A

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

CHEMISTRY

H

Higher Tier **Paper 1**

8462/1H

Time allowed: 1 hour 45 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]

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. Do not write on blank pages.**
- **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 100.**
- **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.**

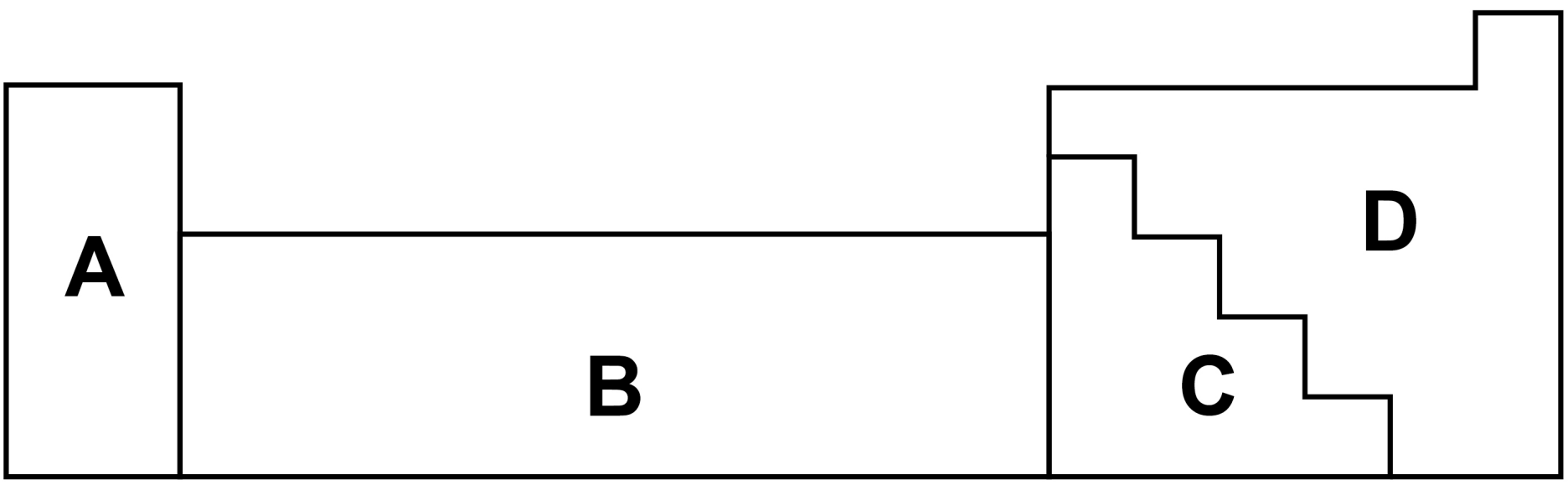
DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

This question is about metals and non-metals.

FIGURE 1 shows an outline of part of the periodic table.

FIGURE 1



0 1 . 1

Element Q is a dull solid with a melting point of 44 °C.

Element Q does not conduct electricity.

Which section of the periodic table in FIGURE 1 is most likely to contain element Q? [1 mark]

Tick (✓) ONE box.

☐ **A**

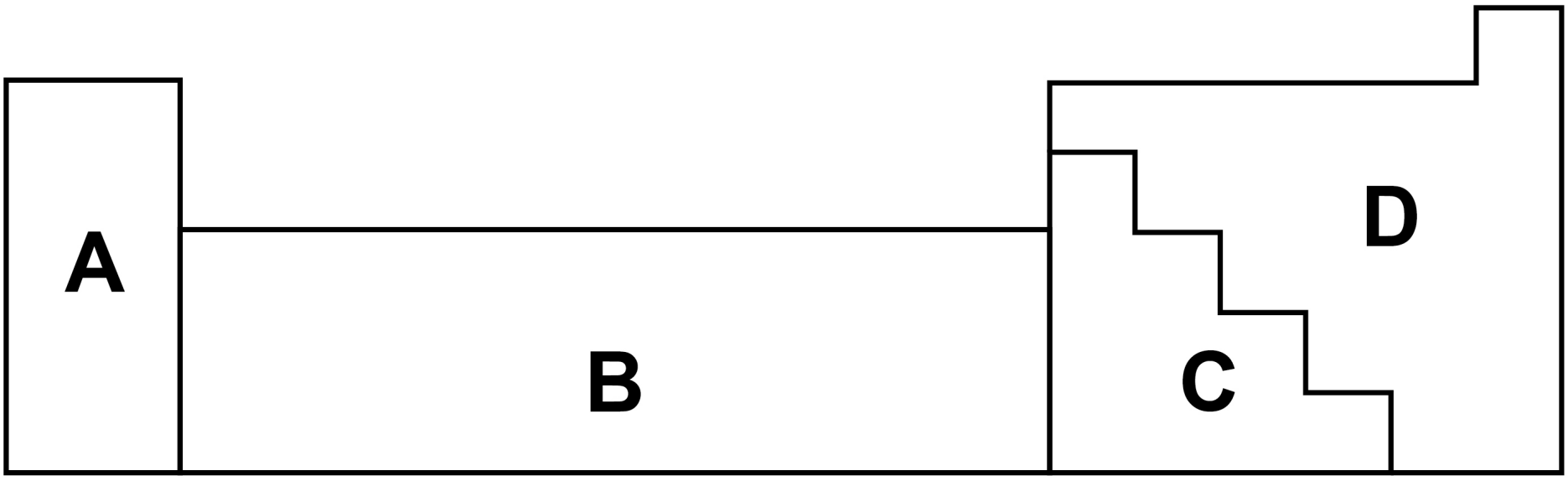
☐ **B**

☐ **C**

☐ **D**

[Turn over]

REPEAT OF FIGURE 1



0 1 . 2

Element R forms ions of formula R^{2+} and R^{3+}

Which section of the periodic table in FIGURE 1 is most likely to contain element R? [1 mark]

Tick (✓) ONE box.

☐ **A**

☐ **B**

☐ **C**

☐ **D**

[Turn over]

0 1 . 3

Give TWO differences between the physical properties of the elements in Group 1 and those of the transition elements. [2 marks]

