A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier

Physics Paper 1H

8464/P/1H

Wednesday 22 May 2019 Afternoon

Time allowed: 1 hour 15 minutes

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

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 1 9 8 4 6 4 P 1 H 0 1

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INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided.**
- **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

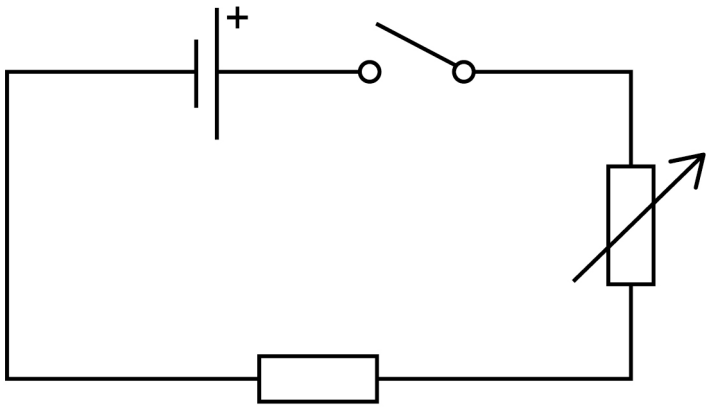
- **The maximum mark for this paper is 70.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **A student investigated how the current in a resistor varies with the potential difference across the resistor.**

FIGURE 1 shows part of the circuit used.

FIGURE 1



0 1 . 1 **The student connected an ammeter and a voltmeter into the circuit.**

What is the correct way to connect the ammeter and the voltmeter into the circuit? [1 mark]

Tick (✓) ONE box.

	AMMETER	VOLTMETER
☐	In parallel with the resistor	In series with the resistor
☐	In parallel with the cell	In series with the resistor
☐	In series with the resistor	In parallel with the resistor
☐	In series with the resistor	In parallel with the cell

0 1 . 2 **The student increased the resistance of the variable resistor.**

How did increasing the resistance affect the current in the circuit? [1 mark]

0 1 . 3 **How should the student change the circuit to give negative values for current and potential difference? [1 mark]**

0 1 . 4 **Name the type of relationship between current and potential difference for a resistor at constant temperature. [1 mark]**

0 1 . 5 **Write the equation which links current, potential difference and resistance. [1 mark]**

[Turn over]

0 1 . 6 **The current in the resistor was 0.12 A when the potential difference across the resistor was 3.0 V**

Calculate the resistance of the resistor.
[3 marks]

Resistance = _____ Ω

8

0 2 **A scientist cooled the air inside a container.**

0 2 . 1 **The temperature of the air changed from 20 °C to 0 °C**

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.
[3 marks]

0 2 . 2 **The air contained water that froze at 0 °C**

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet. [3 marks]

Mass of ice = _____ kg

0 2 . 3 **The air also contained oxygen, nitrogen and carbon dioxide.**

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C? [2 marks]

Tick (✓) ONE box for EACH row of the table.

Substance	Solid	Liquid	Gas
Oxygen			
Nitrogen			
Carbon dioxide			

0 2 . 4 **The air also contained a small amount of argon.**

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased. [6 marks]

14

[Turn over]

0 3 **A hybrid car has an electric motor and a petrol engine.**

0 3 . 1 **Petrol is a non-renewable energy resource.**

What is meant by a non-renewable energy resource? [1 mark]

0 3 . 2 **The electric motor in the car is powered by a battery.**

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery. [4 marks]

Current = _____ A

0 3 . 3 **Mains electricity is an ac supply.**

Explain the difference between direct and alternating potential difference. [2 marks]

0 3 . 4 **The cable used to connect the car to the mains electricity supply has a low resistance.**

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance. [2 marks]

_____

_____

_____

_____

_____

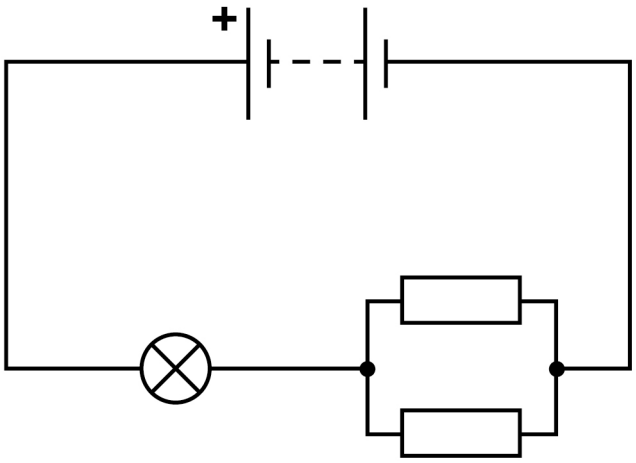
_____

9

[Turn over]

0 4 **FIGURE 2 shows a circuit that a student built.**

FIGURE 2



0 4 . 1 **The lamp has a resistance of 10 Ω**

Each resistor has a resistance of 10 Ω

What is the total resistance of the circuit?
[1 mark]

Tick (✓) ONE box.

