



Oxford Cambridge and RSA

Friday 13 June 2025 – Morning

GCSE (9–1) Chemistry A (Gateway Science)

J248/02 (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:

- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Chemistry A (inside this document)

You can use:

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

Last name

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined page at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **32** pages.

ADVICE

- Read each question carefully before you start your answer.

Section A

You should spend a **maximum** of **30 minutes** on this section.

Write your answer to each question in the box provided.

- 1 Butane is an alkane.

What is a **use** for butane?

- A Ceramics
- B Fertiliser
- C Fuel
- D Surfacing roads

Your answer

[1]

- 2 A student adds sodium hydroxide to a solution containing copper ions.

Which colour **precipitate** is made?

- A Blue
- B Green
- C Orange-brown
- D White

Your answer

[1]

- 3 Which molecule can be cracked to make octane, C_8H_{18} ?

- A C_6H_{12}
- B C_6H_{14}
- C C_8H_{16}
- D $C_{12}H_{26}$

Your answer

[1]

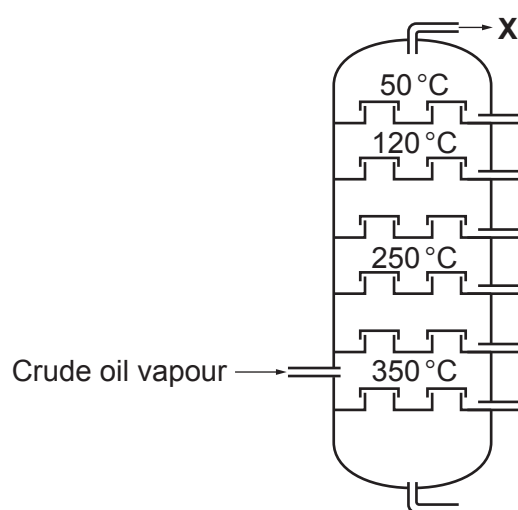
4 What is a property of a **Group 1** metal?

- A Brittle
- B Does not conduct electricity
- C Forms coloured compounds
- D Low density

Your answer

[1]

5 Crude oil is separated into fractions by fractional distillation.



Which fraction is obtained at **X**?

- A Bitumen
- B Diesel
- C LPG
- D Petrol

Your answer

[1]

- 6 Magnesium reacts with excess hydrochloric acid.

What would **increase** the rate of the reaction?

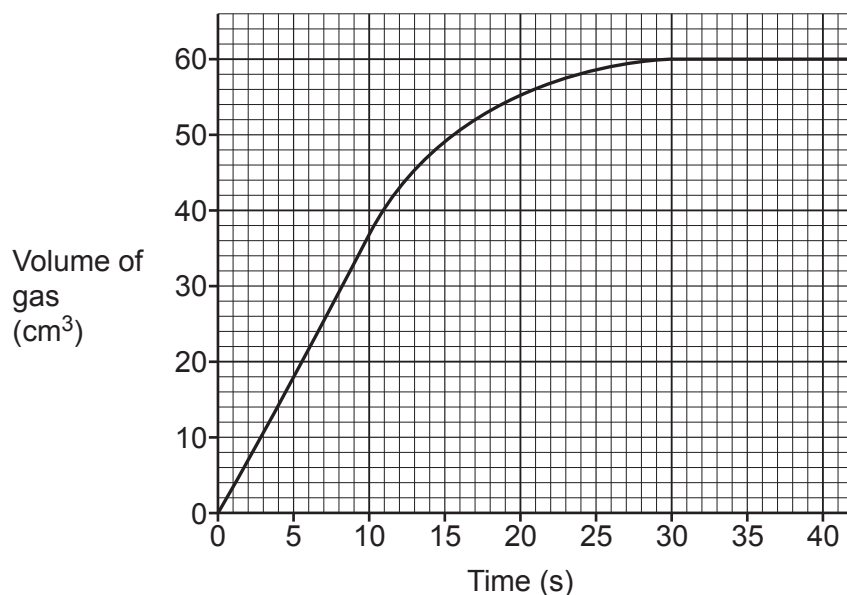
- A Use a larger volume of hydrochloric acid.
- B Use a smaller beaker for the reaction.
- C Use larger pieces of magnesium.
- D Use more concentrated hydrochloric acid.