1

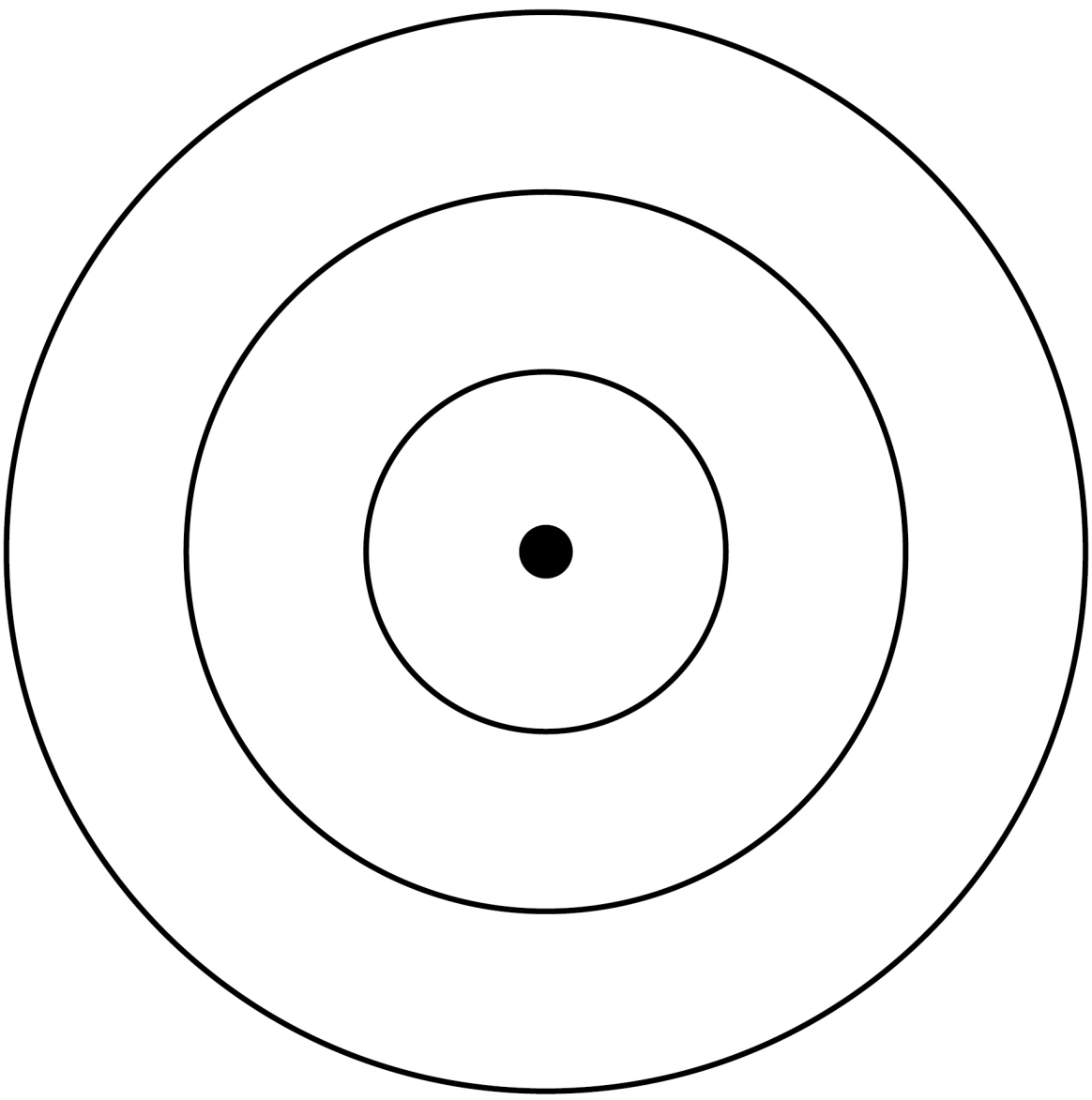
2

0 1 . 4

Complete FIGURE 2 to show the electronic structure of an aluminium atom.

Use the periodic table. [1 mark]

FIGURE 2



[Turn over]

0 1 . 5

Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons. [3 marks]

0 1 . 6

Name the type of bonding in compounds formed between metals and non-metals.
[1 mark]

0 1 . 7

Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer. [4 marks]

[Turn over]

0 2

Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.

The equation for the reaction is:

$$Na_2CO_3(s) + 2\,HCl(aq) \longrightarrow 2\,NaCl(aq) + CO_2(g) + H_2O(l)$$

A student investigated the effect of changing the mass of sodium carbonate powder on the highest temperature reached by the reaction mixture.

0 2 . 1

Plan a method to investigate the effect of changing the mass of sodium carbonate powder on the highest temperature reached. [6 marks]

[Turn over]

FIGURE 3, on page 18, shows a line of best fit drawn through the student's results.

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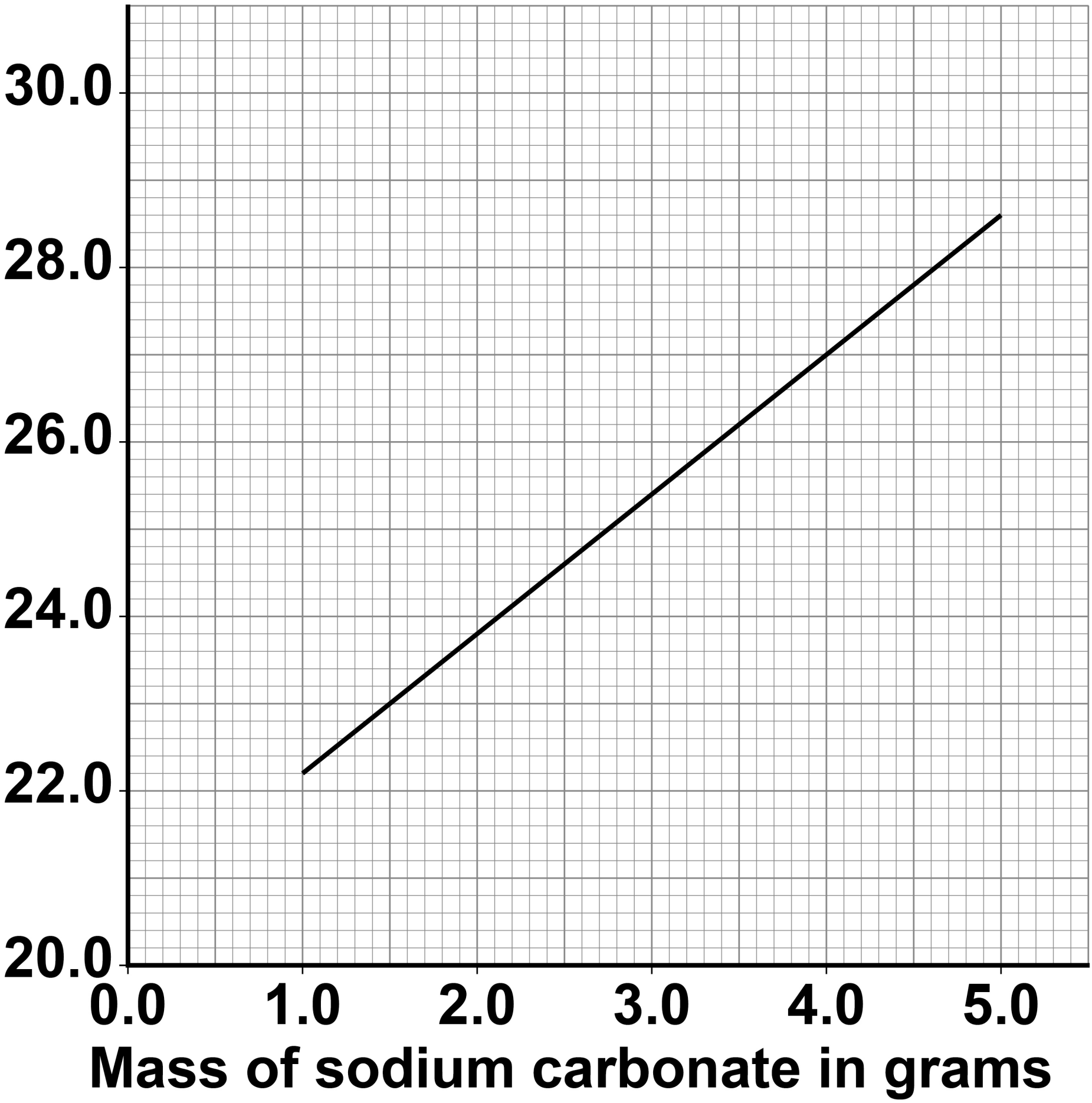
[Turn over]

FIGURE 3


Highest temperature reached by the reaction mixture in °C
30.0
28.0
26.0
24.0
22.0
20.0
0.0
1.0
2.0
3.0
4.0
5.0
Mass of sodium carbonate in grams

0 2 . 2

Determine the gradient of the line of best fit in FIGURE 3.

