A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE
COMBINED SCIENCE: TRILOGY
Higher Tier
Chemistry Paper 1H
8464/C/1H

H

Thursday 17 May 2018 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]

For this paper you must have:

- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed).**

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.**

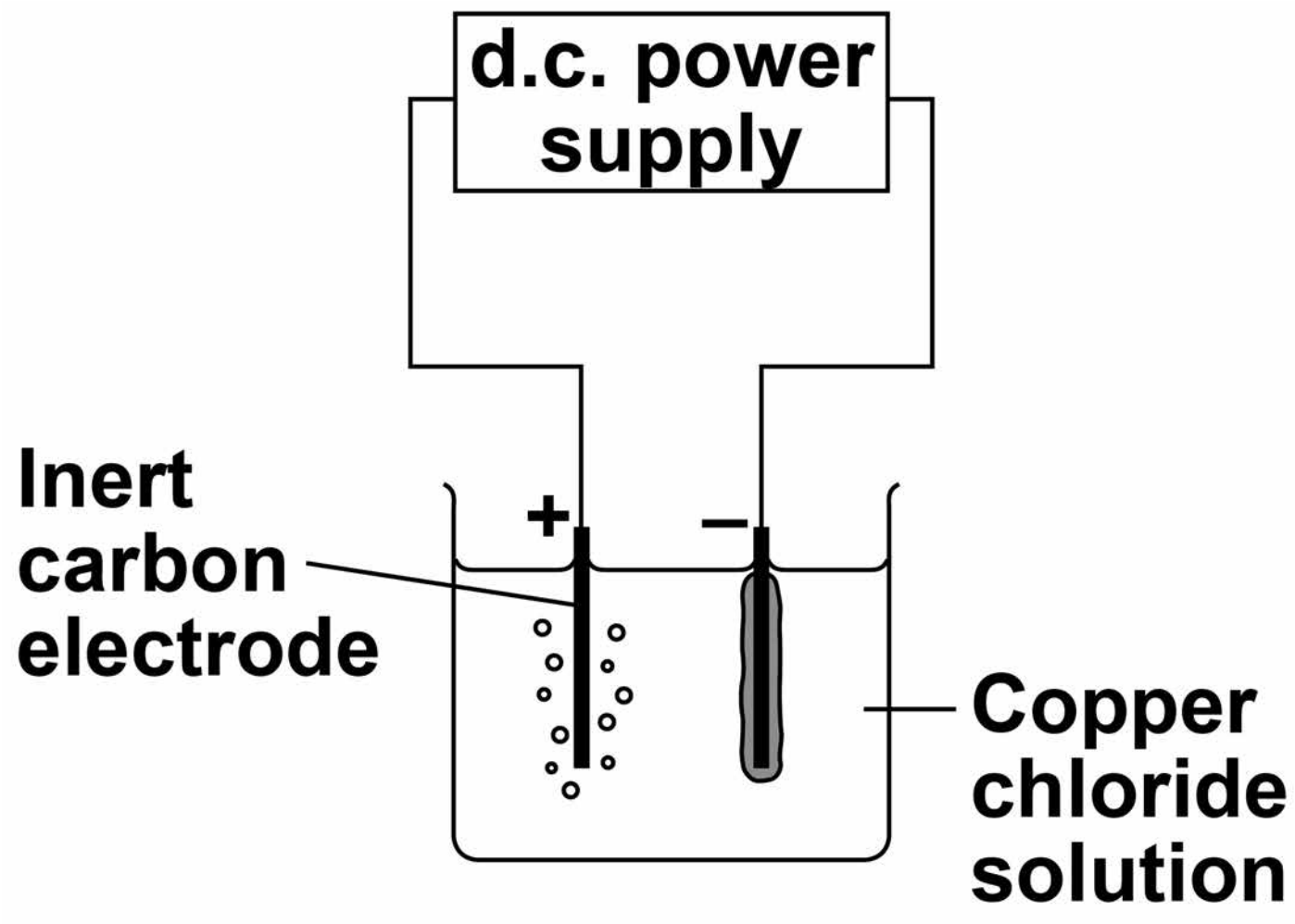
DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1 **This question is about electrolysis.**

A student investigates the mass of copper produced during electrolysis of copper chloride solution.

