
INTERNATIONAL GCSE CORE CHEMISTRY

9222

Paper 1

Specimen paper

07:00 GMT

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a 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.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or 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 answer book. Cross through any work you do not want to be marked.
- Show all your working.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a calculator where appropriate.
- A periodic table is provided as a loose insert.

The letters **A, B, C, D** and **E** are **not** the symbols of the elements.

[illegible]

0	1	.	1
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[1 mark]

neutron number

Elements in the periodic table are arranged in columns known as groups.

0 1 . 2 Which element in **Figure 1** is in Group 3?

Tick (✓) **one** box.

[1 mark]

A ☐ B ☐ C ☐ D ☐ E ☐

0 1 . 3 Which element in **Figure 1** is a noble gas?

Tick (✓) **one** box.

[1 mark]

A ☐ B ☐ C ☐ D ☐ E ☐

0 1 . 4 Which **two** elements in **Figure 1** have the same number of outer shell electrons in their atoms?

Tick (✓) **two** boxes.

[1 mark]

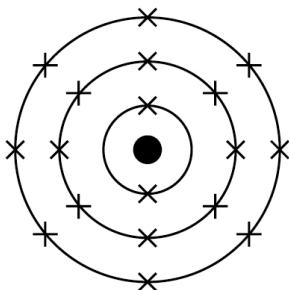
A ☐ B ☐ C ☐ D ☐ E ☐

Question 1 continues on the next page

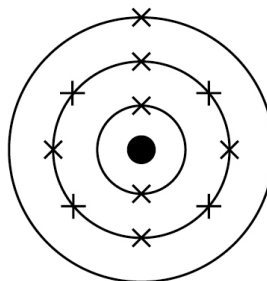
Figure 2 shows the electronic structure of an atom of argon and an atom of sodium.

Figure 2

Argon atom



Sodium atom



0 1 . 5

Give **one** similarity and **one** difference between the electronic structures of argon and sodium.

Use **Figure 2**.

[2 marks]

Similarity _____

Difference _____

0 1 . 6

What is the symbol for a sodium ion?

Use **Figure 2**.

Tick (✓) **one** box.

[1 mark]

Na ☐

Na⁺ ☐

Na⁻ ☐

0 1 . 7

What is the centre of an argon atom called?

[1 mark]

0 2

A student investigated the reaction of magnesium carbonate with hydrochloric acid.
A gas is produced.

0 2 . 1

What is the pH of hydrochloric acid?

Tick (✓) **one** box.

[1 mark]**1**☐**7**☐**10**☐**14**☐**0 2 . 2**

What is the formula of hydrochloric acid?

Tick (✓) **one** box.

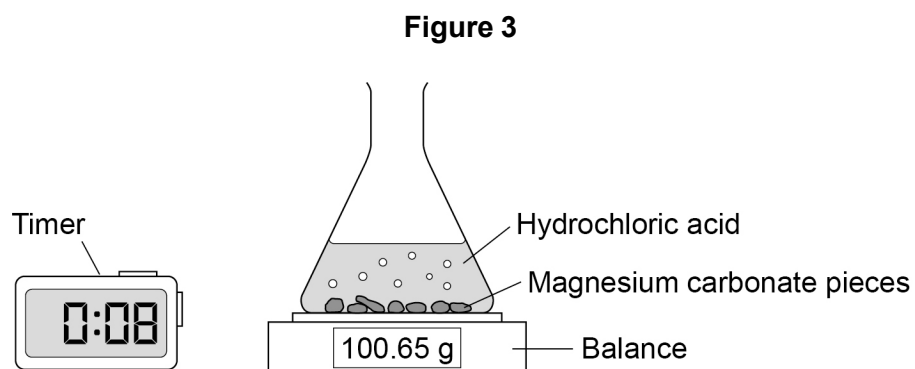
[1 mark]

