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CHEMISTRY**0620/61**

Paper 6 Alternative to Practical

May/June 2025**1 hour**

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
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- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

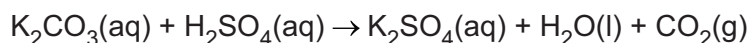
INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **16** pages. Any blank pages are indicated.



- 1 A student prepares some crystals of pure potassium sulfate by reacting aqueous potassium carbonate with dilute sulfuric acid. The equation for the reaction is shown.



The student:

- places 25.0 cm^3 of aqueous potassium carbonate in a conical flask
- adds a few drops of a suitable indicator to the conical flask
- uses a burette to add dilute sulfuric acid to the conical flask until the end-point is reached and the indicator changes colour.

Table 1.1 shows the burette readings the student obtains.

Table 1.1

final burette reading / cm^3	18.8
initial burette reading / cm^3	4.2
volume of dilute sulfuric acid added / cm^3	

- (a) Complete Table 1.1 by calculating the volume of dilute sulfuric acid added to the conical flask. [1]

- (b) State which solution, aqueous potassium carbonate or dilute sulfuric acid, is the **least** concentrated. Give a reason for your answer.

least concentrated solution

reason [1]

- (c) Name a piece of apparatus suitable for measuring the 25.0 cm^3 of aqueous potassium carbonate.

..... [1]

- (d) Name a suitable indicator and give the colour change of this indicator at the end-point.

indicator

colour change at end-point to [2]

- (e) As the student added the dilute sulfuric acid to the aqueous potassium carbonate they looked for a colour change.

State what the student should do as they add the dilute sulfuric acid to the aqueous potassium carbonate in the conical flask. Do **not** include observations in your answer.

.....

..... [1]





(f) Describe what the student should now do to obtain crystals of pure potassium sulfate.

.....

.....

.....

.....

..... [3]

[Total: 9]





- 2 A student investigates how the rate of reaction of magnesium ribbon with dilute acid changes as the concentration of the acid is changed. The student uses five solutions of the same acid, **A**, **B**, **C**, **D**, and **E**. Each solution has a different concentration. The acid is in excess in all experiments.

The student does five experiments.

Experiment 1

- Use a 50 cm³ measuring cylinder to pour 30 cm³ of acid **A** into a 100 cm³ conical flask.
- Add a coil of magnesium ribbon to the acid in the conical flask and immediately start a stop-watch.
- Continually swirl the mixture in the conical flask until the magnesium ribbon disappears completely. Immediately stop the stop-watch and record the time in seconds to the nearest second.
- Empty and rinse the conical flask with distilled water.

Experiment 2

- Repeat Experiment 1 using 30 cm³ of acid **B** instead of acid **A**.

Experiment 3

- Repeat Experiment 1 using 30 cm³ of acid **C** instead of acid **A**.

Experiment 4

- Repeat Experiment 1 using 30 cm³ of acid **D** instead of acid **A**.

Experiment 5

- Repeat Experiment 1 using 30 cm³ of acid **E** instead of acid **A**.





(a) Use the stop-watch diagrams to complete Table 2.1

Table 2.1

experiment	acid	concentration of acid in mol/dm ³	stop-watch diagram	time for magnesium to disappear in s
1	A	2.0		
2	B	1.5		
3	C	1.0		
4	D	0.8		
5	E	0.5		

[2]



- (b) Write a suitable scale on the y-axis and plot the results from Experiments 1 to 5 on Fig. 2.1.

Draw a line of best fit.