FIGURE 1 shows the apparatus.

FIGURE 1



0 1 . 1 **Which gas is produced at the positive electrode (anode)? [1 mark]**

Tick ONE box.

- ☐ carbon dioxide
- ☐ chlorine
- ☐ hydrogen
- ☐ oxygen

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0 1 . 2 **Copper is produced at the negative electrode (cathode).**

What does this tell you about the reactivity of copper?
[1 mark]

Tick ONE box.

☐ **Copper is less reactive than hydrogen**

☐ **Copper is less reactive than oxygen**

☐ **Copper is more reactive than carbon**

☐ **Copper is more reactive than chlorine**

[Turn over]

TABLE 1 shows the student's results.

TABLE 1

	Total mass of copper produced in mg			
Time in mins	Experiment 1	Experiment 2	Experiment 3	Mean
1	0.60	0.58	0.62	0.60
2	1.17	1.22	1.21	1.20
4	2.40	2.41	2.39	2.40
5	3.02	X	3.01	3.06

0 1 . 3 **Determine the MEAN mass of copper produced after 3 minutes. [1 mark]**

_____

_____

_____

Mass = _____ mg

[Turn over]

TABLE 1 shows the student's results.

TABLE 1

	Total mass of copper produced in mg			
Time in mins	Experiment 1	Experiment 2	Experiment 3	Mean
1	0.60	0.58	0.62	0.60
2	1.17	1.22	1.21	1.20
4	2.40	2.41	2.39	2.40
5	3.02	X	3.01	3.06

0 1 . 4 **Calculate the mass X of copper produced in EXPERIMENT 2 after 5 minutes.**

Use TABLE 1 on page 10 [2 marks]

Mass X = _____ mg

[Turn over]

0 1 . 5 **The copper chloride solution used in the investigation contained 300 grams per dm^3 of solid $CuCl_2$ dissolved in 1 dm^3 of water.**

The student used 50 cm^3 of copper chloride solution in each experiment.

Calculate the mass of solid copper chloride used in each experiment. [3 marks]

_____

_____

_____

Mass = _____ g

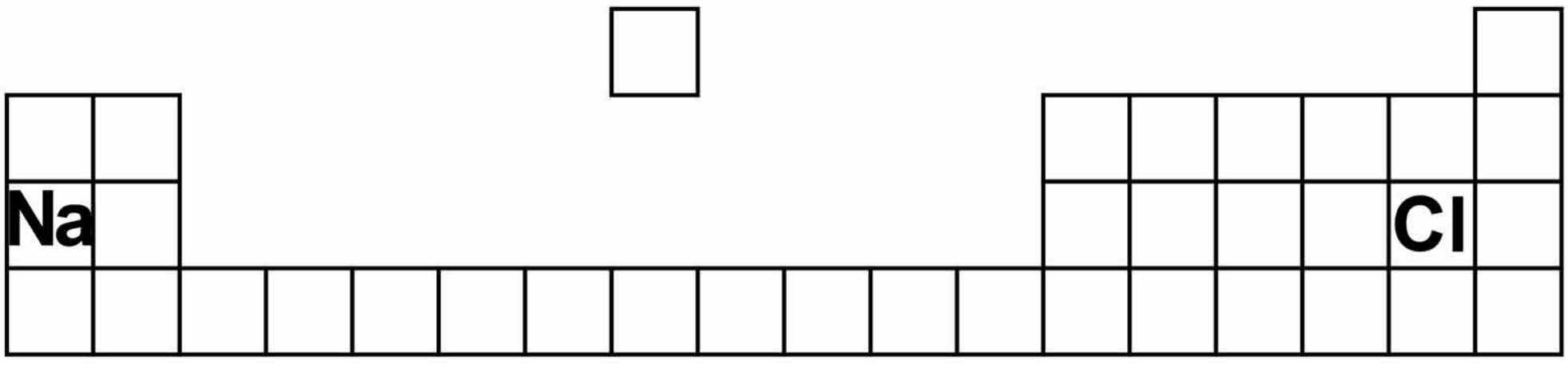
[Turn over]

8

0 2 **This question is about sodium and chlorine.**

FIGURE 2 shows the positions of sodium and chlorine in the periodic table.

