AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

0 1 A student investigated the density of different types of rock.

Figure 1 shows a piece of limestone.

Figure 1

0 1 . 1 The student was **not** able to calculate the volume of the piece of limestone using measurements taken with a ruler.

What is the reason?

[1 mark]

Tick (✓) **one** box.

A ruler is not very accurate. ☐

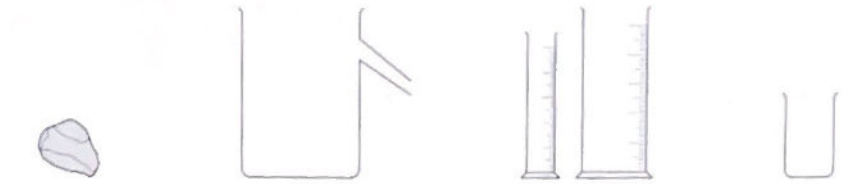
The piece of limestone has an irregular shape. ☑

There is a large uncertainty when using a ruler. ☐

Question 1 continues on the next page

0 1 . 2 **Figure 2** shows some of the equipment given to the student.

Figure 2



Describe a method the student could use to determine the volume of the piece of limestone.

[4 marks]

Fill the displacement can with water until level with the spout. Put the piece of limestone in the water, without splashing any water out of the can. Collect the displaced water in the beaker and use the measuring cylinder to determine the volume of the rock.

0 1 . 3 The mass of the piece of limestone was 155 g.

The volume of the piece of limestone was 62 cm^3.

Calculate the density of the piece of limestone.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

density = $\frac{155}{62}$ ✓

density = 2.5 (g/cm^3)

Density = 2.5 g/cm^3

0 1 . 4 Density can be measured in g/cm^3.

What is another unit for density?

[1 mark]

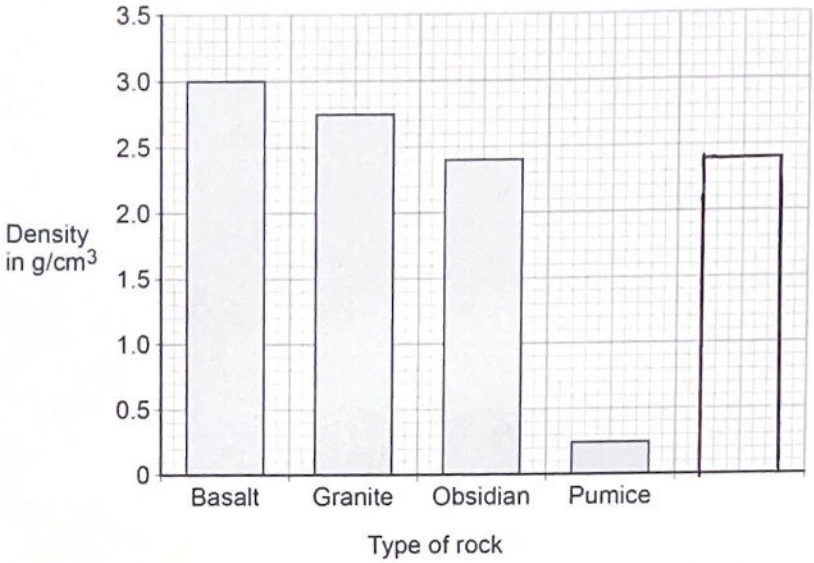
Tick (✓) **one** box.

- cm/g^3 ☐
- kg/m^3 ☑
- kg^3/m ☐
- kg^3/cm ☐

Question 1 continues on the next page

Figure 3 gives the density of some other types of rock.

Figure 3



The student has a sample of an unknown type of rock.

The density of this rock is 2.4 g/cm^3.

0 1 . 5 Draw a bar on **Figure 3** to show the density of the unknown type of rock.

[1 mark]

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

basalt	**granite**	**obsidian**	**pumice**

The data in **Figure 3** suggests that the unknown type of rock is Obsidian.

0 1 . 7 The student **cannot** be certain that the unknown type of rock is one of the types of rock in **Figure 3**.