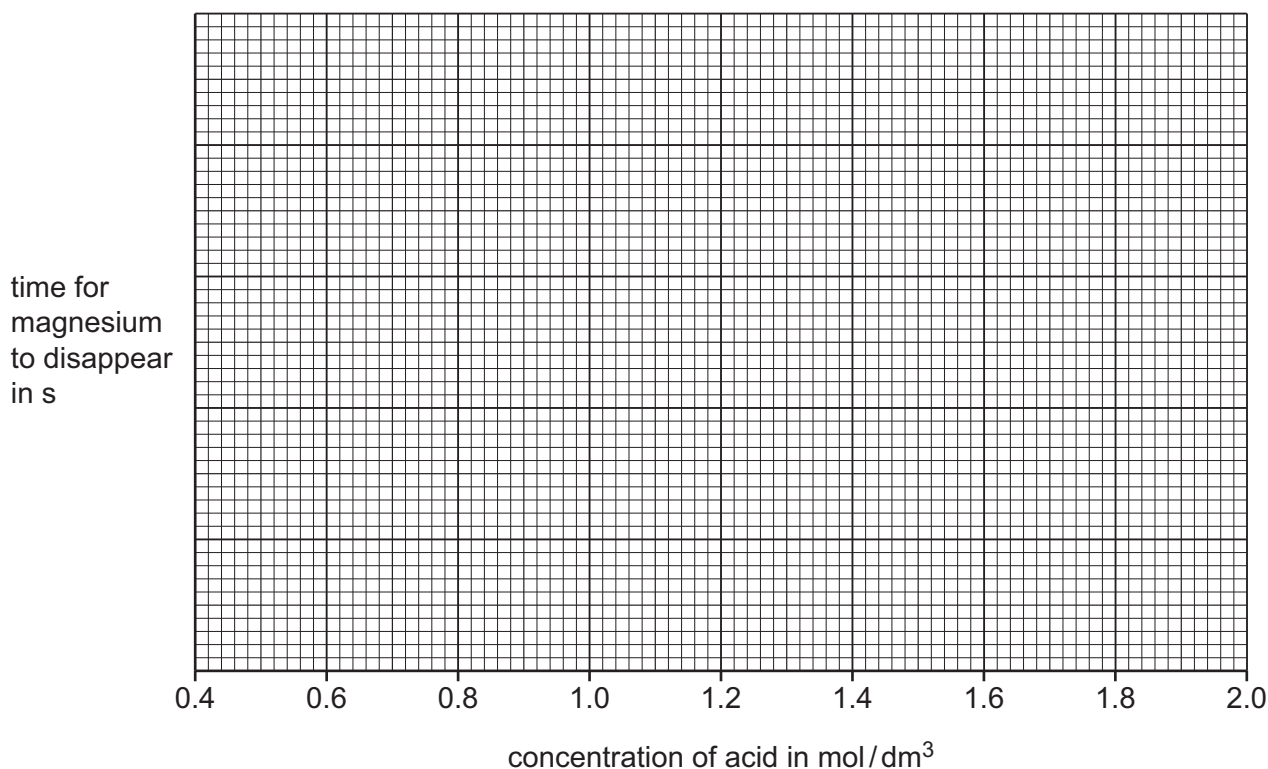


Fig. 2.1

[4]

- (c) From your graph in Fig. 2.1, deduce the time for the magnesium to disappear when the concentration of the acid is 1.3 mol/dm^3 .

Show clearly on Fig. 2.1 how you worked out your answer.

time for magnesium to disappear = ... s [2]

- (d) The mean rate of reaction is calculated using the equation shown.

$$\text{mean rate of reaction} = \frac{\text{length of magnesium ribbon in cm}}{\text{time for magnesium to disappear in s}}$$

The length of each coil of magnesium ribbon used in all five experiments was 5 cm.

- (i) Calculate the mean rate of reaction in Experiment 1. Give units for the rate you have calculated.

mean rate of reaction = ...

units

[2]

- (ii) Deduce in which Experiment, 1, 2, 3, 4 or 5, the mean rate of reaction is the slowest.

[1]





(e) Explain why repeating each experiment is an improvement.

.....
 [1]

(f) The student does another experiment to find the temperature change when magnesium reacts with acid **A**.

- Use the measuring cylinder to pour 30 cm^3 of acid **A** into the 100 cm^3 conical flask.
- Measure the initial temperature of the acid in the conical flask.
- Add a coil of magnesium ribbon to the acid in the conical flask.
- Continually swirl the conical flask until the magnesium ribbon disappears completely.
- Measure the final temperature of the acid in the conical flask.

(i) Use the thermometer diagrams to complete Table 2.2.

Table 2.2

thermometer diagram for initial temperature	initial temperature / °C	thermometer diagram for final temperature	final temperature / °C	temperature change / °C

[2]

(ii) Explain why controlling the temperature of the acid so that it remains constant is an improvement.

.....
 [1]

(iii) Explain why using a polystyrene cup instead of the 100 cm^3 conical flask does **not** control the temperature of the acid.

.....
 [1]

(iv) Describe how the temperature of the acid can be controlled and kept constant.

.....
 [1]

[Total: 17]





- 3 A student tests two solids: solid **F** and solid **G**.

Tests on solid **F**

Solid **F** is calcium carbonate.

- (a) The student adds about 15 cm^3 of dilute hydrochloric acid to the sample of solid **F** in a boiling tube and tests any gas produced.

observations

.....

