Z

AQA

Surname _____

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Centre Number _____

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I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 1H

8464/P/1H

Wednesday 20 May 2020 Afternoon

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

J U N 2 0 8 4 6 4 P 1 H 0 1

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.**
- **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.**

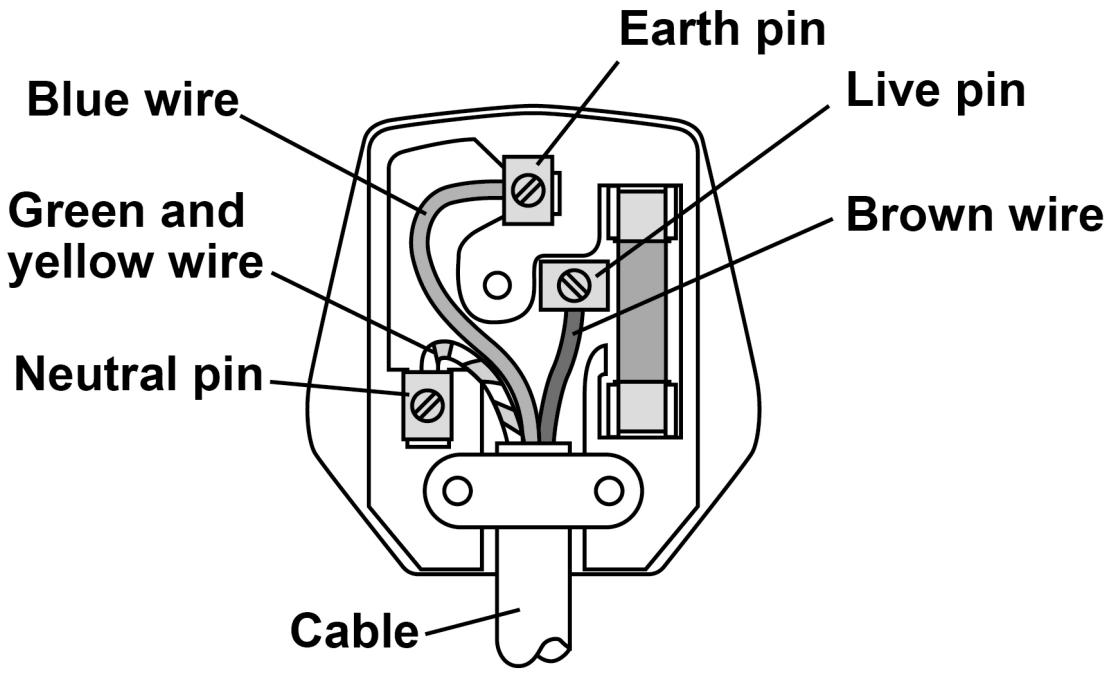
INFORMATION

- **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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **FIGURE 1 shows the inside of a plug.**

FIGURE 1



0 1 . 1 **The plug is NOT wired correctly.**

What should be done to connect the wires in the plug correctly? [1 mark]

The correctly wired plug and cable connects a washing machine to the mains electricity supply.

0 1 . 2 Give the potential difference and frequency of the mains electricity supply in the UK.
[2 marks]

The potential difference is _____ V

The frequency is _____ Hz

0 1 . 3 The washing machine is switched on.

What is the potential difference between the neutral wire and the earth wire? [1 mark]

Potential difference = _____ V

[Turn over]

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0 1 . 4 **The plug has a fuse.**

Draw the circuit symbol for a fuse in the space below. [1 mark]

[Turn over]

The washing machine has a metal case.

A fault causes the live wire to make an electrical connection with the metal case of the washing machine.

0 1 . 5 **The earth wire is NOT connected to the metal case of the washing machine.**

Explain why it would not be safe for a person to touch the metal case. [2 marks]

0 1 . 6 **The earth wire is now connected to the metal case of the washing machine.**

Explain why it would now be safe for a person to touch the metal case, even if the live wire touches the metal case. [2 marks]

9

0 2 **Different radioactive isotopes emit different types of nuclear radiation.**

A polonium-210 (Po) nucleus emits an alpha particle (α) and turns into a lead (Pb) nucleus.

