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

Thursday 25 May 2023 Morning 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.

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.

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

0 1 A scientist investigated the radiation emitted by different radioactive isotopes.

The scientist had a sample of polonium-210.

The radiation emitted by polonium-210 can be represented by the symbol ${}^{4}_{2}He$.

0 1 . 1 Which type of radiation can be represented by the symbol ${}^{4}_{2}He$?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Gamma ☐

0 1 . 2 How many protons are there in a particle of radiation represented by ${}^{4}_{2}He$?

[1 mark]

Tick (✓) **one** box.

2 ☐ 4 ☐ 6 ☐ 8 ☐

0 1 . 3 A polonium-210 (Po) nucleus changes into a lead (Pb) nucleus by emitting a ${}^{4}_{2}He$ particle. This is shown by the following nuclear equation.

$$ {}^{210}_{84}Po \rightarrow {}^{206}_{\mathbf{X}}Pb + {}^{4}_{2}He $$

What is the value of **X**?

[1 mark]

Tick (✓) **one** box.

80 ☐ 82 ☐ 84 ☐ 86 ☐

0 1 . 4 The sample of polonium-210 had an activity of 100 Bq.

Complete the sentence.

Choose the answer from the box.

[1 mark]

25	**50**	**100**	**200**

After one half-life, the activity of polonium-210 in the sample

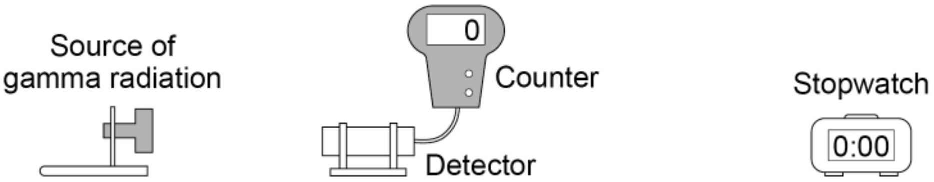
was _______________ Bq.

Question 1 continues on the next page

The scientist investigated another radioactive isotope that is a source of gamma radiation.

Figure 1 shows the equipment used.

Figure 1



0 1 . 5 The count-rate is the number of counts detected each second.

In 30 seconds the number of counts detected was 1500.

Calculate the count-rate.

[2 marks]

____

____

____

Count-rate = ____________________ counts per second

Do not write outside the box

The scientist placed a thick sheet of lead between the source of gamma radiation and the detector.

0 1 . 6 What was the effect of the sheet of lead on the count-rate?

Give a reason for your answer.

[2 marks]

Effect ____

____

Reason ____

____

0 1 . 7 The lead was irradiated by the gamma radiation.

What happened to the lead when it was irradiated by the gamma radiation?

[1 mark]

Tick (✓) **one** box.

The lead atoms became radioactive.	☐
The lead gained atoms from the radioactive source.	☐
The lead was exposed to gamma radiation.	☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 8 Gamma radiation is emitted from the nucleus of an atom.

Complete the sentence.

Choose the answer from the box.

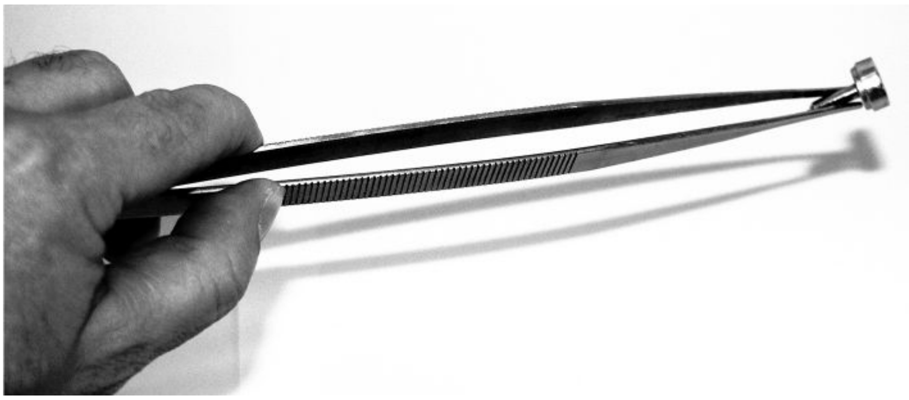
[1 mark]

electromagnetic waves	**high speed electrons**
neutrons	**positively charged ions**

Gamma radiation consists of ____________________________________.

