Cambridge IGCSE™ (9–1)

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

1859443945

PHYSICS **0972/31**

Paper 3 Theory (Core) **May/June 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages.

1 Fig. 1.1 shows a dripping tap and a measuring cylinder. The water drops all have the same volume. The drops fall from the tap at equal time intervals.

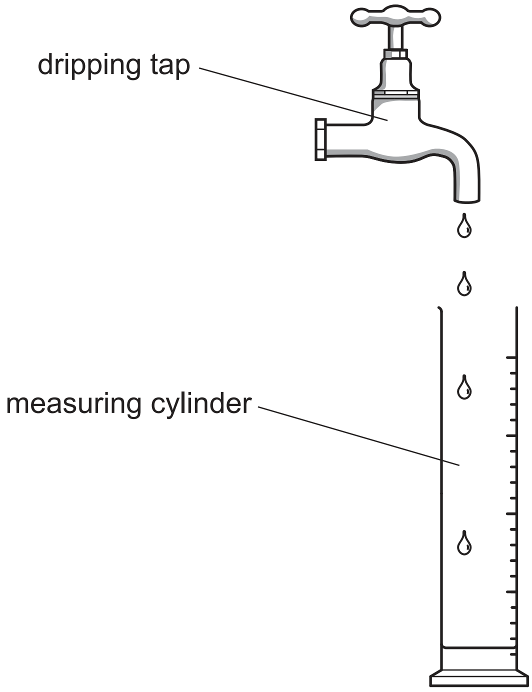

Fig. 1.1 (not to scale)

(a) (i) The student collects 200 of the drops in a measuring cylinder. The total volume collected is 60 cm^3.

Calculate the average volume of **one** drop of water.

volume = ... cm^3 [3]

(ii) Another student uses a stop-watch to measure the time taken for the tap to produce 200 drops. Fig. 1.2 shows the time reading on the stop-watch.

Fig. 1.2

Determine the time, in seconds, for the tap to produce 200 drops.

time = ... s [2]

(iii) Determine the average time interval between one drop starting to fall and the next drop starting to fall.

time interval = ... s [2]

(b) Fig. 1.3 shows the volume of water collected in the measuring cylinder by another student.

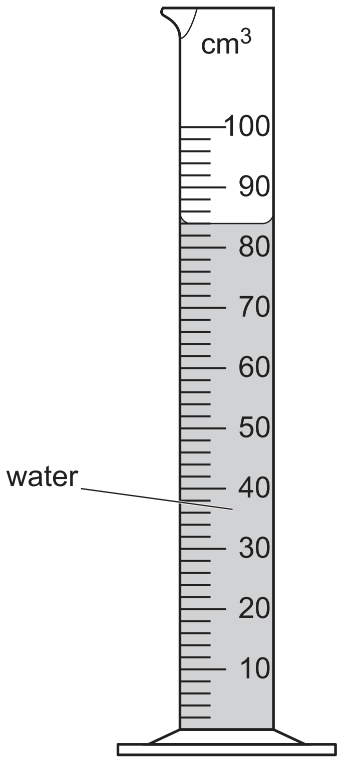

Fig. 1.3

Determine the volume of water in the measuring cylinder in Fig. 1.3.

volume = ... cm^3 [1]

[Total: 8]