Your answer

[1]

- 7 A student measures the volume of gas made during a reaction.

The graph shows their results.



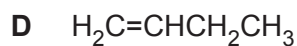
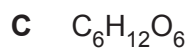
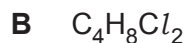
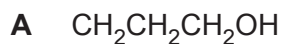
Which statement about the reaction is **not** correct?

- A The final volume of gas made is 60 cm³.
- B The rate of reaction speeds up during the reaction.
- C The reaction finishes at 30 s.
- D The volume of gas made increases during the reaction.

Your answer

[1]

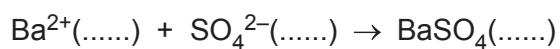
8 Which of the following formulas is for a **hydrocarbon**?



Your answer

[1]

9 A solution of barium ions reacts with a solution of sulfate ions to form a white precipitate.



What is the state symbol for each species?

	Ba^{2+}	SO_4^{2-}	BaSO_4
A	aq	aq	s
B	aq	l	s
C	l	aq	l
D	l	l	s

Your answer

[1]

10 What are the products of the **complete** combustion of methane?

A Carbon and water

B Carbon, carbon monoxide, carbon dioxide and water

C Carbon dioxide and water

D Carbon monoxide and water

Your answer

[1]

- 11 The alkanes have the general formula C_nH_{2n+2} .

What is the formula for the alkane with 7 carbon atoms?

- A C_7H_{14}
- B C_7H_{16}
- C C_7H_{18}
- D C_7H_{20}

Your answer

[1]

- 12 What is a **disadvantage** of using a hydrogen/oxygen fuel cell instead of petrol to power a car?

- A Hydrogen is a renewable resource.
- B Hydrogen is difficult to store.
- C The fuel cell does not produce carbon dioxide.
- D The fuel cell only produces water.

Your answer

[1]

- 13 The theoretical yield of a product in a reaction is 100g.

The actual yield is 60g.

What is the **percentage yield**?

- A 40%
- B 60%
- C 67%
- D 167%

Your answer

[1]

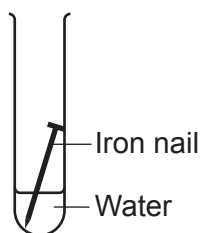
- 14 Which row in the table shows the change in the percentage of each gas in the **Earth's atmosphere today** compared to the Earth's early atmosphere?

	Carbon dioxide	Oxygen
A	decreased	decreased
B	decreased	increased
C	increased	decreased
D	increased	increased

Your answer

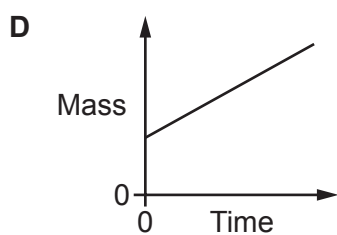
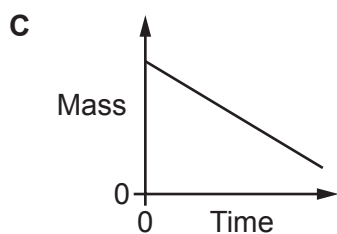
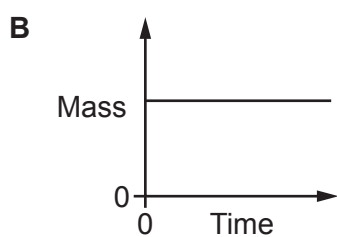
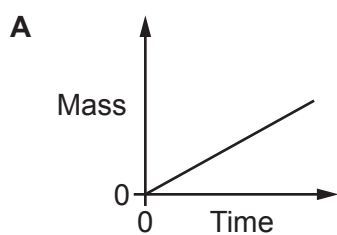
[1]

- 15 An iron nail is left in a test tube containing water.