This can be represented by the equation:

$$^{210}_{84}\mathrm{Po} \longrightarrow {}^{A}_{Z}\mathrm{Pb} + \alpha$$

0 2 . 1 **What is the value of A in the equation? [1 mark]**

Tick (✓) ONE box.

- ☐ **A = 206**
- ☐ **A = 208**
- ☐ **A = 210**
- ☐ **A = 211**

0 2 . 2 **What is the value of Z in the equation?**
[1 mark]

Tick (✓) ONE box.

- ☐ **Z = 80**
- ☐ **Z = 82**
- ☐ **Z = 85**
- ☐ **Z = 86**

[Turn over]

0 2 . 3 **A strontium-89 nucleus (Sr) emits a beta particle (β) and turns into an yttrium nucleus (Y).**

This can be represented by the equation:

$$^{89}_{38}\mathrm{Sr} \longrightarrow {}^{A}_{Z}\mathrm{Y} + \beta$$

What are the values of A and Z in the equation? [2 marks]

A = _____

Z = _____

0 2 . 4 **Gamma radiation is another type of nuclear radiation.**

What does gamma radiation consist of?
[1 mark]

Tick (✓) ONE box.

- ☐ **High energy neutrons**
- ☐ **Electromagnetic waves**
- ☐ **Particles with no charge**
- ☐ **Positively charged ions**

[Turn over]

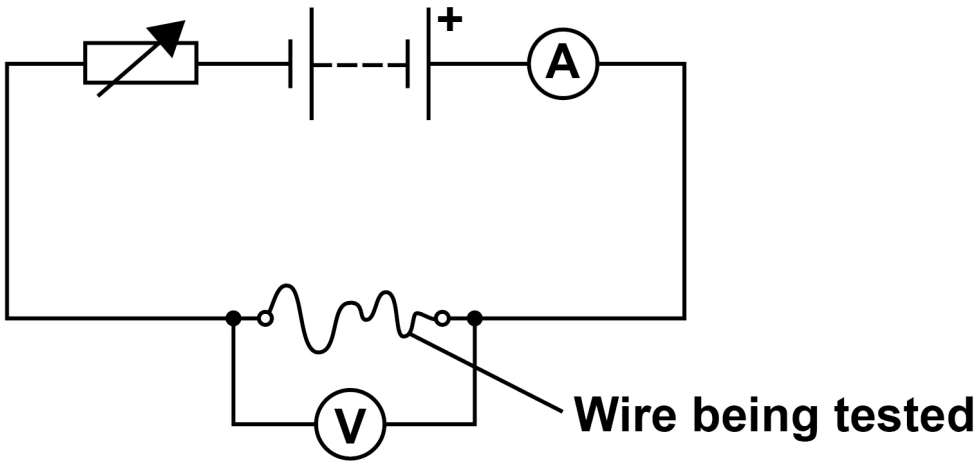
0 2 . 5 **Explain the differences between the properties of alpha, beta and gamma radiations. [6 marks]**

11

0 3 **A student investigated how the resistance of a piece of wire varies with its length.**

0 3 . 1 **FIGURE 2 shows the circuit used.**

FIGURE 2



Explain why the student needed to adjust the variable resistor each time she changed the length of the wire. [3 marks]

[Turn over]

0 3 . 2 **The student recorded three measurements of the potential difference across a 0.10 m length of wire.**

TABLE 1 shows the results.

TABLE 1

Length in m	Potential difference in V			
	1	2	3	Mean
0.10	X	0.18	0.15	0.17

Calculate X in TABLE 1. [2 marks]