FIGURE 2



0 2 . 1 **State ONE difference and ONE similarity in the electronic structure of sodium and of chlorine. [2 marks]**

Difference _____

_____

Similarity _____

_____

0 2 . 2 **Sodium atoms react with chlorine atoms to produce sodium chloride (NaCl).**

Describe what happens when a sodium atom reacts with a chlorine atom.

Write about electron transfer in your answer. [4 marks]

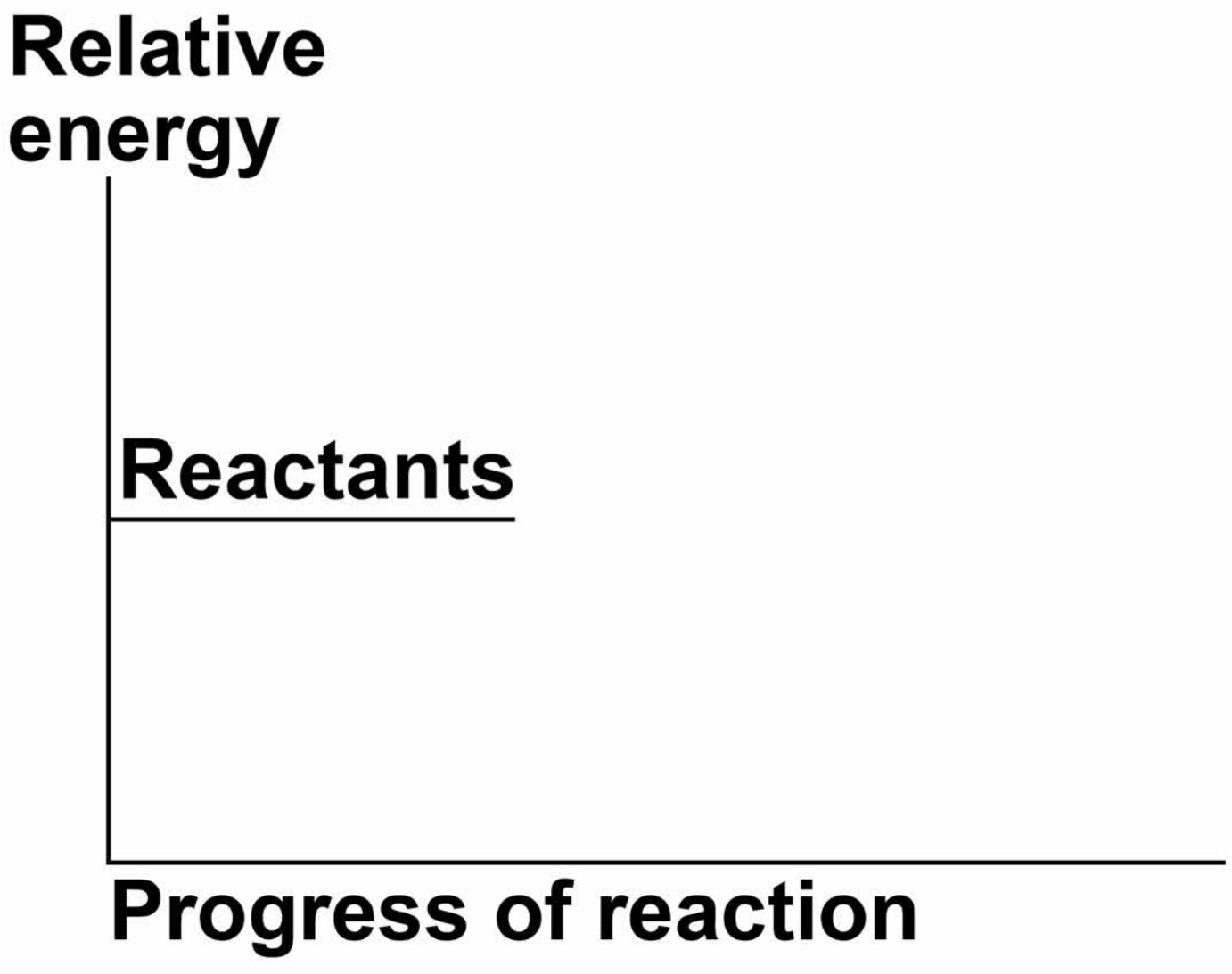
[Turn over]

0 2 . 3 **The reaction between sodium and chlorine is an exothermic reaction.**

Complete the reaction profile for the reaction between sodium and chlorine.