2 Fig. 2.1 shows the speed–time graphs for two cars, A and B.

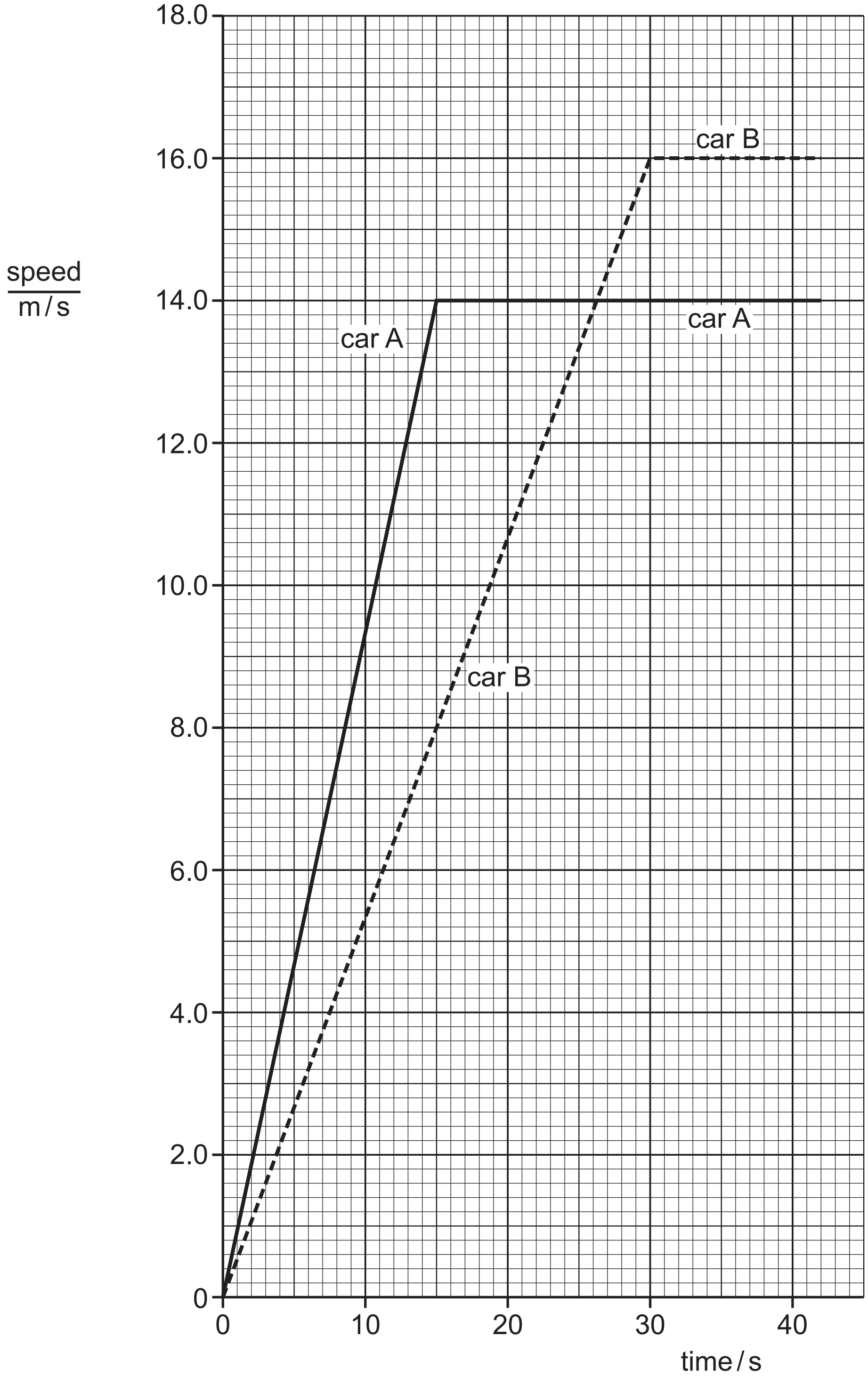

Fig. 2.1

(a) **(i)** Determine the speed of car A at time = 10 s.

speed = ... m/s [2]

(ii) State and explain which car, A or B, has the greater acceleration during the first 10 seconds. Use information from the graph in Fig. 2.1 in your explanation.

....

.... [2]

(b) (i) Describe the motion of car B after 30 s.

....

.... [2]

(ii) Calculate the distance moved by car B from time = 0 to time = 30.0 s.

distance = ... m [3]

[Total: 9]

3 **(a)** Fig. 3.1 shows a metal block and its dimensions.