Use the equation:

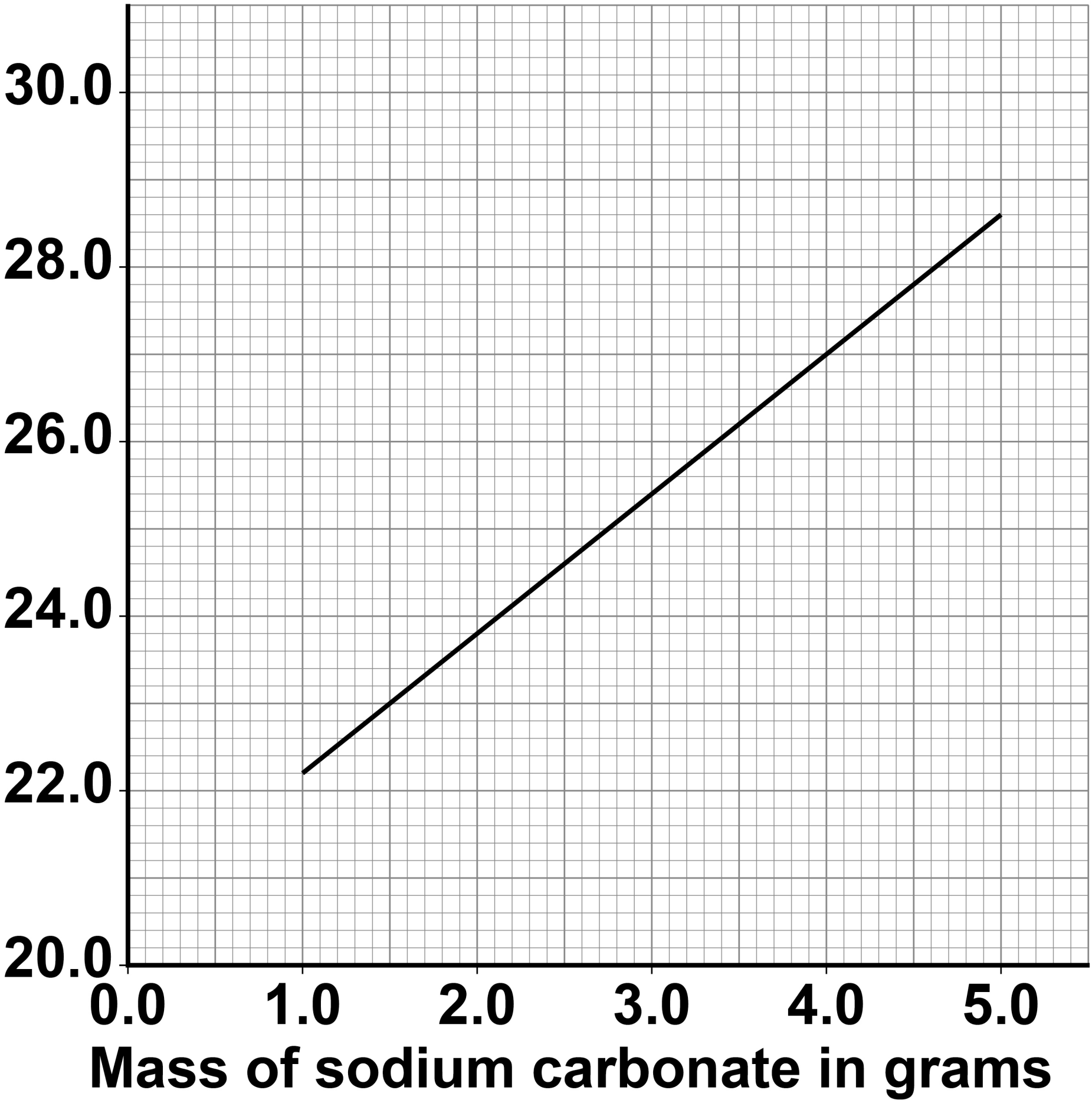
$$\text{Gradient} = \frac{\text{Change in highest temperature}}{\text{Change in mass}}$$

Give the unit. [5 marks]

Gradient = _____ Unit _____

[Turn over]

REPEAT OF FIGURE 3



0 2 . 3

The initial temperature of the reaction mixture is where the line of best fit would meet the *y*-axis.

Determine the initial temperature of the reaction mixture.

Show your working on FIGURE 3.
[2 marks]

Initial temperature of the reaction mixture = _____ °C

[Turn over]

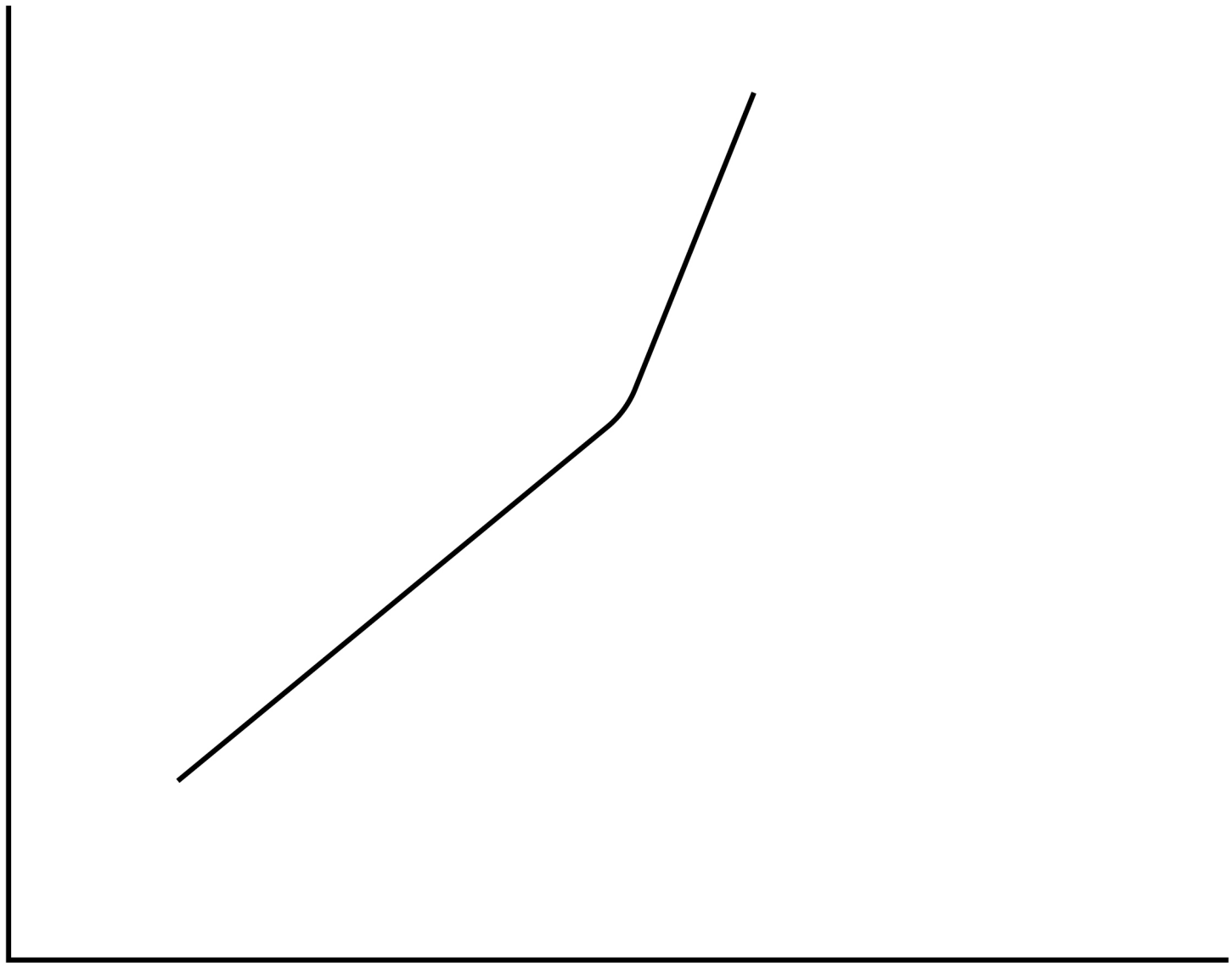
0 2 . 4

Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

Which sketch graph, on pages 23 to 25, shows the results obtained when sodium carbonate was added until in excess? [1 mark]

Tick (✓) ONE box.

