A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

Higher Tier

Chemistry Paper 1H

8464/C/1H

H

Thursday 14 May 2020 Morning

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]

JUN208464C1H01

For this paper you must have:

- **a ruler**
- **a scientific calculator**
- **the periodic table (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

This question is about the extraction of aluminium.

0 1 . 1

An aluminium atom is represented as:

$^{27}_{13}Al$

Give the number of electrons and neutrons in the aluminium atom.
[2 marks]

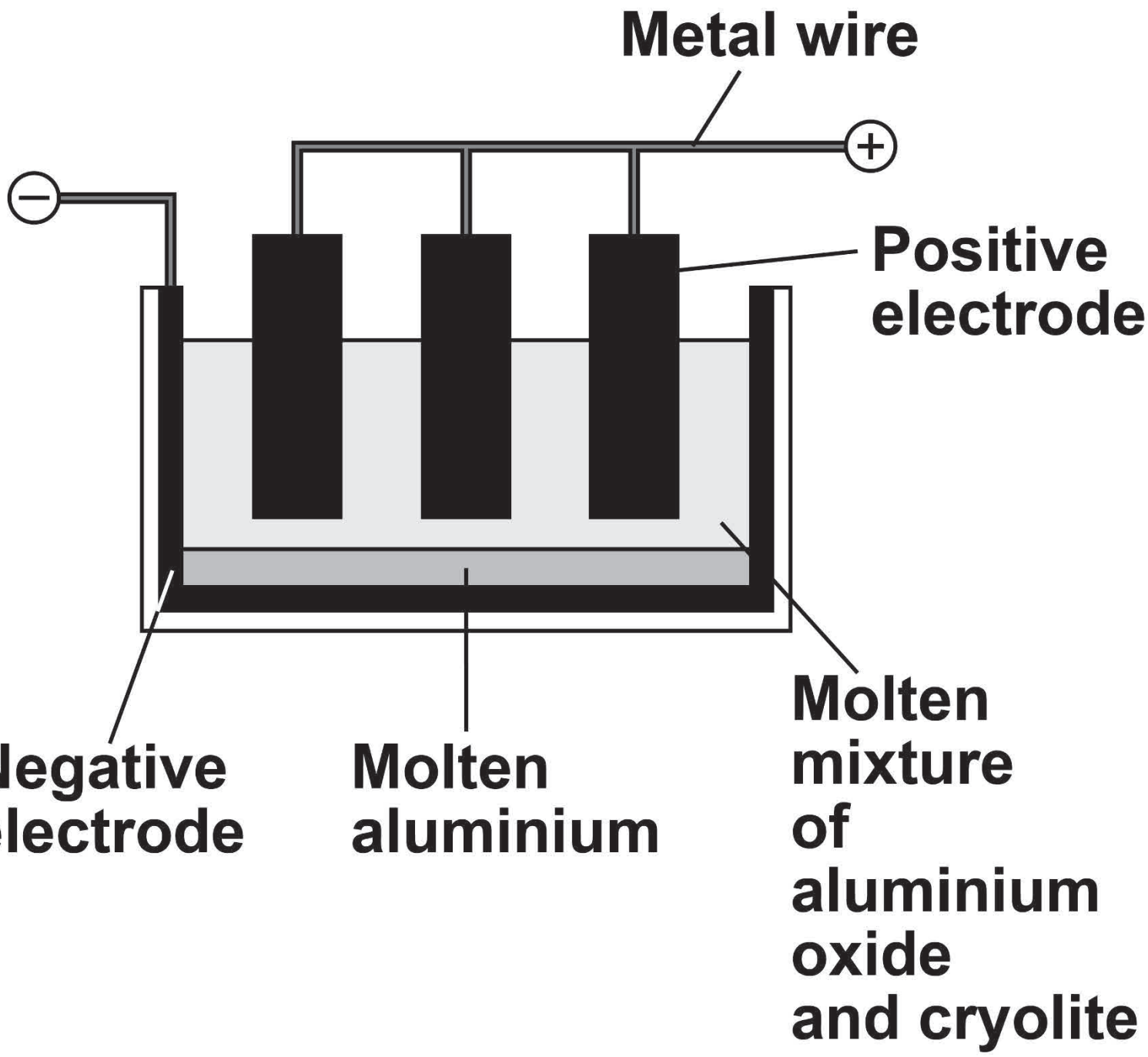
Number of electrons _____

Number of neutrons _____

Aluminium is extracted by the electrolysis of a molten mixture of aluminium oxide and cryolite.