0 1 . 9 **Figure 2** shows the scientist holding the radioactive source using tongs.

Figure 2



Suggest **one** reason why using long tongs rather than short tongs was safer for the scientist.

[1 mark]

____

____

11

Turn over for the next question

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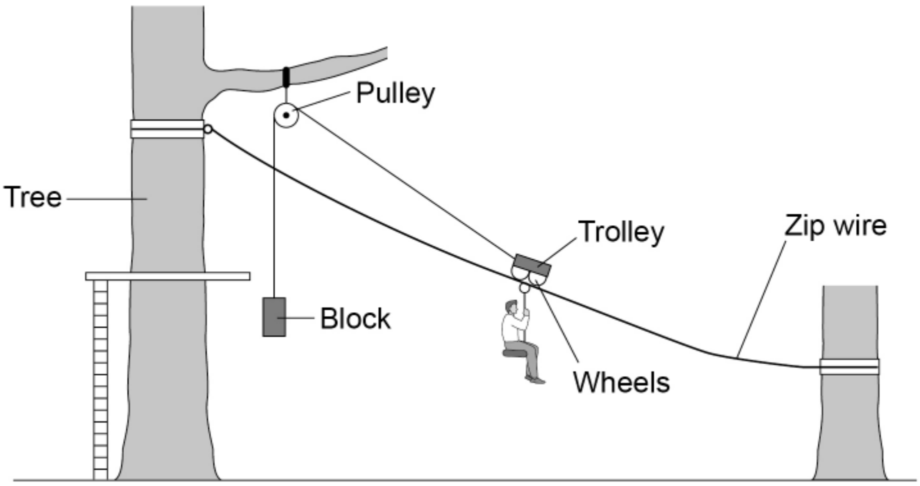
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 **Figure 3** shows a person using a zip wire to move from a tree to the ground.

Figure 3



As the person moves down the zip wire, the block moves upwards.

0 2 . 1 What happens to the gravitational potential energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

Do not write outside the box

0 2 . 2 What happens to the kinetic energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

0 2 . 3 The block is 3.4 m above the ground when the person is at the bottom of the zip wire.

mass of block = 2.5 kg

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the block.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

____

____

____

Gravitational potential energy = ____________________ J

Question 2 continues on the next page

The trolley is a seat suspended from wheels which can roll along the zip wire.

0 2 . 4 When the person reaches the end of the zip wire, the person gets off the trolley.

The block falls downwards pulling the trolley back to the top of the zip wire.

maximum speed of block = 4.8 m/s

mass of block = 2.5 kg

Calculate the maximum kinetic energy of the block.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

Maximum kinetic energy = ____________________ J

0 2 . 5 As the trolley moves, work is done against friction.

What is the effect of this?

[1 mark]

Tick (✓) **one** box.

Some energy is destroyed. ☐

Some energy is transferred to the surroundings. ☐

The total energy of the block and trolley increases. ☐

0 2 . 6 The person oils the wheels on the trolley.

Explain how this will affect the speed of the person down the zip wire.

[2 marks]

____

____

____

____

9

Turn over for the next question

0 3 A piece of steel is heated until it has all melted.

0 3 . 1 Calculate the change in thermal energy when the temperature of the piece of steel is increased by 50 °C.

mass of steel = 4.0 kg

specific heat capacity of steel = 420 J/kg °C

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

____

____

____

Change in thermal energy = ____________________ J

0 3 . 2 The internal energy of the steel increases as the steel is heated.

What is meant by 'internal energy of the steel'?

[1 mark]

Tick (✓) **one** box.