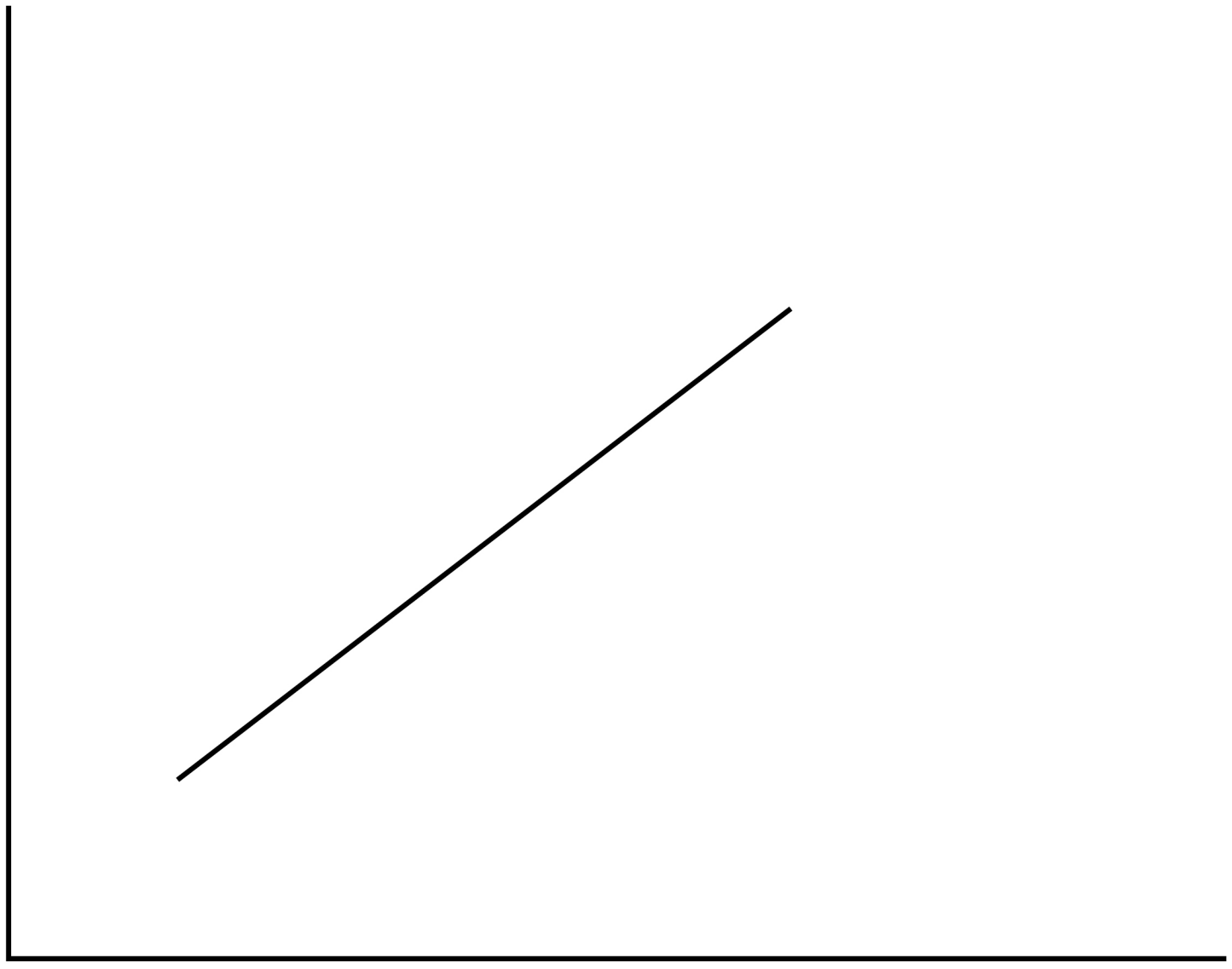
☐ A Highest temperature reached by the reaction mixture in °C