HCl

☐HNO₃☐H₂SO₄☐

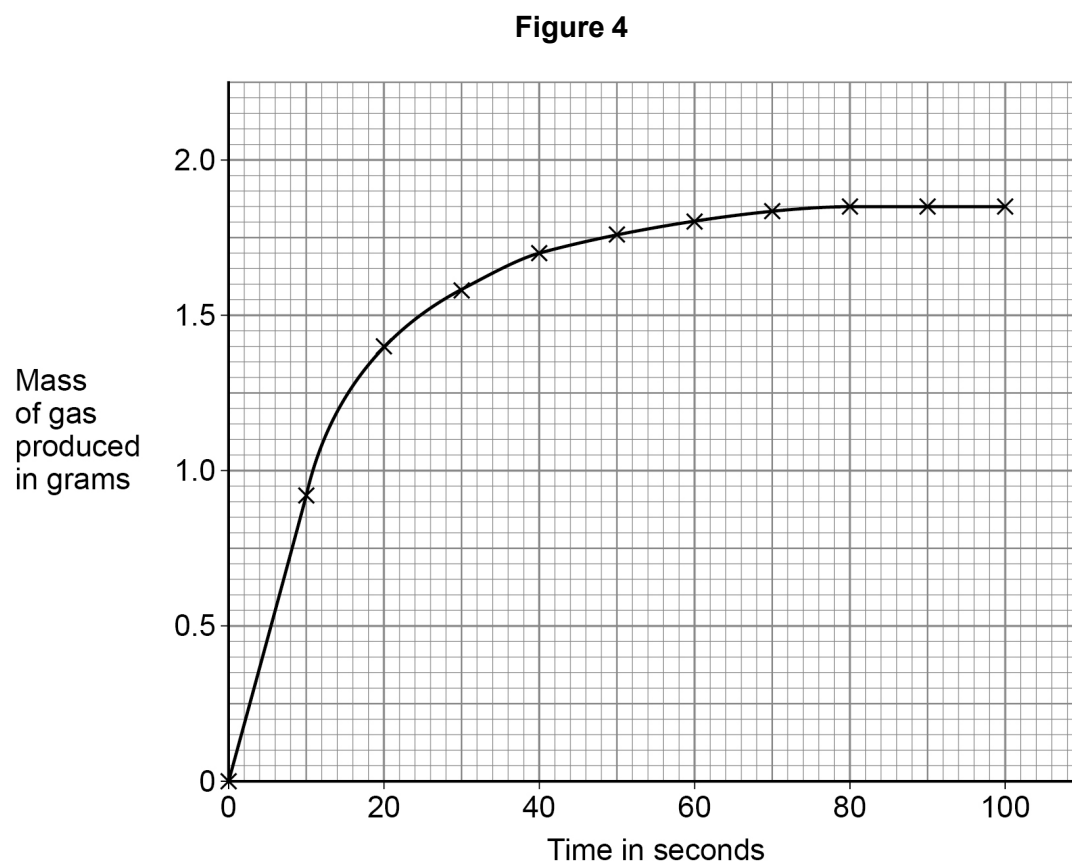
Question 2 continues on the next page

Figure 3 shows the apparatus.



The student determined the mass of gas produced every 10 seconds for 100 seconds.

Figure 4 shows the results.



0 2 . 3Suggest **one** safety precaution the student should take when doing the experiment.**[1 mark]**

0 2 . 4Give **three** conclusions from the results in **Figure 4**.**[3 marks]**1

2

3

0 2 . 5

Determine the mean rate of reaction between 20 seconds and 60 seconds.

Use **Figure 4**.**[4 marks]**

Mean rate of reaction = _____ g/s

Question 2 continues on the next page

The student changed the size of the magnesium carbonate pieces.

[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.[illegible]

0	2	.	7
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The formula of magnesium carbonate is MgCO_3

Calculate the percentage by mass of magnesium in magnesium carbonate.

Relative atomic masses (A_r): $\text{Mg} = 24$ $\text{C} = 12$ $\text{O} = 16$

Give your answer to 2 significant figures.

[4 marks]

Percentage by mass of magnesium (2 significant figures) = _____ %

20

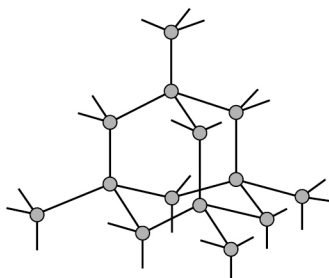
0 3

Diamond, graphite and fullerenes are different forms of carbon.