Give a reason why.

[1 mark]

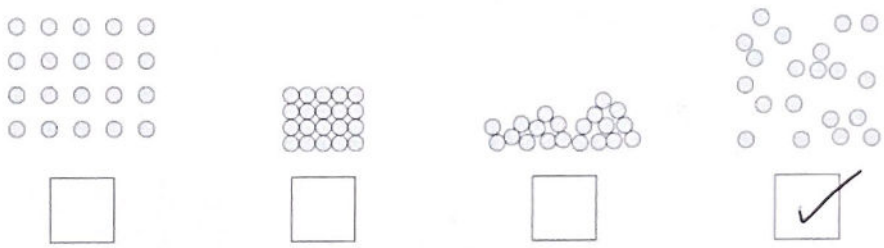
Other types of rocks may have the same density as obsidian.

Pumice is a type of rock that has holes in it. The holes contain air.

0 1 . 8 Which diagram shows the arrangement of particles in air?

[1 mark]

Tick (✓) **one** box.



0 1 . 9 Complete the sentence.

Choose the answer from the box.

[1 mark]

less than	the same as	more than

The holes containing air cause the density of pumice to

be less than the density of other types of rock.

13

0 2 In a sport called far-leaping, an athlete uses a long pole to cross a river.

Figure 4 shows an athlete far-leaping.

Figure 4

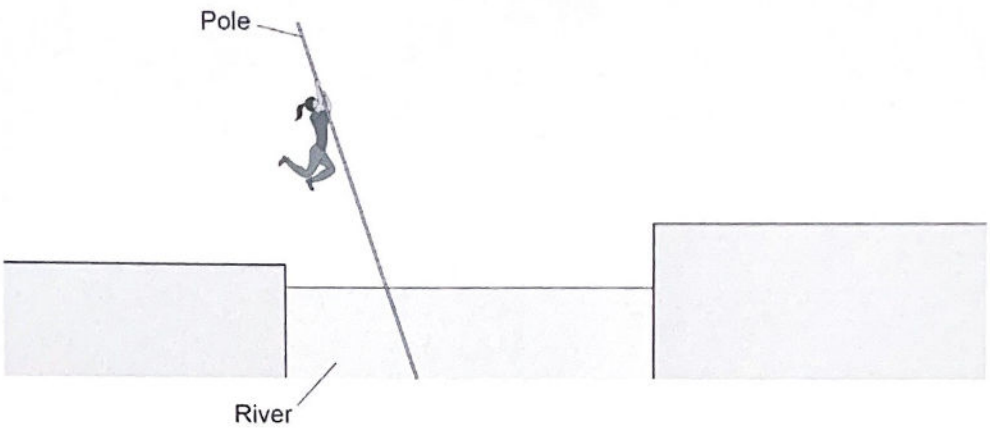
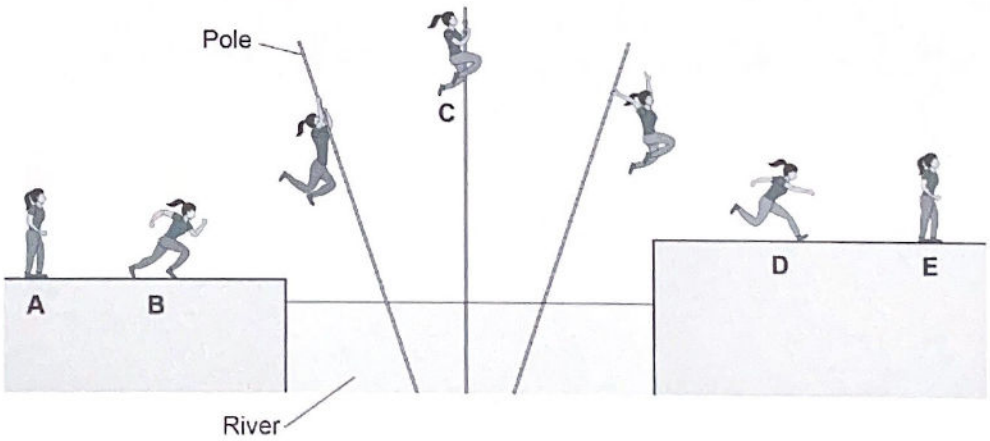


Figure 5 shows the athlete in different stages of far-leaping.