X = _____ V

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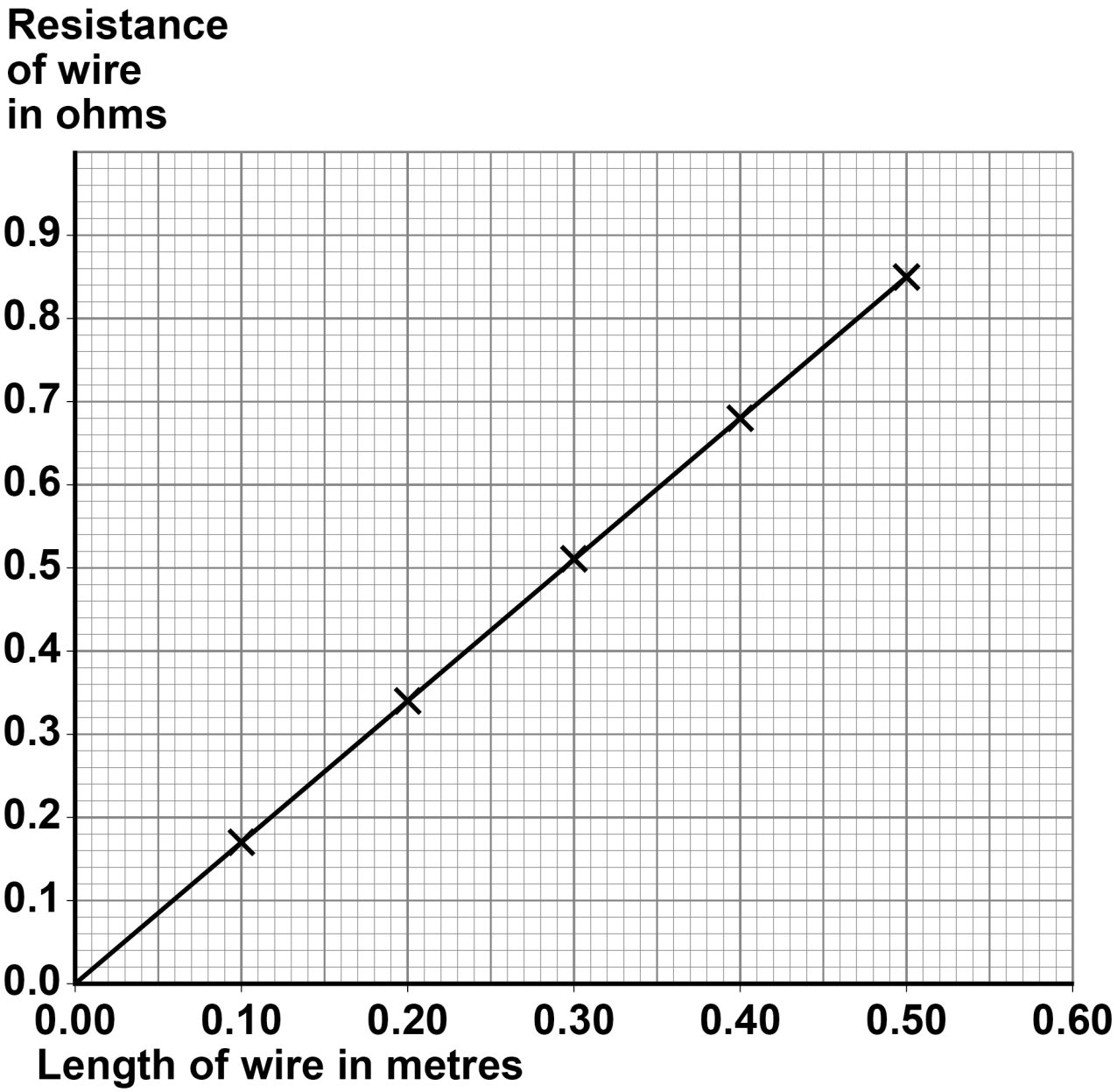
[Turn over]

FIGURE 3


Resistance of wire in ohms
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Length of wire in metres

0 3 . 3 **FIGURE 3 shows the results for five different lengths of the wire.**
Describe the relationship between the length of the wire and the resistance of the wire.
[2 marks]