FIGURE 1 shows the cell used for the electrolysis.

FIGURE 1



[Turn over]

0 1 . 2

Aluminium is produced by the reduction of aluminium oxide (Al_2O_3).

What is meant by the term reduction?
[1 mark]

0 1 . 3

Oxygen is formed at the positive carbon electrodes.

Explain why the positive carbon electrodes must be continually replaced.

[3 marks]

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0 1 . 4

A substance conducts electricity because of free moving, charged particles.

What are the free moving, charged particles in a:

- **carbon electrode (made from graphite)**
- **molten mixture of aluminium oxide and cryolite**
- **metal wire?**

[3 marks]

Carbon electrode (made from graphite)

Molten mixture of aluminium oxide and cryolite _____

Metal wire _____

[Turn over]

9

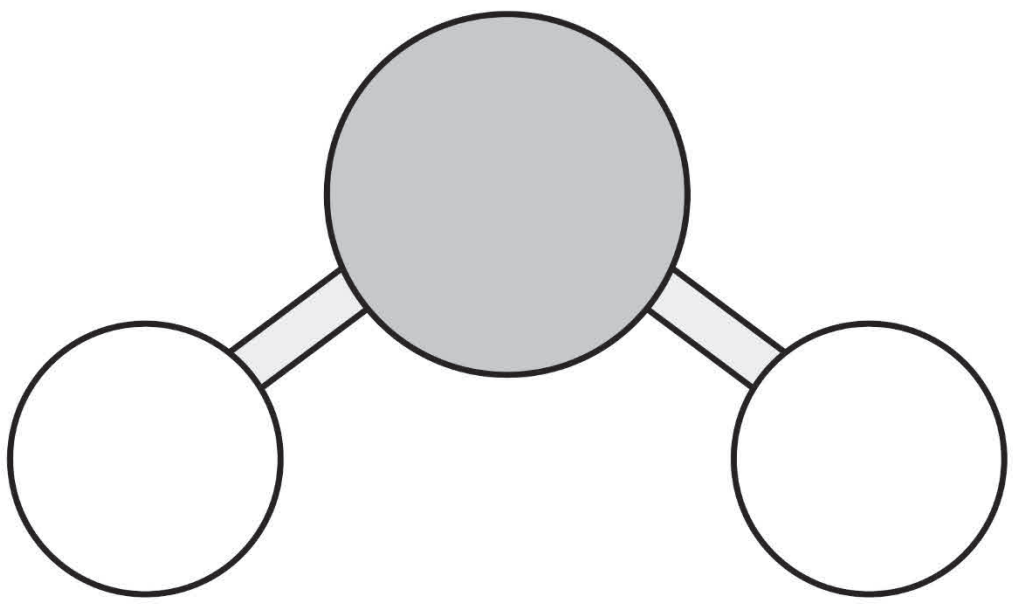
0 2

This question is about substances with covalent bonding.

0 2 . 1

FIGURE 2 shows a ball and stick model of a water molecule (H_2O).

FIGURE 2



Suggest ONE limitation of using a ball and stick model for a water molecule. [1 mark]

_____

_____

_____

0 2 . 2

Ice has a low melting point.

Water molecules in ice are held together by intermolecular forces.

Complete the sentence. [1 mark]