Figure 5



0 2 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**nuclear**	**kinetic**
elastic potential		**gravitational potential**

Between positions **A** and **B** the athlete speeds up. There is

an increase in the athlete's kinetic energy and

a decrease in the athlete's chemical store of energy.

0 2 . 2 Between positions **B** and **C** the athlete jumps to the pole and climbs up it.

Which statement describes a change in the athlete's energy between positions **B** and **C**?

[1 mark]

Tick (✓) **one** box.

- Elastic potential energy decreases. ☐
- Elastic potential energy increases. ☐
- Gravitational potential energy decreases. ☐
- Gravitational potential energy increases. ☑

Question 2 continues on the next page

0 2 . 3 The pole falls over from position **C**. The athlete lets go of the pole and lands at position **D**.

The change in height of the athlete between positions **C** and **D** is 3.0 m.

mass of athlete = 50 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the athlete between positions **C** and **D**.

Use the equation:

change in gravitational potential energy = mass × gravitational field strength × change in height

[2 marks]

Change in g.p.e = 50 × 9.8 × 3.0

E_p = 1470 J

Change in gravitational potential energy = 1470 J

0 2 . 4 The kinetic energy of the athlete at position **D** is 1600 J.

mass of athlete = 50 kg

Calculate the speed of the athlete at position **D**.

Use the equation:

$$\text{speed} = \sqrt{\frac{2 \times \text{kinetic energy}}{\text{mass}}}$$

Choose the unit from the box.

[3 marks]

m/s	J/kg	J/s

Speed $= \sqrt{2 \times \frac{1600}{50}}$

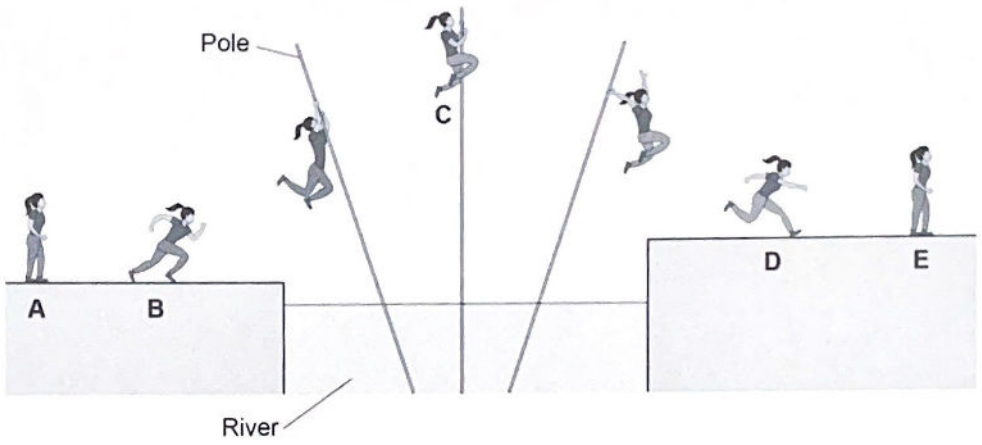
Speed $= 8$

Speed = 8 Unit m/s

Question 2 continues on the next page

Figure 5 is repeated below.

Figure 5



0 2 . 5 At positions **A** and **E**, the athlete is standing still.

Why does the athlete have less energy in position **E** than in position **A**?

[1 mark]

Tick (✓) **one** box.

Energy has been transferred from the athlete to the air. ✓

The air temperature has decreased.

The height of the athlete above the water has increased.

0 2 . 6 Athletes have a large power output when they are far-leaping.

What is meant by the power of an athlete?

[1 mark]

Tick (✓) **one** box.