☐ **Between 20 and 30 Ω**

☐ **Exactly 20 Ω**

☐ **Exactly 30 Ω**

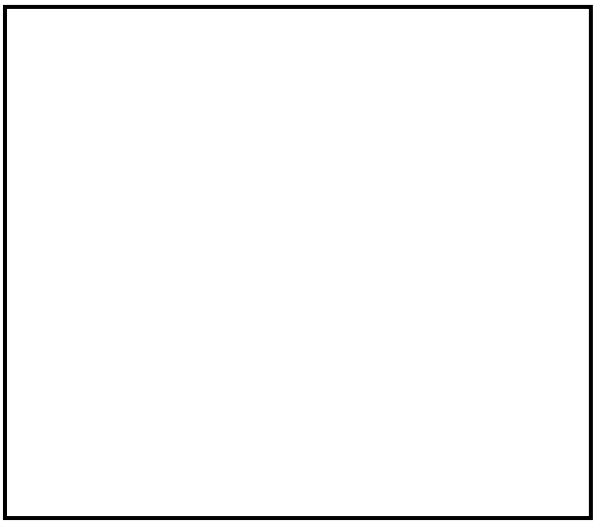
☐ **Less than 20 Ω**

0 4 . 2 Explain your answer to Question 04.1
[2 marks]

[Turn over]

The student replaced one of the resistors with a thermistor.

0 4 . 3 Draw the circuit symbol for a thermistor in the box below. [1 mark]

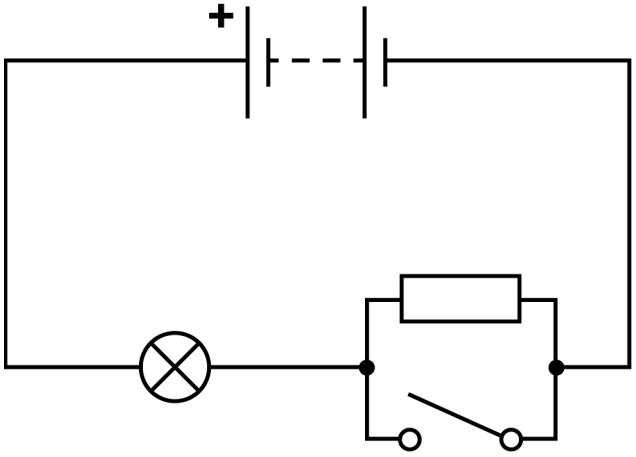


0 4 . 4 **The student increased the temperature of the thermistor.**

Explain how the current in the thermistor changed. [2 marks]

0 4 . 5 **FIGURE 3 shows another circuit the student built.**

FIGURE 3



Explain how the potential difference across the resistor and the lamp will change when the switch is closed. [4 marks]

The resistor _____

_____

_____

_____

_____

_____

The lamp _____

_____

_____

_____

_____

_____

10

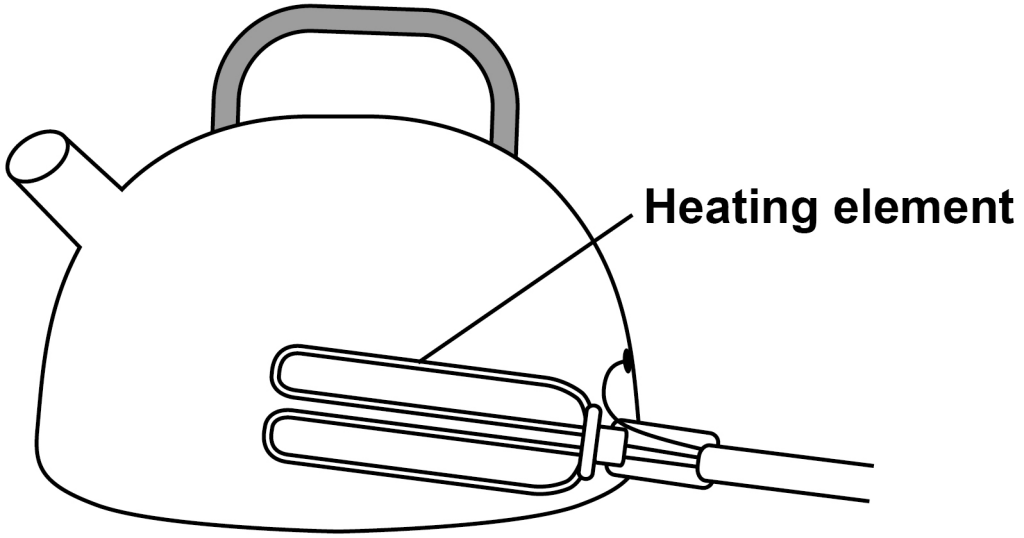
[Turn over]

