

AQA • GCSE COMBINED SCIENCE: TRILOGY 8464

Chemistry — Higher Tier, Paper 1

June 2025 exam series

QUESTION PAPER

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Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 1H

Monday 19 May 2025

Morning

Time allowed: 1 hour 15 minutes

Materials

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.
- Fill in the boxes at the top of this page.
- 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.

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



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8464/C/1H

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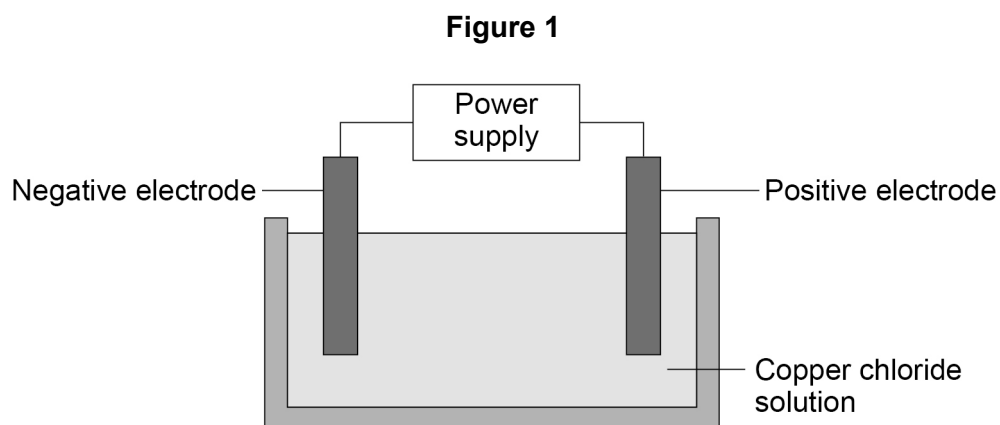
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ANSWER IN THE SPACES PROVIDED**



0 1

A teacher demonstrated the electrolysis of copper chloride solution.

Figure 1 shows the apparatus.



The teacher measured the mass of the negative electrode every 60 seconds.

0 1

1

Chlorine gas is given off during the electrolysis of copper chloride solution.

Chlorine gas is poisonous.

Give **one** way of reducing the risk of harm.

[1 mark]

Question 1 continues on the next page

Turn over ►



Table 1 shows the results.

Table 1

Time in seconds	Mass of negative electrode in grams
0	20.2
60	22.0
120	23.4
180	24.2
240	24.8
300	25.2
360	25.2

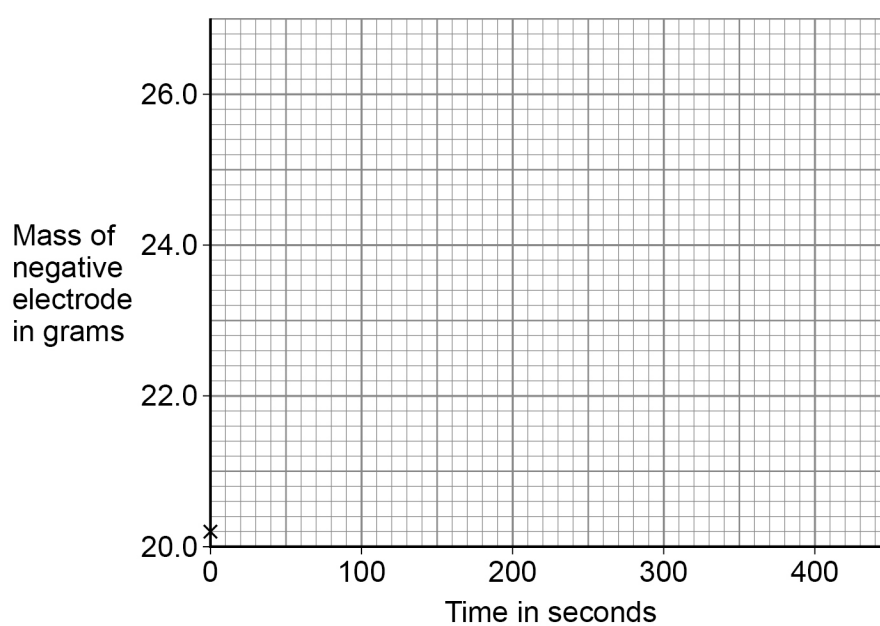
0 1 . 2 Plot the data from **Table 1** on **Figure 2**.