- The rate at which the athlete transfers energy. ✓
- The size of the maximum force exerted by the athlete.
- The total energy transferred by the athlete.

0 2 . 7 A second athlete crossed the same river by far-leaping.

The second athlete had less power than the first athlete when running between position **A** and position **B**.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

less than	the same as	more than

Two factors that could explain why the second athlete had less power than the first athlete are:

1. The time taken by the second athlete to run between position **A** and position **B** was more than the first athlete.

2. The work done by the second athlete was less than the first athlete.

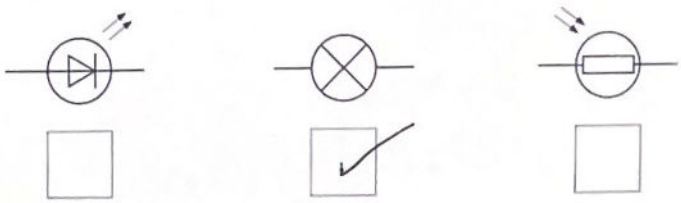
12

0 3 A filament lamp breaks if the electric current in the filament becomes too big.

0 3 . 1 What is the correct symbol for a filament lamp?

[1 mark]

Tick (✓) **one** box.



0 3 . 2 What is meant by an electric current?

[1 mark]

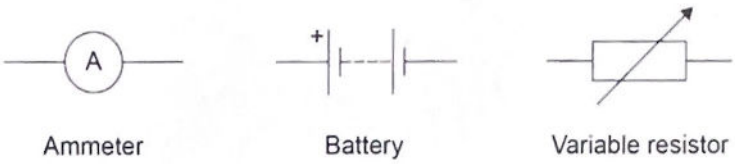
Tick (✓) **one** box.

- The energy carried by each unit of charge ☐
- The flow of electrical charge ☑
- The number of electrons in a circuit ☐
- The speed at which charge moves ☐

A manufacturer investigated the maximum current value of some filament lamps.

0 3 . 3 **Figure 6** shows the symbols for an ammeter, a battery and a variable resistor.

Figure 6



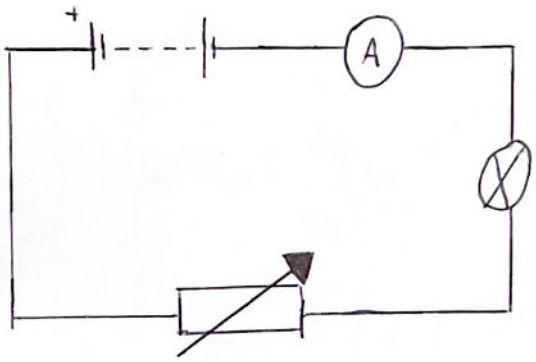
Ammeter Battery Variable resistor

The manufacturer connected an ammeter, battery, filament lamp and variable resistor in series.

Draw a circuit diagram to show the manufacturer's circuit.

Include the symbol for a filament lamp from Question **03.1**

[1 mark]



0 3 . 4 How could the manufacturer increase the current in the filament lamp?

[1 mark]

Tick (✓) **one** box.

Add an extra ammeter to the circuit. ☐

Decrease the resistance of the variable resistor. ☑

Use a battery with a smaller potential difference. ☐

0 3 . 5 When the potential difference across a filament lamp was 0.75 V, the current in the filament lamp was 0.16 A.

Calculate the power of the filament lamp.

Use the equation:

power = potential difference × current

[2 marks]

power = 0.75 x 0.16

P = 0.12 W

Power = 0.12 W W

0 3 . 6 Write down the equation which links charge flow (Q), current (I) and time (t).

[1 mark]

charge flow = current x time

or $Q = It$

0 3 . 7 The manufacturer increased the current in the filament lamp to 200 mA.

Calculate the charge flow through the filament lamp in 15 s.

[3 marks]

200 mA = 0.2 A

Charge flow = current x time

Charge flow = 0.2 x 15

Charge flow = 3.0 C

Charge flow = 3.0 C

Do not write outside the box

0 3 . 8 The manufacturer increased the current in the filament lamp from 200 mA.