Mass of sodium carbonate in grams

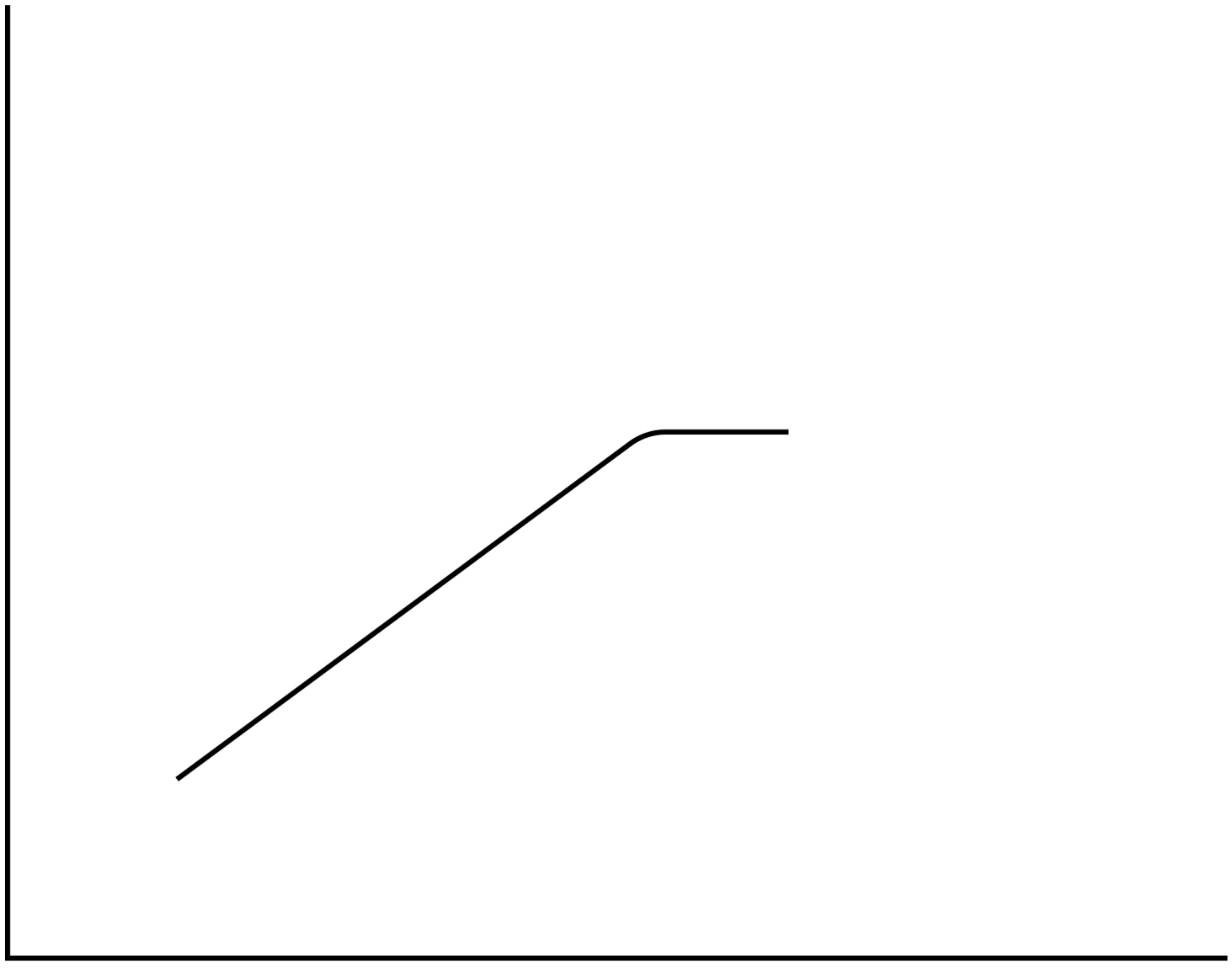
B

Highest temperature reached by the reaction mixture in °C



Mass of sodium carbonate in grams

C Highest temperature reached by the reaction mixture in °C

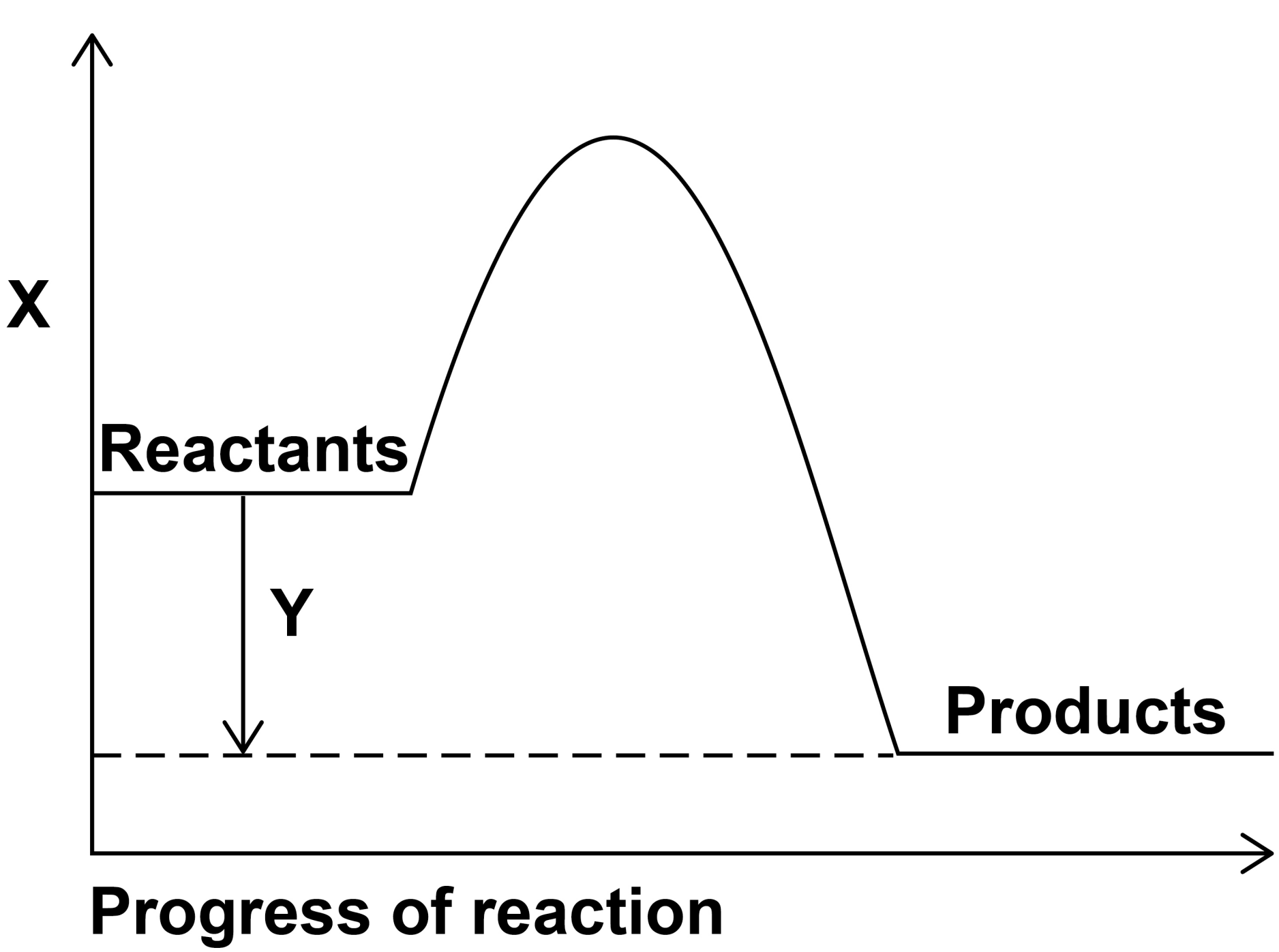


Mass of sodium carbonate in grams

[Turn over]

FIGURE 4 shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

FIGURE 4



0 2 . 5

What do labels X and Y represent on FIGURE 4? [2 marks]

X _____

Y _____

0 2 . 6

How does the reaction profile show that the reaction is exothermic?

Use FIGURE 4. [1 mark]

_____

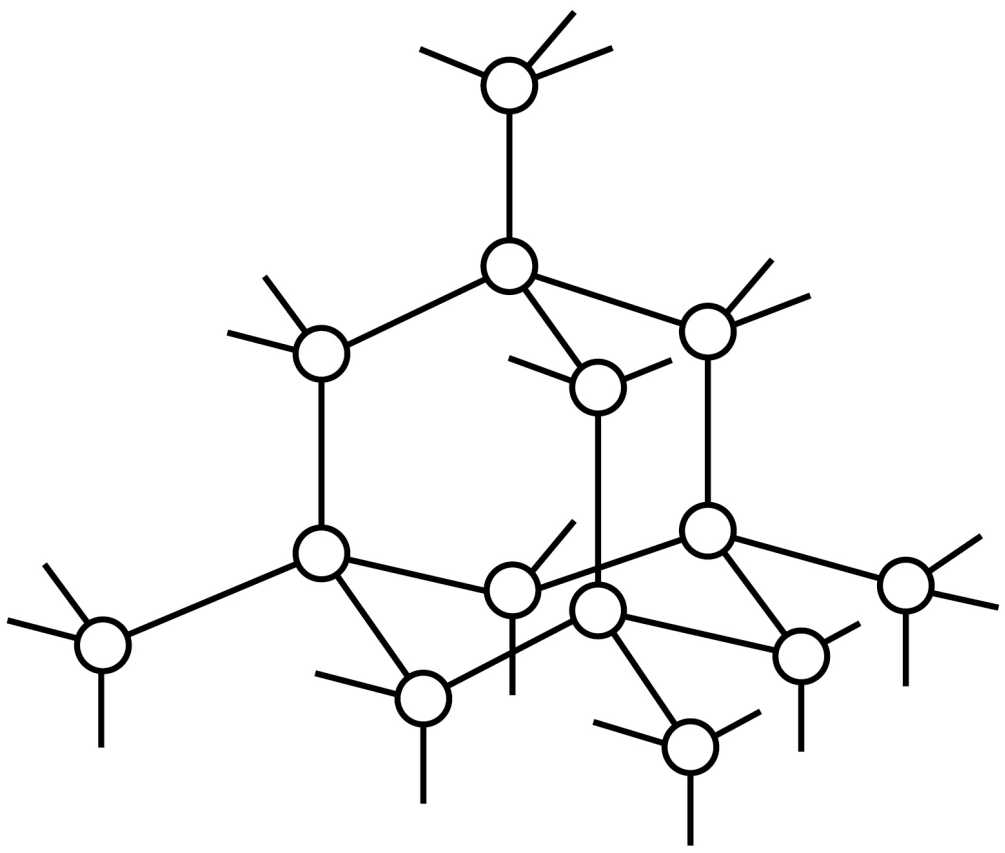
_____

0 3

This question is about different forms of carbon.