The change in energy of the steel particles as the steel melts. ☐

The energy added to the steel particles as they are heated. ☐

The total kinetic energy and potential energy of the steel particles. ☐

Do not write outside the box

0 3 . 3 Solid steel cannot be poured.

Which statement about the particles in a solid gives the reason why?

[1 mark]

Tick (✓) **one** box.

The number of particles always stays the same. ☐

The particles are close together. ☐

The particles are in fixed positions. ☐

The particles have a fixed size. ☐

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

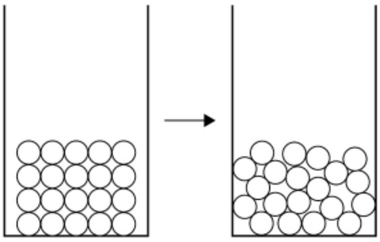
As the piece of solid steel melts, the mass of the steel ____________________ .

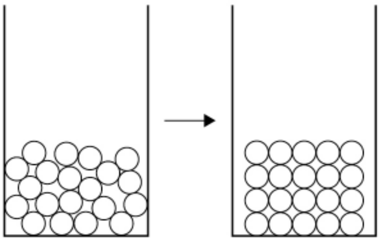
Question 3 continues on the next page

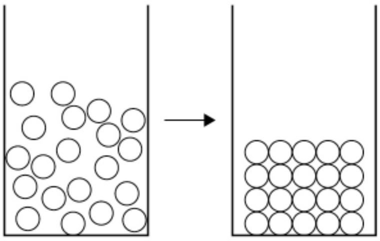
0 3 . 5 Which diagram shows how the arrangement of particles changes when a solid melts and becomes a liquid?

[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

0 3 . 6 The density of steel decreases as it melts.

How does the spacing of the particles change as the steel melts?

[1 mark]

____

____

Do not write outside the box

0 3 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

chemical	**permanent**	**physical**

Melting is an example of a ____________________________ change.

0 3 . 8 Steel is a mixture of iron and a small amount of carbon.

Table 1 shows the mass of carbon in 1.0 kg of different types of steel.

Table 1

Type of steel	Mass of carbon in 1.0 kg of steel
Low carbon	2.0 g
Medium carbon	4.5 g
High carbon	7.0 g

A 4.0 kg piece of steel contains 18 grams of carbon.

Determine which type of steel the 4.0 kg piece is made from.

You should include a calculation in your answer.

[3 marks]

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Type of steel ____________________________

Do not write outside the box

0 3 . 9 The 4.0 kg piece of solid steel was heated until it reached its melting point.

The additional energy required to melt the piece of steel was 280 000 J.

Calculate the specific latent heat of fusion of the steel.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of steel = ______________________ J/kg

14

Turn over for the next question

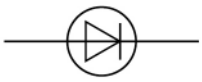
0 4 A gardener wanted to build an electrical circuit to monitor the temperature in a greenhouse.

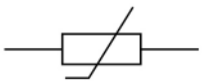
0 4 . 1 Which symbol represents an electrical component with a resistance that decreases as its temperature increases?

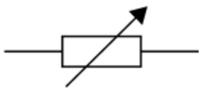
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

0 4 . 2 When the resistance of an electrical circuit decreases, the current in the circuit increases.

Complete the sentence.

Choose the answer from the box.

[1 mark]

charge	**energy**	**potential difference**	**power**

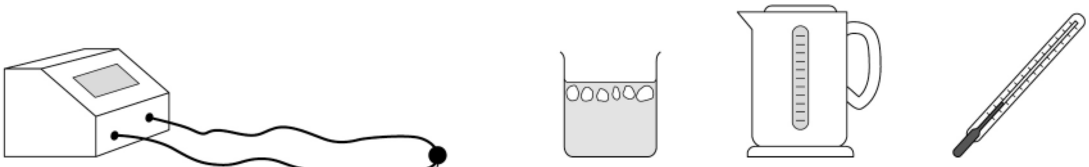
Electrical current is a flow of ____________________________ .