..... [2]

- (b) The student filters the product from (a) to obtain solution **H** as the filtrate.
The student divides solution **H** into three approximately equal portions in three test-tubes.

- (i) To the first portion of solution **H**, the student adds about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

- (ii) To the second portion of solution **H**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise

observations in excess

[2]

- (iii) To the third portion of solution **H**, the student adds about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations

..... [1]



**Tests on solid G**

Table 3.1 shows the tests and the student's observations for solid **G**.

Table 3.1

tests	observations
test 1 Do a flame test on solid G .	 lilac coloured flame
test 2 Dissolve the remaining solid G in water to form solution G . Divide solution G into three portions. To the first portion of solution G , add about 1 cm ³ of aqueous chlorine.	 orange solution forms
test 3 To the second portion of solution G , add about 1 cm ³ of aqueous sodium hydroxide.	 remains colourless
test 4 To the third portion of solution G , add about 1 cm ³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.	 cream precipitate forms

(c) Identify solid **G**.

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

[Total: 8]





- [6









Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	—
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution





Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	'pops' with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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- 1 When heated, magnesium reacts with steam to make magnesium oxide and hydrogen gas.

Fig. 1.1 shows the apparatus a teacher uses to react clean magnesium ribbon with steam and collect the hydrogen gas produced.

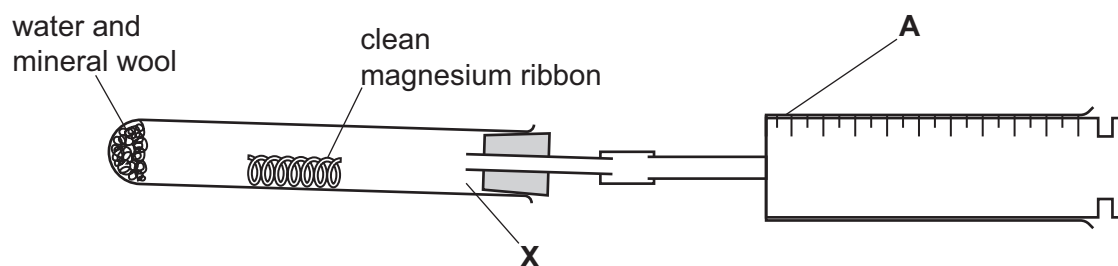


Fig. 1.1

- (a) Name the item of apparatus labelled **A** in Fig. 1.1.

..... [1]

- (b) Suggest how the magnesium ribbon should be cleaned before use.

.....
 [1]

- (c) State the purpose of the mineral wool.

.....
 [1]

- (d) Draw **two** arrows on Fig. 1.1 to show the **two** places where the apparatus should be heated. [2]

- (e) During the reaction a colourless liquid collects at the point marked **X** on Fig. 1.1.

Suggest the identity of liquid **X**.

..... [1]

- (f) The gas collected in **A** is **not pure** hydrogen.

Suggest why the gas collected is **not pure**.

.....
 [1]

[Total: 7]



- 2 A student investigates the temperature change when anhydrous lithium chloride dissolves in water.

The student does five experiments.

Experiment 1

- Use a 50 cm³ measuring cylinder to pour 40 cm³ of distilled water into a 100 cm³ beaker.
- Use a thermometer to measure the initial temperature of the water.
- Add a 2.0 g sample of anhydrous lithium chloride to the water in the beaker.
- Continually stir the mixture in the beaker using the thermometer.
- Measure the highest temperature reached by the mixture in the beaker.
- Empty the beaker and rinse the beaker with distilled water.

Experiment 2

- Repeat Experiment 1 using 30 cm³ of distilled water instead of 40 cm³.

Experiment 3

- Repeat Experiment 1 using 25 cm³ of distilled water instead of 40 cm³.

Experiment 4

- Repeat Experiment 1 using 20 cm³ of distilled water instead of 40 cm³.

Experiment 5

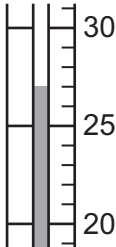
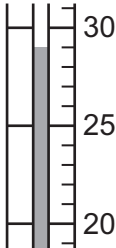
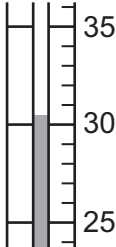
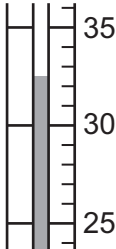
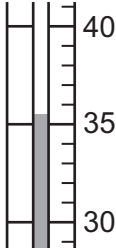
- Repeat Experiment 1 using 15 cm³ of distilled water instead of 40 cm³.