FIGURE 5 represents the structure of diamond.

FIGURE 5



KEY

○ **Carbon atom**

0 3 . 1

Describe the structure and bonding of diamond. [3 marks]

0 3 . 2

Explain why diamond has a very high melting point. [3 marks]

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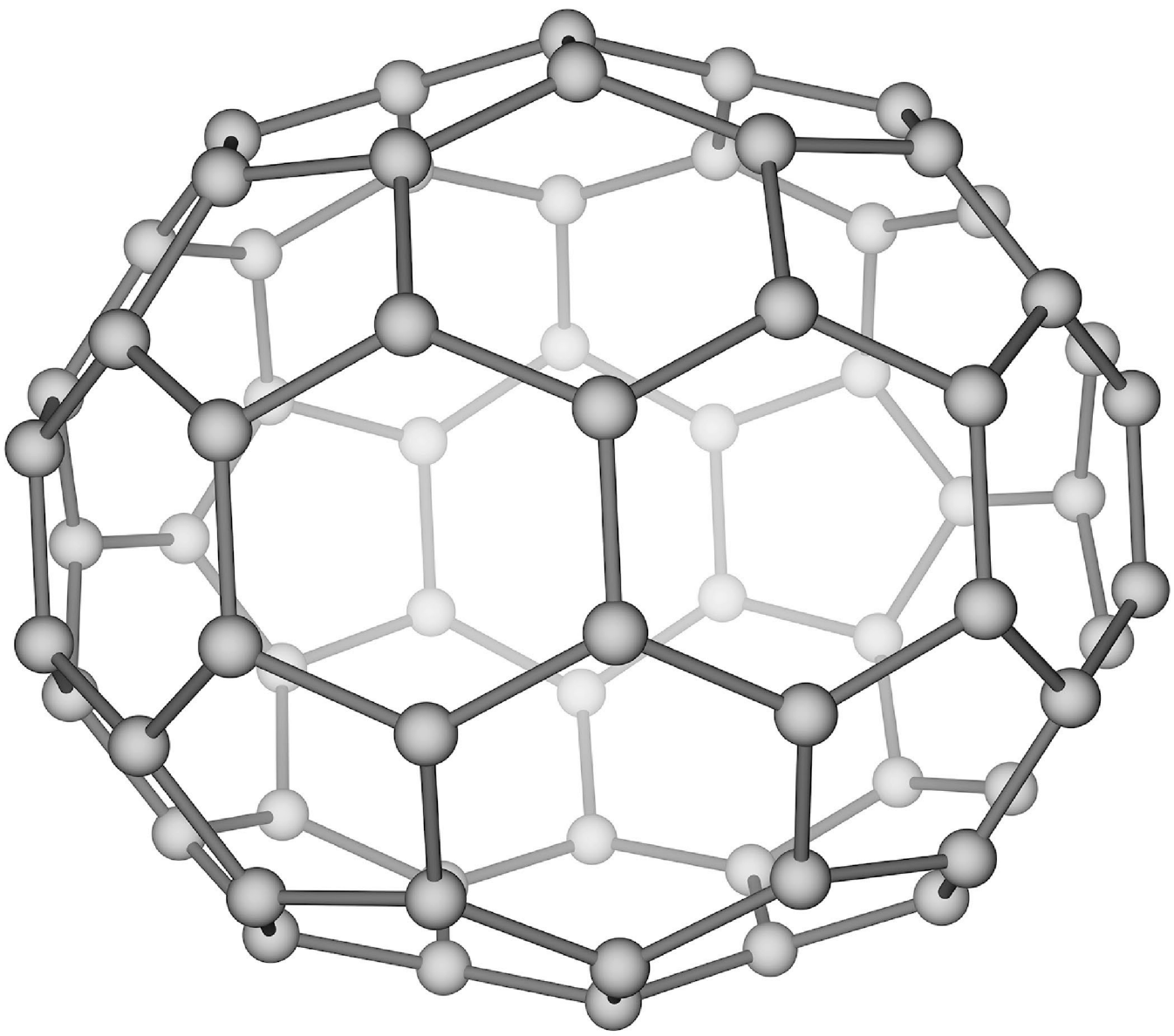
[Turn over]

FIGURE 6 represents the molecule C_{70}

FIGURE 6



0 3 . 3

What is the name of this type of molecule? [1 mark]

Tick (✓) ONE box.

- ☐ **Fullerene**
- ☐ **Graphene**
- ☐ **Nanotube**
- ☐ **Polymer**

[Turn over]

0 3 . 4

Molecules such as C_{70} can be used in medicine to move drugs around the body.

Suggest ONE reason why the C_{70} molecule is suitable for this use.
[1 mark]

0 3 . 5

Calculate the number of C_{70} molecules that can be made from one mole of carbon atoms.

The Avogadro constant = 6.02×10^{23} per mole

[3 marks]

Number of molecules = _____

11

[Turn over]

0 4

This question is about zinc and compounds of zinc.

A student produces pure crystals of zinc chloride by reacting zinc oxide with hydrochloric acid.

The equation for the reaction is:

$$ZnO(s) + 2\,HCl(aq) \longrightarrow ZnCl_2(aq) + H_2O(l)$$

0 4 . 1

The student adds zinc oxide to hydrochloric acid until the zinc oxide is in excess.

Give ONE observation that the student could make to show that the zinc oxide is in excess. [1 mark]

0 4 . 2

Why is excess zinc oxide used rather than excess hydrochloric acid? [1 mark]

[Turn over]

0 4 . 3

Name ONE OTHER compound that the student could add to hydrochloric acid to produce zinc chloride. [1 mark]

0 4 . 4

Describe how the student should obtain crystals of zinc chloride from a solution of zinc chloride. [2 marks]

BLANK PAGE

[Turn over]

Zinc chloride is also produced in a displacement reaction between zinc and copper chloride solution.

The equation for the reaction is:

$$Zn + CuCl_2 \longrightarrow ZnCl_2 + Cu$$

0 4 . 5

Complete the ionic equation for this reaction. [1 mark]

$$Zn + \_\_\_\_\_ \longrightarrow Zn^{2+} + \_\_\_\_\_$$

0 4 . 6

Why is zinc described as being oxidised in this reaction? [1 mark]

_____

_____

_____

[Turn over]

0 4 . 7

Zinc and copper can be used with another substance to produce electricity.

Complete FIGURE 7, on the opposite page, to show how zinc, copper and another substance can be used to light a lamp.