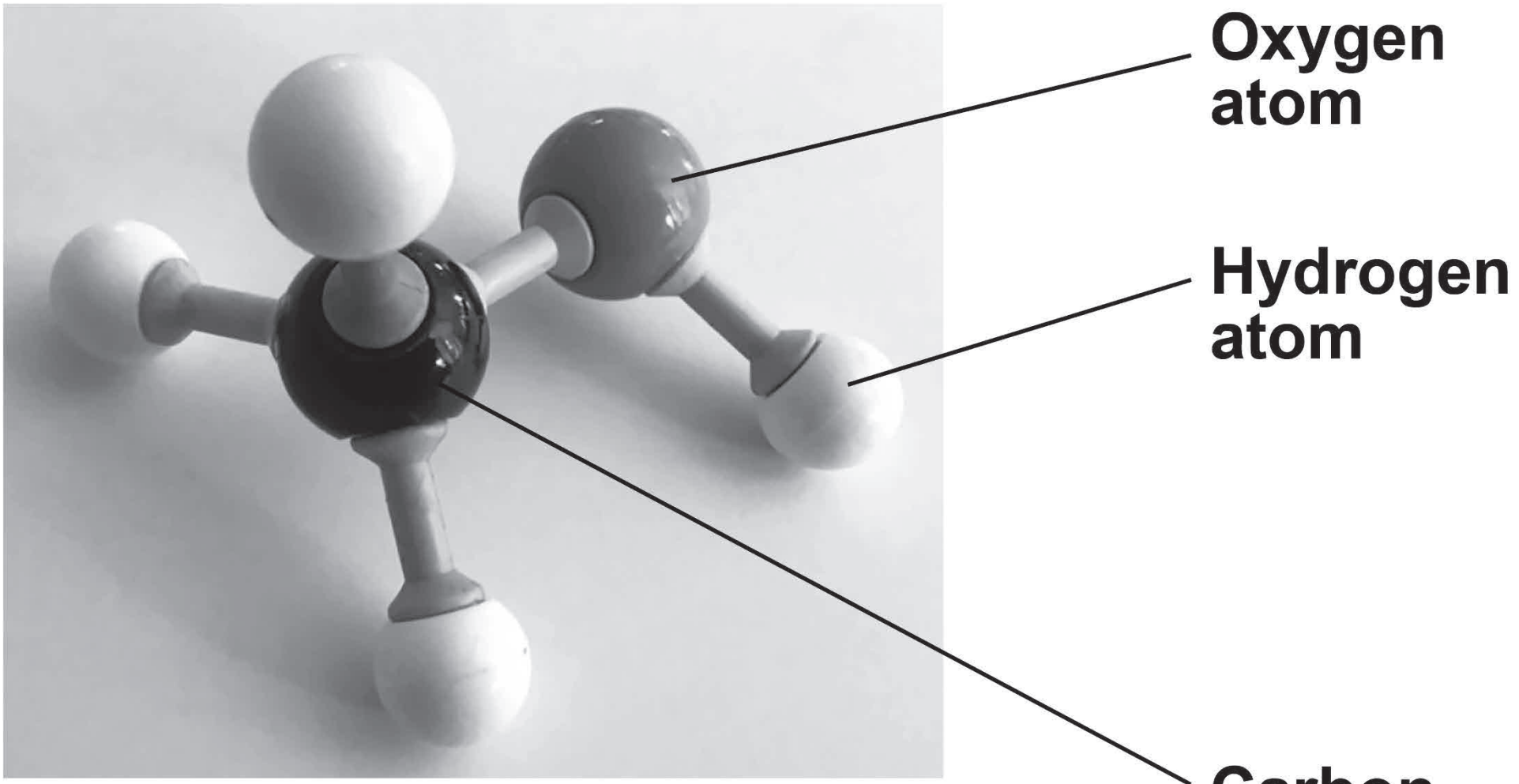
Ice has a low melting point because the intermolecular forces are

_____ .

0 2 . 3

FIGURE 3 shows the structure of a molecule.

FIGURE 3



What is the molecular formula of the molecule in FIGURE 3? [1 mark]

Diamond has a giant covalent structure.

0 2 . 4

What is the number of bonds formed by each carbon atom in diamond? [1 mark]

Tick (✓) ONE box.

- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 8

0 2 . 5

Give TWO physical properties of diamond. [2 marks]

1 _____

_____

2 _____

_____

0 2 . 6

Name TWO other substances with giant covalent structures. [2 marks]

1 _____

_____

2 _____

_____

8

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[Turn over]

0 3

Some students investigated the thermal decomposition of metal carbonates.

The word equation for the reaction is:

metal carbonate

⟶ metal oxide + carbon dioxide

The students made the following hypothesis:

‘When heated the same mass of any metal carbonate produces the same mass of carbon dioxide.’

The students heated a test tube containing copper carbonate.

TABLE 1, on the opposite page, shows their results.

TABLE 1

Time the test tube containing copper carbonate was heated in mins	0	2	4	6
Mass of test tube and contents in g	17.7	17.1	17.0	17.0

Plan a method the students could use to test their hypothesis.

You should show how the students use their results to test the hypothesis.

You do NOT need to write about safety precautions. [6 marks]

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[Turn over]

0 4

This question is about acids, alkalis and bases.

A student reacted zinc oxide powder with hydrochloric acid to produce zinc chloride solution.