- (a) Use the information in the description of the experiments and the thermometer diagrams to complete Table 2.1.





Table 2.1

experiment	mass of anhydrous lithium chloride /g	volume of distilled water /cm ³	initial temperature /°C	thermometer diagram for highest temperature reached /°C	highest temperature reached /°C	temperature change /°C
1	2.0	40	22.5			
2		30	22.5			
3		25	22.5			
4		20	22.0			
5		15	22.0			

[4]



- (b) Complete a suitable scale on the y-axis and plot your results from Experiments 1 to 5 on Fig. 2.1.

Draw a line of best fit.

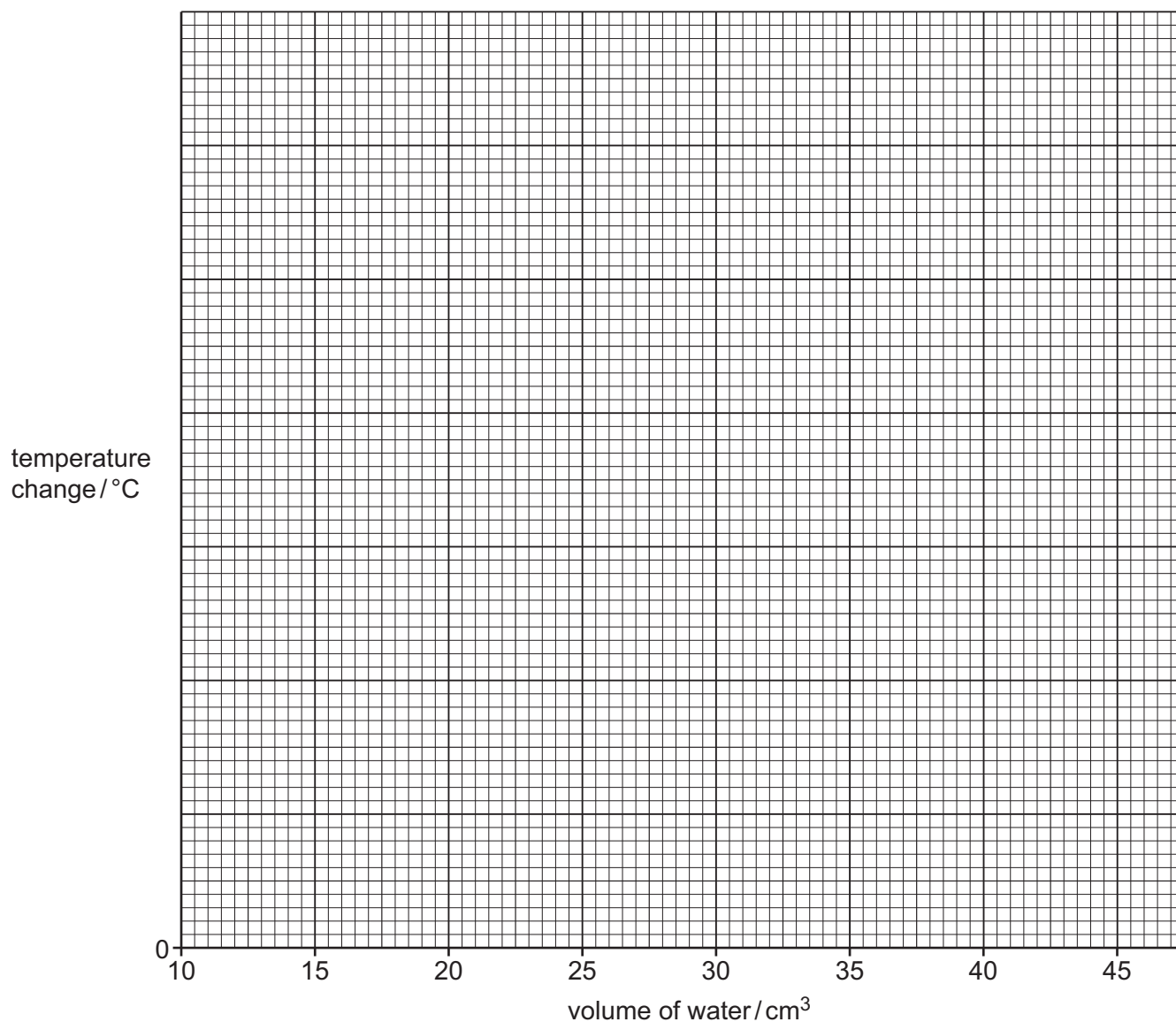


Fig. 2.1

[4]

- (c) Extrapolate the line on your graph in Fig. 2.1 to deduce the temperature change when Experiment 1 is repeated with 45 cm^3 of water instead of 40 cm^3 of water.