Label:

- **zinc**
- **copper**
- **the other substance used.**

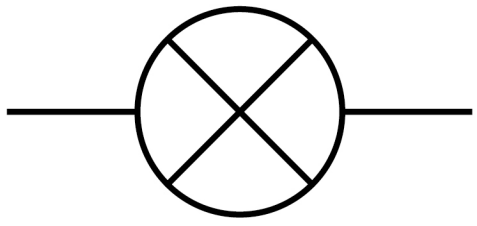
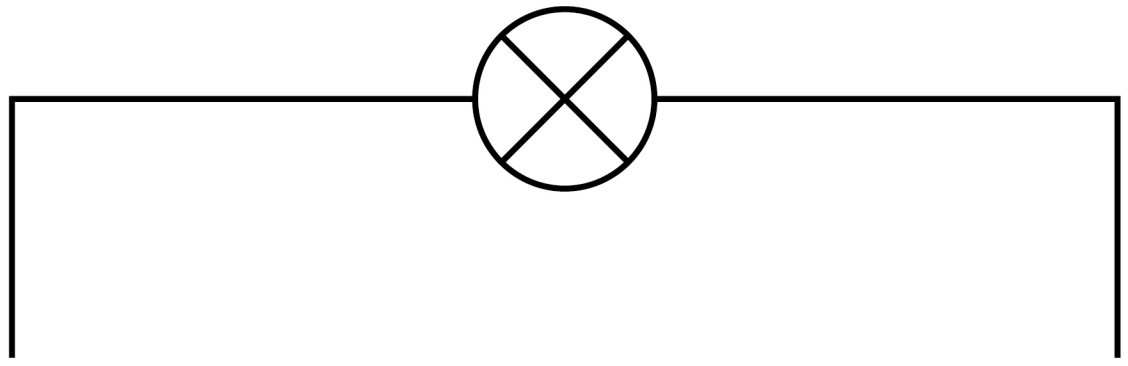
The symbol  **represents the lamp. [3 marks]**

FIGURE 7



[Turn over]

10

0 5

This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

0 5 . 1

Rubidium and potassium are added to water.

Predict ONE observation you would see that shows that rubidium is more reactive than potassium. [1 mark]

0 5 . 2

Explain why rubidium is more reactive than potassium. [3 marks]

0 5 . 3

Complete the equation for the reaction of rubidium with water.

You should balance the equation.
[3 marks]

The noble gases are in Group 0.

0 5 . 4

Which is a correct statement about the noble gases? [1 mark]

Tick (✓) ONE box.

☐ The noble gases all have atoms with eight electrons in the outer shell.

☐ The noble gases have boiling points that increase going down the group.

☐ The noble gases have molecules with two atoms.

☐ The noble gases react with metals to form ionic compounds.

0 5 . 5

TABLE 1 shows information about the three isotopes of neon.

TABLE 1

Mass number	Percentage abundance (%)
20	90.48
21	0.27
22	9.25

Calculate the relative atomic mass (A_r) of neon.

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

Relative atomic mass (3 significant figures) = _____

11

0 6

This question is about electrolysis.

Molten sodium chloride is electrolysed in an industrial process to produce sodium.

FIGURE 8, on page 52, shows a simplified version of the electrolysis cell used.

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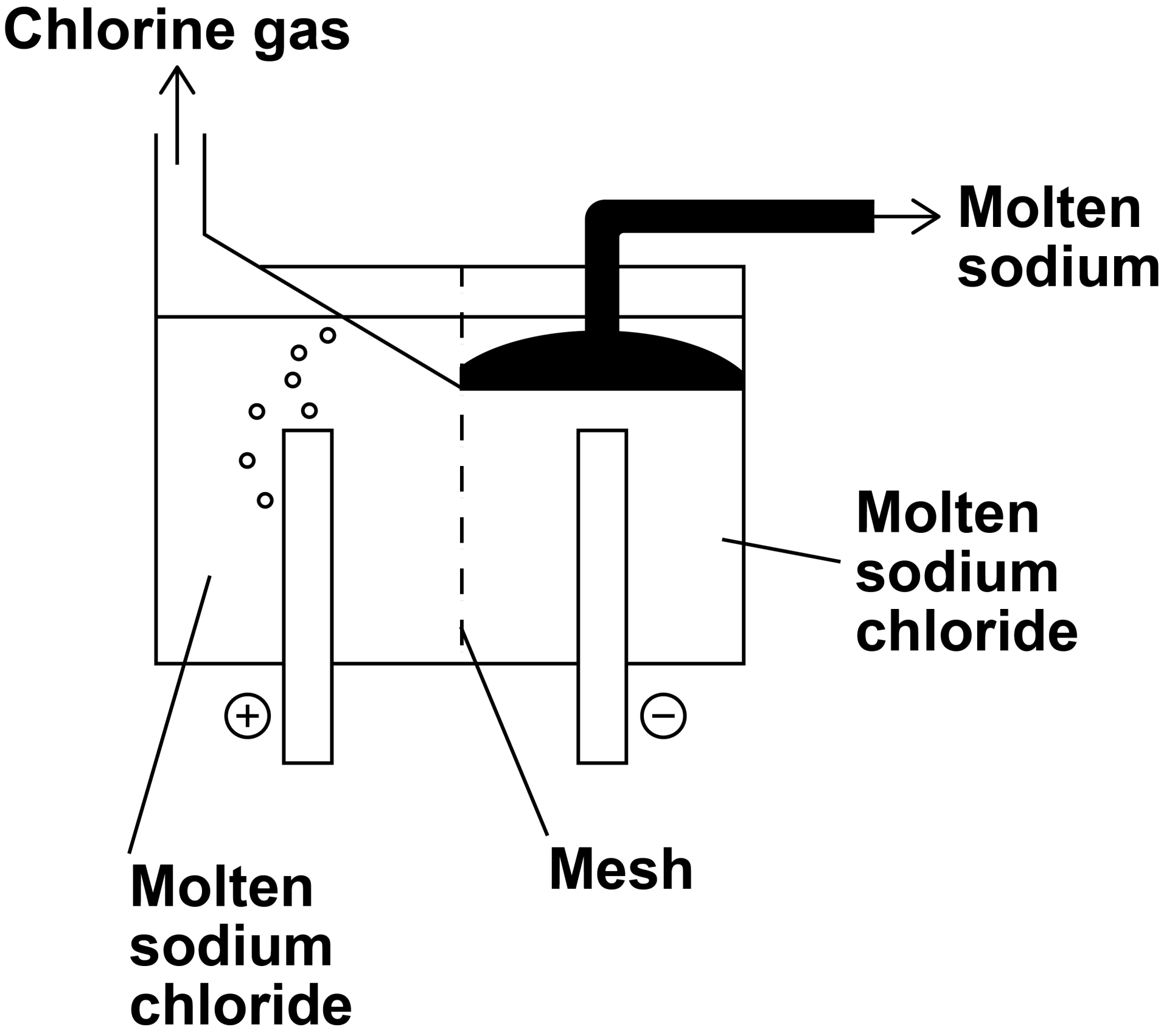
[Turn over]

FIGURE 8


Chlorine gas
Molten sodium
Molten sodium chloride
Molten sodium chloride
Mesh
+
−

0 6 . 1

Which is the correct half equation for the production of sodium? [1 mark]

Tick (✓) ONE box.

☐ $Na + e^- \longrightarrow Na^+$

☐ $Na \longrightarrow Na^+ + e^-$

☐ $Na^+ + e^- \longrightarrow Na$

☐ $Na^+ \longrightarrow Na + e^-$

A mesh is used to keep the products of the electrolysis apart.

0 6 . 2

Suggest ONE reason why the products of the electrolysis must be kept apart.
[1 mark]

0 6 . 3

Which type of particle passes through the mesh in the electrolysis of molten sodium chloride? [1 mark]

Tick (✓) ONE box.