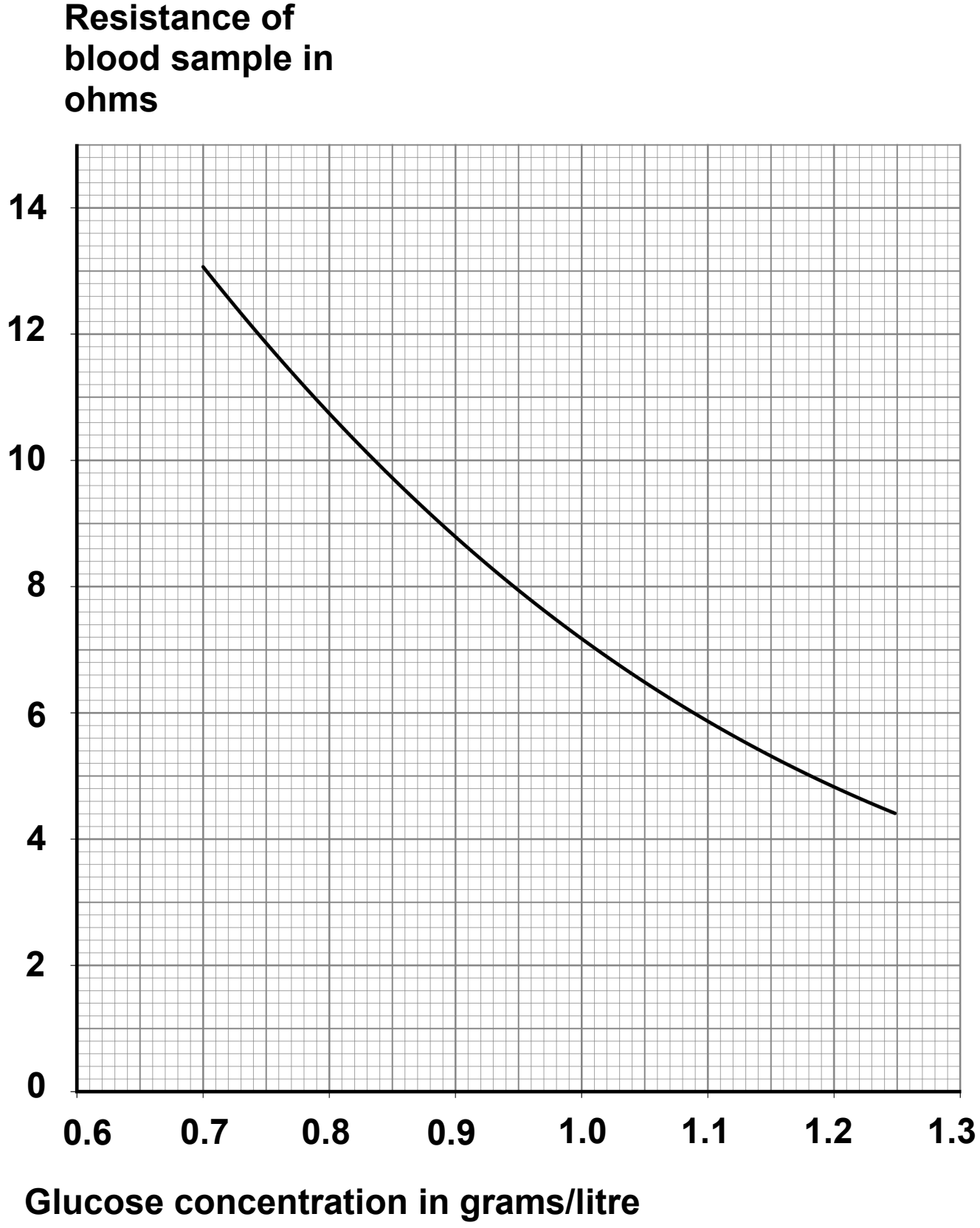
A glucometer uses the resistance of a blood sample to calculate the glucose concentration in a person's blood.

A blood sample is put into a small tube, which is put inside the glucometer. The blood then acts like a resistance wire.

FIGURE 4, on page 22, shows the relationship between the resistance of a blood sample and the glucose concentration.

[Turn over]

FIGURE 4


Resistance of blood sample in ohms
14
12
10
8
6
4
2
0
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
Glucose concentration in grams/litre

0 3 . 4 **The glucometer applies a potential difference of 0.90 volts across a blood sample.**

The glucose concentration of the blood sample is 0.98 grams/litre.

