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

H

Higher Tier
Physics Paper 1H

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 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 **Figure 1** shows a mobile phone with its battery removed.

Figure 1

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

0 1 . 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 1 continues on the next page

Do not write outside the box

0 1 . 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]

$V = IR$

$3.9 = 0.12 \times R$ $\quad R = \frac{3.9}{1.2}$

$R = 32.5\ (\Omega)$

Resistance = _____ Ω

0 1 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

energy = power x time

0 1 . 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 in seconds = 2500 x 60 = 150,000 s

energy = power x time

energy = 0.46 x 150,000

energy = 69,000 J

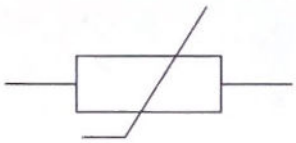
Energy transferred = 69,000 J

Question 1 continues on the next page

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

Figure 2 shows the circuit symbol for a component used in the sensor.

Figure 2



0 1 . 5 What component does the circuit symbol shown in **Figure 2** represent?

[1 mark]

Thermistor

0 1 . 6 The temperature of the component in **Figure 2** increases.

The potential difference across the component remains constant.

Explain what happens to the current in the component.

[2 marks]

The current in the component will increase because the resistance decreases.

11

0 2 A radioactive source emits alpha, beta and gamma radiation.

0 2 . 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 2 . 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 2 continues on the next page

0 2 . 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.

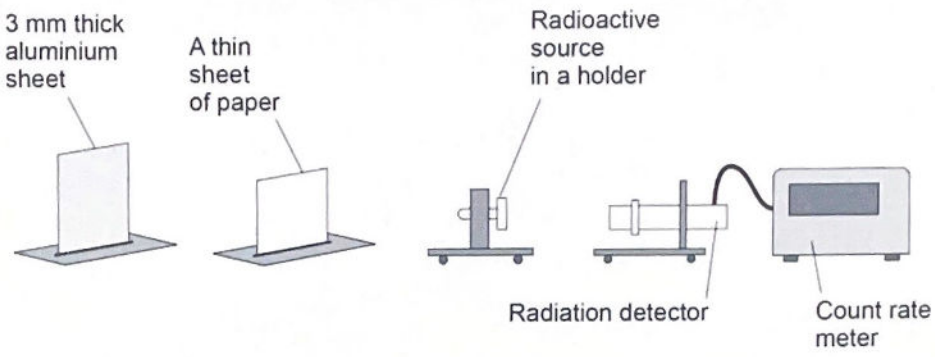
[1 mark]

Beta radiation is only weakly ionising.

0 2 . 4 A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

Figure 3 shows the equipment the teacher has.

Figure 3



Describe a method the teacher could use.

[6 marks]

First move the detector very close to the source and record the count rate. place the paper between the source and the detector and record the new count rate. If the count rate is significantly less than without, then the source emits alpha radiation. Replace the paper with the aluminium and record the new count rate. Alpha and Beta radiation will not penetrate through aluminium, so if the count rate has significantly decreased compared with using paper then beta radiation is present. If radiation penetrates through the aluminium then gamma radiation is present.

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

10

0 3 **Figure 4** shows a sailing boat crossing an ocean.

Figure 4

There is a wind turbine on the boat.

0 3 . 1 The wind turbine generates electricity to charge a battery on the boat.

Name one **other** renewable energy resource that could be used on the boat to generate electricity.

[1 mark]

Solar

0 3 . 2 The boat also has a generator that burns a fossil fuel.

The battery can be charged by either the wind turbine **or** the generator.

Give **two** reasons why this is useful.

[2 marks]

1 Sometimes there is no wind, but the battery can still be charged using the generator.

2 When there is wind less fuel is burned

0 3 . 3 Explain **one** environmental impact of using fossil fuels to generate electricity.

[2 marks]

The Carbon dioxide released increases global Warming

0 3 . 4 The kinetic energy of the boat is 81 kJ.

mass of boat = 8000 kg

Calculate the speed of the boat.