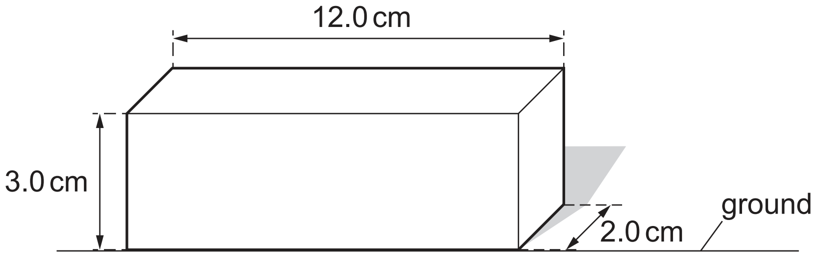

Fig. 3.1 (not to scale)

(i) Calculate the area of the metal block in contact with the ground.

area = ... cm^2 [2]

(ii) The mass of the metal block is 0.84 kg.

Calculate the weight of the metal block.

weight = ... N [2]

(b) A different metal block has a weight of 24 N. The area of this metal block in contact with the ground is 4.0 cm^2.

Calculate the pressure of this block on the ground.

pressure = ... N/cm^2 [3]

[Total: 7]

4 Fig. 4.1 shows an electric motor and pulley wheel being used to raise a load M. The electric motor uses a belt to turn the pulley wheel.

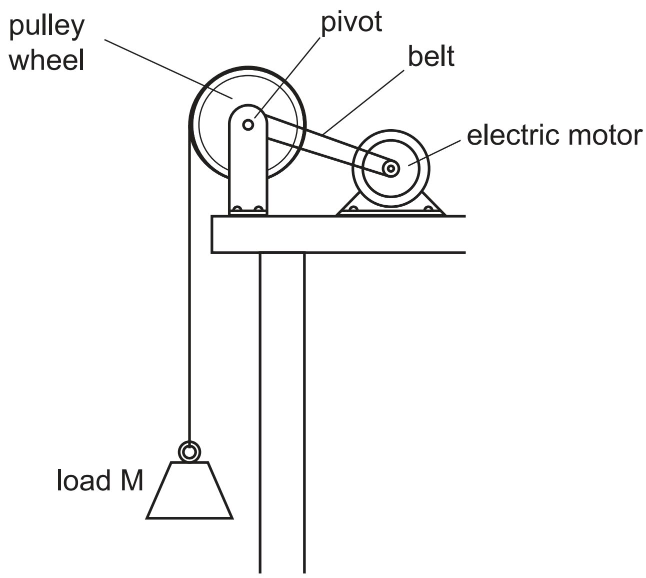

Fig. 4.1

(a) When the electric motor lifts the load, it transfers energy. Fig. 4.2 shows the energy transfers.

Write on Fig. 4.2 to complete the label in each box. The first label is done for you.

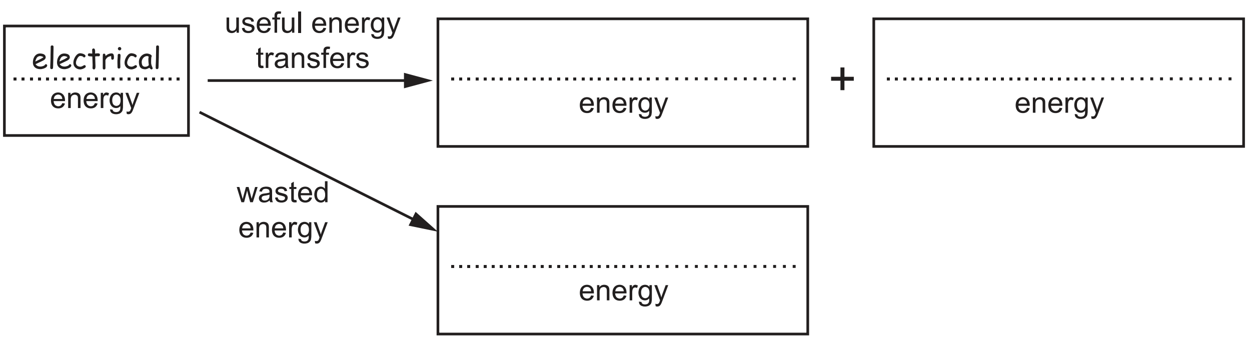

Fig. 4.2

[3]

(b) Fig. 4.3 shows the force on the pulley from the load M.