The iron nail rusts.

Which graph shows how the mass of the iron nail changes?



Your answer

[1]

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Section B

16 An alloy is a mixture of a metal and one or more other elements.

(a) Brass is an example of an alloy.

Complete the sentence about brass.

Use a word from the list.

iron	magnesium	zinc
------	-----------	------

Brass is an alloy of copper and

[1]

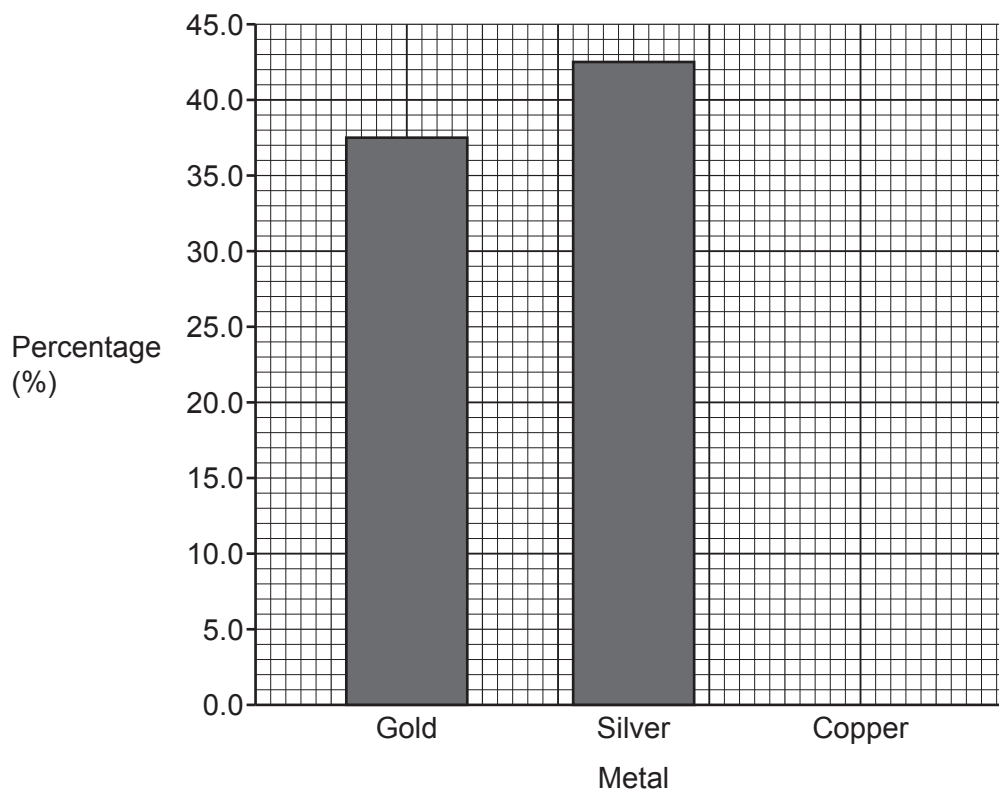
(b) A 9 carat gold ring is made from a mixture of metals.

Table 16.1 shows the percentage of the different metals in the ring.

Table 16.1

Metal	Percentage (%)
Gold	37.5
Silver	42.5
Copper	20.0

(i) Complete the bar chart by drawing the bar for copper.



[1]

- (ii) The ring has a mass of 5.0 g.

Calculate the mass of **gold** in the ring. Use **Table 16.1**.

Mass of gold = g [2]

- (c) Magnalium is an alloy of aluminium and magnesium.

Table 16.2 shows some information about aluminium, magnesium and magnalium.

Table 16.2

	Density (g/cm ³)	Relative strength	Resistance to corrosion
Aluminium	2.7	low	high
Magnesium	1.7	low	low
Magnalium	2.0	high	very high

Magnalium is used to make aircraft parts.

Explain why magnalium is used to make aircraft parts rather than pure aluminium or pure magnesium.