[2 marks]

FIGURE 3



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[Turn over]

0 3 **A student plans a method to prepare pure crystals of copper sulfate.**

The student's method is:

1. **Add one spatula of calcium carbonate to dilute hydrochloric acid in a beaker.**
2. **When the fizzing stops, heat the solution with a Bunsen burner until all the liquid is gone.**

The method contains several errors and does not produce copper sulfate crystals.

Explain the improvements the student should make to the method so that pure crystals of copper sulfate are produced.
[6 marks]

[Turn over]

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[Turn over]

0 4 **This question is about the halogens.**

0 4 . 1 **Write the state symbol for chlorine at room temperature. [1 mark]**

Cl_2 (_____)

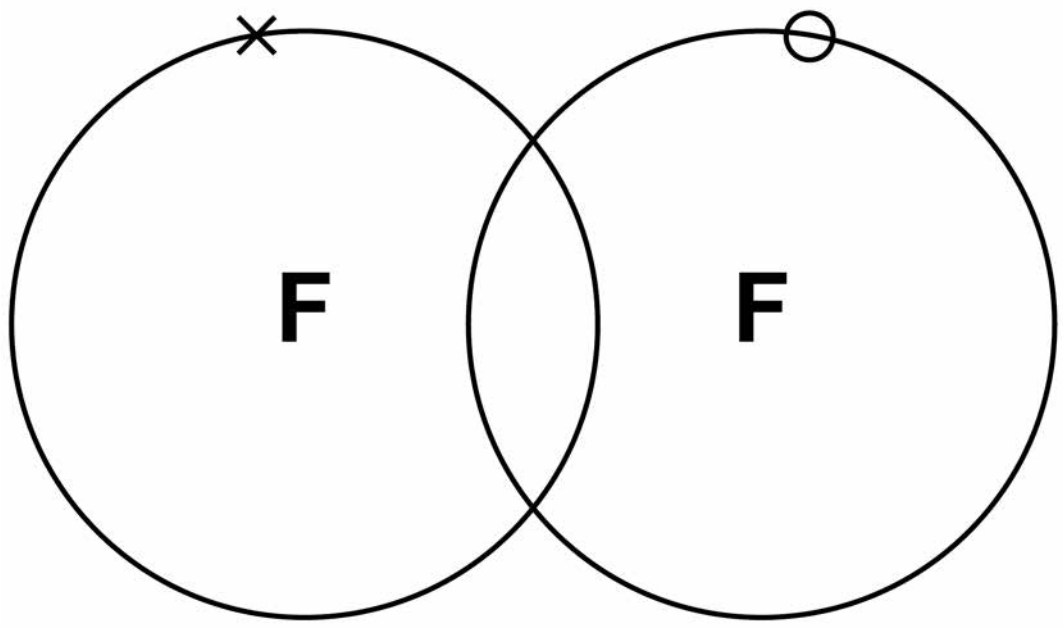
0 4 . 2 **FIGURE 4 represents one molecule of fluorine.**

Complete the dot and cross diagram on FIGURE 4

You should show only the electrons in the outer shells.

[2 marks]

FIGURE 4



0 4 . 3 A fluorine atom can be represented as $^{19}_{9}F$

What is the total number of electrons in a fluorine molecule (F_2)? [1 mark]

Tick ONE box.

- ☐ 9
- ☐ 14
- ☐ 18
- ☐ 38

0 4 . 4 **Aluminium reacts with bromine to produce aluminium bromide.**

Complete the balanced chemical equation for this reaction. [2 marks]

_____ Al + _____ Br_2 → 2 _____

[Turn over]

0 4 . 5 When chlorine reacts with potassium bromide, chlorine displaces bromine.