[4 marks]

Kinetic energy = $\frac{1}{2} m v^2$

$E_k = 0.5 \times 8000 \times v^2$

$81\,kJ = 81000\,J$ $\quad 81000 = 0.5 \times 8000 \times v^2$

$v = \sqrt{\frac{81000}{0.5 \times 8000}} = 4.5$ m/s

Speed = 4.5 m/s

Question 3 continues on the next page

0 3 . 5 As the boat passes over a wave, the gravitational potential energy of the boat increases by 19 600 J.

mass of boat = 8000 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the centre of mass of the boat as it passes over the wave.

[3 marks]

$\Delta E_p = mg\Delta h$

$19600 = 8000 \times 9.8 \times \Delta h$

$\Delta h = \frac{19600}{8000 \times 9.8}$ $\Delta h = 0.25\ m$

Change in height = 0.25 m

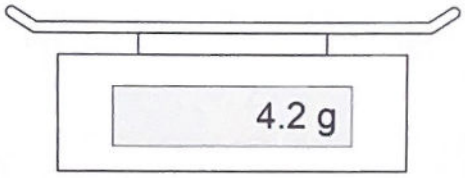
12

0 4 A student determined the density of a cube made of bronze.

The student used a balance to measure the mass of the bronze cube.

Figure 5 shows the balance before the cube was added.

Figure 5



0 4 . 1 What type of error is shown on the balance?

[1 mark]

Zero error

0 4 . 2 How could the student get a correct value for the mass of the cube from the balance?

[1 mark]

Reset the balance to zero g

0 4 . 3 The student measured the length of the bronze cube using Vernier callipers and then using a micrometer.

Table 1 shows the results.

Table 1

Equipment	Length in mm
Vernier callipers	20.1
Micrometer	20.14

Complete the sentence.

[1 mark]

The results in **Table 1** show that the Vernier callipers and the micrometer have a different resolution .

Question 4 continues on the next page

The student wanted to determine the density of a bronze coin.

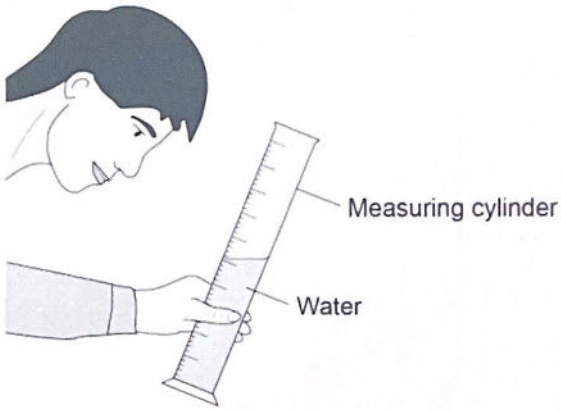
The student had several identical coins.

The volume of each coin was very small.

0 4 . 4 The student added water to a measuring cylinder.

Figure 6 shows the student reading the volume of water in the measuring cylinder.

Figure 6



Give **two** changes the student should make to increase the accuracy of the volume measurement.

[2 marks]

1 place the measuring cylinder on a horizontal surface.

2 View with eye in line with the level of the water.

0 4 . 5 Describe how the student could use a displacement method to determine an accurate value for the volume of a single coin.

[3 marks]

The Student could add several coins to the measuring cylinder. Measure the change in the water level in the measuring cylinder, and then divide this by the number of coins added.

Question 4 continues on the next page

0 4 . 6 Old penny coins were made from a disc of bronze.

New penny coins are made from a disc of a different metal.

Figure 7 shows a disc of metal.

Figure 7

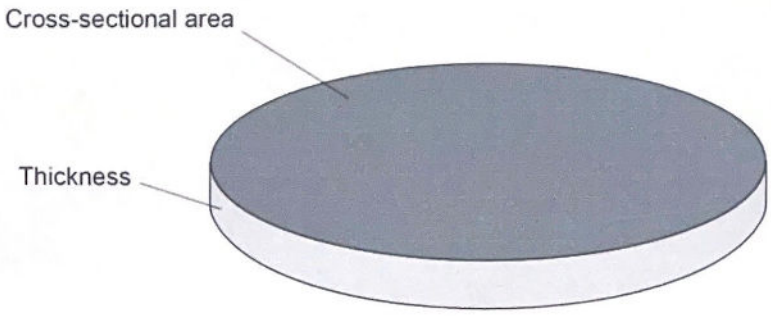


Table 2 shows information about the discs used to make each coin.