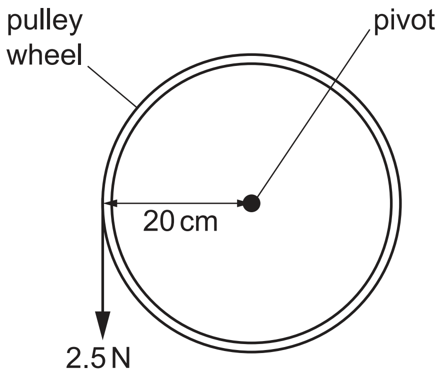

Fig. 4.3

The weight of load M is 2.5 N and the weight acts at a distance of 20 cm from the pivot of the pulley wheel.

Calculate the moment of the weight of load M about the pivot.

moment = ... N cm [3]

[Total: 6]

5 **(a)** Describe how a wind turbine generates electricity from energy in the wind.

....

....

.... [3]

(b) Apart from cost, state **two advantages** of generating electricity using wind turbines compared with using a power station that burns coal.

1. ....

2. ....
[2]

(c) Apart from cost, state **two disadvantages** of generating electricity using wind turbines compared with using a power station that burns coal.

1. ....

2. ....
[2]

[Total: 7]

6 A teacher fills a copper can with solid wax and heats the can. She measures the temperature of the wax every minute. She continues heating once the wax has melted and stops heating when the wax is boiling.

(a) **(i)** State the term used for the process that transfers thermal energy through the copper.

.... [1]

(ii) Fig. 6.1 shows how the temperature of the wax changes as it is heated.

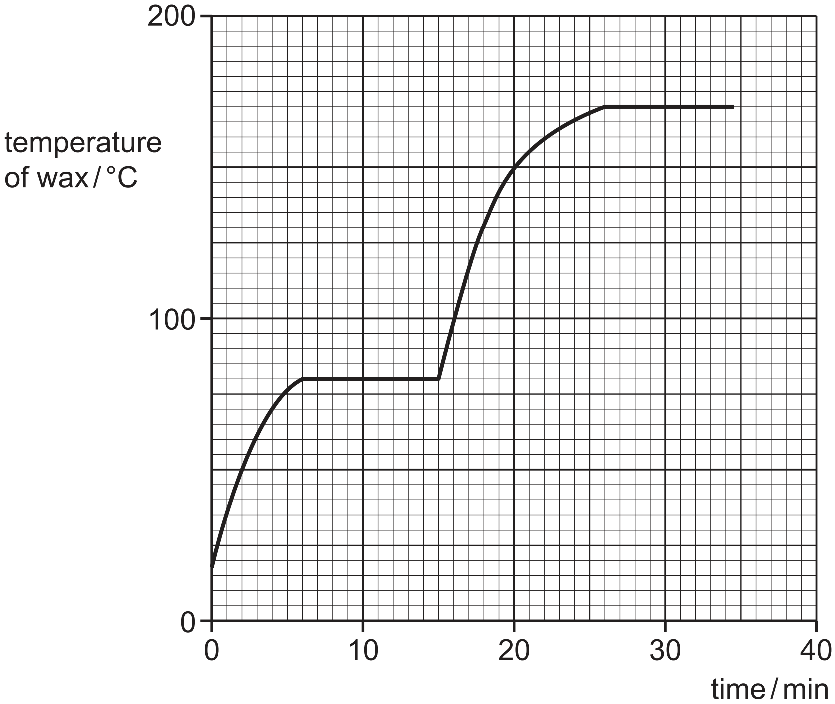

Fig. 6.1

Using the graph in Fig. 6.1, determine:

1. the melting point of the wax .... °C [1]

2. the boiling point of the wax .... °C [1]

3. the time at which the wax starts to boil. .... min [1]

(b) Describe the molecular structure of the wax in terms of the arrangement, separation and motion of its molecules when it is a solid and when it is a gas.

solid wax ....