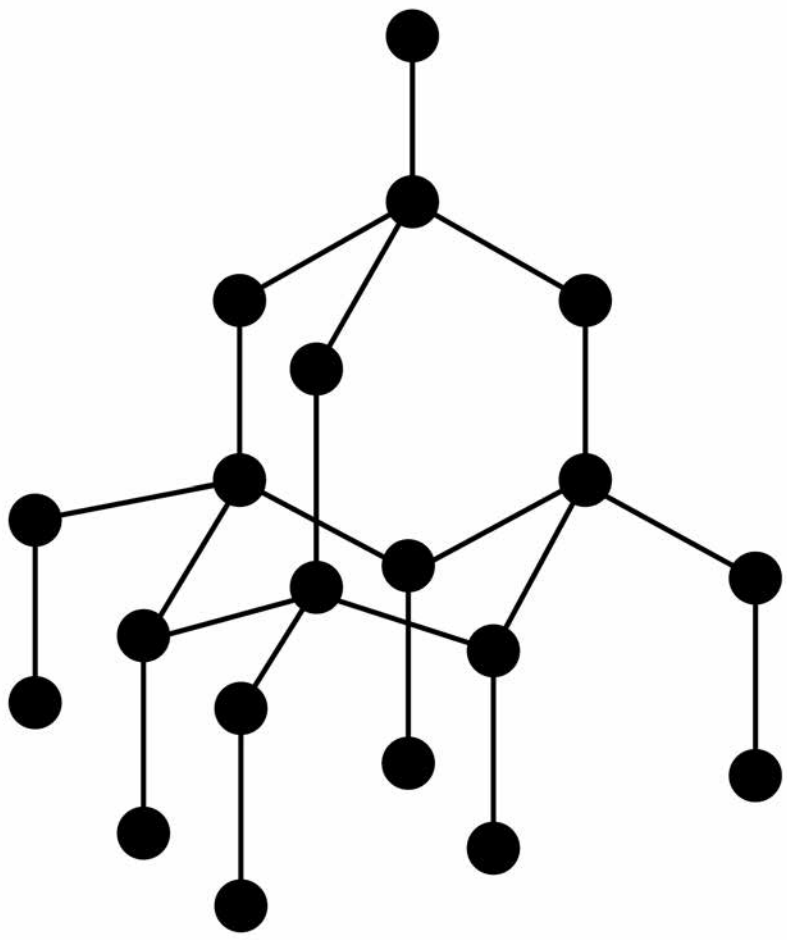
$Cl_2 + 2\,KBr \rightarrow Br_2 + 2\,KCl$

Explain why chlorine is more reactive than bromine.
[3 marks]

0 5 This question is about structure and bonding.

0 5 . 1 FIGURE 5 shows part of the structure and bonding in diamond.