Show clearly on Fig. 2.1 how you worked out your answer.

temperature change = ... [3]





- (d) The energy, in J, given out when 2.0g of anhydrous lithium chloride dissolves is calculated using the equation shown.

$$\text{energy given out} = \text{temperature change} \times 4.2 \times \text{volume of water}$$

Calculate the energy given out when 2.0g of anhydrous lithium chloride dissolves in Experiment 5.

$$\text{energy given out} = \dots\dots\dots \text{ J [1]}$$

- (e) Estimate the temperature change when Experiment 1 is repeated using 4.0g of anhydrous lithium chloride instead of 2.0g.

Give a reason for your answer.

temperature change

reason

[2]

- (f) Explain why the results obtained would be more accurate if the beaker used in each experiment was replaced by a polystyrene cup.

.....

.....

..... [2]

- (g) (i) Explain why using a burette instead of a measuring cylinder is an improvement.

.....

..... [1]

- (ii) Explain why standing the beaker in a water-bath is **not** an improvement.

.....

..... [1]

[Total: 18]





- 3 A student tests two solids: solid **J** and solid **K**.

Tests on solid J

Solid **J** is iron(II) iodide.

The student dissolves solid **J** in water to form solution **J**. Solution **J** is divided into four portions.

- (a) To the first portion of solution **J**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise

observations when added in excess

[2]

- (b) To the second portion of solution **J**, the student adds 1 cm³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

- (c) To the third portion of solution **J**, the student adds 1 cm³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations

..... [1]

- (d) To the fourth portion of solution **J**, the student adds 1 cm³ of aqueous chlorine.

observations

..... [1]





Tests on solid K

Table 3.1 shows the tests and the student's observations for solid **K**.

Table 3.1

tests	observations
test 1 Carry out a flame test on solid K .	lilac coloured flame
test 2 The remaining solid K is dissolved in water to form solution K . Solution K is divided into two portions. To the first portion of solution K in a boiling tube, add 1 cm ³ aqueous sodium hydroxide. Warm the product and hold damp red litmus paper at the mouth of the boiling tube.	the damp red litmus paper remains red
test 3 To the second portion of solution K in a boiling tube, add about 1 cm ³ of aqueous sodium hydroxide and a piece of aluminium foil. Warm the mixture and test any gas given off.	effervescence is seen damp red litmus paper turns blue

(e) State the conclusion about solid **K** that can be made from the observations in **test 2**.

..... [1]

(f) Identify the gas given off in **test 3**.

..... [1]

(g) Identify solid **K**.

.....
 [2]

[Total: 9]





The solubility of a salt is the mass of the salt, in g, that dissolves in 100 cm^3 of water at a specified temperature.

Plan an investigation to determine the solubility of magnesium sulfate in water at 50 °C. Your plan must include how the solubility of magnesium sulfate, in g per 100 cm³ of water, can be found.

You are provided with solid magnesium sulfate, distilled water and common laboratory apparatus.

[6]





Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	—
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution





Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	'pops' with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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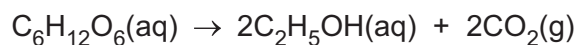
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- 1 Fermentation is a process in which yeast is used to convert aqueous glucose to ethanol and carbon dioxide. Fermentation takes place at a temperature of between 25 °C and 35 °C.



A student uses the apparatus shown in Fig. 1.1 to make carbon dioxide by fermentation.