The filament in the lamp broke when the current reached 320 mA.

How many times greater than 200 mA was the current at which the filament broke?

[1 mark]

$\frac{320}{200} = 1.6$

1.6 times greater

0 3 . 9 The manufacturer tested lots of filament lamps.

The current at which the filament lamps broke was 320 ± 60 mA.

What is the range of currents at which the filament lamps broke?

[1 mark]

Tick (✓) **one** box.

- 60 mA to 320 mA ☐
- 260 mA to 320 mA ☐
- 320 mA to 380 mA ☐
- 260 mA to 380 mA ☑

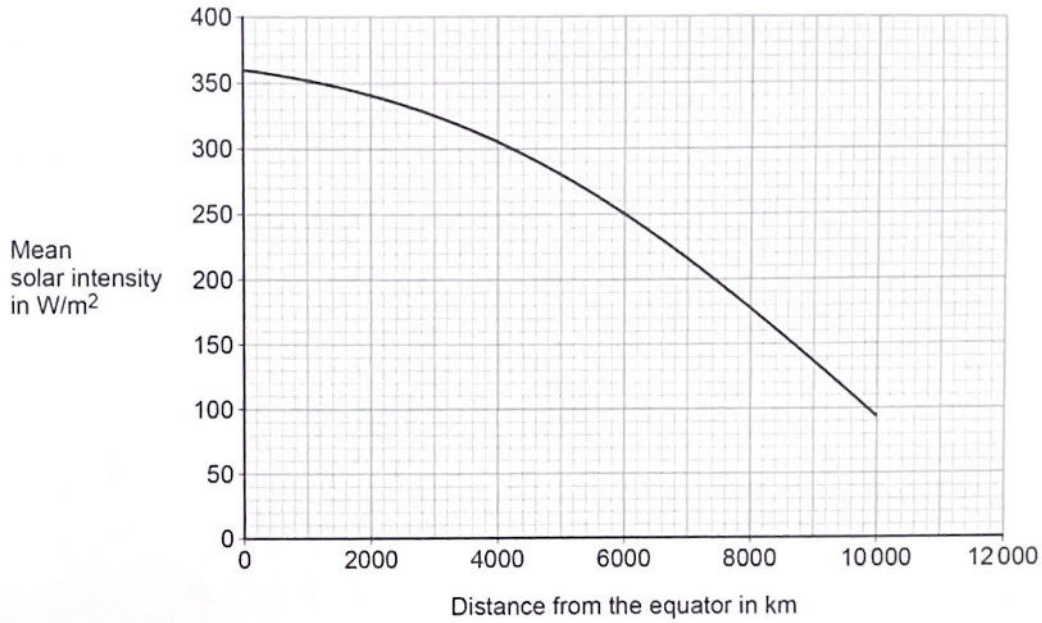
12

Turn over for the next question

0 4 Solar intensity is a measure of the radiation received from the Sun at the surface of the Earth.

Figure 7 shows how the mean solar intensity changes with the distance from the equator.

Figure 7



0 4 . 1 The city of Athens is 4200 km from the equator.

What is the mean solar intensity in Athens?

[1 mark]

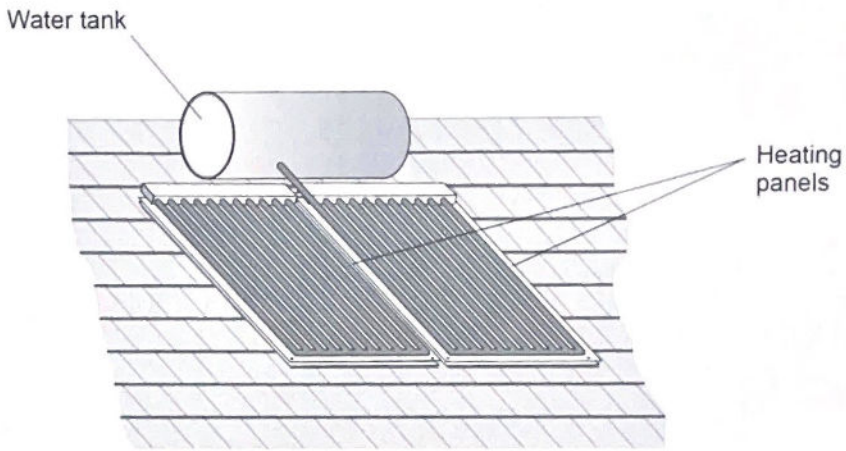
Mean solar intensity = 300 W/m^2

Solar water heaters use radiation from the Sun to heat water.