Determine the current in the blood sample. [4 marks]

Current = _____ A

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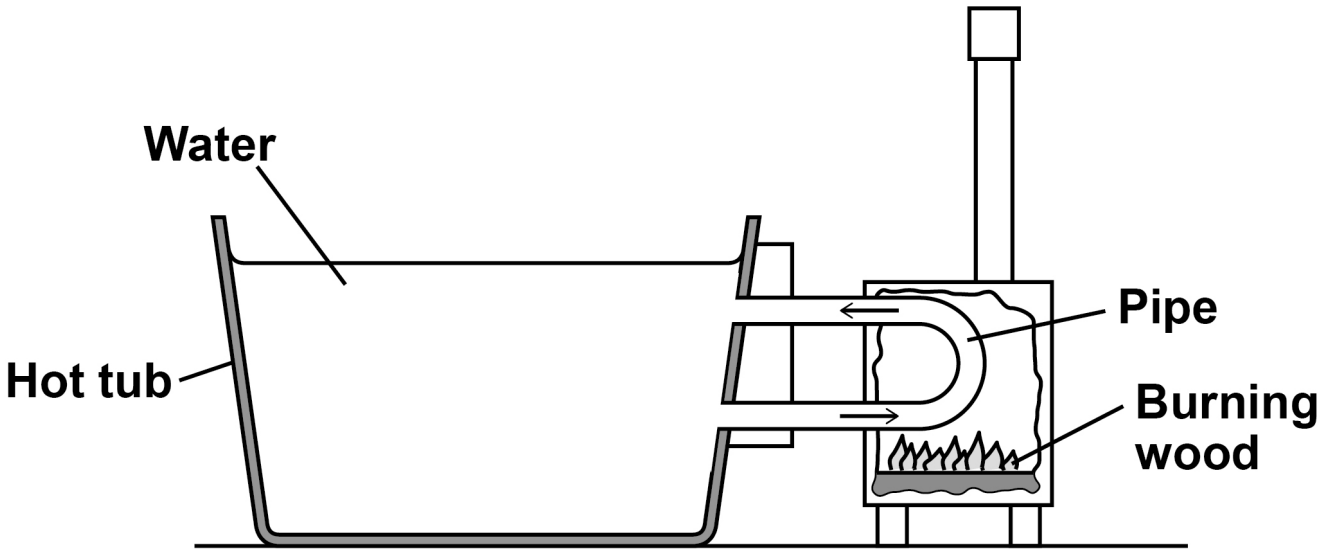
0 3 . 5 **A new tube is used each time a blood sample is tested.**

Explain why valid results are only obtained if each tube is identical. [2 marks]

13

0 4 **FIGURE 5 shows a wood-fired hot tub.**

FIGURE 5



0 4 . 1 **What type of fuel is wood? [1 mark]**

Tick (✓) ONE box.

- ☐ **A non-renewable biofuel**
- ☐ **A non-renewable fossil fuel**
- ☐ **A renewable biofuel**
- ☐ **A renewable fossil fuel**

0 4 . 2 **Give TWO environmental effects of using wood as an energy resource. [2 marks]**

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

0 4 . 3 **Describe the change to the stores of energy of the wood, pipe and water as the water is heated. [3 marks]**

Wood _____

_____

_____

Pipe _____

_____

_____

Water _____

_____

_____

0 4 . 4 **The temperature of the water reaches 42 °C**

The temperature then stays constant even though the fire continues to burn.

Explain why the temperature of the water stays constant. [2 marks]

8

0 5 **Ice cream is made by cooling a mixture of liquid ingredients until they freeze.**

0 5 . 1 **Which statement describes the motion of the particles in solid ice cream? [1 mark]**

Tick (✓) ONE box.

- ☐ **They are stationary.**
- ☐ **They move freely.**
- ☐ **They vibrate about fixed positions.**

0 5 . 2 **How do the kinetic energy and the potential energy of the particles change as a liquid is cooled and frozen? [1 mark]**

Tick (✓) ONE box.

