both attract end X.
**B** End P attracts end X but repels end Y.
**C** End P neither attracts nor repels end X.
**D** End P repels end X but attracts end Y.

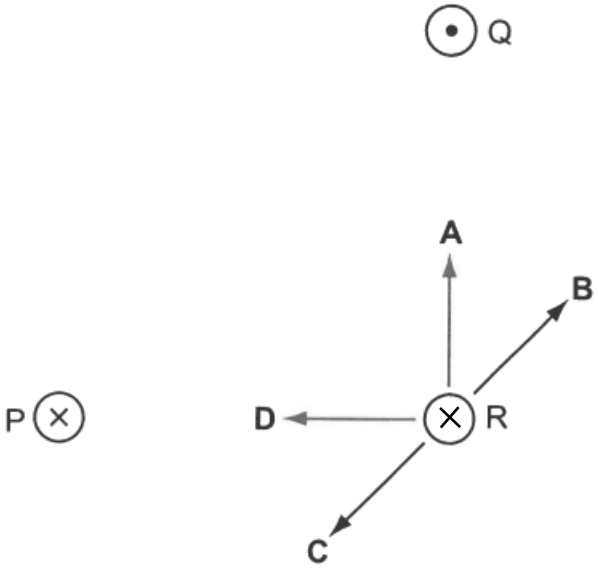
**37** A charged particle Q is moving in a magnetic field, first in direction X and then in direction Y.



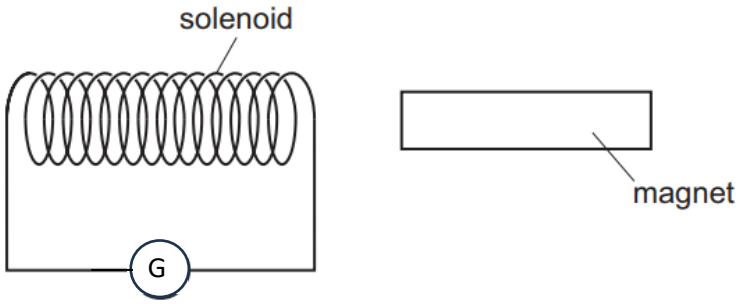

In which direction of motion will the charged particle experience a force due to the magnetic field?

**A** X only
**B** Y only
**C** both X and Y
**D** neither X nor Y

**38** Three parallel wires P, Q and R are placed perpendicular to the paper at three corners of a square.
The current in each wire has the same magnitude and their directions are as shown in the diagram.
What is the direction of the resultant force acting on wire R?



**39** A magnet is placed near to a short solenoid that is connected to a sensitive galvanometer.

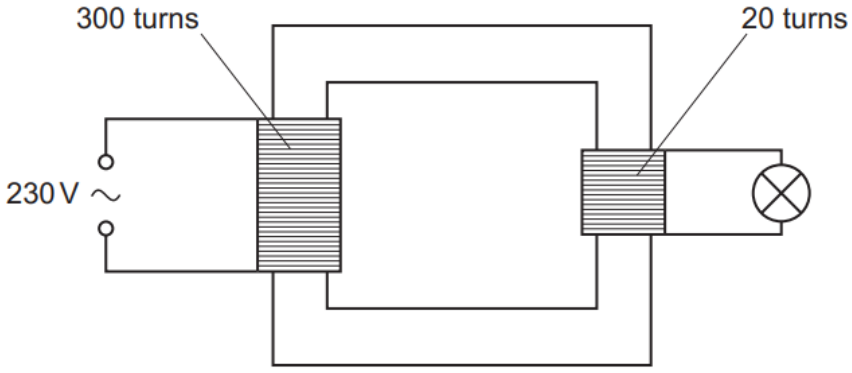



galvanometer

The magnet is pushed towards the short solenoid. It accelerates, then moves at constant speed, then decelerates and stops inside the solenoid.
When is the reading on the galvanometer zero?

**A** when the magnet is accelerating
**B** when the magnet is decelerating
**C** when the magnet is stationary
**D** when the magnet is moving at constant speed

**40** A student uses a transformer to light a filament lamp using a 230 V a.c. supply. The lamp has a maximum voltage rating of 6.0 V.




What happens when the circuit is switched on?

**A** The lamp flashes on and off continuously.
**B** The lamp lights dimly.
**C** The lamp lights at normal brightness.
**D** The lamp lights up brightly and then goes out.