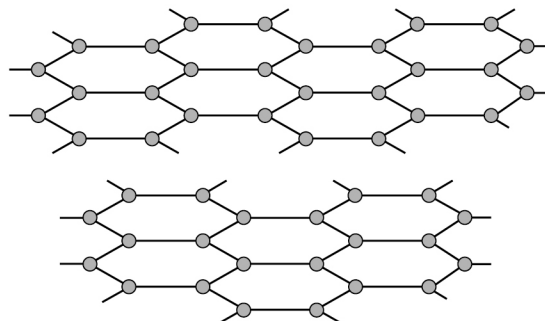
Diamond and graphite have giant covalent structures made of carbon atoms.

Figure 5 represents the structures of the diamond and graphite.

Figure 5



Diamond



Graphite

0 3 . 1

Give **two** differences between the **structures** of diamond and graphite.

Use **Figure 5**.

[2 marks]

- 1 _____
- _____
- 2 _____
- _____

0 3 . 2

Which is a property of diamond?

Tick (✓) **one** box.

[1 mark]

Conducts electricity

☐

Dissolves in water

☐

Hard

☐

0 3 . 3 Table 1 shows the relative hardness of diamond and of graphite.

Table 1

	Relative hardness
Diamond	10
Graphite	1.6

Calculate how many times harder diamond is than graphite.

[2 marks]

Number of times harder = _____

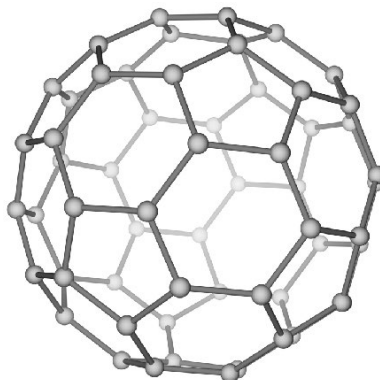
0 3 . 4 Explain why graphite is a good conductor of heat.

[3 marks]

Question 3 continues on the next page

Figure 6 represents the structure of a fullerene molecule.

Figure 6



0 3 . 5 Suggest why fullerenes are used as lubricants.

Use **Figure 6**.

[2 marks]

0 3 . 6 Give **one** other use for fullerenes.

[1 mark]

0 4

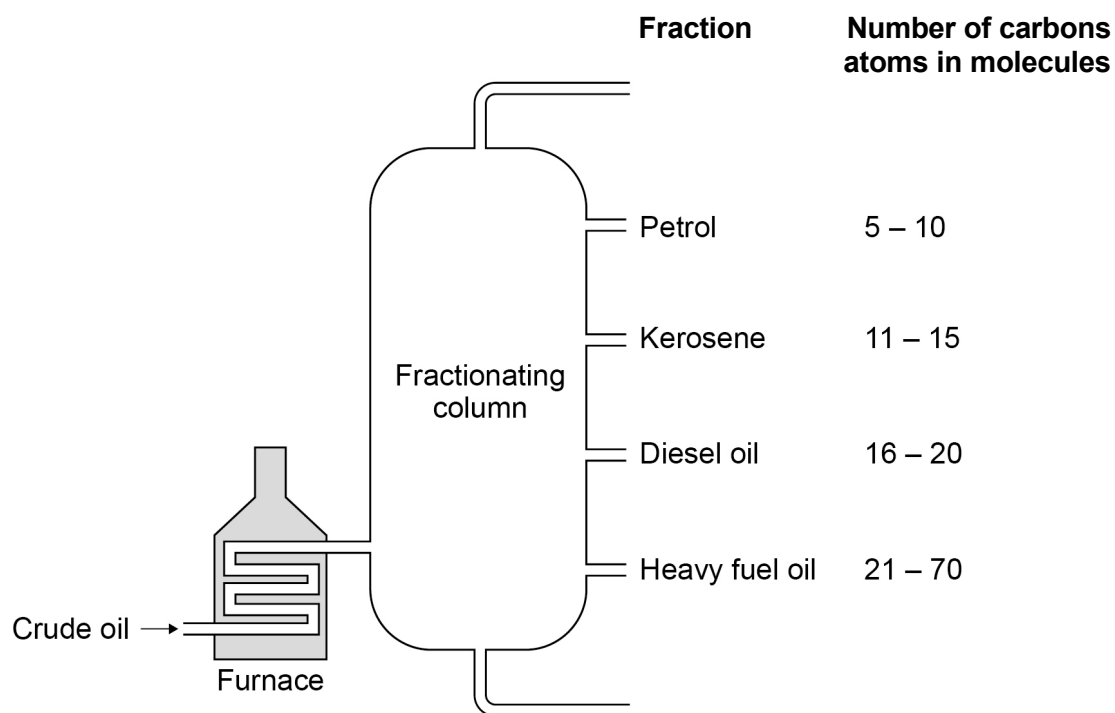
This question is about hydrocarbons.