Draw a line of best fit.

The first point has been plotted for you.

[3 marks]

Figure 2



0 1 . 3 A student made the hypothesis:

‘The negative electrode will increase by a constant mass every 60 seconds.’

How do the results in **Table 1** show that the hypothesis is **not** correct?

[1 mark]

0 1 . 4 25 cm³ of the solution of copper chloride contained 5.5 g of copper chloride.

Calculate the concentration of the solution in g/dm³.

1 dm³ = 1000 cm³

[3 marks]

Concentration = _____ g/dm³

Question 1 continues on the next page

Turn over ►



0 1 . 5

The teacher also electrolysed potassium chloride solution.

Hydrogen gas was given off at the negative electrode.

Why was hydrogen gas given off?

[1 mark]

Tick (✓) **one** box.

Hydrogen is less reactive than potassium.

☐

Hydrogen has the same reactivity as potassium.

☐

Hydrogen is more reactive than potassium.

☐

9



0 2

A student investigated an exothermic reaction.

The student reacted solid calcium oxide with water to produce calcium hydroxide.

0 2 . 1

What is meant by an 'exothermic' reaction?

[1 mark]

0 2 . 2

The formula of calcium hydroxide is $\text{Ca}(\text{OH})_2$

Calculate the percentage by mass of oxygen in calcium hydroxide.

Relative atomic mass (A_r): O = 16

Relative formula mass (M_r): $\text{Ca}(\text{OH})_2 = 74$

[3 marks]

Percentage = _____ %

Question 2 continues on the next page

Turn over ►

When solid calcium oxide is added to water, the temperature of the reaction mixture changes.

Plan a method to investigate how changing the mass of calcium oxide affects the temperature change of the reaction mixture.

[6 marks]

[illegible]

Extra space _____

10



0 3

This question is about atoms, ions and elements.

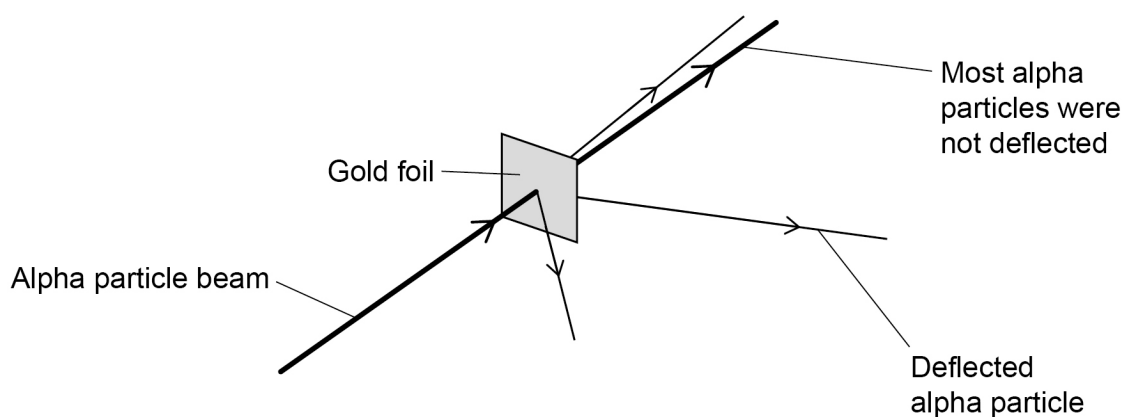
0 3 . 1

Figure 3 shows the results of the alpha particle scattering experiment.

In the experiment, alpha particles were fired at gold foil.

Alpha particles are positively charged.

Figure 3



What **two** conclusions were made from the results?

[2 marks]

Tick (✓) **two** boxes.

Atoms are very small.

☐

Atoms have a charged nucleus.

☐

Electrons orbit the nucleus at specific distances.

☐

Isotopes of an element have a different number of neutrons.

☐

The mass of an atom is concentrated in the nucleus.

☐

Turn over ►



Particle **X** consists of:

- 35 protons
- 44 neutrons
- 36 electrons.

0 3 . 2

Why is particle **X** **not** an atom?

Answer in terms of subatomic particles.

[1 mark]

0 3 . 3

Which is the correct representation of particle **X**?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

${}_{35}^{79}\text{Br}^+$

☐

${}_{35}^{79}\text{Br}^-$

☐

${}_{35}^{79}\text{Se}^+$

☐

${}_{35}^{79}\text{Se}^-$

☐

Group 7 elements are known as the halogens.