Do not write outside the box

0 4 . 3 The gardener wanted to find how the resistance of the component varies with temperature.

Figure 4 shows the equipment used by the gardener.

Figure 4



The resistance meter displays the resistance of the component.

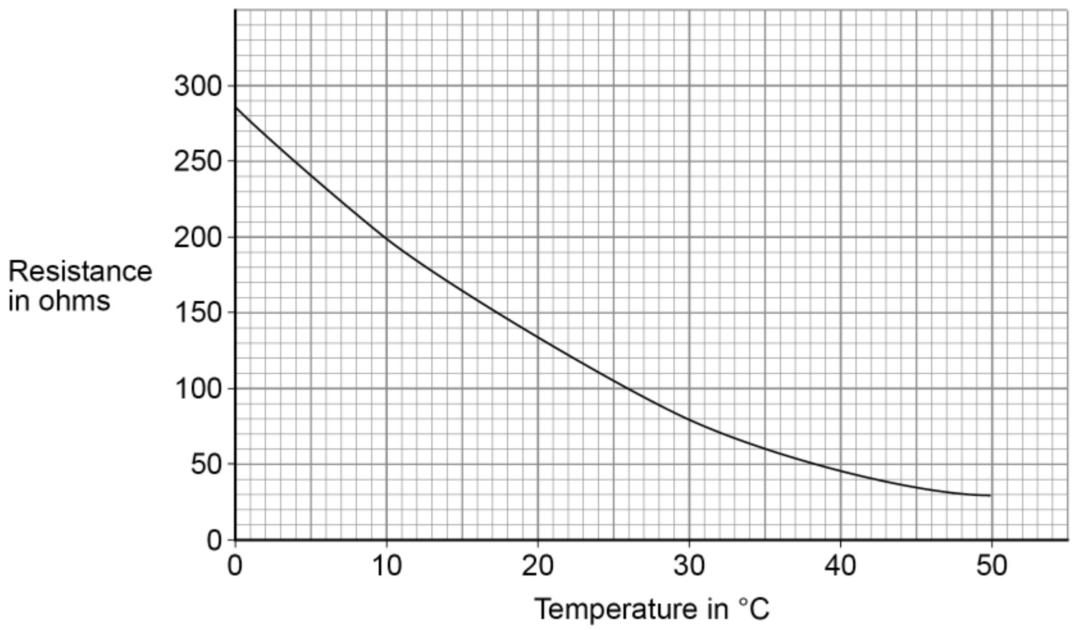
Plan a method the gardener could use to find how the resistance of the component varies with temperature.

[4 marks]

Question 4 continues on the next page

Figure 5 shows how the resistance of the component varies with temperature.

Figure 5



0 4 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

linear	**non-linear**	**directly proportional**

The relationship between the temperature and the resistance of the component

is ________________________________ .

Do not write outside the box

0 4 . 5 The temperature in the greenhouse changed from 10 °C to 30 °C.

Determine the change in resistance of the component between these temperatures.

Use **Figure 5**.

[2 marks]

Change in resistance = ____________________ Ω

Question 4 continues on the next page

Do not write outside the box

The gardener builds a circuit that switches a heater on when the greenhouse gets too cold.

Use the Physics Equations Sheet to answer questions **04.6** and **04.7**.

0 4 . 6 Write down the equation that links current (I), potential difference (V) and power (P).

[1 mark]

____

____

0 4 . 7 The power of the heater is 2900 W.

The potential difference across the heater is 230 V.

Calculate the current in the heater.

[3 marks]

____

____

____

____

____

Current = ____________________ A

13

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0 5 Wind power and solar power are both renewable energy resources used to generate electricity for the National Grid.

0 5 . 1 Which of the following is also a renewable energy resource?

[1 mark]

Tick (✓) **one** box.

Geothermal ☐

Natural gas ☐

Nuclear fuel ☐

0 5 . 2 The energy transferred by the National Grid in one second was 36 gigajoules (GJ).

Which of the following is the same as 36 gigajoules?