0 5 **A student investigated how the mass of water in an electric kettle affected the time taken for the water to reach boiling point.**

The kettle switched off when the water reached boiling point.

FIGURE 4 shows the kettle.

FIGURE 4



0 5 . 1 **The heating element of the kettle was connected to the mains supply.**

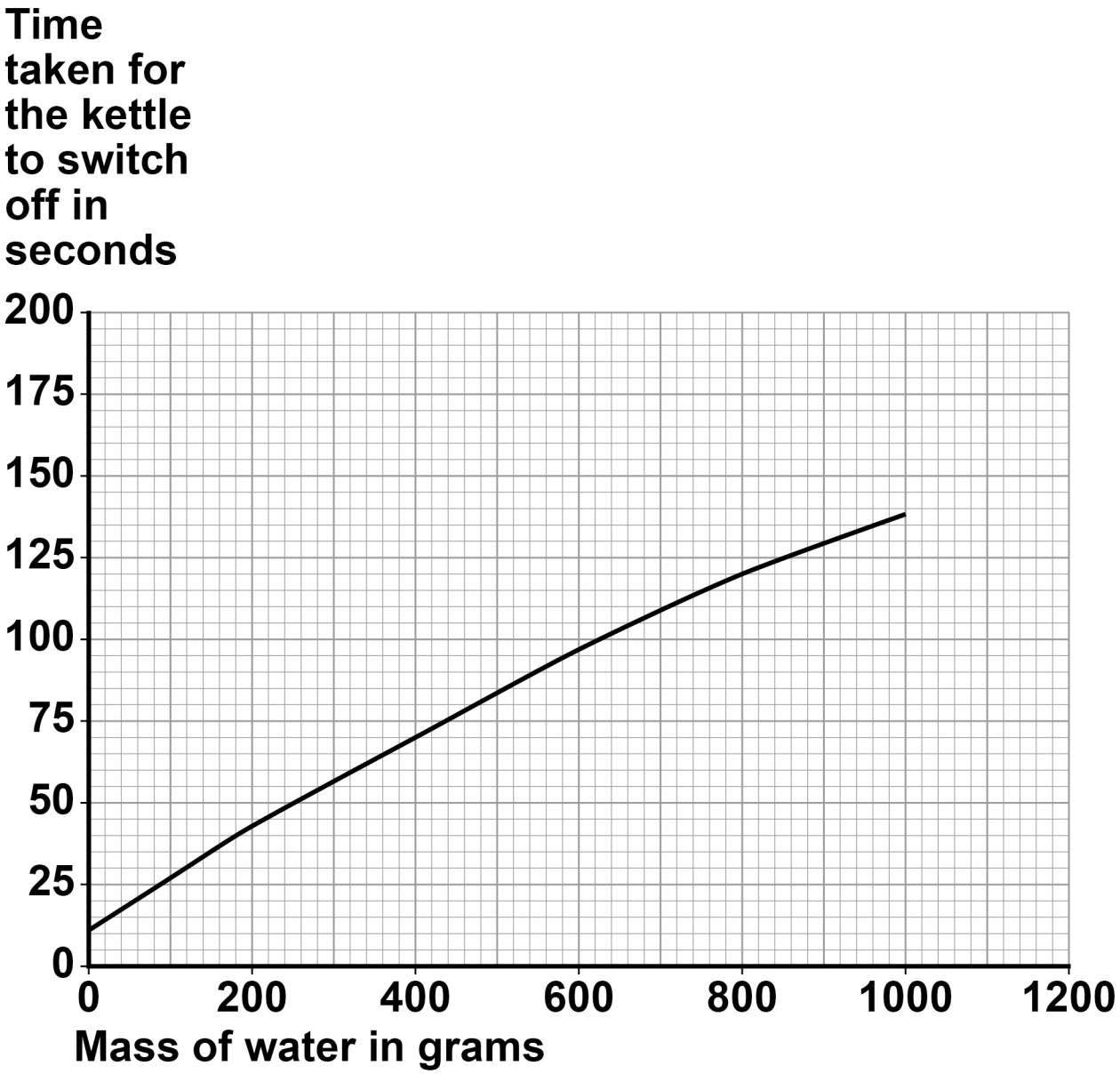
Explain why the temperature of the heating element increased. [2 marks]

0 5 . 2 **Give ONE variable that the student should have controlled. [1 mark]**

[Turn over]

FIGURE 5 shows how the mass of water in the kettle affected the time taken for the kettle to switch off.