Use the information in **Table 16.2**.

.....

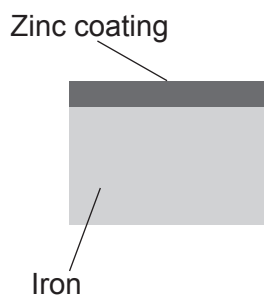
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.....

.....

..... [3]

- (d) Iron can be protected from corrosion (rusting) by coating the iron with a layer of zinc.



- (i) Explain how the layer of zinc acts as a barrier to protect the iron from corrosion.

.....
..... [1]

- (ii) Explain how the iron is protected from corrosion even if the layer of zinc is damaged.

.....
..... [1]

13
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17 This question is about metals.

Part of the reactivity series is:

Metal X	Most reactive
Sodium	
Magnesium	
Carbon	
Metal Y	
Iron	
Copper	Least reactive

(a) Draw **two** lines to connect each **metal** with the correct **method used to extract the metal**.

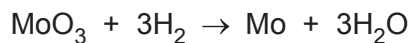
Use the reactivity series.

Metal	Method used to extract the metal
	extracted by electrolysis of a molten ionic compound
Metal X	
	extracted from its oxide by heating with carbon
Metal Y	
	extracted from the Earth as the metal itself

[2]

- (b) Metals can also be extracted from their metal oxide by reduction with hydrogen.

The equation shows how the metal molybdenum, Mo, is extracted using hydrogen.



- (i) Explain how the equation shows that molybdenum oxide, MoO_3 , is **reduced**.

.....
 [1]

- (ii) Calculate the atom economy for the reaction.

Use the equation:

$$\text{atom economy} = \frac{A_r \text{ of Mo}}{A_r \text{ of Mo} + M_r \text{ of } 3\text{H}_2\text{O}} \times 100$$

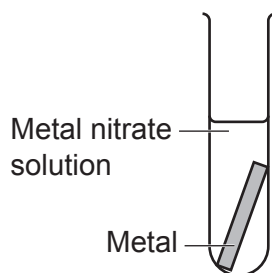
Relative atomic mass (A_r): H = 1.0 O = 16.0 Mo = 95.9

Give your answer to **2** significant figures.

Atom economy = % [3]

- (c) A student investigates the reactivity of four different metals, **A**, **B**, **C** and **D**.

The student adds a piece of each metal to a metal nitrate solution of each of the metals.



- (i) State **one** observation that would show that a reaction took place.

.....
 [1]

- (ii) The table shows the student's results.

	Metal nitrate solution			
Metal	Metal A nitrate	Metal B nitrate	Metal C nitrate	Metal D nitrate
A	x	x	✓	x
B	✓	x	✓	x
C	x	x	x	x
D	✓	✓	✓	x

✓ means a reaction took place

x means a reaction did **not** take place

Write the four different metals, **A**, **B**, **C** and **D**, in order of reactivity.

..... **Most reactive**

.....

.....

..... **Least reactive**

[2]

- (iii) Explain why you placed the metals in this order of reactivity.

.....
 [1]

(d) Copper is a transition metal.

Potassium is a Group 1 metal.

Identify **two** differences between copper and potassium.

Tick (✓) **two** boxes.

Copper has a lower melting point.

☐

Copper is harder.

☐

Copper is less dense.

☐

Copper is less reactive.

☐

Copper is less strong.

☐

[2]

18 A life-cycle assessment is an analysis of the overall environmental impact that a product may have throughout its lifetime.

(a) The life-cycle assessment is broken down into different stages.

The first stage is looking at obtaining the **raw materials**.

State **one** other stage in a life-cycle assessment.

..... [1]

(b) A company does a life-cycle assessment to investigate two possible materials for making a single-use takeaway food container.

Table 18.1 gives some of the information the company uses.

Table 18.1

	Aluminium	Poly(propene)
Mass of raw materials (g)	8	31.5
Energy used (MJ/kg)	61	73
Percentage recycled (%)	54	11
Cost per kg (£)	1.40	0.98

The company decides to use aluminium to make the food container.