[1 mark]

Tick (✓) **one** box.

36×10^{3} J ☐

36×10^{6} J ☐

36×10^{9} J ☐

36×10^{12} J ☐

Question 5 continues on the next page

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0 5 . 3 **Figure 6** shows how the mean power output from solar and wind energy resources in the UK varied between 2014 and 2019.

Figure 6

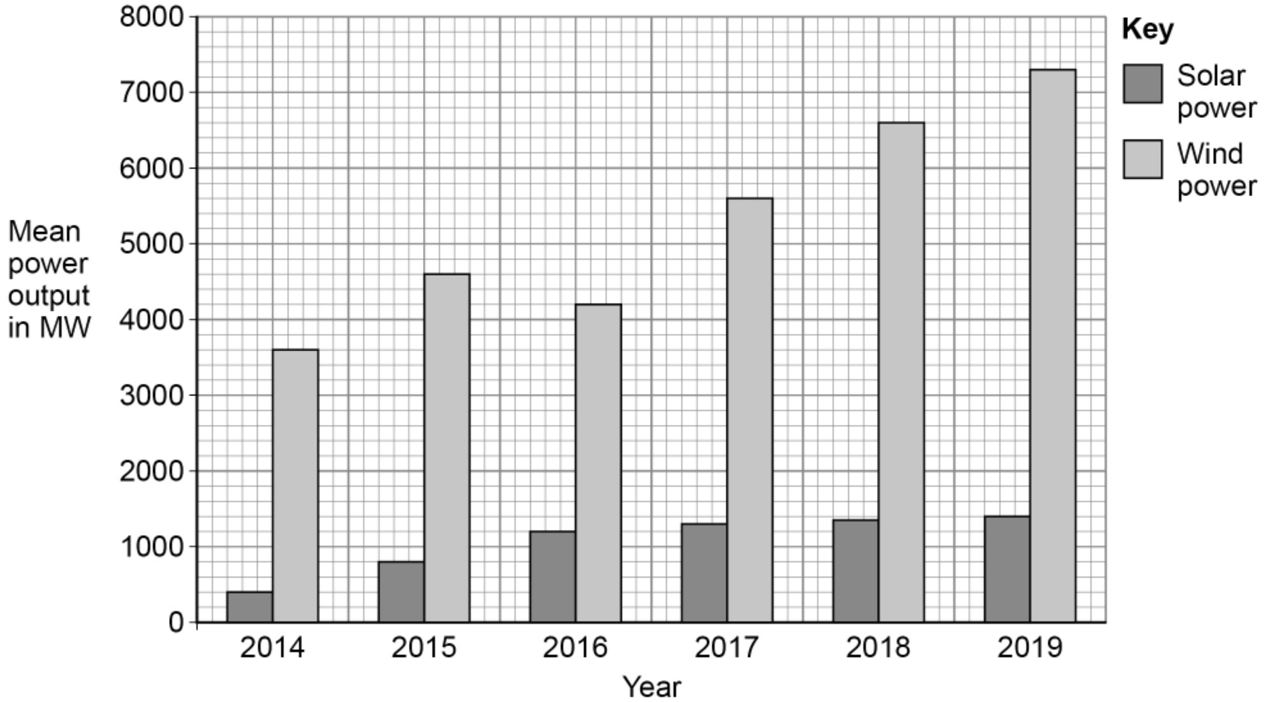
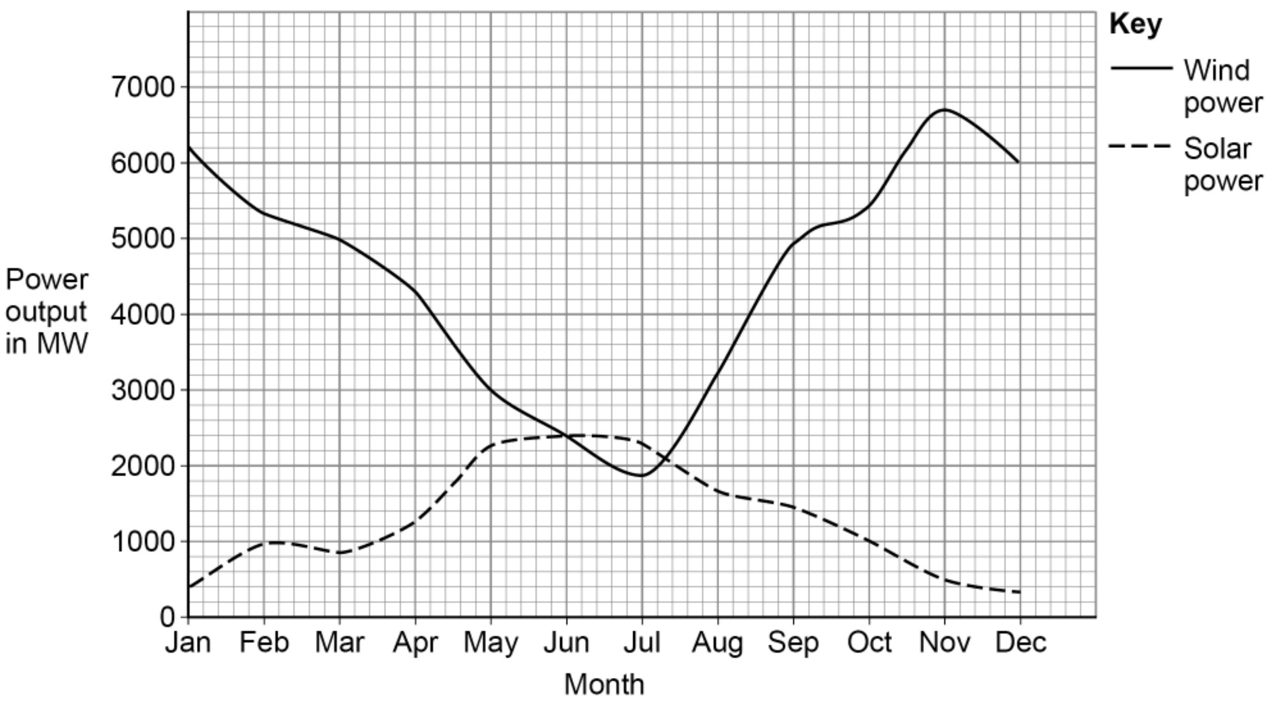