FIGURE 5



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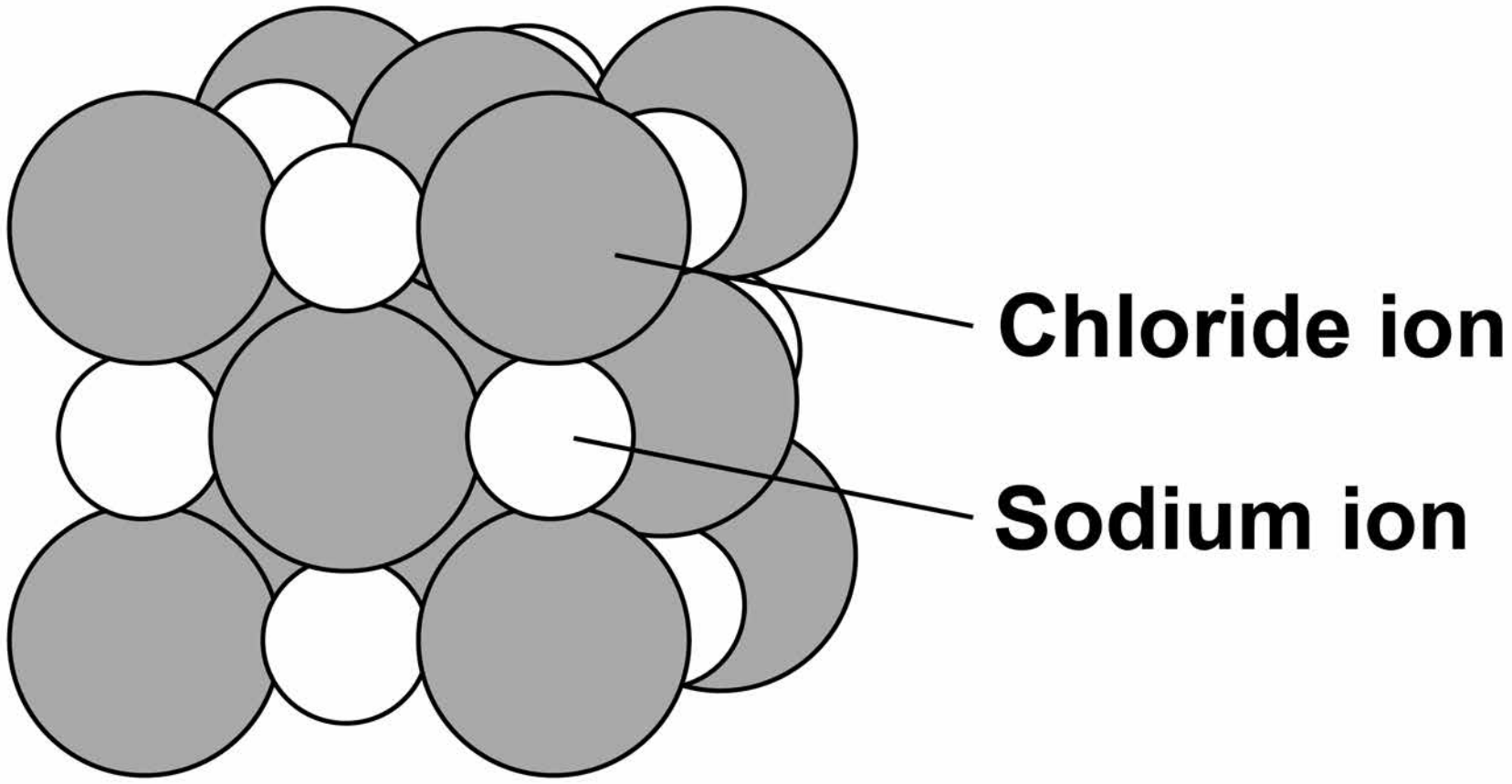
Explain why diamond has a high melting point. [3 marks]

0 5 . 2 **FIGURE 6 shows part of the structure and bonding in sodium chloride (NaCl).**