0 3 . 4 **Table 2** shows the boiling points of some Group 7 elements.

Table 2

Element	Boiling point in °C
Fluorine	−188
Chlorine	−35
Bromine	59
Iodine	184

Explain the increase in the boiling points of the Group 7 elements going down the group.

[3 marks]

Question 3 continues on the next page

Turn over ►



0 3 . 5 Chlorine reacts with fluorine to form a compound with the formula ClF_3

What is the type of bonding in the compound ClF_3 ?

[1 mark]

0 3 . 6 Chlorine reacts with a solution of sodium bromide.

Complete the word equation for the reaction.

[1 mark]

chlorine + sodium bromide $\rightarrow$ _____ + _____

0 3 . 7 Explain why Group 7 elements become less reactive going down the group.

[3 marks]



Turn over for the next question

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0	4
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This question is about metals.

0	4	.	1
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Iron is extracted from iron oxide by reduction with carbon.

Why can iron be extracted by reduction with carbon?

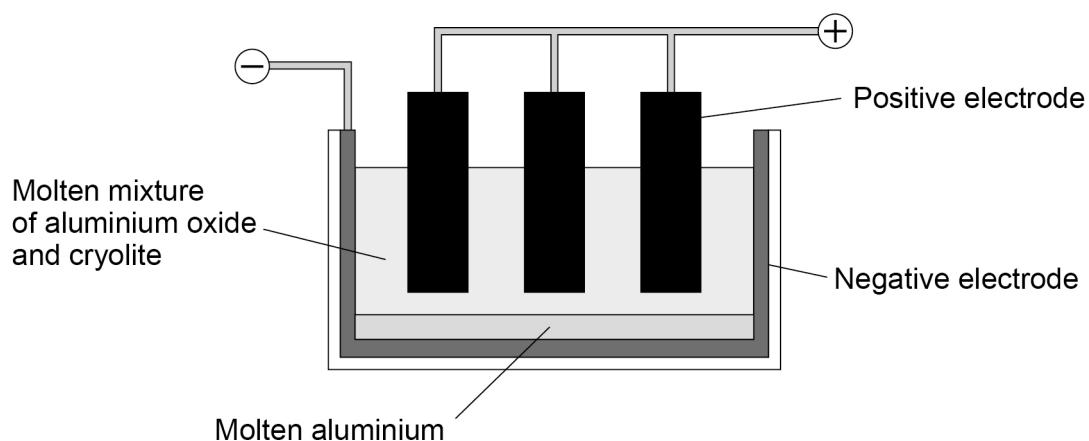
Answer in terms of reactivity.

[1 mark]

Aluminium is extracted by the electrolysis of aluminium oxide.

Figure 4 shows the apparatus used to extract aluminium.

Figure 4



0 4 . 2

Explain why a mixture of aluminium oxide and cryolite is used as the electrolyte instead of only aluminium oxide.

[2 marks]

0 4 . 3

Oxygen gas is produced at the positive electrode.

Write a balanced half equation for the production of oxygen at the positive electrode.

[2 marks]



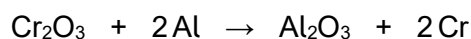
Question 4 continues on the next page

Turn over ►



Chromium is extracted by reacting chromium oxide with aluminium.

The equation for the reaction is:



0 4 . 4 Which substance in the equation is reduced?

[1 mark]

Table 3 shows the relative cost of extracting equal masses of aluminium, chromium and iron.

Table 3

Metal	Relative cost of extraction
Aluminium	2
Chromium	20
Iron	1

0 4 . 5 Give **one** reason for the difference in the cost of extracting aluminium and **iron**.

Use **Table 3**.

[1 mark]



0 4 . 6

Give **one** reason for the difference in the cost of extracting aluminium and **chromium**.Use **Table 3**.**[1 mark]**

0 4 . 7

Metals are mixed together to form alloys.

Explain why alloys are harder than pure metals.

[3 marks]

11

Turn over for the next question**Turn over ►**

0 5

This question is about hydrogen chloride (HCl) and hydrogen chlorate (HOCl).

Hydrogen chloride and hydrogen chlorate both form acids when dissolved in water.

0 5 . 1

Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Give the state symbols for:

- hydrogen chloride
- water
- hydrochloric acid.