Explain why using aluminium is better than using poly(propene).

Use information from **Table 18.1**.

.....

.....

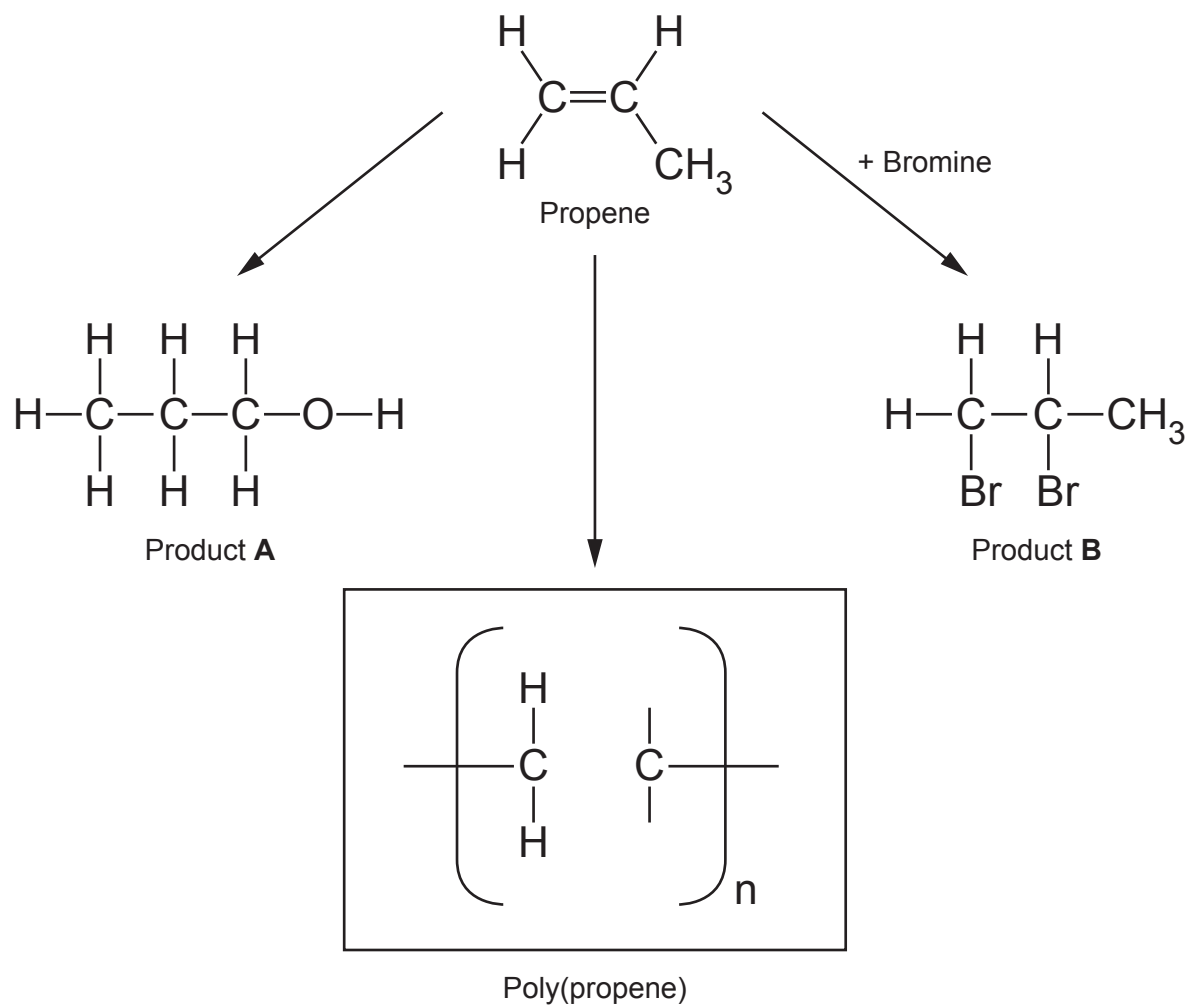
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.....