Figure 7 shows how the power output from solar and wind energy resources varies in a typical year.

Figure 7



Explain the changes in power output from solar and wind energy resources between 2014 and 2019.

You should include an explanation of the change in power output during a typical year.

[6 marks]

8

Turn over for the next question

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0 6 Body analysis scales use the electrical resistance of a person's legs to estimate the percentage of water in the person's body.

Figure 8 shows body analysis scales.

Figure 8

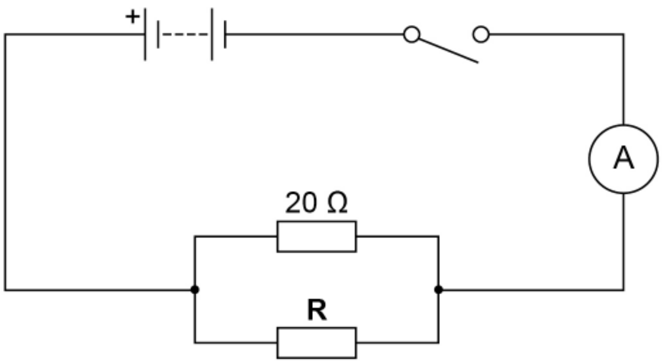
The person's legs contain both solid tissue and water.

A student used resistors to model the solid tissue and water.

The student connected a 20 Ω resistor in parallel with a resistor, **R**.

Figure 9 shows the circuit diagram.

Figure 9



0 6 . 1 To determine the total resistance of both resistors, a voltmeter must be connected into the circuit.

Complete **Figure 9** to show where the voltmeter should be connected.