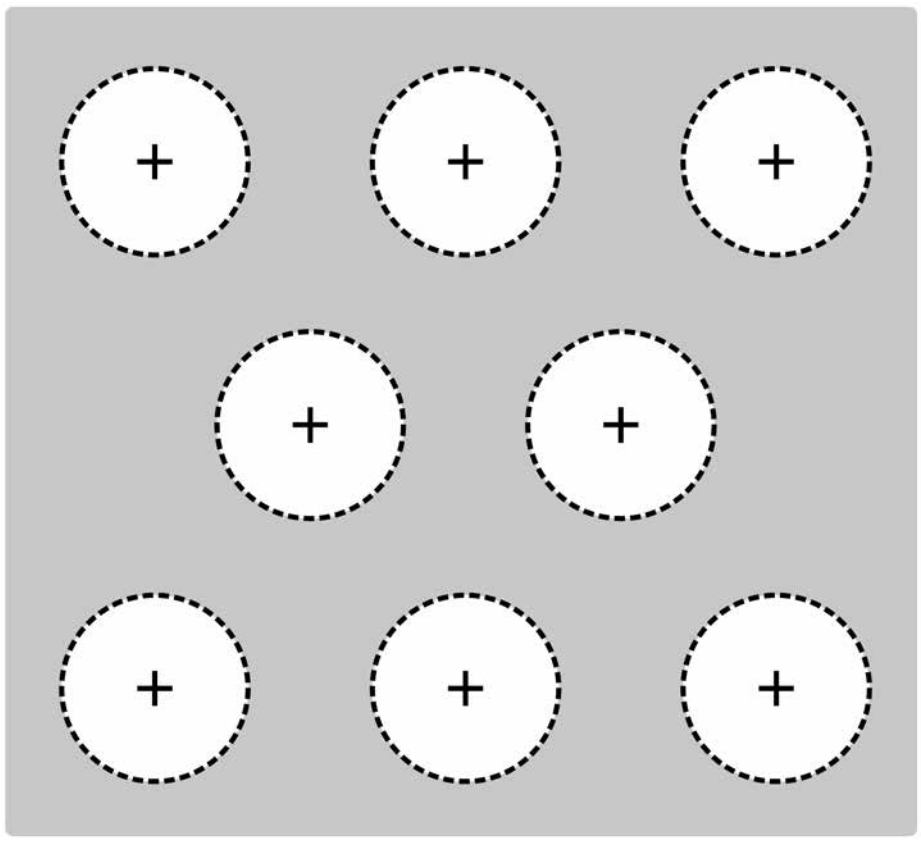
FIGURE 6



Explain the conditions needed for sodium chloride to conduct electricity. [3 marks]

0 5 . 3 **FIGURE 7 shows the structure of sodium.**

FIGURE 7



Describe how sodium conducts thermal energy.
[3 marks]

0 6 **Group 2 metal carbonates thermally decompose to produce a metal oxide and a gas.**

0 6 . 1 **Give the formula of each product when calcium carbonate ($CaCO_3$) is heated.**

[2 marks]

_____ **and** _____

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[Turn over]

0 6 . 2 The relative formula mass (M_r) of a Group 2 metal carbonate is 197

Relative atomic masses (A_r):

C = 12 O = 16

Calculate the relative atomic mass (A_r) of the Group 2 metal in the metal carbonate.

Name the Group 2 metal.
[3 marks]