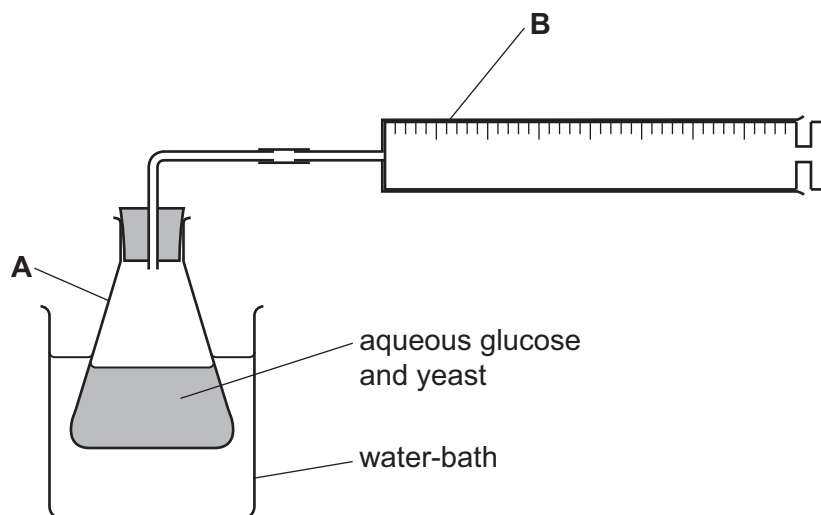


Fig. 1.1

- (a) Name the items of apparatus labelled **A** and **B** in Fig. 1.1.

A

B [2]

- (b) Suggest why a water-bath is used.

.....

..... [1]



- (c) The student measures the volume of gas that is collected every 10 minutes for 90 minutes.

Their results are shown in Fig. 1.2.

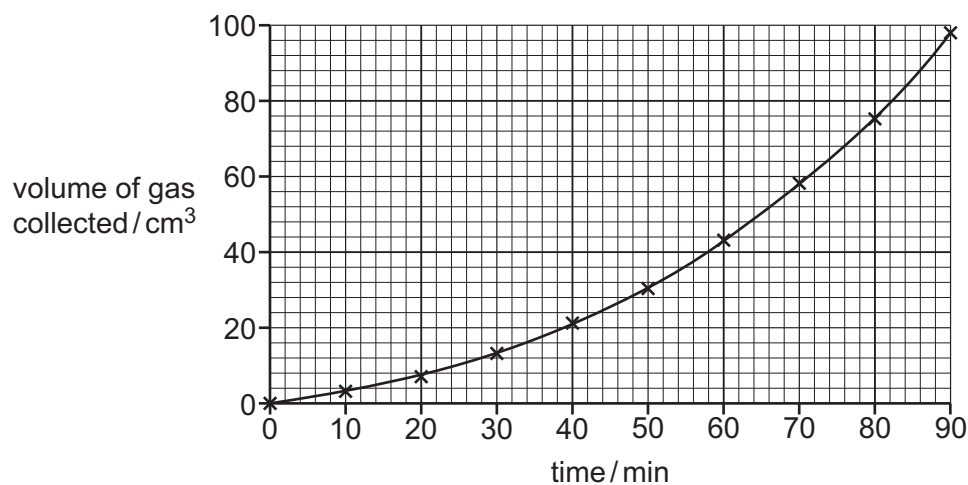


Fig. 1.2

Describe how the results in Fig. 1.2 show that the fermentation is **not** complete after 90 minutes.

..... [1]

- (d) The student repeats the experiment using the apparatus shown in Fig. 1.3.

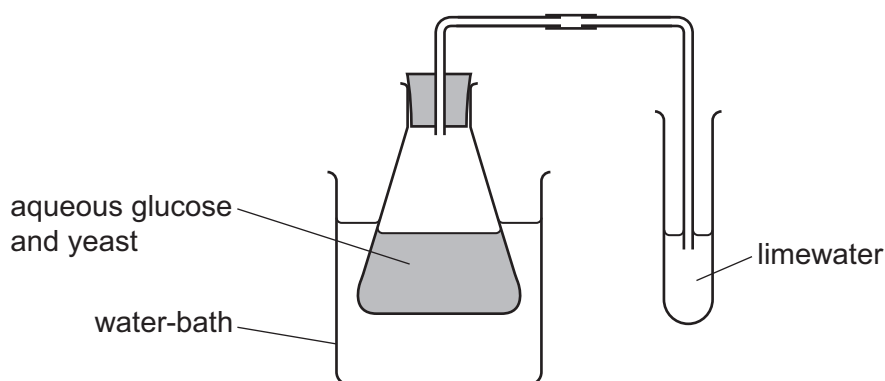


Fig. 1.3

- (i) State what happens to the appearance of the limewater during fermentation.

..... [1]

- (ii) State **one** observation the student would make that shows that fermentation is complete.

..... [1]

- (e) State the method the student should use to obtain ethanol from the fermentation mixture.

..... [1]





- 2 A student investigates how the rate of reaction between dilute hydrochloric acid and aqueous sodium thiosulfate changes as the concentration of the aqueous sodium thiosulfate decreases. During the reaction, the solution slowly becomes cloudy. As the solution becomes cloudy, it becomes more difficult to see through the solution.