Crude oil is a mixture of hydrocarbon molecules.

Crude oil is separated into fractions in a fractionating column.

Figure 7 shows a fractionating column.

Figure 7



0 4 . 1

Complete the sentence.

Choose the answer from the box.

[1 mark]

chromatography

crystallisation

distillation

filtration

Hydrocarbon molecules are separated from crude oil by fractional

_____.

0 4 . 2 Which fraction in **Figure 7** is the most flammable?

Tick (✓) **one** box.

[1 mark]

Diesel oil

☐

Heavy fuel oil

☐

Kerosene

☐

Petrol

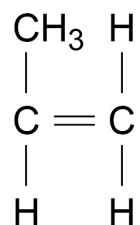
☐

Propene is a hydrocarbon produced from crude oil.

Propene is an alkene.

Figure 8 represents a molecule of propene (C_3H_6).

Figure 8

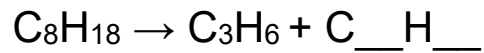


0 4 . 3 What does = represent in **Figure 8**?

[1 mark]

Octane (C_8H_{18}) can be cracked to produce propene (C_3H_6) and **one** other product.

The equation for the reaction is:



0 4 . 4 Which is the formula of the other product?

Tick (✓) **one** box.

[1 mark]

$$\text{C}_2\text{H}_6$$
$$\text{C}_3\text{H}_8$$

10

$$\text{C}_4\text{H}_{10}$$

10

$$\text{C}_5\text{H}_{12}$$

10

0 4 . 5 What type of reaction is cracking?

Tick (✓) **one** box.

[1 mark]

Combustion

11

Decomposition

7

Neutralisation

10

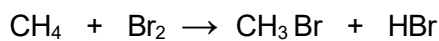
Oxidation

11

Methane is a hydrocarbon.

Methane reacts with bromine when sunlight is present.

The equation for the reaction is:



0 4 . 6

Sunlight provides the activation energy for the reaction.

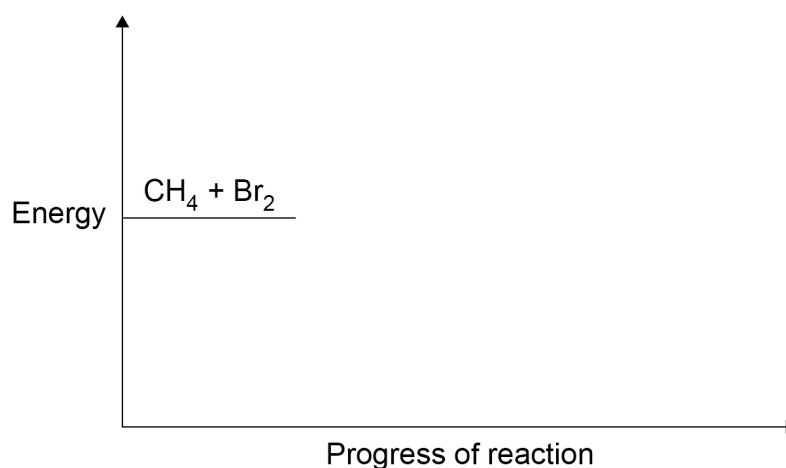
What is meant by 'activation energy'?

[1 mark]

0 4 . 7

Figure 9 shows part of an energy level diagram for the exothermic reaction between methane and bromine.

Figure 9



Complete **Figure 9**.

You should:

- label the activation energy
- label the overall energy change
- include the formulae of the products.

[4 marks]

0 4 . 8

Figure 10 shows the displayed structures for the reaction between methane and bromine.

Figure 10

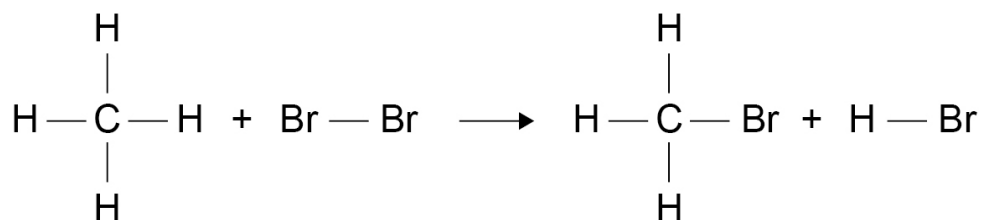


Table 2 shows the bond energies.