[1 mark]

Do not write outside the box

0 6 . 2 The student calculated the total resistance of the two resistors.

The student's answer was 26 Ω.

Explain why the student's answer **cannot** be correct.

[2 marks]

Use the Physics Equations Sheet to answer questions **06.3** and **06.4**.

0 6 . 3 Write down the equation that links current (*I*), resistance (*R*) and potential difference (*V*).

[1 mark]

0 6 . 4 When the total resistance of the resistors was 7.5 Ω the current in the circuit was 480 mA.

Calculate the potential difference across the two resistors.

[3 marks]

Potential difference = ____________________ V

Turn over ►

The student investigated how the resistance of **R** affected the total resistance of the circuit.

Table 2 shows the results.

Table 2

Resistance of R in ohms	**Total resistance of the circuit in ohms**
5.0	4.0
10.0	6.7
15.0	8.6
20.0	10.0
25.0	11.1

Some of the results are plotted in **Figure 10**.

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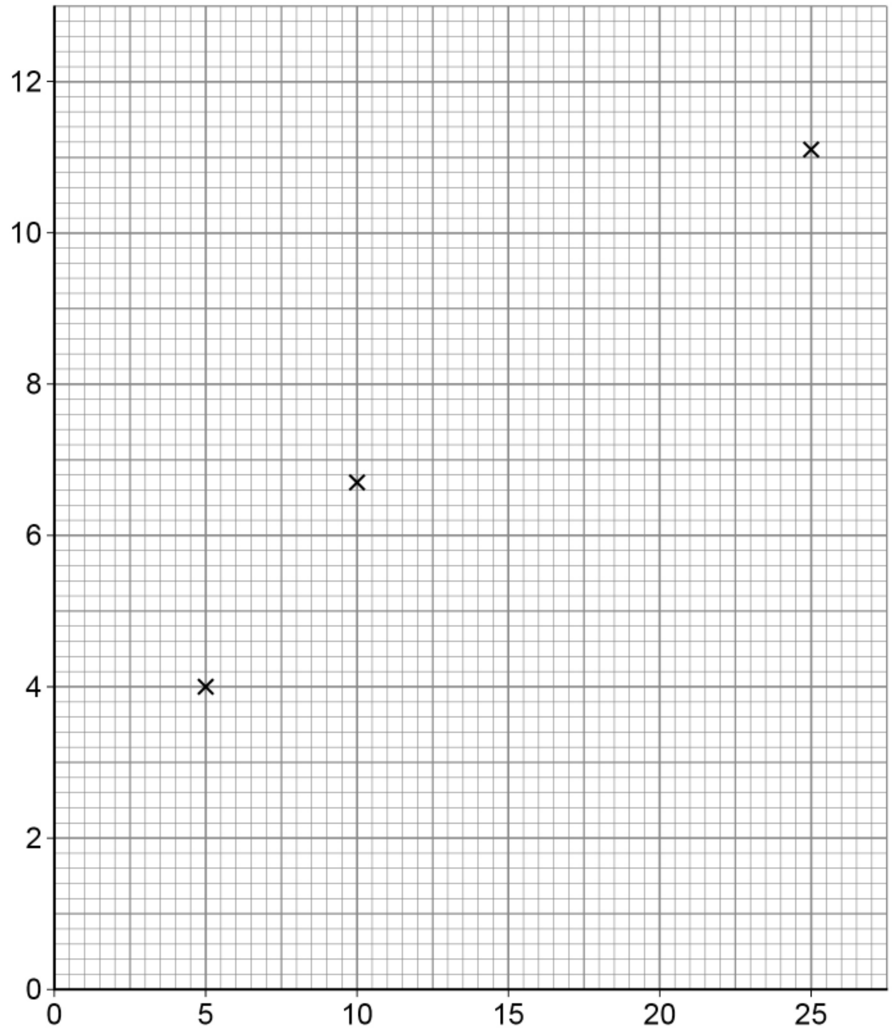
Figure 10



0 6 . 5 Complete **Figure 10**.