The student does five experiments.

Experiment 1

- Use a 50 cm^3 measuring cylinder to pour 50 cm^3 of aqueous sodium thiosulfate into a 100 cm^3 beaker.
- Use a 10 cm^3 measuring cylinder to pour 5 cm^3 of dilute hydrochloric acid into the beaker containing the aqueous sodium thiosulfate.
- Immediately start a stop-watch and stir the contents of the beaker.
- Stand the beaker on a printed sheet and look down from above the beaker as shown in Fig. 2.1.

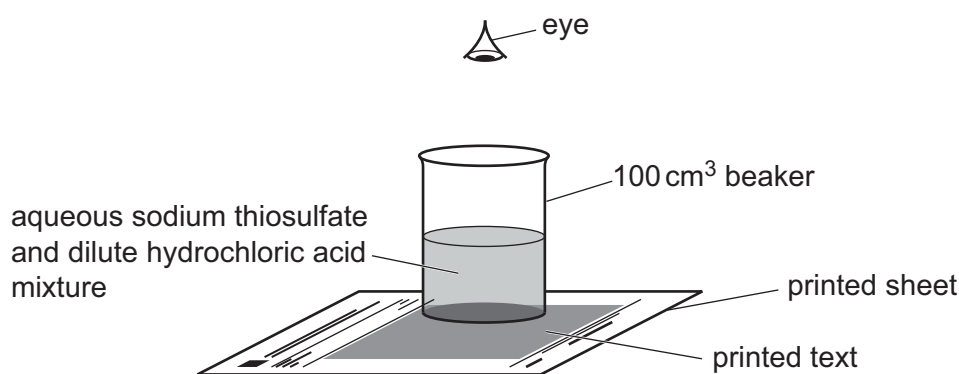


Fig. 2.1

- When the text on the printed sheet is **not** visible, stop the stop-watch and record the time to the nearest whole number of seconds.
- Empty the contents of the beaker and rinse the beaker with distilled water.

Experiment 2

- Repeat Experiment 1 using 40 cm^3 of aqueous sodium thiosulfate instead of 50 cm^3 . Use the 50 cm^3 measuring cylinder to add 10 cm^3 of distilled water to the beaker **before** adding the dilute hydrochloric acid.

Experiment 3

- Repeat Experiment 2 using 30 cm^3 of aqueous sodium thiosulfate and 20 cm^3 of distilled water.

Experiment 4

- Repeat Experiment 2 using 25 cm^3 of aqueous sodium thiosulfate and 25 cm^3 of distilled water.

Experiment 5

- Repeat Experiment 2 using 20 cm^3 of aqueous sodium thiosulfate and 30 cm^3 of distilled water.





- (a) Use the information in the description of the experiments and the stop-watch diagrams to complete Table 2.1.

Table 2.1

experiment	volume of aqueous sodium thiosulfate /cm ³	volume of distilled water /cm ³	volume of dilute hydrochloric acid /cm ³	stop-watch diagram	time taken for text to not be visible /s
1	50	0	5		
2					
3					
4					
5					

[3]



(b) Write a suitable scale on the y-axis and plot the results from Experiments 1 to 5 on Fig. 2.2.

Draw a curve of best fit.