The heated water is stored in a water tank.

Figure 8 shows a solar water heater on the roof of a building.

Figure 8



0 4 . 2 Cities closer to the equator have many more buildings with solar water heaters than cities further away from the equator.

Suggest why.

[1 mark]

Cities closer to the equator receive a greater solar intensity.

0 4 . 3 The use of solar water heaters may reduce the need to burn fossil fuels.

Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon dioxide	nitrogen	oxygen

Burning fossil fuels contributes to global warming because there is an increase in the amount of Carbon dioxide in the atmosphere.

0 4 . 4 The efficiency of the solar water heater is 0.61

Calculate the useful power output when the total power input to the solar water heater is 1100 W.

Use the equation:

useful power output = efficiency × total power input

[2 marks]

useful power output = 0.61 × 1100

useful power output = 671 W

Useful power output = 671 W

0 4 . 5 Different solar water heaters have different sized heating panels.

Suggest how the size of the heating panels affects the input power to a solar water heater.

[1 mark]

Larger heating panels have a greater input power.

0 4 . 6 Water has a high specific heat capacity.

What is meant by the specific heat capacity of water?

[1 mark]

Tick (✓) **one** box.

- The energy required to change the state of 1 kg of water from liquid to gas. ☐
- The energy required to increase the temperature of 1 kg of water by 1 °C. ✓
- The power required to change the state of 1 kg of water from liquid to gas. ☐
- The power required to increase the temperature of 1 kg of water by 1 °C. ☐

0 4 . 7 The water tank contained 80 kg of water.

The change in thermal energy of the water was 8 400 000 J.

specific heat capacity of water = 4200 J/kg °C

Calculate the temperature change of the water.

Use the Physics Equations Sheet.

[3 marks]

~~AE~~ Change in thermal energy = mass x specific heat capacity x temp. change.

Change in thermal energy = 80 x 4200 x $\Delta\theta$

$\Delta\theta = \frac{8400\,000}{80 \times 4200} = 25\,^{\circ}C$

Temperature change = 25 °C

0 4 . 8 The water tank is thermally insulated.

How does thermal insulation affect the rate of energy transfer from the water in the tank?

[1 mark]

Tick (✓) **one** box.

- Thermal insulation decreases the rate of energy transfer. ✓
- Thermal insulation does not change the rate of energy transfer.
- Thermal insulation increases the rate of energy transfer.

Question 4 continues on the next page

0 4 . 9 **Table 1** shows information about different materials.

Table 1

Material	Thermal conductivity in arbitrary units
A	3
B	2
C	8
D	4

Which material in **Table 1** is the best thermal insulator?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☑ C ☐ D ☐

12

0 5 **Figure 9** shows a mobile phone with its battery removed.

Figure 9

A student measured the potential difference across the battery and then put the battery into the phone.

0 5 . 1 What is the equation linking current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V R$ ☐

$R = I V$ ☐

$V = I R$ ☑

$V = I^2 R$ ☐

Question 5 continues on the next page

0 5 . 2 The current in the electronic circuit in the mobile phone was 0.12 A.

The potential difference across the battery was 3.9 V.

Calculate the resistance of the electronic circuit in the mobile phone.

[3 marks]

$V = IR$

$3.9 = 0.12 \times R$

$R = \frac{3.9}{0.12}$

$R = 32.5\ \Omega$

Resistance = 32.5 Ω

Do not write outside the box

0 5 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

Energy = power x time

0 5 . 4 The battery was fully charged when it was put into the mobile phone.