....

wax as a gas ....

....

[6]

[Total: 10]

7 **(a)** Fig. 7.1 shows the displacement of particles in a water wave.

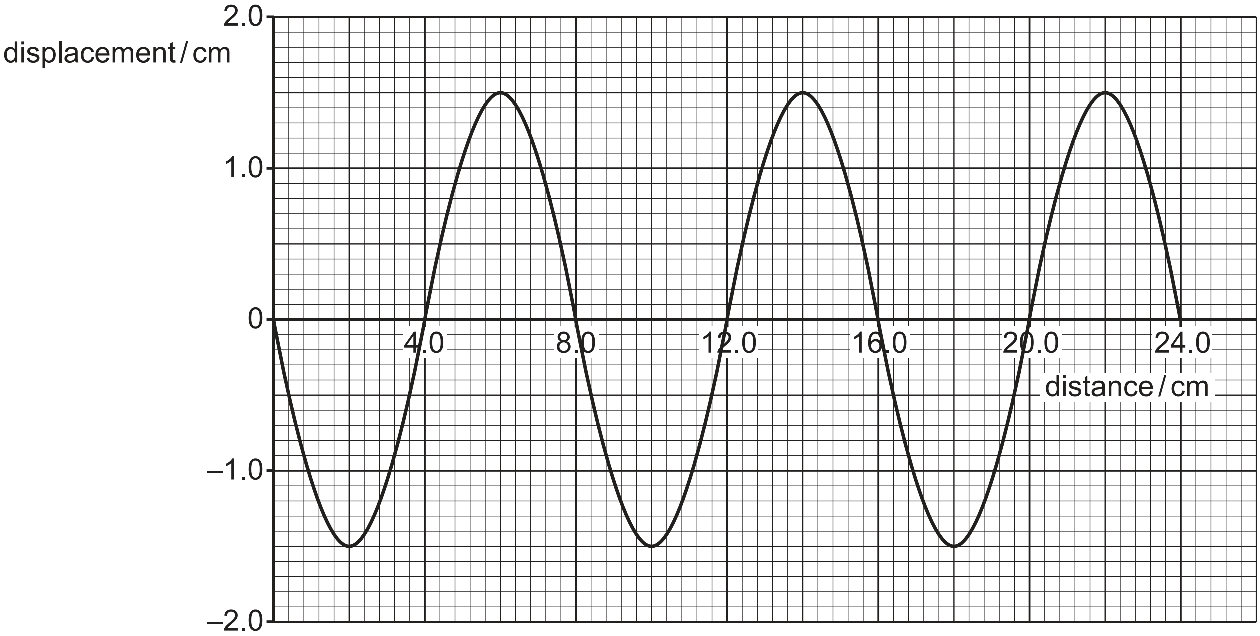

Fig. 7.1

Using the information in Fig. 7.1, determine:

(i) the wavelength of the wave

wavelength = ... cm [1]

(ii) the amplitude of the wave.

amplitude = ... cm [1]

(b) The water waves travel from deep water into shallow water. The water waves have a lower speed in the shallow water.

Fig. 7.2 shows wavefronts for the waves in deep water to the left of the boundary.

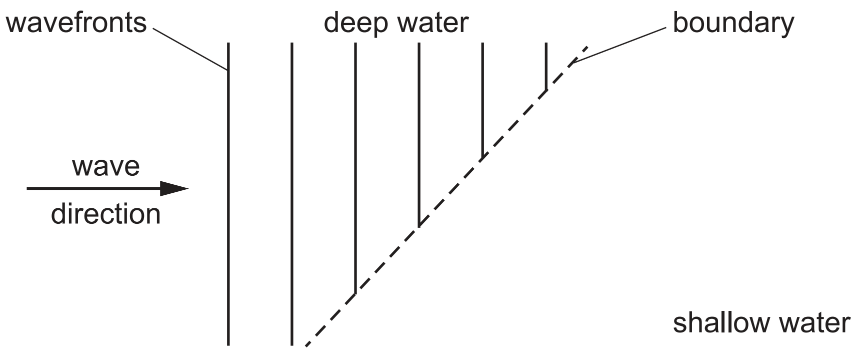

Fig. 7.2

(i) On Fig. 7.2, complete **three** wavefronts for the waves in shallow water to the right of the boundary. [2]

(ii) State the term for the process at the boundary in Fig. 7.2.