Table 2

Disc	Mass in g	Density in g/cm^3	Thickness in cm
Old penny	3.6	8.9	0.16
New penny	3.6	**X**	0.17

The discs used to make the old and the new coins have the **same** cross-sectional area.

Calculate value **X** in **Table 2**.

Give your answer to 2 significant figures.

The volume of a disc can be calculated using the equation:

volume of a disc = cross-sectional area × thickness

[5 marks]

Density = $\frac{\text{mass}}{\text{volume}}$ $8.9 = \frac{3.6}{\text{area} \times 0.16}$

area = $\frac{3.6}{8.9 \times 0.16} = 2.528$

Density = $\frac{3.6}{2.528 \times 0.17} = 8.37$ g/cm^3

To 2 Sig figs : 8.4 g/cm^3

Density (2 significant figures) = 8.4 g/cm^3

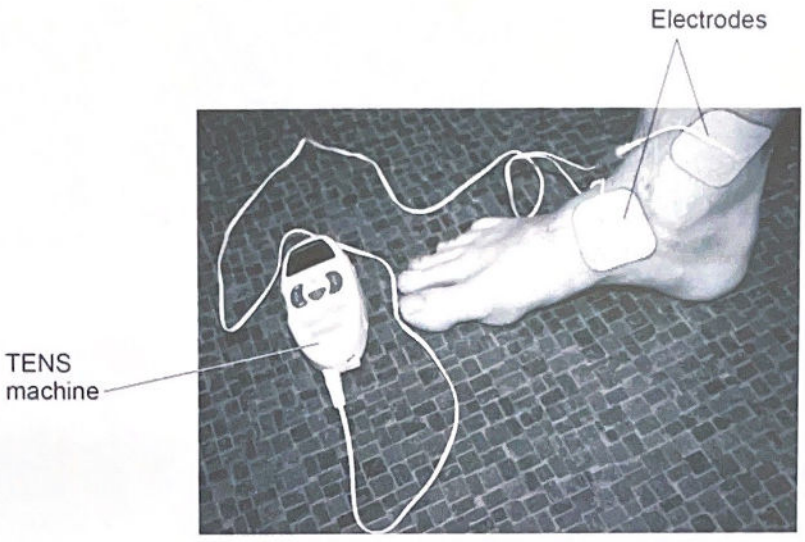
13

Turn over for the next question

0 5 A TENS machine uses an electrical current to relieve pain.

Figure 8 shows the electrodes of a TENS machine connected across an ankle.

Figure 8



0 5 . 1 The maximum power of the TENS machine is 240 mW.

The potential difference across the battery in the TENS machine is 2.5 V.

Calculate the maximum current from the battery.

[4 marks]