- ☐ **Atom**
- ☐ **Electron**
- ☐ **Ion**
- ☐ **Molecule**

[Turn over]

Aqueous sodium chloride solution is electrolysed in a different industrial process.

Two gases and an alkaline solution are produced.

0 6 . 4

Which TWO ions are present in aqueous sodium chloride solution in addition to sodium ions and chloride ions?
[2 marks]

1 _____

2 _____

0 6 . 5

Name the alkaline solution produced.
[1 mark]

_____

0 6 . 6

Explain how the alkaline solution is produced.

You should refer to the processes at the electrodes. [3 marks]

[Turn over]

0 7

This question is about silicon and compounds of silicon.

0 7 . 1

The reactivity series sometimes includes non-metals such as carbon, hydrogen and silicon.

Silicon can be extracted by reducing silicon dioxide with different substances.

The equation for one possible reaction is:

$$2\,C(s) + SiO_2(s) \longrightarrow Si(s) + 2\,CO(g)$$

Explain what this reaction shows about the position of silicon in the reactivity series. [2 marks]

0 7 . 2

Aluminium also reduces silicon dioxide.

Carbon is used rather than aluminium to reduce silicon dioxide because carbon is cheaper than aluminium.

Carbon can be obtained by heating coal.

Aluminium is obtained from aluminium oxide.

Explain why aluminium is more expensive than carbon. [2 marks]

Magnesium also reduces silicon dioxide.

The equation for the reaction is:

$$2\ Mg(s) + SiO_2(s) \longrightarrow Si(s) + 2\ MgO(s)$$

0 7 . 3

Give ONE reason why the products are difficult to separate if magnesium is used to reduce silicon dioxide. [1 mark]

0 7 . 4

Calculate the minimum mass in grams of magnesium needed to completely reduce 1.2 kg of silicon dioxide.

Relative atomic masses (A_r):

O = 16 Mg = 24 Si = 28

[5 marks]

Minimum mass of magnesium =

_____ **g**

[Turn over]

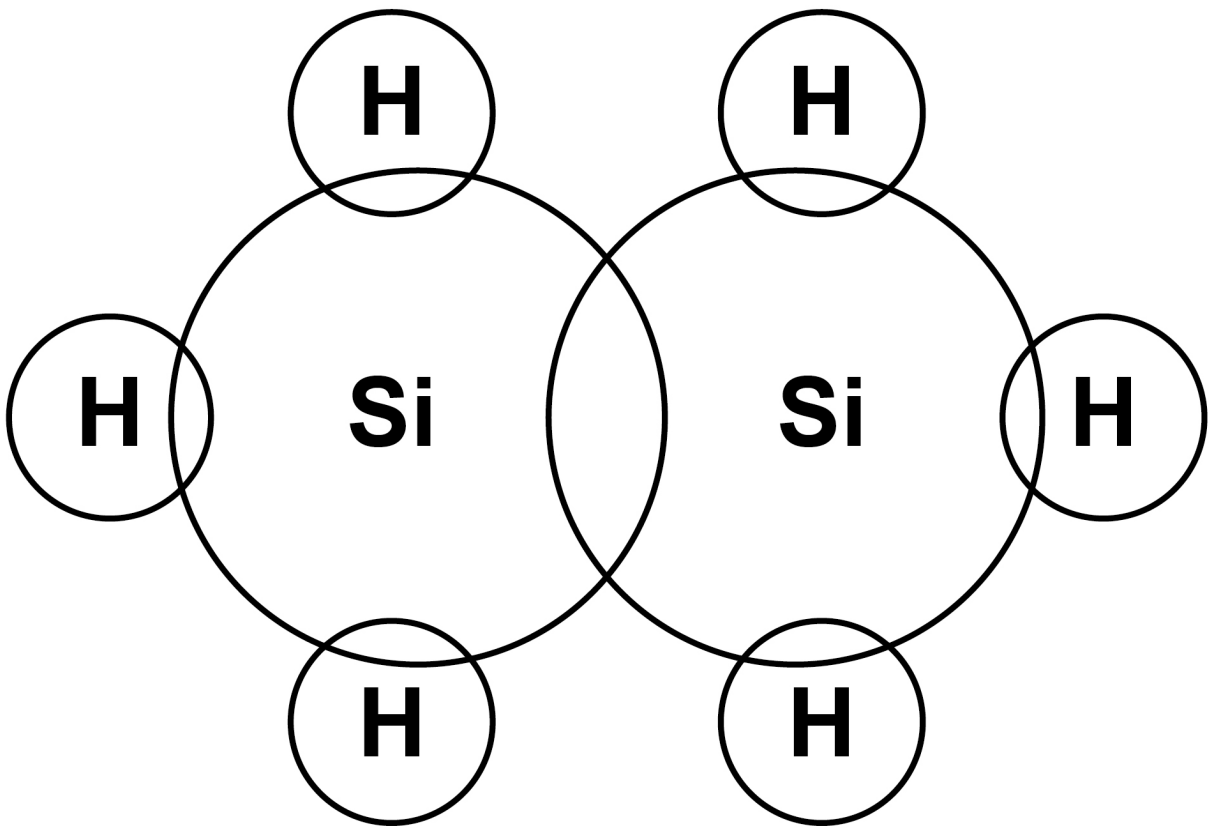
Si_2H_6 is a covalent compound of silicon and hydrogen.

0 7 . 5

Complete FIGURE 9 to show the outer shell electrons in a molecule of Si_2H_6

[1 mark]

FIGURE 9



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[Turn over]

0 7 . 6

Si_2H_6 reacts with oxygen.

The equation for the reaction is:

$$2\ Si_2H_6(g) + 7\ O_2(g) \longrightarrow 4\ SiO_2(s) + 6\ H_2O(g)$$

30 cm^3 of Si_2H_6 is reacted with 150 cm^3 (an excess) of oxygen.

Calculate the total volume of gases present after the reaction.

All volumes of gases are measured at the same temperature and pressure.
[4 marks]

Volume of gases = _____ cm^3

15

[Turn over]

0 8

This question is about acids and alkalis.

0 8 . 1

Explain why the pH of an acid depends on:

- **the strength of the acid**
- **the concentration of the acid.**

[4 marks]

[Turn over]

0 8 . 2

A student titrated 25.00 cm^3 of hydrochloric acid with 0.100 mol/dm^3 barium hydroxide solution.

TABLE 2 shows the results.

TABLE 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm^3	23.90	23.45	23.55	23.55	23.45

The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm^3.

Explain why the student used a volume of 23.50 cm^3 of barium hydroxide solution in the titration calculation.
[2 marks]

0 8 . 3

25.00 cm^3 of the hydrochloric acid reacted with 23.50 cm^3 of the 0.100 mol/dm^3 barium hydroxide solution.

The equation for the reaction is:

$$2\ HCl(aq) + Ba(OH)_2(aq) \longrightarrow BaCl_2(aq) + 2\ H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol/dm^3. [4 marks]

Concentration of the hydrochloric acid = _____ mol/dm^3

[Turn over]

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

$$H_2SO_4(aq) + Ba(OH)_2(aq) \longrightarrow BaSO_4(s) + 2\,H_2O(l)$$

The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

FIGURE 10, on page 76, shows the results.

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[Turn over]

FIGURE 10


Electrical conductivity in arbitrary units
3
2
1
0
0
10
20
30
40
Volume of barium hydroxide solution added in cm3

0 8 . 4

Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer. [3 marks]

0 8 . 5

The student then added a further 10 cm^3 of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give ONE reason why. [1 mark]

_____

_____

_____

14

END OF QUESTIONS

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.

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	