..... [3]

(c) Fig. 18.1 shows some reactions of propene.

Fig. 18.1



(i) State the name of product **A**.

..... [1]

(ii) State the colour change when bromine is added to propene to make product **B**.

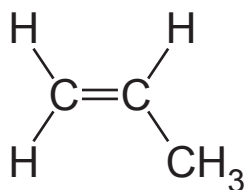
..... [1]

(iii) Poly(propene) is made by addition polymerisation of propene monomers.

Complete the structure of poly(propene) in the box on Fig. 18.1.

[2]

(d) Propene is an alkene.



(i) Propene reacts with hydrogen to make propane, C_3H_8 .

Describe how the structure of propane is different from propene.

Use ideas about covalent bonds.

Propane

Propene

[2]

(ii) Table 18.2 shows the boiling points of the first four alkenes.

Table 18.2

	Boiling point (°C)
Ethene	−104
Propene	−47
Butene	−6
Pentene	30

State what happens to the boiling point as the number of carbon atoms in the alkene increases.

..... [1]

19 In the last 75 years there has been an increase in both

- the world population
- the concentration of carbon dioxide in the atmosphere.

(a) Why may the increase in the world population have caused the increase in the concentration of carbon dioxide in the atmosphere?

Tick (✓) **one** box.

More fossil fuels are being burned.

☐

More people are cycling instead of driving.

☐

More trees are being planted.

☐

More wind turbines are being used.

☐

[1]

(b) A problem with an increase in the concentration of carbon dioxide is global warming.

State **two** problems caused by global warming.

1

2

[2]

(c) Describe the test for carbon dioxide gas.

Test

Result

[2]

20 A student plans a titration experiment to find the concentration of a solution of sulfuric acid.

This is their method:

- Fill the burette with dilute sulfuric acid.
- Add 25.0 cm^3 of 0.50 mol/dm^3 sodium hydroxide solution to a conical flask.
- Add 5 drops of indicator to the sodium hydroxide solution.
- Add the dilute sulfuric acid to the sodium hydroxide solution until the indicator changes colour.
- Repeat the titration.

(a)

(i) Which piece of equipment should the student use to accurately measure the 25.0 cm^3 of sodium hydroxide solution?

Tick (✓) **one** box.

Beaker

☐

Dropping pipette

☐

Measuring cylinder

☐

Volumetric pipette

☐

[1]

(ii) State a suitable indicator for the student to use in the titration.

..... **[1]**

(iii) Suggest an improvement to the student's method.

.....

..... **[1]**

- (b) The reading at the start of the rough titration is 0.0 cm^3 .

At the end of the rough titration the student reads the volume of dilute sulfuric acid added from the burette.



What is the volume of dilute sulfuric acid added?

Give your answer to **1** decimal place.

Volume = cm^3

[1]

- (c) After the rough titration the student repeats the experiment four more times.

The table shows their results.

Titration number	1	2	3	4
Volume of dilute sulfuric acid added (cm^3)	24.40	24.50	24.50	24.40

Calculate the mean volume of dilute sulfuric acid added.

Give your answer to **2** decimal places.

Mean volume of dilute sulfuric acid = cm^3 [2]

- (d) Write the **balanced symbol equation** for the reaction between sulfuric acid, H_2SO_4 , and sodium hydroxide, NaOH .

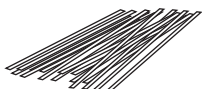
Sodium sulfate, Na_2SO_4 , and water are made.

..... [2]

They think the solid is one of the following:

- lithium bromide
- lithium iodide
- sodium carbonate.

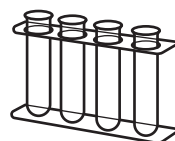
A lit Bunsen burner



Wooden splints



Pipette



Test tubes and rack



Dilute
nitric
acid



Silver
nitrate
solution

Distilled
water

Include the results of each experiment.