You should:

- label both axes
- plot the two remaining values from **Table 2**
- draw the line of best fit.

[3 marks]

0 6 . 6 What resistance of **R** would give a total resistance of 4.4 Ω?

Use **Figure 10**.

[1 mark]

Resistance of **R** = ____________ Ω

Turn over ►

The body analysis scales initially show a reading of 0.0 kg.

When the student steps onto the scales the reading is 64.8 kg.

The student steps off the scales and then immediately steps back on.

The scales now show a reading of 64.1 kg.

0 6 . 7 Complete the sentence.

[1 mark]

The difference between the two values given by the scales is due

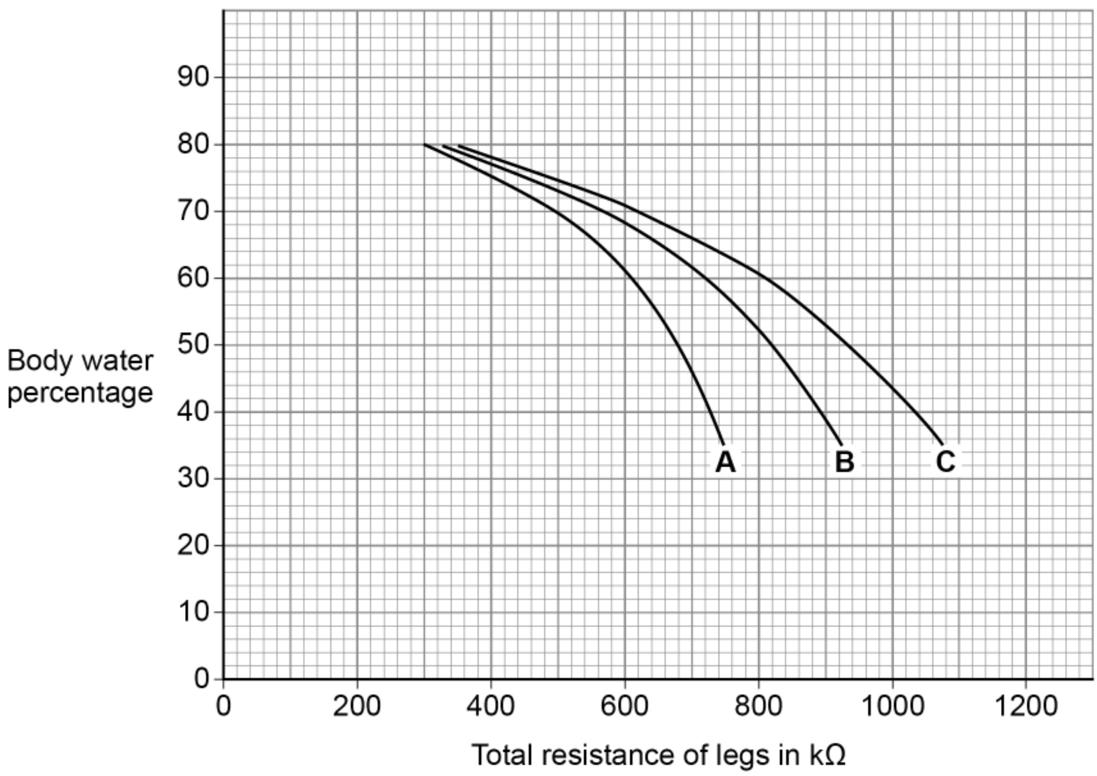
to a ________________________________ error.

0 6 . 8 The height of the student is programmed into the scales.

The scales place the student into a category, **A**, **B** or **C**, based on height and mass.

Figure 11 shows how the scales use the category and the total resistance of the legs to determine the body water percentage.

Figure 11



The total resistance of the student's legs is 600 kΩ. A healthy body water percentage is between 45% and 65%.

The different measurements of the mass of the student mean that the student could be in either category **A** or category **B**.

Evaluate if the student has a healthy body water percentage.

[3 marks]

15

END OF QUESTIONS

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