[1 mark]

Hydrogen chloride _____

Water _____

Hydrochloric acid _____

0 5 . 2

A solution of hydrochloric acid has:

- a pH of 2.5
- a concentration of H^+ ions of $3.16 \times 10^{-3} \text{ mol/dm}^3$.

What is the concentration of H^+ ions in a solution of hydrochloric acid that has a pH of 3.5?

[1 mark]

Concentration = _____ mol/dm^3



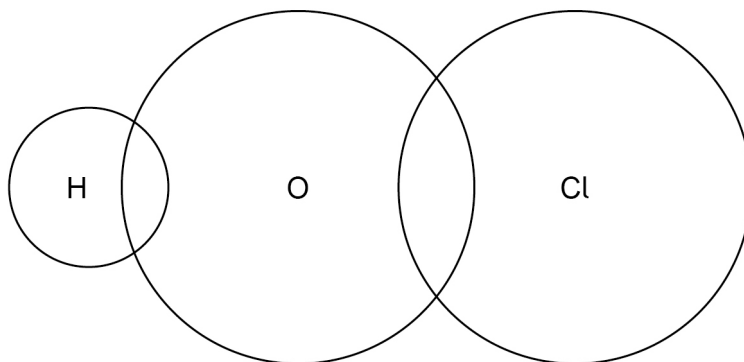
0 5 . 3

Figure 5 shows the outer shells in one molecule of hydrogen chlorate (HOCl).

Complete the dot and cross diagram to show the electrons in the outer shells.

[2 marks]

Figure 5



0 5 . 4

Hydrogen chlorate dissolves in water to form a weak acid.

Explain why a weak acid has a higher pH than a strong acid of the same concentration.

[2 marks]

Question 5 continues on the next page

Turn over ►



0 5 . 5 Hydrogen chloride is produced in the reaction between methane and chlorine.

Figure 6 represents the equation for the reaction.

Figure 6

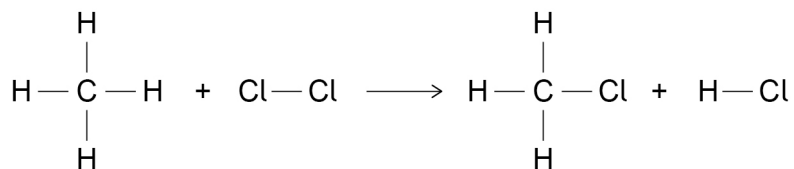


Table 4 shows the bond energies.

Table 4

Bond	C — H	Cl — Cl	C — Cl	H — Cl
Bond energy in kJ/mol	413	243	346	432

Calculate the overall energy change for the reaction.

[3 marks]

Overall energy change = _____ kJ/mol

9



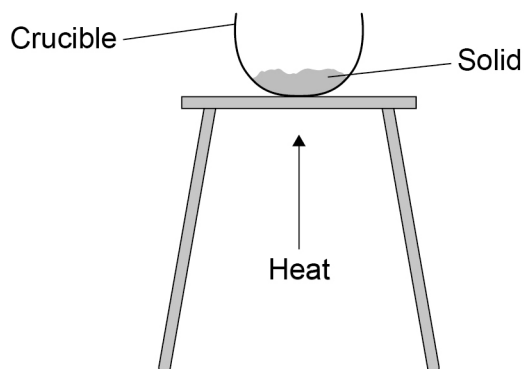
0 6

Some reactions appear to involve a change in mass.

A student investigated the change in mass when solids were heated.

Figure 7 shows the apparatus.

Figure 7



The student determined the mass of the contents of the crucible at regular intervals.

0 6 . 1

The student used a Bunsen burner instead of a water bath to heat the crucible.

Suggest **one** reason why.

[1 mark]

Question 6 continues on the next page

Turn over ►



The student planned to heat:

- 0.01 mol of magnesium
- 0.01 mol of magnesium carbonate.