0 4 . 1

Complete the equation for the reaction by writing the state symbols. [2 marks]

ZnO(_____) + 2 HCl(_____)

$\longrightarrow$ $ZnCl_2$( ) + H_2O( )

0 4 . 2

Give ONE way that the student could speed up the reaction between zinc oxide powder and hydrochloric acid. [1 mark]

Hydrochloric acid was the limiting reactant.

0 4 . 3

How could the student know when all the hydrochloric acid has reacted? [1 mark]

0 4 . 4

How could the student obtain zinc chloride solution from the reaction mixture when all the hydrochloric acid has reacted? [1 mark]

0 4 . 5

Describe how zinc chloride crystals are produced from zinc chloride solution. [2 marks]

Sulfuric acid and sodium hydroxide react to produce sodium sulfate.

0 4 . 6

Sulfuric acid is gradually added to sodium hydroxide solution.

The pH of the mixture changes as the sulfuric acid is added until in excess.

Suggest the pH at:

- **the start before sulfuric acid is added**
- **the end when sulfuric acid is in excess.**

[2 marks]

pH at start = _____

pH at end = _____

[Turn over]

0 4 . 7

Complete the symbol equation for the preparation of sodium sulfate.

You should balance the equation.
[2 marks]

0 4 . 8

A solution of hydrochloric acid had a hydrogen ion concentration of 1.0 mol/dm^3

Water was added to the hydrochloric acid until the pH increased by 1

What was the hydrogen ion concentration of the hydrochloric acid after water had been added? [1 mark]

Tick (✓) ONE box.

☐ **100 mol/dm^3**

☐ **10 mol/dm^3**

☐ **0.10 mol/dm^3**

☐ **0.010 mol/dm^3**

[Turn over]

12

0 5

A student investigated the temperature change when magnesium was added to copper sulfate solution.

This is the method used.

1. **Pour 30 cm^3 of copper sulfate solution into a polystyrene cup.**

2. **Measure the temperature of copper sulfate solution every minute for 3 minutes.**

3. **Add magnesium on the fourth minute.**

4. **Measure the temperature of the mixture at 5 minutes and then every minute up to 14 minutes.**

0 5 . 1

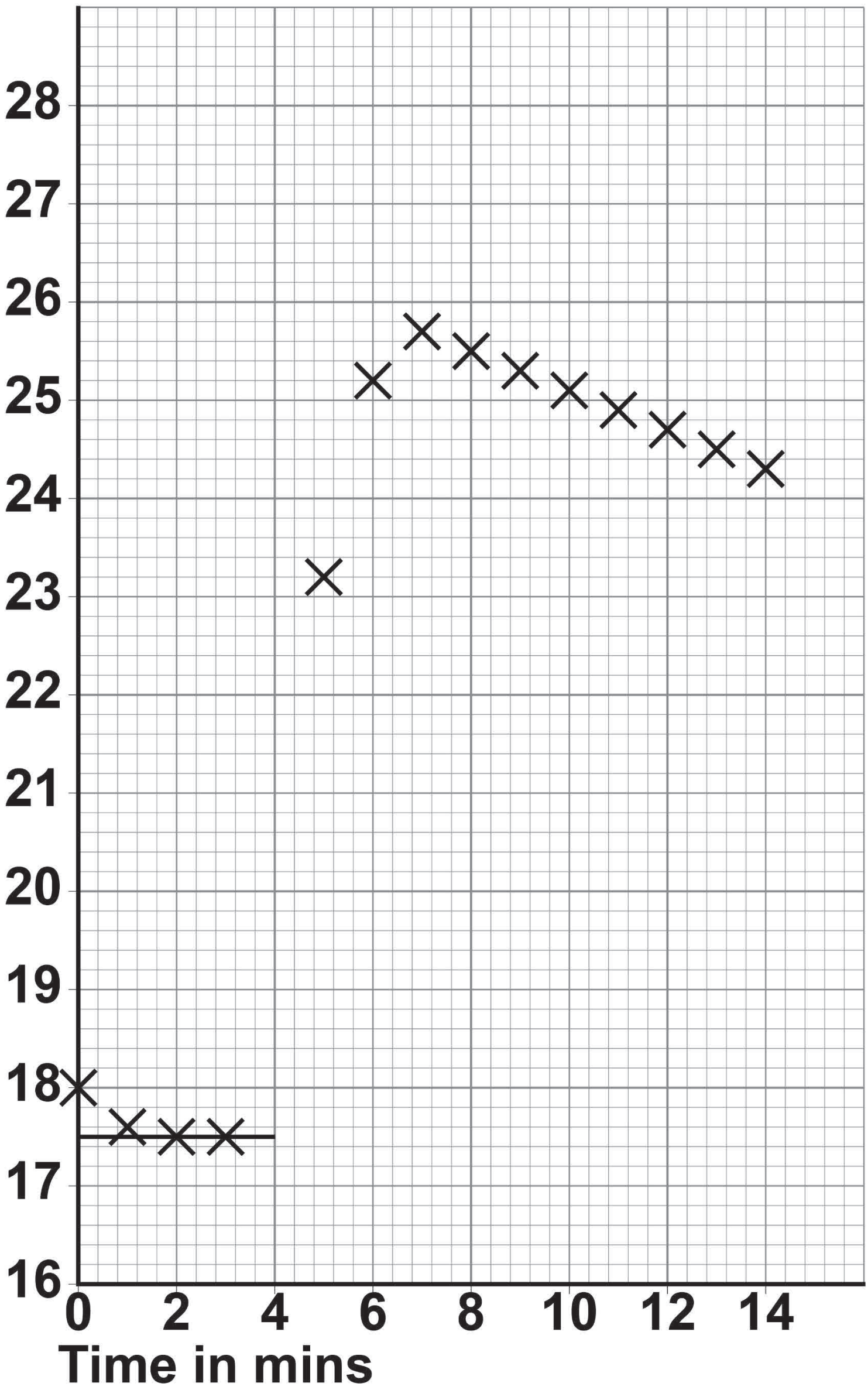
What is the dependent variable in this investigation? [1 mark]