Table 2

Bond	C-H	Br-Br	C-Br	H-Br
Bond energy in kJ/mol	412	193	290	366

Calculate the enthalpy change (ΔH) of the reaction.

Use **Figure 10** and **Table 2**.

[4 marks]

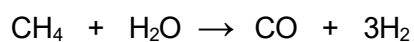
Enthalpy change (ΔH) = _____ kJ/mol

0	4	.	9
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Methane reacts with steam to produce carbon monoxide and hydrogen.

The reaction is endothermic.

The equation for the reaction is:



Explain why the reaction is endothermic.

Refer to bonds broken and bonds formed in your answer.

[3 marks]

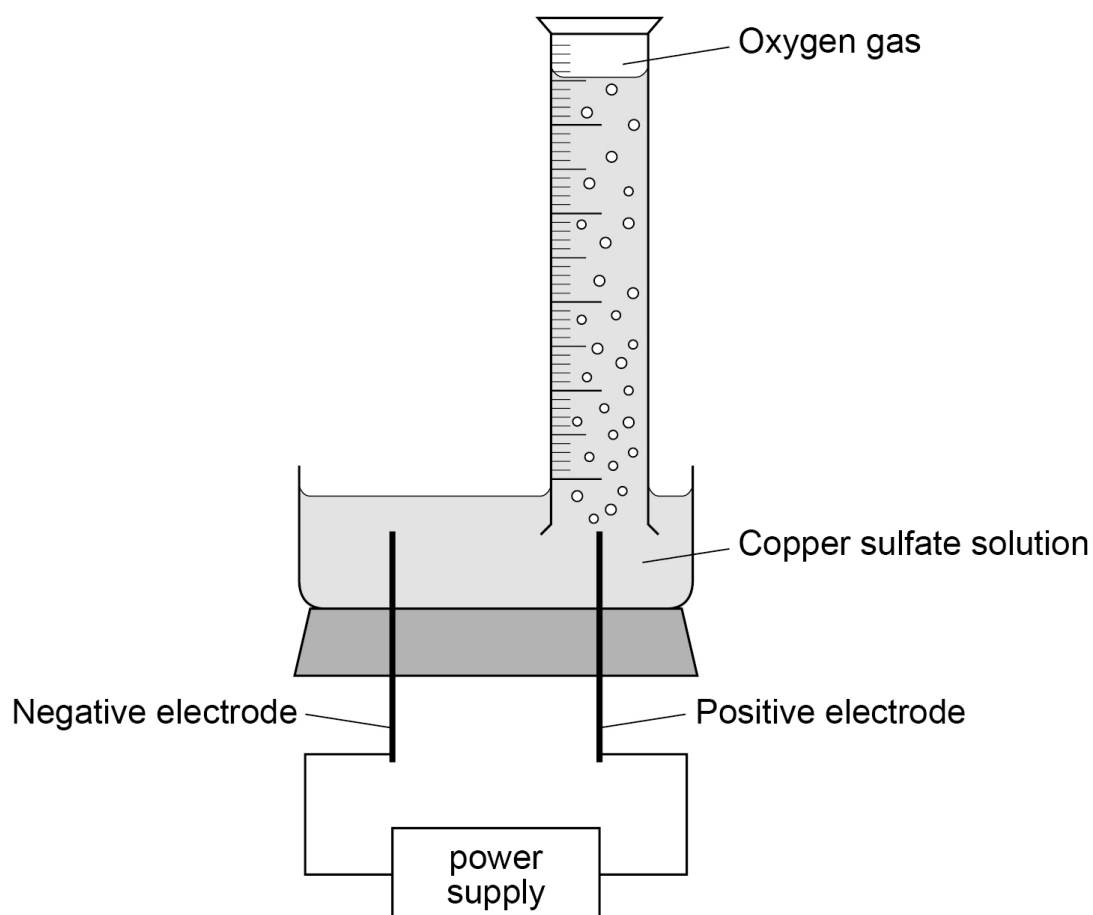
0 5

This question is about electrolysis.

A student investigated the electrolysis of copper sulfate solution.

Figure 11 shows the apparatus used.