240 mW = 0.24 W

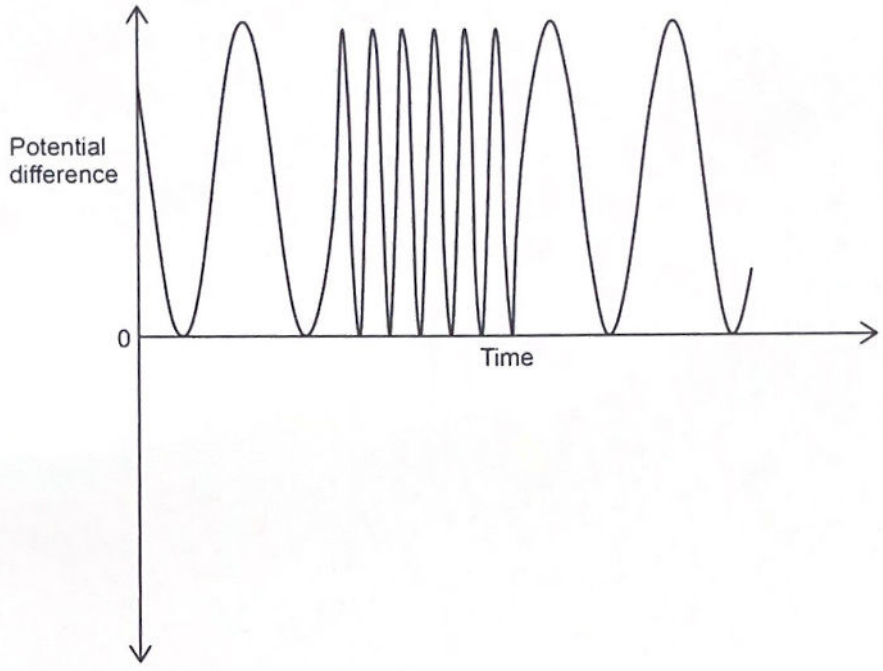
$P = VI$ $\quad 0.24 = 2.5 \times I$

$I = \frac{0.24}{2.5}$ $\quad I = 0.096$ A

Maximum current = 0.096 A

0 5 . 2 **Figure 9** is a sketch graph showing how the potential difference across the electrodes varies with time.

Figure 9



A student concluded that there was an alternating potential difference across the electrodes.

How does **Figure 9** show that the student was **not** correct?

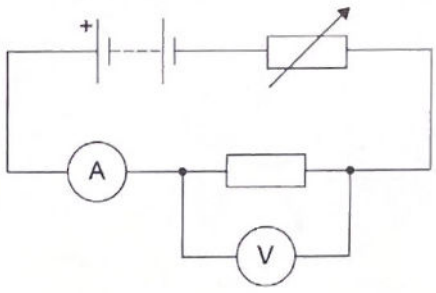
[1 mark]

Because the potential difference is always positive.

Question 5 continues on the next page

Figure 10 shows a circuit the student built using the battery from the TENS machine.

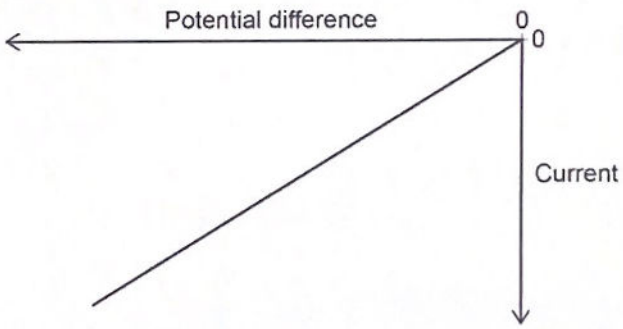
Figure 10



The student recorded how the current in the resistor varied with the potential difference across the resistor.

Figure 11 shows a sketch graph of the results.

Figure 11



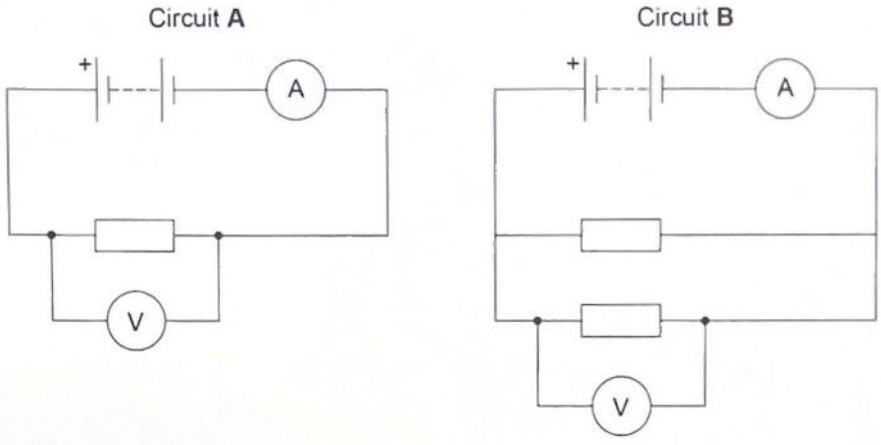
0 5 . 3 What relationship does **Figure 11** show?

[1 mark]

That potential difference is directly proportional to current

0 5 . 4 **Figure 12** shows two more circuits that the student built using the battery from the TENS machine.

Figure 12



The resistors all have the same resistance.

Compare the readings on the voltmeter and ammeter in circuit **A** and circuit **B**.

[3 marks]

Voltmeter The readings in Circuit A and Circuit B is the same on the voltmeter

Ammeter The ammeter readings in Circuit B is twice the reading of Circuit A.