_____

_____

[Turn over]

FIGURE 4


Temperature in °C
28
27
26
25
24
23
22
21
20
19
18
17
16
0
2
4
6
8
10
12
14
Time in mins

The student used the results to plot a graph.

FIGURE 4, on the opposite page, shows the graph.

0 5 . 2

Suggest why the copper sulfate solution was left for four minutes before adding the magnesium. [1 mark]

0 5 . 3

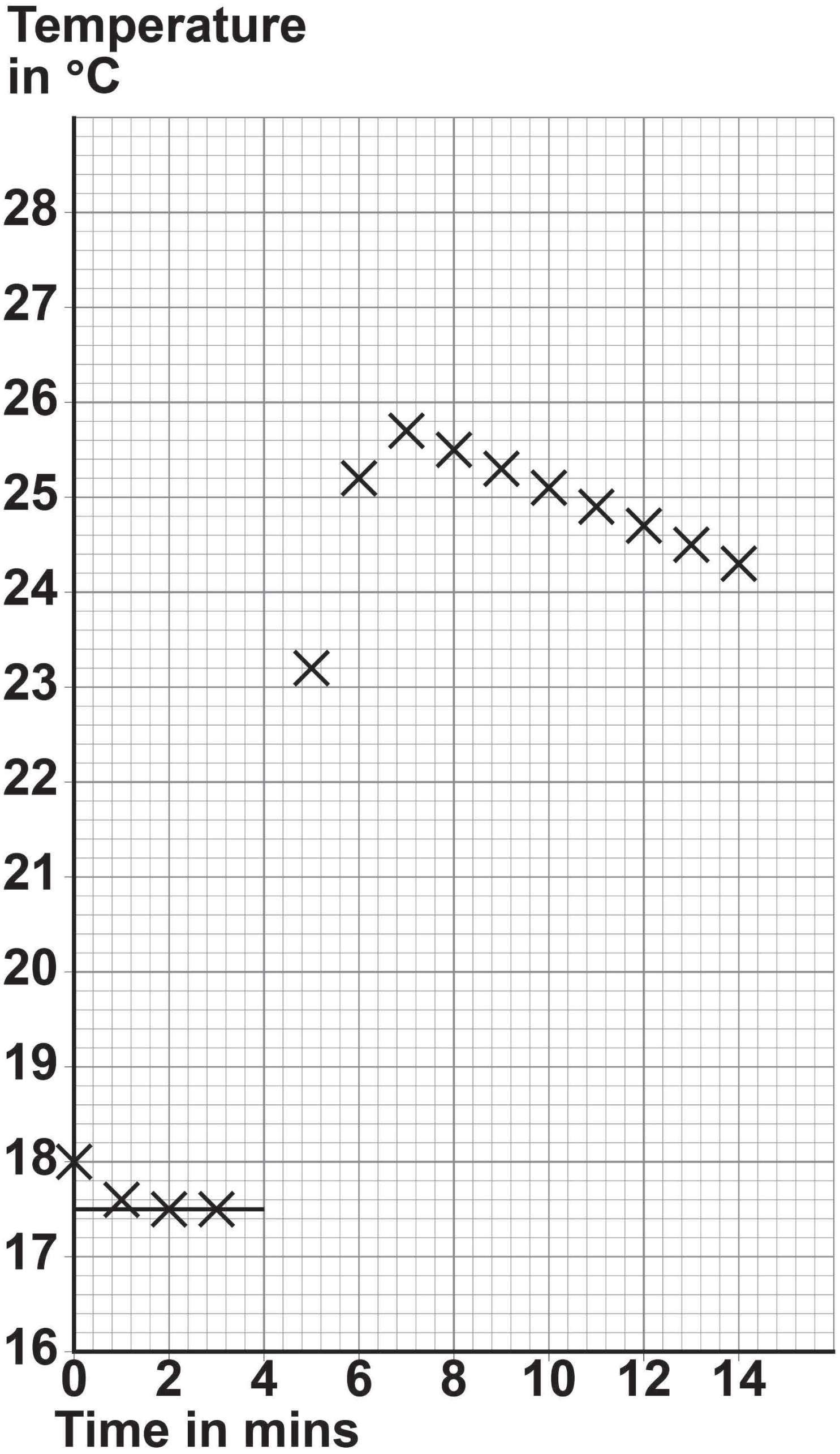
Complete FIGURE 4 by:

- drawing a line of best fit through all the points after 7 minutes
- extending the line back to 4 minutes.

[2 marks]

[Turn over]

REPEAT OF FIGURE 4



0 5 . 4

The temperature change for the reaction is the temperature difference between the two graph lines at 4 minutes.

Determine the temperature change for the reaction.

Use FIGURE 4. [2 marks]

_____

_____

_____

Temperature change = _____ °C

0 5 . 5

Explain why the temperature of the mixture decreases after 7 minutes.
[2 marks]

0 5 . 6

The student repeated the experiment with an unknown metal Q instead of magnesium.

All the other variables were kept the same.

The student recorded a smaller temperature change.

Suggest the identity of metal Q.

Give ONE reason for your answer.
[2 marks]

Metal Q _____

Reason _____

_____

_____

[Turn over]

0 5 . 7

A copper sulfate solution contained 0.100 moles of copper sulfate dissolved in 0.500 dm^3 of water.

Calculate the mass of copper sulfate in 30.0 cm^3 of this solution.

Relative formula mass (M_r): $CuSO_4$ = 159.5

[4 marks]

Mass = _____ g

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[Turn over]

0 6

This question is about gold and compounds of gold.

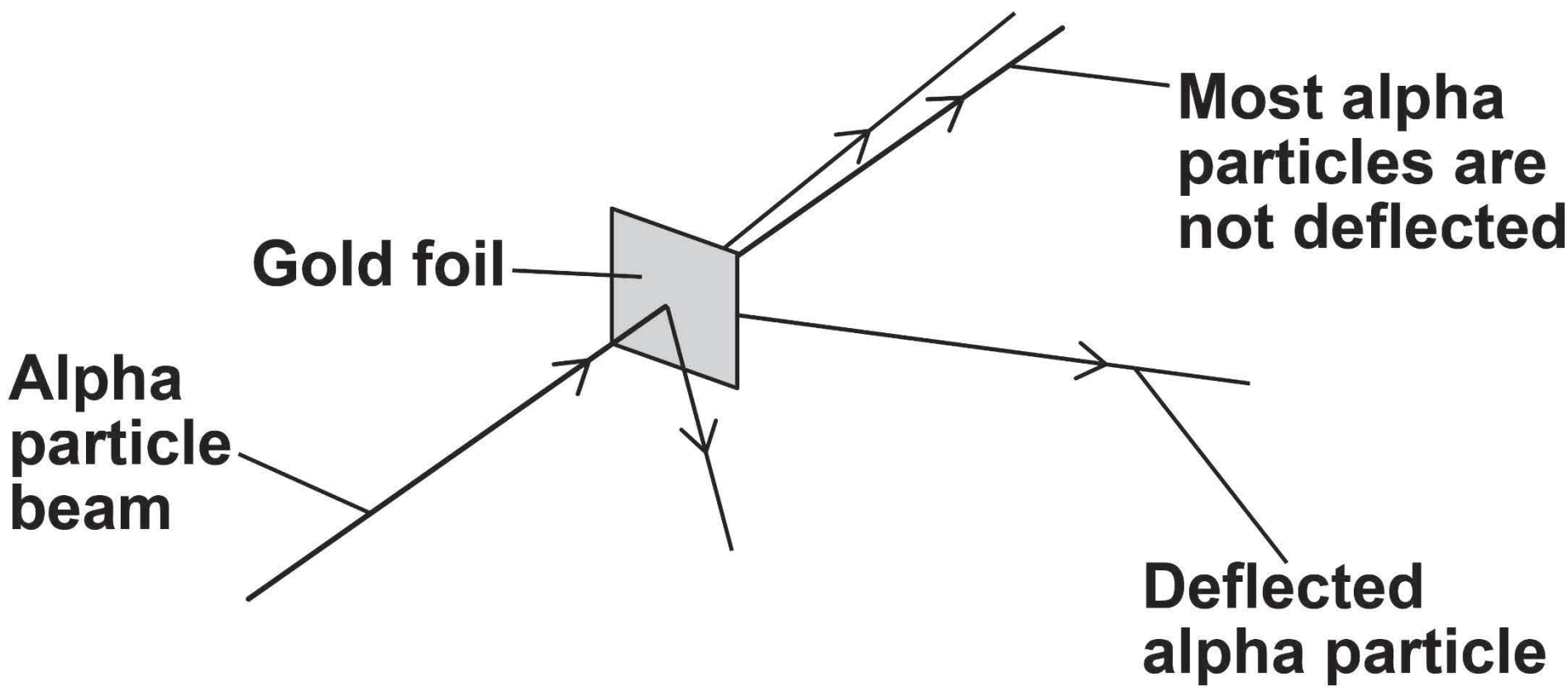
0 6 . 1

In the alpha particle scattering experiment alpha particles are fired at gold foil.

Alpha particles are positively charged.

FIGURE 5 shows the results.

FIGURE 5



What TWO conclusions can be made from the results? [2 marks]

Tick (✓) TWO boxes.

- ☐ **Atoms are balls of positive charge with embedded electrons.**
- ☐ **Atoms are tiny spheres that cannot be divided.**
- ☐ **Atoms have a positively charged nucleus.**