Figure 11

**0 5 . 1**

What is the electrolyte in **Figure 11**?

Tick (✓) **one** box.

[1 mark]

Copper sulfate solution

☐

Oxygen gas

☐

Positive electrode

☐

Power supply

☐

Oxygen gas is produced during the electrolysis of copper sulfate.

The student measured the volume of oxygen gas produced during the experiment.

Table 3 shows the results.

Table 3

Time in seconds	Volume of oxygen gas in cm ³
0	0
120	4
240	8
360	12
480	18
600	20

0 5 . 2 Describe the test for oxygen gas.

Give the result if oxygen gas is present.

[2 marks]

Test _____

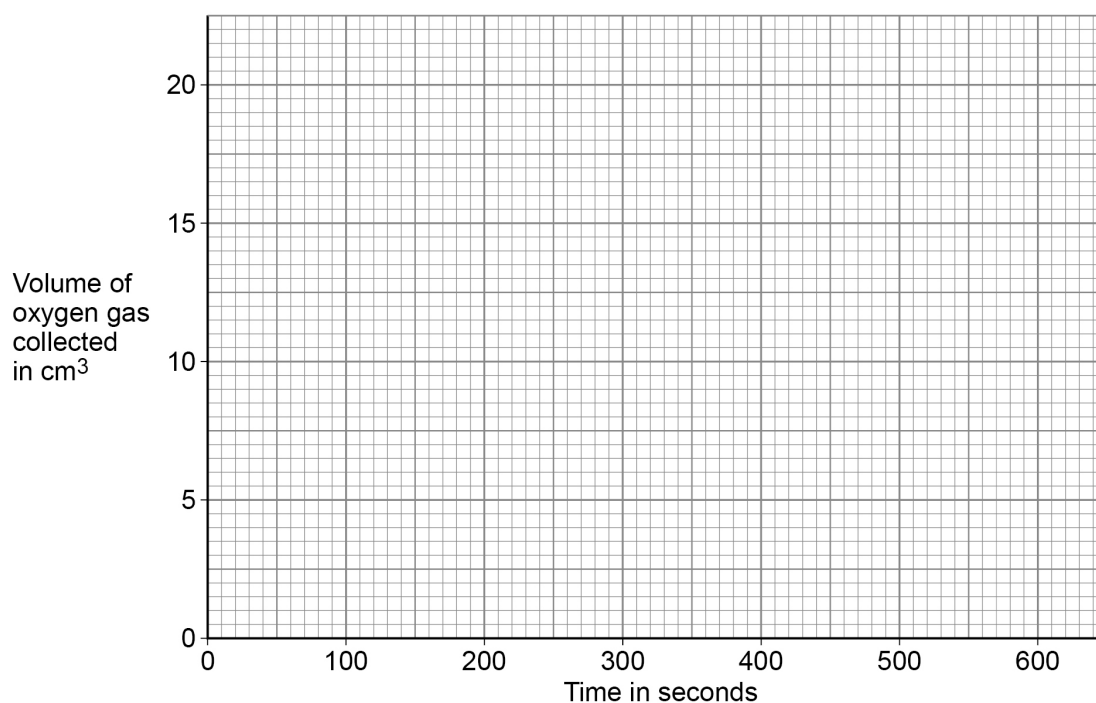
Result _____

0 5 . 3 Plot the data from **Table 3** on **Figure 12**.

Draw a line of best fit.

[3 marks]

Figure 12



0 5 . 4 Describe the relationship between the volume of oxygen gas collected and time.