	Kinetic energy	Potential energy
☐	Decreases	Decreases
☐	Decreases	Does not change
☐	Does not change	Decreases
☐	Does not change	Does not change

[Turn over]

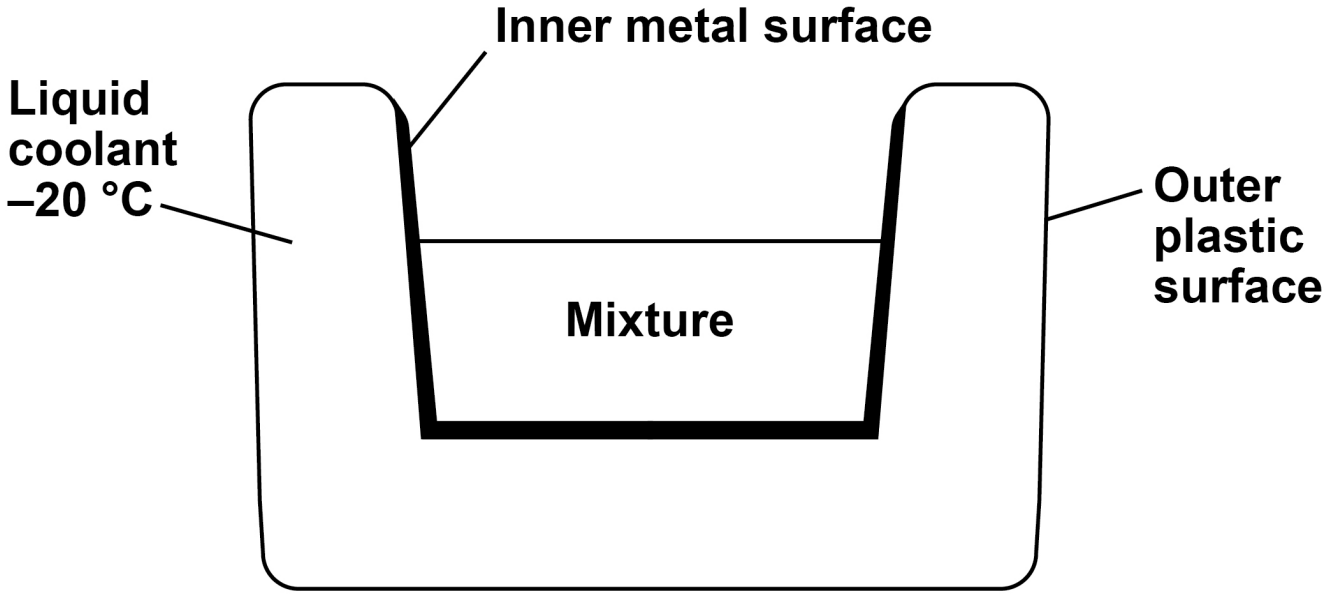
FIGURE 6 shows a bowl used for making ice cream.

The walls of the bowl contain a liquid coolant.

The bowl is cooled to –20 °C before the mixture is put in the bowl.

The bowl causes the mixture to cool down and freeze.

FIGURE 6



0 5 . 3 **Explain why the different thermal conductivities of metal and plastic are important in the design of the bowl. [4 marks]**

Metal _____

_____

_____

_____

_____

_____

Plastic _____

_____

_____

_____

_____

_____

[Turn over]

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0 5 . 4 **The liquid coolant has a freezing point below –20 °C**

Explain ONE other property that the liquid coolant should have. [2 marks]

_____

_____

_____

_____

_____

_____

[Turn over]

0 5 . 5 **The initial temperature of the mixture was +20 °C. The mixture froze at –1.5 °C.**

A total of 165 kJ of internal energy was transferred from the mixture to cool and freeze it.

specific heat capacity of the mixture = 3500 J/kg °C

specific latent heat of fusion of the mixture = 255 000 J/kg

Calculate the mass of the mixture.

Give your answer to 2 significant figures.
[6 marks]

Mass (2 significant figures) =

_____ **kg**

[Turn over]

14

0 6 **A student modelled radioactive decay by rolling some dice in a tray.**

Dice that landed on the number six were removed from the tray.