The equations for the reactions are:

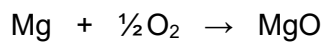
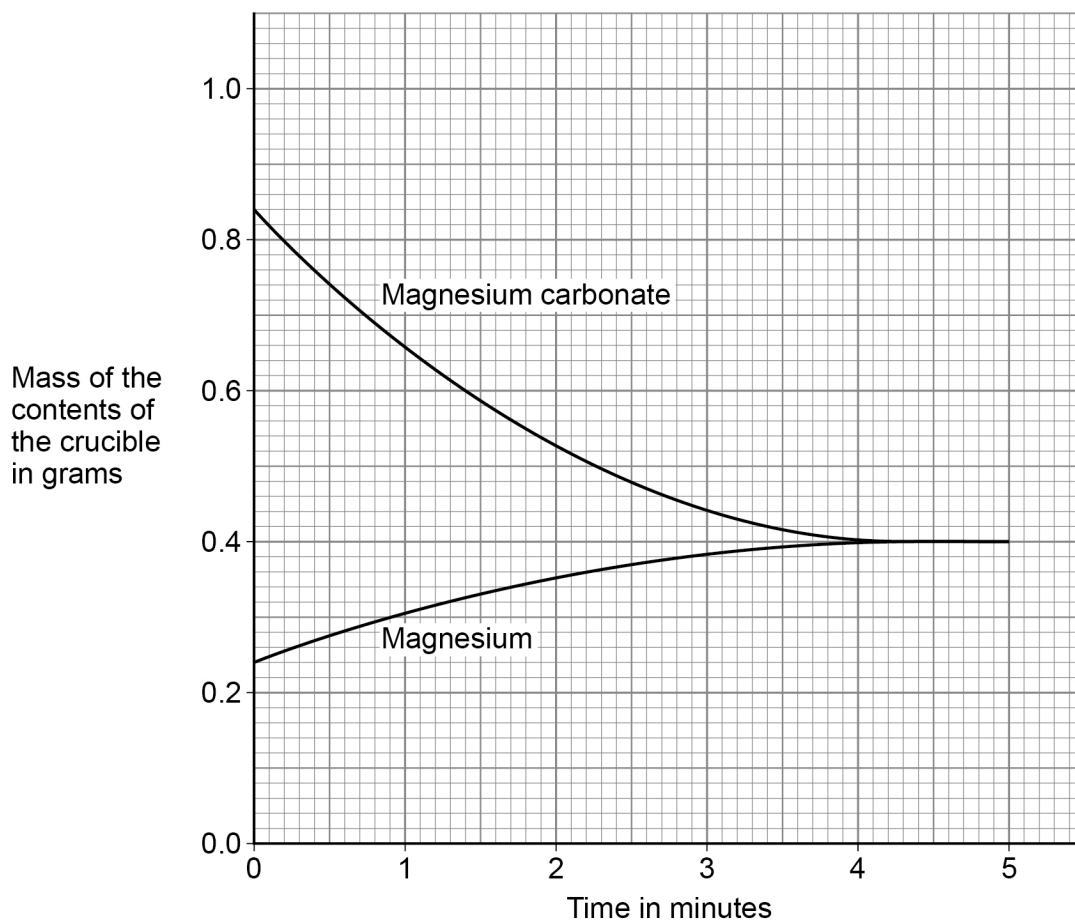


Figure 8 shows the student's **predicted** results.

Figure 8



0 6 . 2

Look at **Figure 8**.Explain the **two** trends for the first 3 minutes.**[4 marks]**

Magnesium _____

Magnesium carbonate _____

0 6 . 3

Figure 8 shows that both reactions are complete after 5 minutes.

Why is the final mass of the contents of the crucible the same for both reactions?