- ☐ **Mass is concentrated in the nucleus in the centre of atoms.**
- ☐ **Neutrons exist within the nucleus.**

0 6 . 2

The gold foil is:

- **4.00 × 10^{-7} metres thick**
- **2400 atoms thick.**

What is the diameter of one gold atom in metres?

Give your answer to 3 significant figures. [3 marks]

Diameter of one gold atom (3 significant figures) = _____ m

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[Turn over]

0 6 . 3

Gold reacts with the elements in Group 7 of the periodic table.

0.175 g of gold reacts with chlorine.

The equation for the reaction is:

$$2\ Au + 3\ Cl_2 \longrightarrow 2\ AuCl_3$$

Calculate the mass of chlorine needed to react with 0.175 g of gold.

Give your answer in mg

Relative atomic masses (A_r):

Cl = 35.5 Au = 197

[5 marks]

Mass of chlorine = _____ mg

[Turn over]

10

0 7

This question is about elements.

Caesium is in Group 1 of the periodic table.

0 7 . 1

Explain what happens to caesium atoms and to oxygen atoms when caesium reacts with oxygen to produce caesium oxide.

You should answer in terms of electrons.
[4 marks]

[Turn over]

0 7 . 2

Explain why caesium is more reactive than sodium.

You should answer in terms of electrons.
[4 marks]

BLANK PAGE

[Turn over]

0 7 . 3

FIGURE 6 shows part of Mendeleev's periodic table.

FIGURE 6

16 O	19 F
32 S	35.5 Cl
79 Se	80 Br
128 Te	127 I

Explain why the early periodic tables placed iodine (I) before tellurium (Te), but then Mendeleev placed tellurium before iodine. [3 marks]

END OF QUESTIONS

11

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	
3	
4	
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TOTAL	