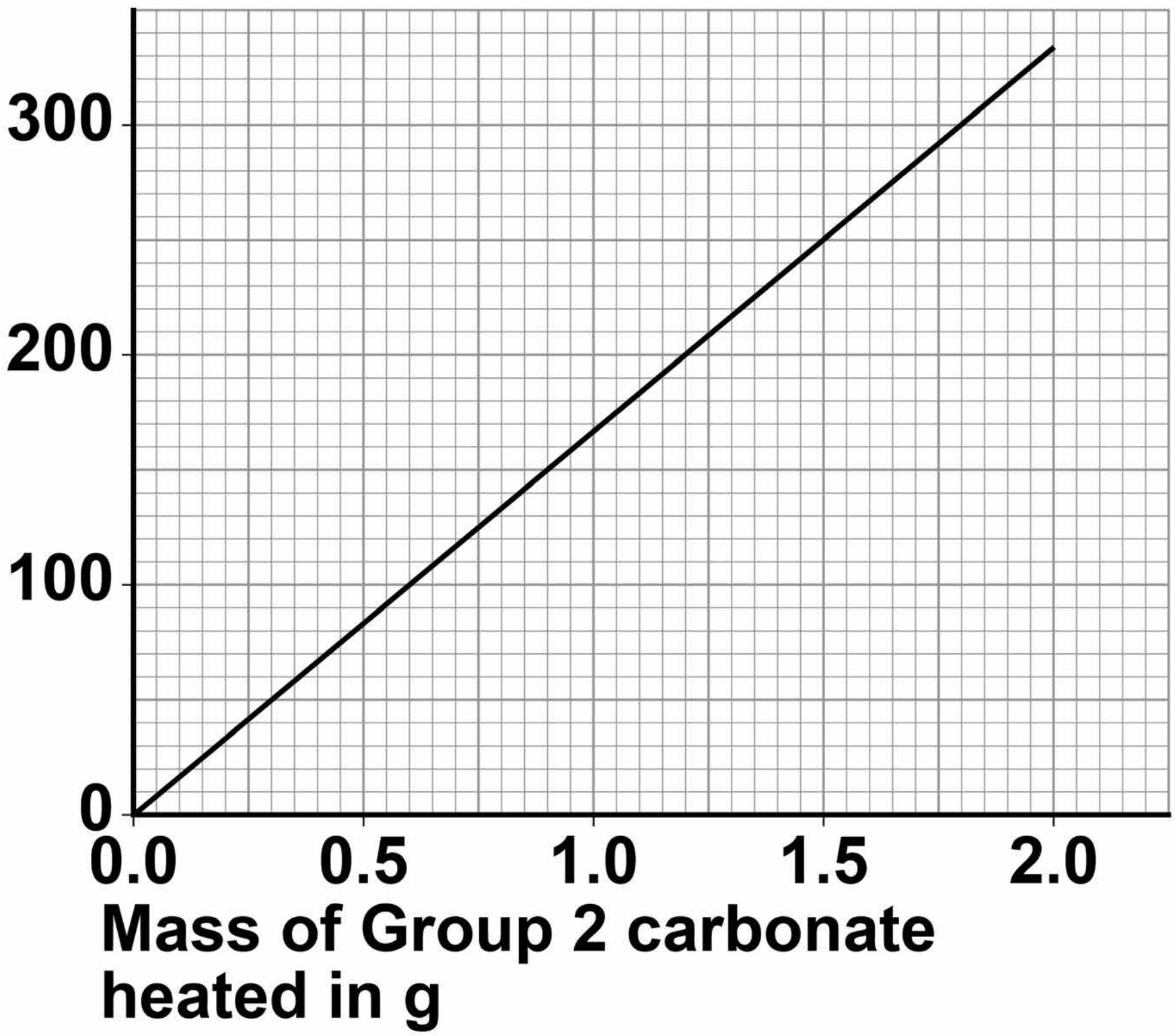
Relative atomic mass (A_r) = _____

Metal _____

[Turn over]

FIGURE 8 shows the volume of gas produced when a different Group 2 carbonate, W, is heated.

FIGURE 8



0 6 . 3 **Calculate the gradient of the line in FIGURE 8, on page 40.**

Give the unit. [3 marks]

Gradient _____

Unit _____

0 6 . 4 **24 dm^3 of gas is produced when one mole of a Group 2 carbonate is heated.**

Determine the relative formula mass of the Group 2 carbonate W.

Use FIGURE 8, on page 40.
[4 marks]

Relative formula mass (M_r) =

12

[Turn over]

0 7 **A scientist does two tests on four white solids. The solids are labelled A, B, C and D.**

TEST 1 **Adds the sample of the solid to distilled water and stirs.**

TEST 2 **Measures the pH of the solution after TEST 1**

TABLE 2 shows the results.

TABLE 2

Solid	Appearance after stirring	pH
A	colourless solution, no solid	14
B	colourless solution, no solid	3
C	colourless solution, solid remains	9
D	colourless liquid, solid remains	7

These four solids are:

- magnesium oxide
- phosphorus oxide
- silicon dioxide
- sodium oxide.

TABLE 3 shows the solubility of these four solids in water.

TABLE 3

Solid	Solubility in grams per 100 cm^3 of water
Magnesium oxide	0.01
Phosphorus oxide	52
Silicon dioxide	0
Sodium oxide	109

[Turn over]

0 7 . 1 **Identify the solids A, B, C and D.**

Explain your answers.
[6 marks]

[Turn over]

0 7 . 2 10 cm^3 of solution B is added to a beaker.

Distilled water is added to the beaker until the final volume in the beaker is 1000 cm^3

The pH of the solution is measured before and after distilled water is added.

TABLE 4 shows the results.

TABLE 4

Volume of solution in beaker	pH of solution B
10 cm^3	3
1000 cm^3	X

Calculate the value of X.
[2 marks]

X = _____

[Turn over]

8

0 8 **This question is about iron.**

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

0 8 . 1 **Name the other product.**
[1 mark]

0 8 . 2 **Suggest how any unreacted iron can be separated from the mixture. [1 mark]**

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[Turn over]

Magnesium reacts with iron chloride solution.

$$3\ Mg + 2\ FeCl_3 \rightarrow 2\ Fe + 3\ MgCl_2$$

0 8 . 3 0.120 g of magnesium reacts with excess iron chloride solution.

Relative atomic masses (A_r):

Mg = 24 Fe = 56

Calculate the mass of iron produced, in mg [5 marks]

Mass of iron = _____

[Turn over]

0 8 . 4 Explain which species is reduced in the reaction between magnesium and iron chloride.

$$3\ Mg + 2\ FeCl_3 \rightarrow 2\ Fe + 3\ MgCl_2$$

Your answer should include the half equation for the reduction. [3 marks]

END OF QUESTIONS

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There are no questions printed on this page

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	