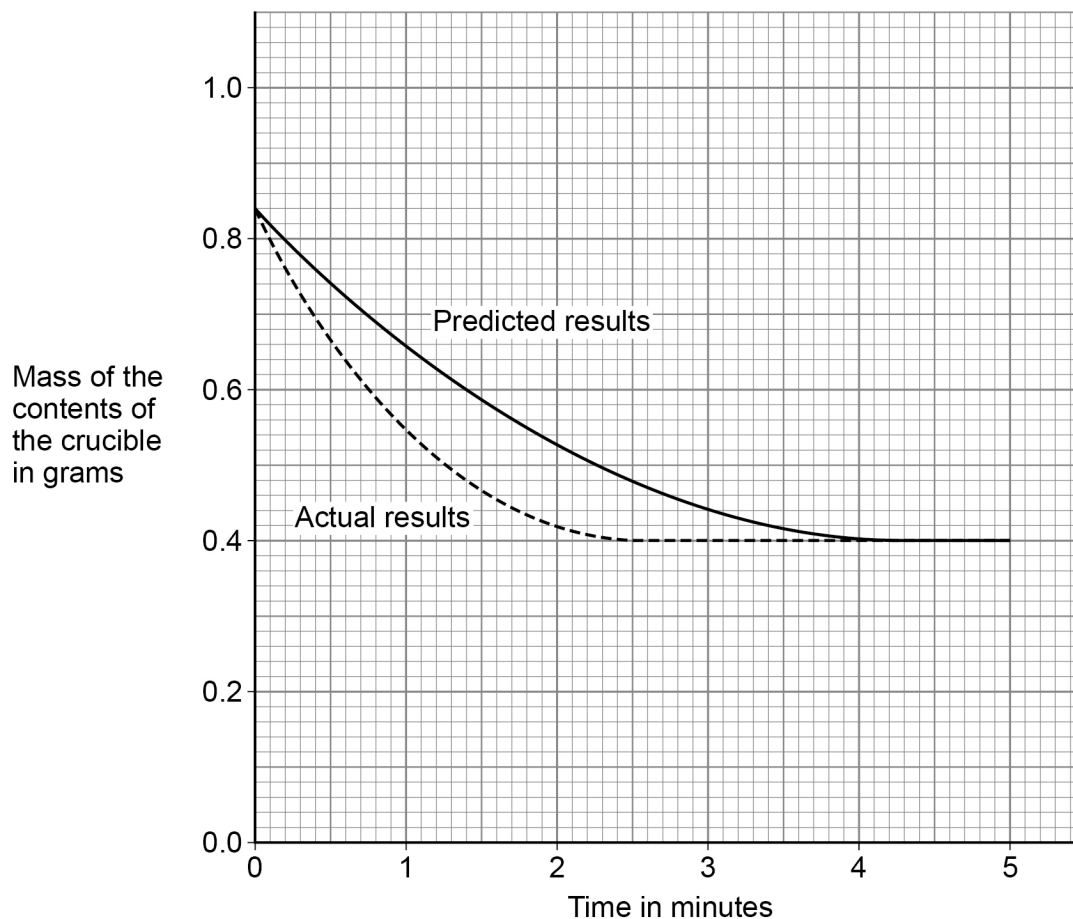
[1 mark]

Question 6 continues on the next page**Turn over ►**

0 6 . 4 The student heated magnesium carbonate.

Figure 9 shows the results.

Figure 9



The student concluded:

‘The difference between the predicted results and the actual results is caused by solid escaping from the crucible.’

Give **one** reason why the results show the student is **not** correct.

[1 mark]



0 6 . 5

Iron reacts with steam (H_2O) to produce an oxide of iron and hydrogen gas.

0.120 moles of iron reacts with 0.160 moles of steam.

Determine the balanced equation for the reaction.

You should determine:

- the simplest whole number mole ratio of Fe : H_2O
- the formula of the iron oxide produced.

[4 marks]

Simplest mole ratio of Fe : H_2O = _____ : _____

Formula of the iron oxide = _____

Balanced equation for the reaction:

_____ + _____ $\rightarrow$ _____ + _____

11

Turn over for the next question

Turn over ►



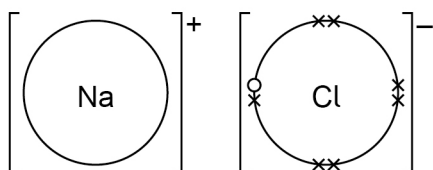
07

This question is about bonding and structures.

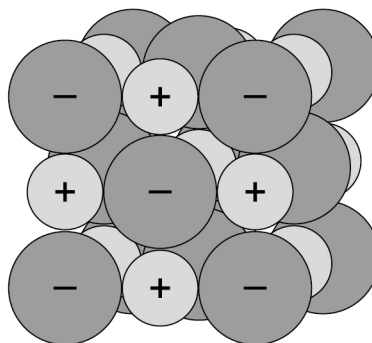
07.1

Figure 10 represents two models of sodium chloride.

Figure 10



Model A



Model B

Give **two** limitations of model **A** compared with model **B**.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

07.2

Aluminium sulfate consists of the ions:

- Al^{3+}
- SO_4^{2-}

What is the formula of aluminium sulfate?

[1 mark]



0 7 . 3 Metals have metallic bonding.

Suggest **one** reason why aluminium metal conducts electricity better than sodium metal.

[1 mark]

0 7 . 4 Silicon dioxide and the polymer poly(ethene) are solid substances.

Compare silicon dioxide with the polymer, poly(ethene).

Answer in terms of structure and bonding.

[4 marks]

Extra space _____

8

END OF QUESTIONS



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3 2



2 5 6 G 8 4 6 4 / C / 1 H

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