The removed dice represent nuclei that have decayed.

0 6 . 1 **Why is rolling dice a suitable model for radioactive decay? [1 mark]**

0 6 . 2 **The student rolled 144 dice and removed all those that landed on the number six.**

The student rolled the remaining dice and again removed all those that landed on the number six.

When the student had rolled the dice 20 times there were 9 dice left.

Calculate the most likely number of times that the student had rolled the dice before the number of dice had halved.

You should show how you work out your answer. [3 marks]

Answer = _____ rolls of the dice

[Turn over]

0 6 . 3 **The number of times the dice have to be rolled to halve the original number of dice in the tray represents the half-life.**

FIGURE 7 shows an eight-sided dice and a six-sided dice.

FIGURE 7

The student now used eight-sided dice to model radioactive decay. Dice that landed on the number six were again removed from the tray.

The half-life represented by rolling eight-sided dice is likely to be different from the half-life represented by rolling six-sided dice.

Explain how. [2 marks]

0 6 . 4 **A teacher has two radioactive sources, A and B.**

Source A has a longer half-life than source B.

What can be deduced about the nuclei in source A compared with the nuclei in source B?

Do NOT refer to isotopes in your answer.
[1 mark]

7

0 7 **Kangaroos are large animals that travel by jumping.**

FIGURE 8 shows a kangaroo.

FIGURE 8

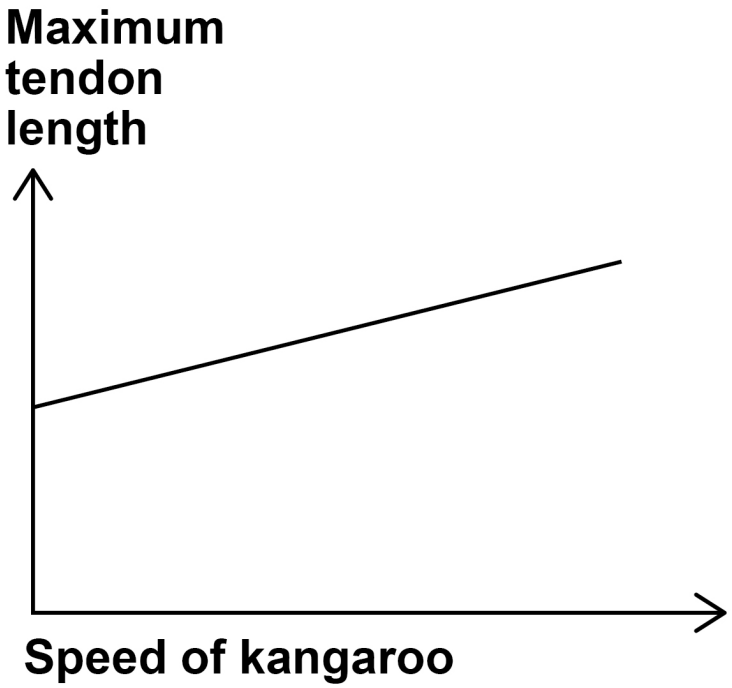
Each leg of a kangaroo has a tendon connected to a muscle. Each tendon can be modelled as a spring.

When a jumping kangaroo lands on the ground, the tendons stretch.

[Turn over]

0 7 . 1 **FIGURE 9 shows a sketch graph of how the maximum tendon length during a jump changes with the speed of the kangaroo.**

FIGURE 9



Explain why a kangaroo can jump higher as its speed increases. [3 marks]

[Turn over]

0 7 . 2 **A kangaroo has a maximum gravitational potential energy during one jump of 770 J**

When the kangaroo lands on the ground 14% of the maximum gravitational potential energy is transferred to elastic potential energy in one tendon.

The tendon has an unstretched length of 35.0 cm

When the kangaroo lands on the ground the tendon stretches to a length of 42.0 cm

Calculate the spring constant of the tendon. [5 marks]

Spring constant = _____ **N/m**

END OF QUESTIONS

8

Additional page, if required.
Write the question numbers in the left-hand margin.

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	