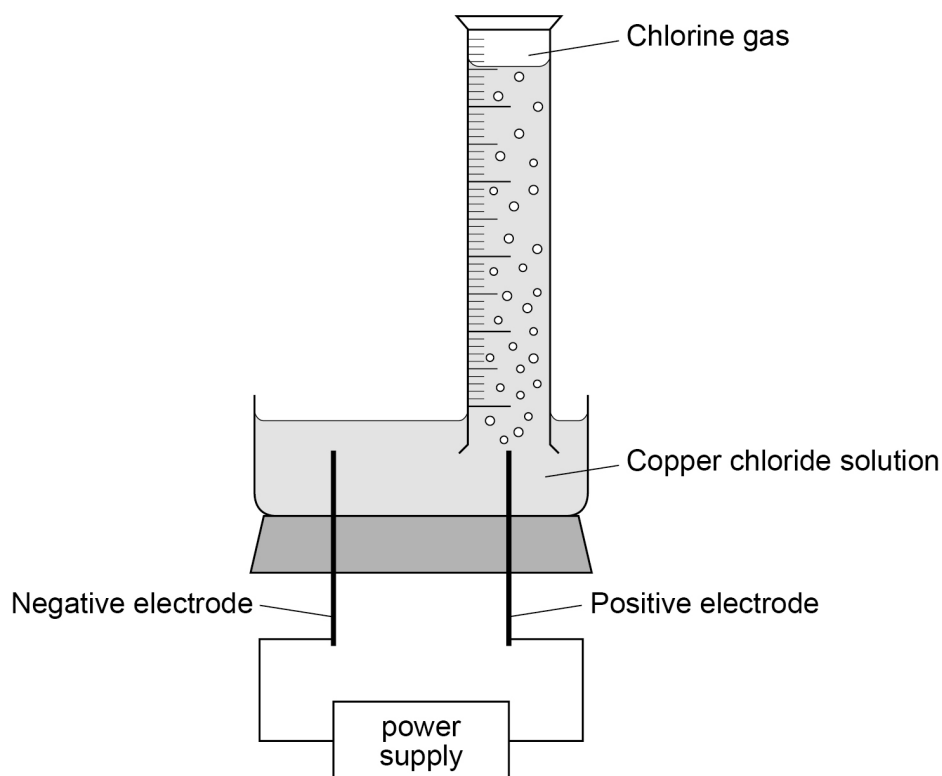
Use **Table 3** and **Figure 12**.

[2 marks]

A teacher then demonstrated the electrolysis of copper chloride solution.

Figure 13 shows the apparatus used.

Figure 13



0 5 . 5

Why does copper chloride need to be dissolved in water for electrolysis to occur?

[1 mark]

0 5 . 6

Explain how copper metal forms at the negative electrode.

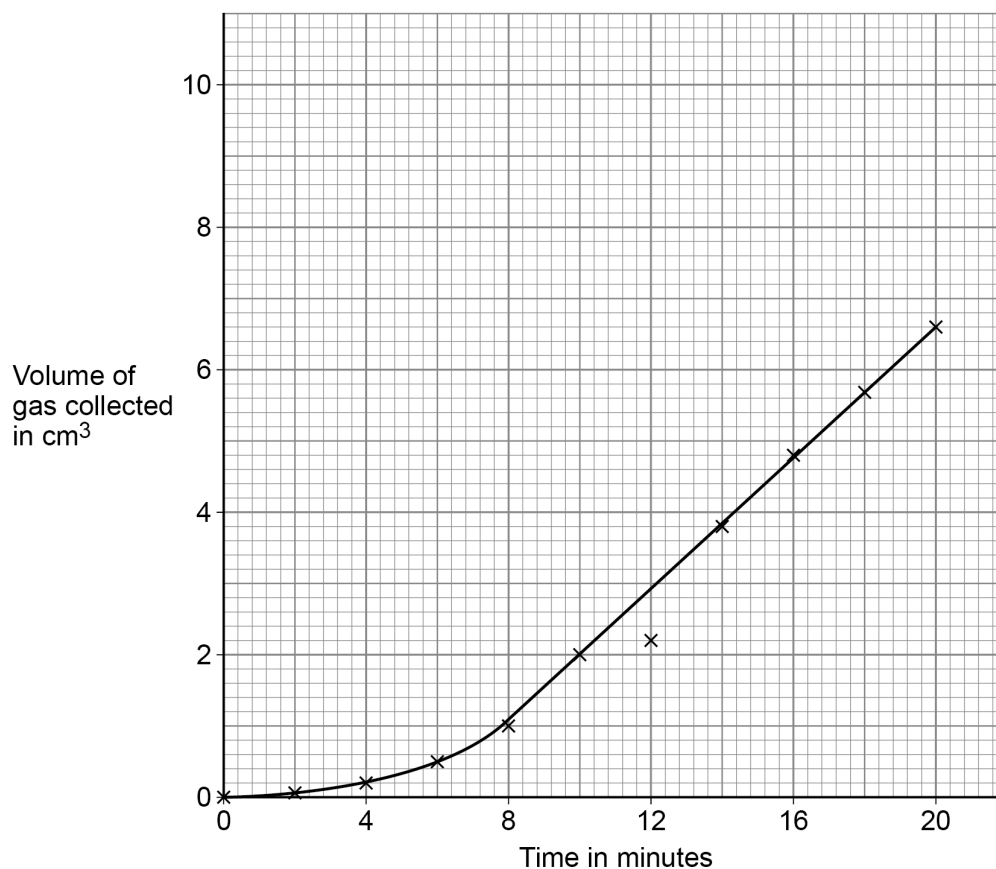
[4 marks]

The teacher measured the volume of chlorine gas collected at the positive electrode every 2 minutes.