The battery discharged when the mobile phone was switched on.

The average power output of the battery as it discharged was 0.46 watts.

The time taken to fully discharge the battery was 2500 minutes.

Calculate the energy transferred by the battery.

[3 marks]

time = 2500 x 60 = 150,000 Seconds

Energy = 0.46 x 150,000

Energy = 69,000 J

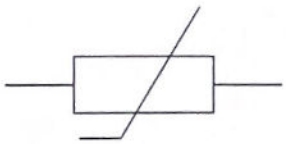
Energy transferred = 69,000 J

Question 5 continues on the next page

The mobile phone includes a sensor to monitor the temperature of the battery.

Figure 10 shows the circuit symbol for a component used in the sensor.

Figure 10



0 5 . 5 What component does the circuit symbol shown in **Figure 10** represent?

[1 mark]

Thermistor

0 5 . 6 The temperature of the component in **Figure 10** increases.

The potential difference across the component remains constant.

Explain what happens to the current in the component.

[2 marks]

The current will increase because the resistance decreases.

11

0 6 A radioactive source emits alpha, beta and gamma radiation.

0 6 . 1 An alpha particle is the same as a helium nucleus.

How many times bigger is the radius of a helium atom than the radius of an alpha particle?

[1 mark]

Tick (✓) **one** box.

- Less than 100 times bigger ☐
- Exactly 5000 times bigger ☐
- More than 10 000 times bigger ☑

0 6 . 2 Alpha particles can ionise atoms in the air.

What happens to an atom when it is ionised by an alpha particle?

[2 marks]

Tick (✓) **two** boxes.

- A neutron in the atom becomes a proton. ☐
- The atom becomes a positive ion. ☑
- The atom gains a neutron. ☐
- The atom gains a proton. ☐
- The atom loses an electron. ☑

Question 6 continues on the next page

0 6 . 3 A spark detector is a device that can be used to detect alpha radiation.

A spark detector works by alpha particles ionising atoms in the air near a wire mesh.

A large potential difference creates a spark when the air near the wire mesh is ionised.

Suggest why a spark detector **cannot** detect beta radiation.

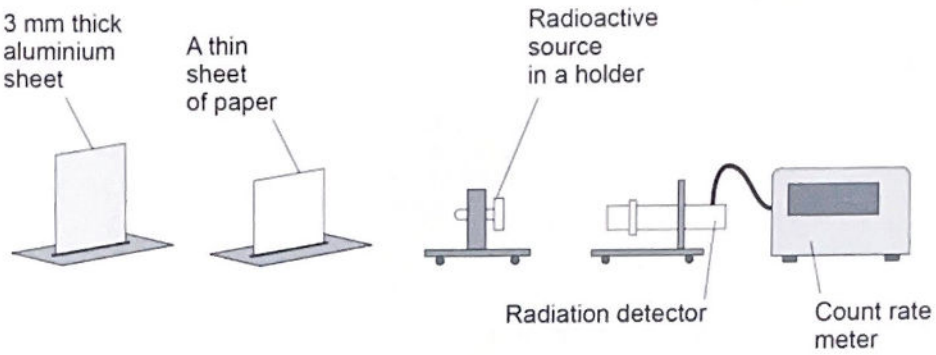
[1 mark]

This is because beta radiation is only weakly ionising.

0 6 . 4 A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

Figure 11 shows the equipment the teacher has.

Figure 11



Describe a method the teacher could use.

[6 marks]

Firstly, move the detector very close the source and record the count rate on the count rate meter. Then, position the paper between the source and the detector. Record the new count rate. Alpha radiation will not penetrate through the paper, and so if the count rate with the paper is significantly reduced then the source emits alpha radiation. Replace the paper with the aluminium and record the new count rate. Alpha and beta will not penetrate through the aluminium, so if the count rate has significantly reduced the beta radiation is present. If radiation penetrates through aluminium the gamma radiation is present

END OF QUESTIONS

The experiment should be repeated and mean results calculated, because radiation is a random process.

10