[6]

- (b) Instrumental methods of analysis can be used to analyse chemical substances.

State **two advantages** of instrumental methods of analysis.

1

2 [2]

- (c) Chlorine, Cl_2 , reacts with lithium bromide, LiBr .

- (i) Complete the **balanced symbol equation** for the reaction.



- (ii) Chlorine, bromine and iodine are in Group 7.

Cl Chlorine
Br Bromine
I Iodine

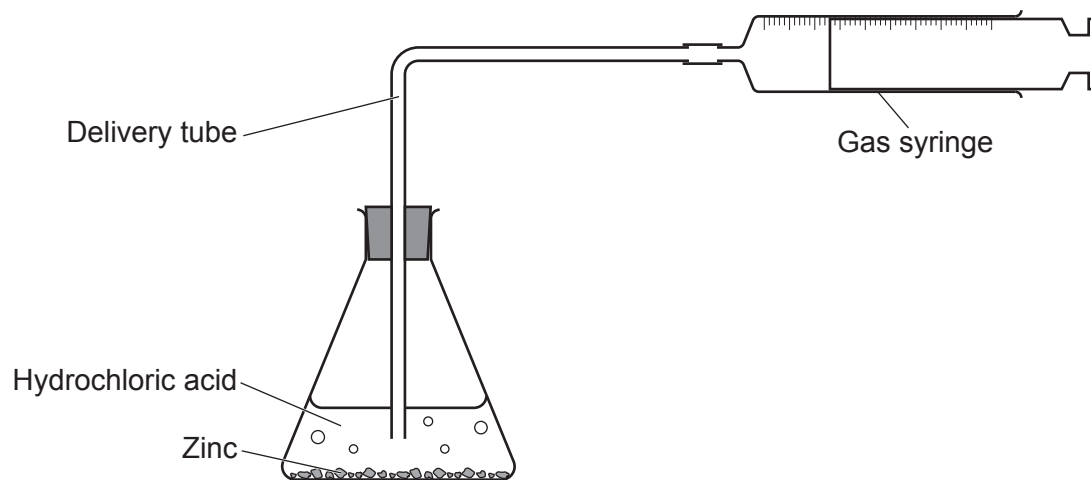
Iodine, I_2 , does **not** react with lithium bromide.

Explain why.

.....
 [2]

- 22 A student investigates the rate of the reaction between zinc and an excess of hydrochloric acid.

The diagram shows the equipment the student uses.



- (a) The student has made a mistake setting up the delivery tube in their experiment.

Describe the mistake and the problem this will cause.

Mistake

.....