.... [1]

(c) **(i)** State the name of **one** type of electromagnetic wave with a wavelength shorter than that of visible light.

.... [1]

(ii) State **one** use of the type of wave you have given in **(c)(i)**.

.... [1]

[Total: 7]

8 **(a)** Fig. 8.1 shows a bar magnet on a piece of card.

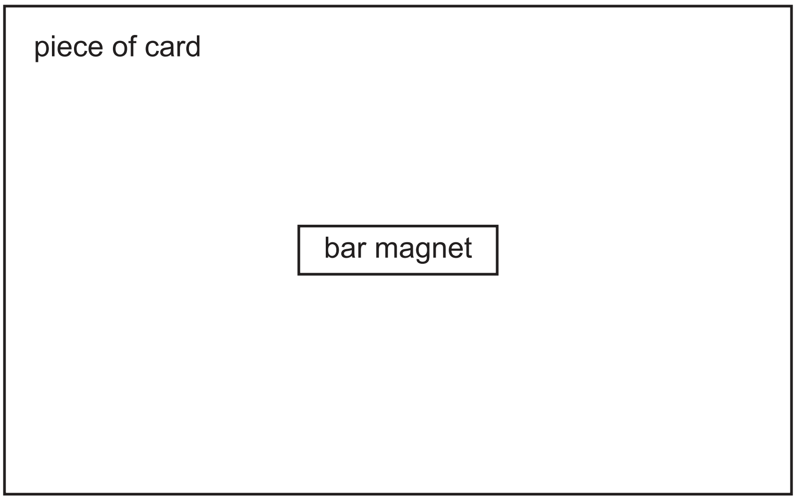

Fig. 8.1

Describe an experiment to determine the pattern of the magnetic field lines around the bar magnet.

You may draw on Fig. 8.1 if it helps to explain your answer.

....

....

....

....

.... [3]

(b) A student has a bar magnet and a metal bar with ends labelled X and Y. The student moves the metal bar close to either pole of the bar magnet. Fig. 8.2 and Fig. 8.3 show the force on the metal bar in each case.

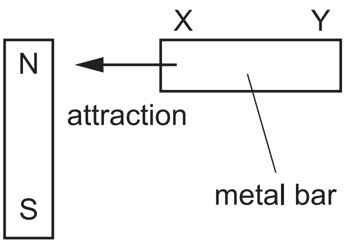

Fig. 8.2

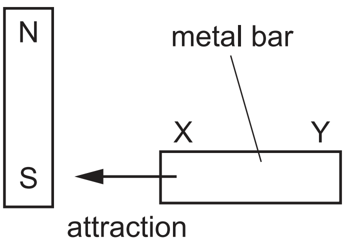

Fig. 8.3

State and explain what these results reveal about the metal bar XY.

....

....

.... [3]

[Total: 6]

9 Fig. 9.1 shows an electric circuit which includes uninsulated resistance wire XY. A teacher shows some students how to complete the circuit by placing the contact C at various positions on the wire XY.