time taken
for text to **not**
be visible/s

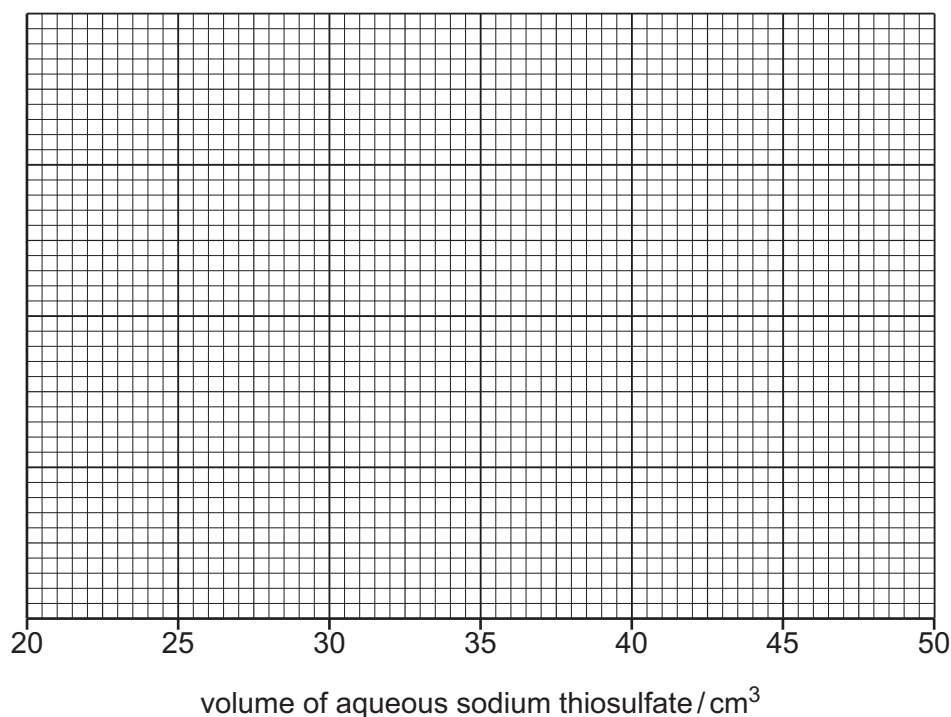


Fig. 2.2

[4]

(c) The relative rate of reaction in each experiment is calculated using the equation shown.

$$\text{relative rate of reaction} = \frac{1}{\text{time taken}}$$

- (i) Calculate the relative rate of reaction in Experiment 1.
Do **not** give units for your answer.

relative rate of reaction = ... [1]

- (ii) State in which Experiment, 1, 2, 3, 4 or 5, the relative rate of reaction was greatest.

..... [1]





(d) In each experiment the total volume of aqueous sodium thiosulfate and distilled water is constant.

- (i) Calculate the volume of distilled water needed when the volume of aqueous sodium thiosulfate is 37 cm^3 .

volume = ... [2]

- (ii) From your graph in Fig. 2.2, deduce the time for the text to **not** be visible when the volume of aqueous sodium thiosulfate is 37 cm^3 .

Show clearly on Fig. 2.2 how you worked out your answer.

time = ... s [2]

- (iii) Explain why the total volume of aqueous sodium thiosulfate and distilled water is kept constant.

.....

 [1]

- (e) (i) State why measuring the volume of the dilute hydrochloric acid with a burette instead of a measuring cylinder would be an improvement.

.....
 [1]

- (ii) Explain why it is **not** possible to use a volumetric pipette to measure the volume of aqueous sodium thiosulfate in each experiment.

.....
 [1]

- (f) Explain why it is important **not** to change the size of the beaker to a larger beaker during the investigation.

.....

 [2]

[Total: 18]



* 0000800000009 *



9

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- 3 A student tests two solids: solid **L** and solid **M**.

Tests on solid **L**

Solid **L** is hydrated aluminium chloride.

The student dissolves solid **L** in distilled water to form solution **L**. Solution **L** is divided into four approximately equal portions.

- (a) To the first portion of solution **L**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise

observations in excess

[2]

- (b) To the second portion of solution **L**, the student adds aqueous ammonia dropwise and then in excess.

observations when added dropwise

observations in excess

[2]

- (c) To the third portion of solution **L**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations

..... [1]

- (d) To the fourth portion of solution **L**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]





Tests on solid M

Table 3.1 shows the tests and the student's observations for solid **M**.

Table 3.1

tests	observations
test 1 Do a flame test on solid M .	light green coloured flame
test 2 Dissolve the remaining solid M in water to form solution M . Divide solution M into three portions. To the first portion of solution M , add about 1 cm ³ of aqueous sodium hydroxide.	no visible change
test 3 To the second portion of solution M , add about 1 cm ³ of aqueous sodium hydroxide and a piece of aluminium foil. Warm the mixture and test any gas given off.	effervescence is seen; damp red litmus paper turns blue
test 4 To the third portion of solution M , add about 1 cm ³ of dilute sulfuric acid.	white precipitate forms

(e) Identify the gas given off in **test 3**.

..... [1]

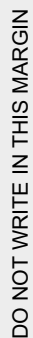
(f) Identify solid **M**.

.....
 [2]

[Total: 9]



- DO NOT WRITE IN THIS MARGIN



DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

[6]







Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	—
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), Cu^{2+}	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), Fe^{2+}	green ppt., insoluble in excess, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, Zn^{2+}	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution





Tests for gases

gas	test and test result
ammonia, NH_3	turns damp red litmus paper blue
carbon dioxide, CO_2	turns limewater milky
chlorine, Cl_2	bleaches damp litmus paper
hydrogen, H_2	'pops' with a lighted splint
oxygen, O_2	relights a glowing splint
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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