FIGURE 5



0 5 . 3 **Suggest why the line on FIGURE 5 does NOT go through the origin. [1 mark]**

0 5 . 4 **Suggest why the results give a non-linear pattern. [1 mark]**

[Turn over]

0 5 . 5 **The power of the kettle was 2.6 kW**

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

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

Specific heat capacity =

_____ **J/kg °C**

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[Turn over]

0 6 **Lanthanum-140 is a radioactive isotope.**

0 6 . 1 **A nucleus of lanthanum-140 emits gamma radiation.**

What happens to the mass number and the charge of the nucleus when gamma radiation is emitted? [1 mark]

Tick (✓) ONE box.

	MASS NUMBER	CHARGE
☐	Decreases	Decreases
☐	Decreases	Stays the same
☐	Stays the same	Decreases
☐	Stays the same	Stays the same

0 6 . 2 **Why is it difficult to detect gamma radiation? [1 mark]**

0 6 . 3 **Activity is the rate at which a radioactive source decays.**

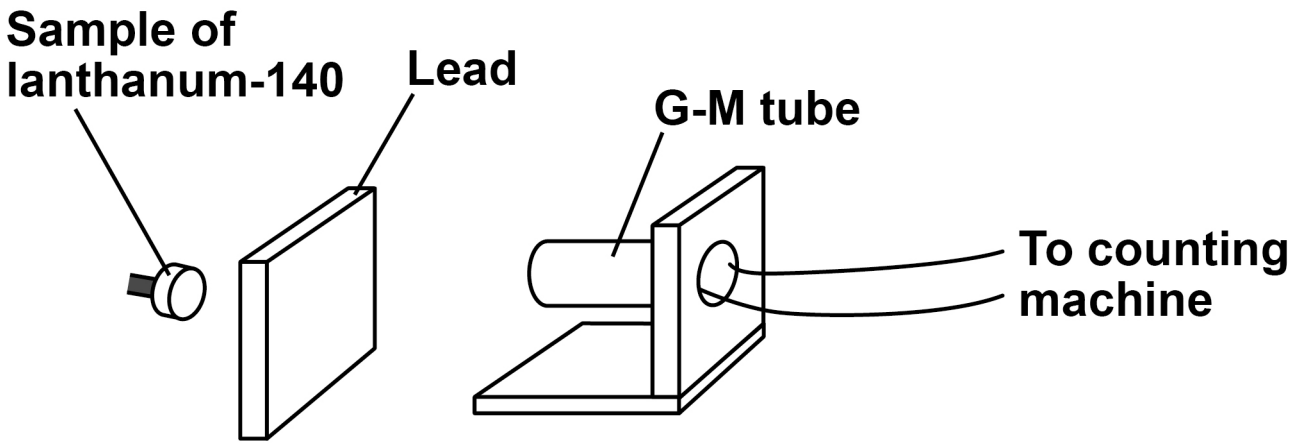
A teacher measured the count-rate from a sample of lanthanum-140 using a Geiger-Muller (G-M) tube.

Explain why the count rate was less than the activity of the sample of lanthanum-140 [2 marks]

The teacher investigated how the thickness of lead affected the amount of gamma radiation that could pass through it.

FIGURE 6 shows the apparatus.

FIGURE 6



0 6 . 4 **Explain why the teacher stood as far away from the apparatus as possible. [2 marks]**

TABLE 1 shows the results.

TABLE 1

Thickness of lead in cm	Count rate in counts per second
0.5	110
1.0	60
1.5	33
2.0	18
2.5	10

0 6 . 5 The teacher concluded that the count rate was NOT inversely proportional to the thickness of lead.

Explain why the teacher was correct.