Problem

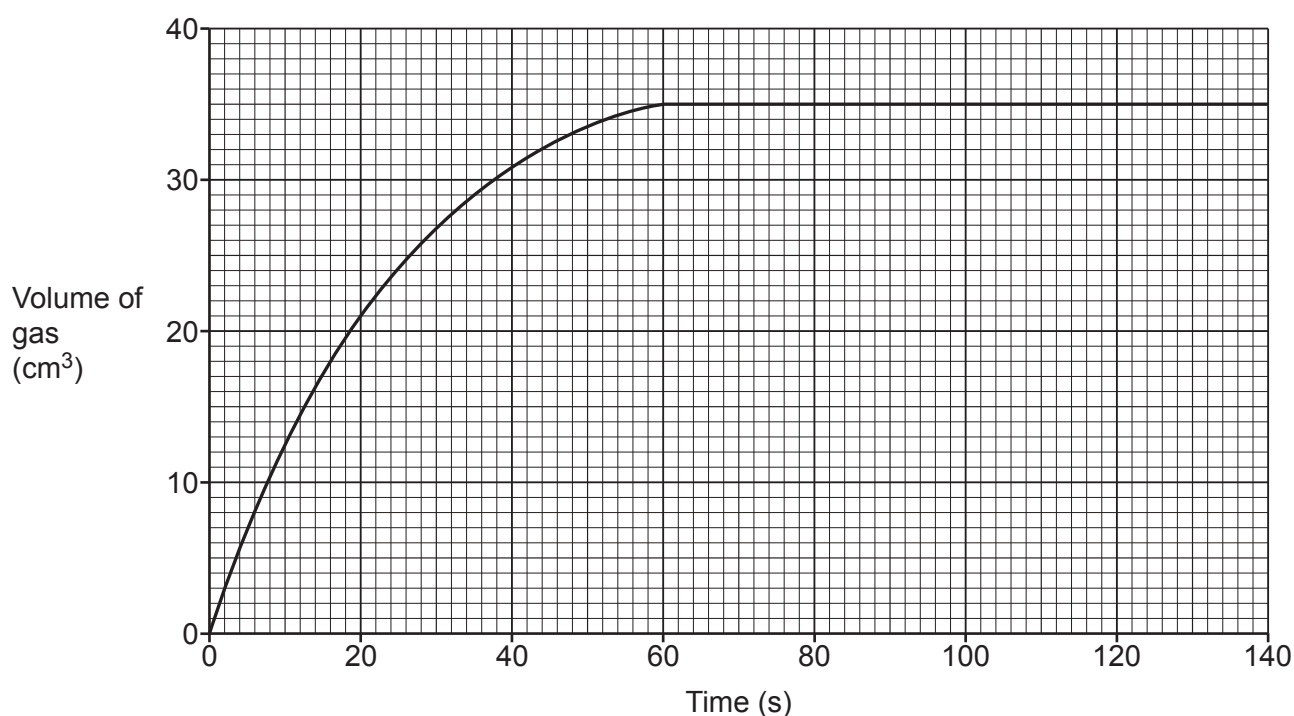
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[2]

(b) The student sets up the experiment correctly.

They measure the volume of gas every 20 seconds.

The graph shows their results.



(i) Calculate the mean rate of reaction between 0 seconds and 60 seconds.

Use the graph and the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas}}{\text{time}}$$

Give the units for your answer.

Mean rate of reaction = Units [4]

(ii) The student repeats the experiment.

They use the same mass of zinc, but in **smaller** pieces.

Draw a line on the graph to show the student's results.

[2]

- (c) The reaction is faster when **more concentrated** hydrochloric acid is used.

Explain why.

.....

.....

..... [2]

29
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23 Ammonia is made from nitrogen and hydrogen in the Haber process.

The word equation for the reaction is:

nitrogen + hydrogen $\rightleftharpoons$ ammonia

(a) What does the symbol $\rightleftharpoons$ tell you about the reaction?

..... [1]

(b) A catalyst is used in the Haber process.

(i) What is the catalyst used?

Tick (✓) **one** box.

Iron

☐

Manganese(IV) oxide

☐

Nickel

☐

Platinum

☐

[1]

(ii) Explain how the catalyst speeds up the reaction.

.....
.....
..... [2]

(c) Ammonia is used in the manufacture of fertilisers.

NPK fertilisers contain the essential elements nitrogen, phosphorus, and potassium.

The table shows the percentages of nitrogen, phosphorus, and potassium in four different fertilisers.

Fertiliser	Percentage (%) of essential element		
	Nitrogen	Phosphorus	Potassium
A	12	6	36
B	8	8	30
C	12	12	17
D	15	5	12

Plants do **not** grow well if they get too little of these essential elements because:

- too little nitrogen can cause yellow leaves
- too little phosphorus can cause poor root growth
- too little potassium can cause poor fruit growth.

(i) Which fertiliser is best at preventing yellow leaves **and** poor fruit growth?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

[1]

(ii) A farmer buys a 25 kg bag of fertiliser **C**.

Calculate the mass of **potassium** in the bag of fertiliser.

Mass of potassium = kg [2]

(iii) Fertilisers are made in industry using a continuous process.

Fertilisers can be made in a school laboratory using a batch process.

State **one advantage** of using a continuous process.

.....
 [1]

END OF QUESTION PAPER

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