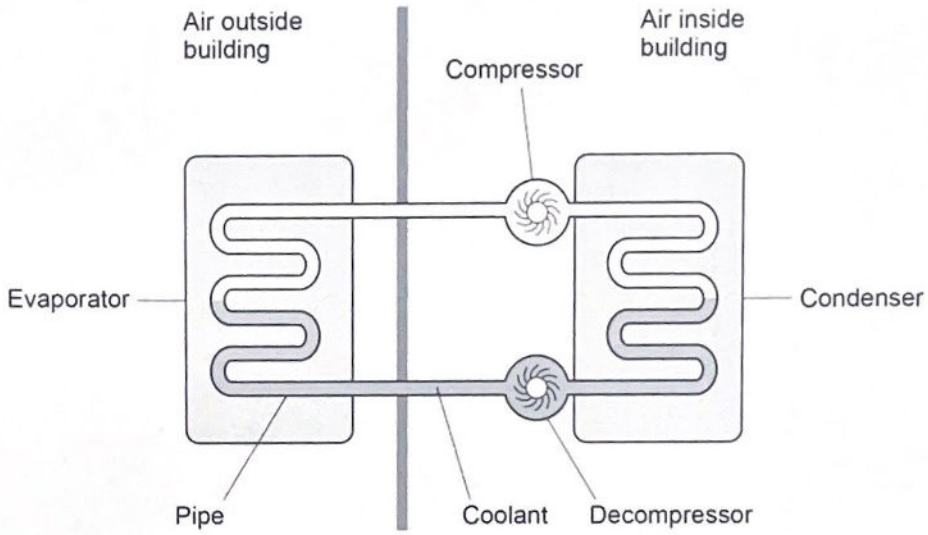
9

Turn over for the next question

0 6 An air source heat pump transfers energy from the air outside a building to increase the temperature of the air inside the building.

Figure 13 shows an air source heat pump.

Figure 13



The compressor is connected to the mains electricity supply.

The pipe in the heat pump contains a substance called coolant.

In the evaporator, energy is transferred from the air outside the building to the liquid coolant.

The temperature of the coolant increases and it evaporates.

0 6 . 1 Explain what happens to the internal energy of the coolant as its temperature increases.

[2 marks]

The kinetic energy and the potential energy of the particles increases. So the internal energy increases because it is the sum of kinetic and potential energy of the particles.

0 6 . 2 What name is given to the energy needed to change the state of the liquid coolant?

[1 mark]

Latent heat of vaporisation.

0 6 . 3 What happens to the mass of the coolant as it evaporates and becomes a vapour?

[1 mark]

Tick (✓) **one** box.

- Decreases ☐
- Stays the same ☑
- Increases ☐

0 6 . 4 The compressor increases the density and temperature of the coolant vapour inside the pipe.

Explain why the pressure in the pipe increases.

[2 marks]

This is because ~~they're~~ there are more collisions per second, and there is a greater force per collision.

Question 6 continues on the next page

0 6 . 5 The condenser transfers energy from the coolant to the air in the building.

When the total energy input to the heat pump system is 1560 kJ the temperature of the air in the building increases from 11.6 °C to 22.1 °C.

The efficiency of the heat pump system is 87.5%.

The mass of the air inside the building is 125 kg.

Calculate the specific heat capacity of the air in the building.

Give your answer in standard form.

[6 marks]

Efficiency = useful output energy transfer / total input energy transfer

0.875 = useful output / 1560000 useful output = 1365000 J

Specific heat capacity

1365000 = 125 × c × (22.1 − 11.6)

Specific heat capacity c = 1365000 / (125 × 10.5) = 1040 J/kg °C

Specific heat capacity (standard form) = 1.040×10^{3} J/kg °C

0 6 . 6 The air in the building gains 400 J for every 100 J of energy transferred from the mains electricity supply to the compressor.

An advertisement claims that the heat pump system has an efficiency of 400%.

Explain why the advertisement is **not** correct.

[3 marks]

The advertisment is not correct because it has igrored the energy input from the surrounding air. So the total energy input is greater than the energy supplied from the electricity. Therefore the efficiency must be less than 100%.

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END OF QUESTIONS