Use the data in TABLE 1. [3 marks]

0 6 . 6 **Lanthanum-140 can also emit beta radiation and change into cerium.**

Complete the equation showing the decay of lanthanum (La) 140 into cerium (Ce).
[2 marks]

$$^{140}_{57}\mathrm{La} \longrightarrow {}^{\quad}_{\quad}\mathrm{e} + {}^{\quad}_{\quad}\mathrm{Ce}$$

[Turn over]

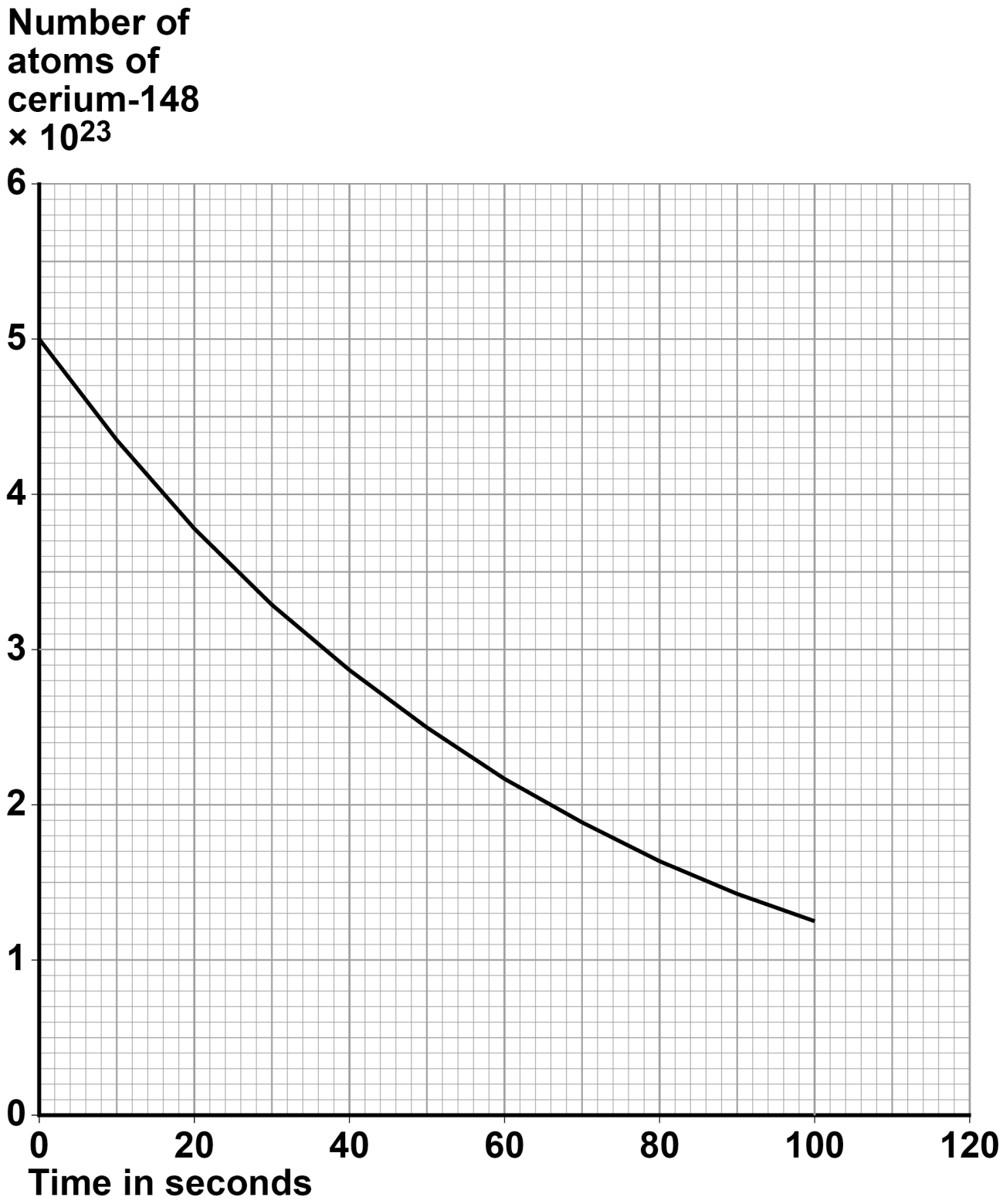
There are other isotopes of cerium which are radioactive.

Different isotopes of cerium have different half-lives.

The half-life of an isotope can be found by studying how the number of atoms changes over time.

FIGURE 7, on the opposite page, shows how the number of atoms of cerium-148 in a 120 g sample changes over time.

FIGURE 7



[Turn over]

0 6 . 7 **Determine the ratio of the number of cerium atoms in the sample when it was 100 seconds old compared with when the sample was 350 seconds old.**

Use data from FIGURE 7 on page 37.
[4 marks]

Ratio = _____

0 6 . 8 **Determine the activity of the sample of cerium when the sample was 20 seconds old.**

Use FIGURE 7 on page 37. [3 marks]

Activity = _____ Bq

END OF QUESTIONS

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