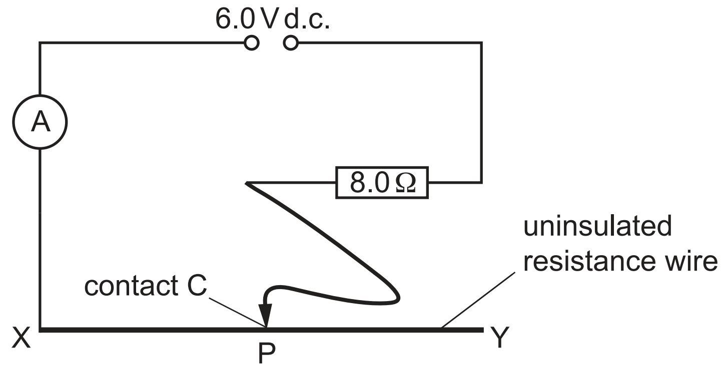

Fig. 9.1

(a) The students place contact C at Y. They measure the current on the ammeter. Then they move the contact C along the wire from Y to X.

State and explain the effect on the ammeter reading when they move the contact C from Y to X.

....

.... [2]

(b) Calculate the reading on the ammeter when contact C is at X.

ammeter reading = ... A [3]

(c) The students move contact C to point P. The resistance of the wire between X and P is 20 Ω.

Calculate the total resistance of the resistance wire between X and P and the fixed resistor.

total resistance = ... Ω [2]

(d) The electric current in the circuit produces two effects.

Place a tick (✓) in the boxes next to these **two** effects.

gravitational ☐

magnetic ☐

heating ☐

sound ☐

X-ray emissions ☐

[2]

[Total: 9]

10 A microwave oven has a metal case and is connected to a 240 V electricity supply.

(a) The microwave oven is fitted with a 13 A fuse and an earth wire is connected to the metal case of the microwave oven. A fault occurs and the live wire of the microwave oven touches the metal case.

Explain how the fuse and an earthed metal case protect the appliance and the user.

....

....

....

....

.... [4]

(b) The electric circuit for the microwave oven includes a transformer.
The voltage to the primary coil of the transformer V_p is 240 V.
The number of turns on the primary coil N_p is 70.

The number of turns on the secondary coil N_s is 560.

Calculate the secondary voltage V_s for the transformer.

V_s = ... V [3]

[Total: 7]

11 A teacher determines the types of emission from a radioactive source. He uses different materials to absorb the emissions. Fig. 11.1 shows the equipment.

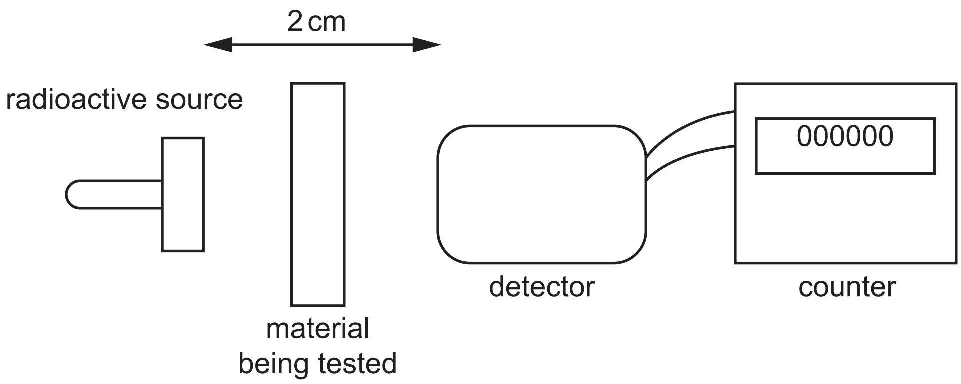

Fig. 11.1 (not to scale)

The teacher places a material between the radioactive source and the detector. The counter shows the count rate for the emission that reaches the detector. The teacher records the count rate. He repeats the experiment for different materials.

Table 11.1 shows the results.

Table 11.1

material being tested	count rate / counts/s
air (no object in gap)	480
thin sheet of paper	481
2 mm sheet of aluminium	479
10 mm block of lead	120

(a) State whether the source emits α (alpha)-particles.
Use information from Table 11.1 to give a reason for your answer.

....

....

.... [2]

(b) State whether the source emits γ (gamma)-rays.
Use information from Table 11.1 to give a reason for your answer.

....

....

.... [2]

[Total: 4]