Chlorine is soluble in water.

Figure 14 shows the results.

Figure 14



0 5 . 7

One of the results shown in **Figure 14** is anomalous.

Which result is anomalous?

Suggest **one** reason for the anomalous result.

[2 marks]

Anomalous result _____

Reason _____

05.8

Explain the trends shown in **Figure 14**.**[4 marks]**

0 6

This question is about Group 1 elements and their reactions.

0 6 . 1

What name is given to the elements in Group 1 of the periodic table?

Tick (✓) **one** box.**[1 mark]**

Alkali metals

☐

Halogens

☐

Noble gases

☐

Transition metals

☐**Table 4** gives some data about Group 1 elements.**Table 4**

Group 1 element	Melting point in °C	Density in g/cm ³
Lithium	181	0.53
Sodium	98	0.97
Potassium	63	0.86
Rubidium	39	1.53
Caesium	29	1.88
Francium	X	

0 6 . 2Describe the **two** trends shown in **Table 4** as you go down Group 1.**[2 marks]**

1

2

0 6 . 3 Predict the melting point (**X**) of francium.

Use **Table 4**.

[1 mark]

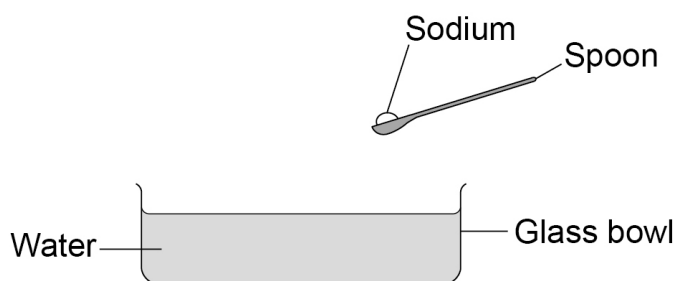
_____ °C

Group 1 elements react with water.

A teacher added a small piece of sodium to water.

Figure 15 shows the apparatus.

Figure 15



The sodium floated on the water.

0 6 . 4 Give **one** other observation made when a small piece of sodium is added to water.

You should **not** refer to floating in your answer.

[1 mark]

0 6 . 5 A small piece of rubidium does **not** float on the surface of the water.

Why does rubidium **not** float on water?

[1 mark]

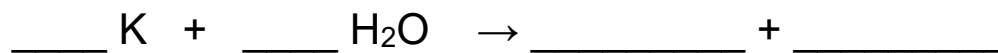
0 6 . 6

Potassium reacts with water to produce potassium hydroxide and hydrogen.

Complete the equation for the reaction of potassium with water.

You should balance the equation.

[3 marks]



0 6 . 7

Explain how the reactivity of the elements changes going down Group 1.

[4 marks]

0	7
---	---

This question is about metal compounds.

Magnesium reacts with fluorine to produce the ionic compound magnesium fluoride.

0	7	.	1
---	---	---	---

Describe what happens when magnesium atoms react with fluorine atoms to produce magnesium fluoride.

[4 marks]

0	7	.	2
---	---	---	---

Explain why magnesium fluoride has a high melting point.

You should answer in terms of structure and bonding.

[4 marks]

0 7 . 3

Table 5 shows the melting points of two magnesium compounds.

Table 5

	Melting point in °C
Magnesium fluoride	1263
Magnesium oxide	2852

Suggest **one** reason why the melting point of magnesium oxide is higher than the melting point of magnesium fluoride.

[1 mark]

0 7 . 4

Lithium carbonate has the formula Li_2CO_3

Calculate the number of moles of lithium ions in 3.70 g of lithium carbonate.

Relative formula mass (M_r): $\text{Li}_2\text{CO}_3 = 74$

[3 marks]

Moles of lithium ions = _____

12

END OF QUESTIONS