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CHEMISTRY **0620/63**

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.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- 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.

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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.

$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$

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

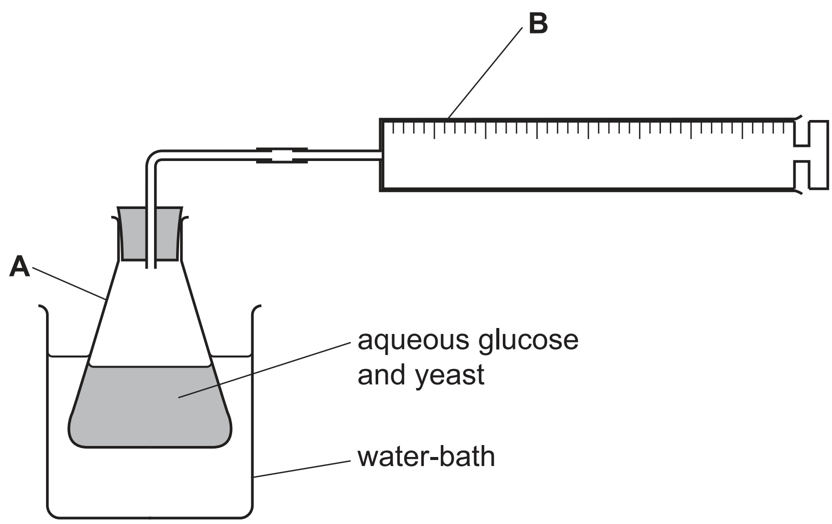

Fig. 1.1

(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.

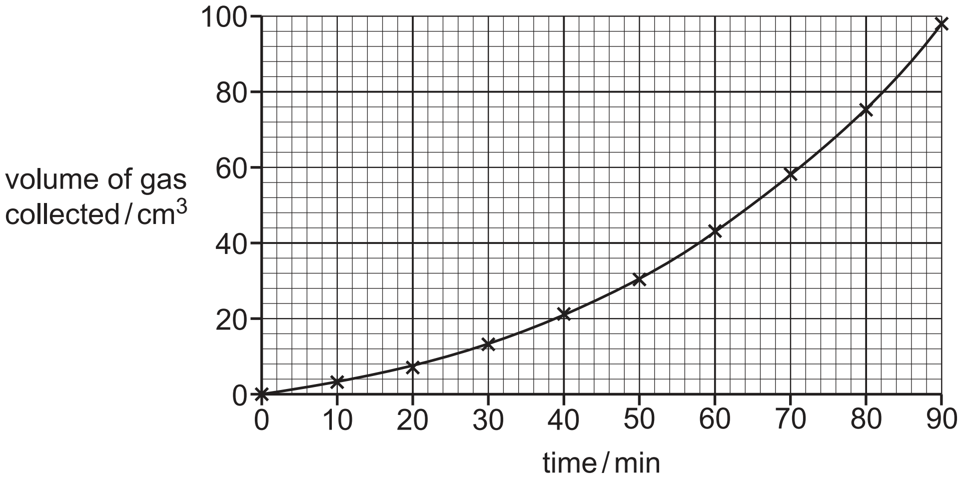

Fig. 1.2

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.

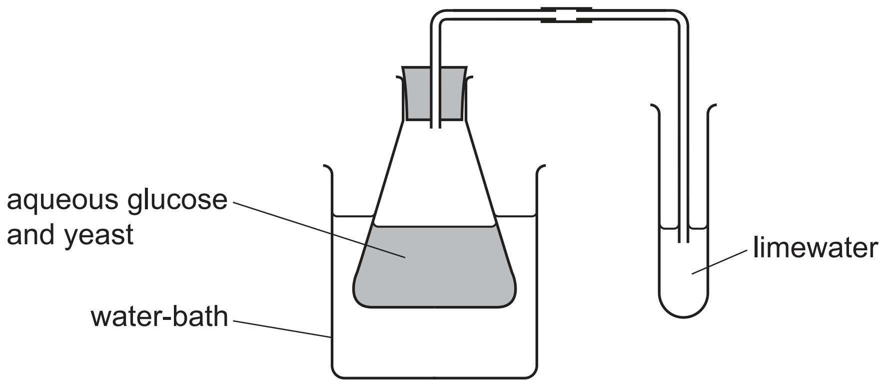

Fig. 1.3

(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]

[Total: 7]

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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.

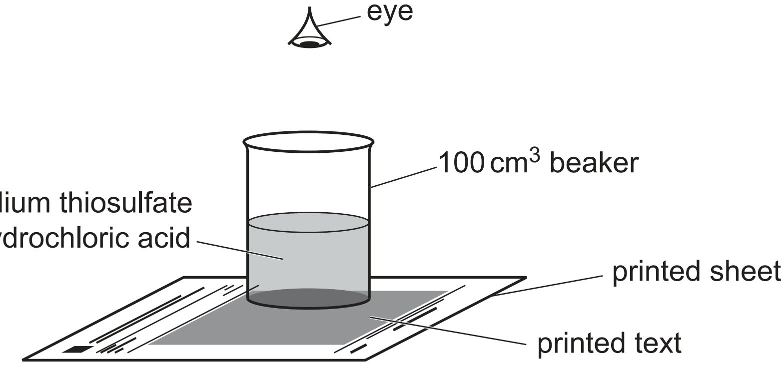


Fig. 2.1

- 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

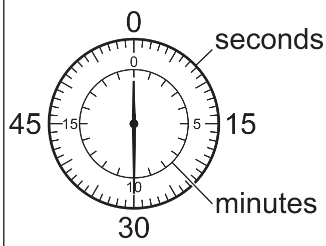
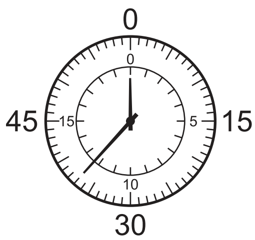
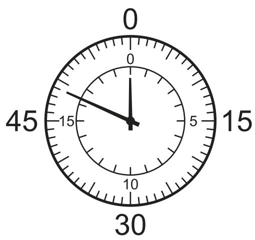
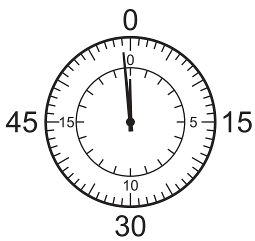
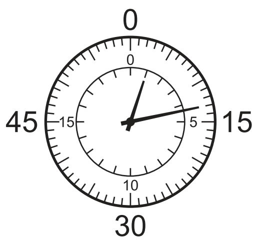
- Repeat Experiment 2 using 25 cm^3 of aqueous sodium thiosulfate and 25 cm^3 of distilled water.

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.

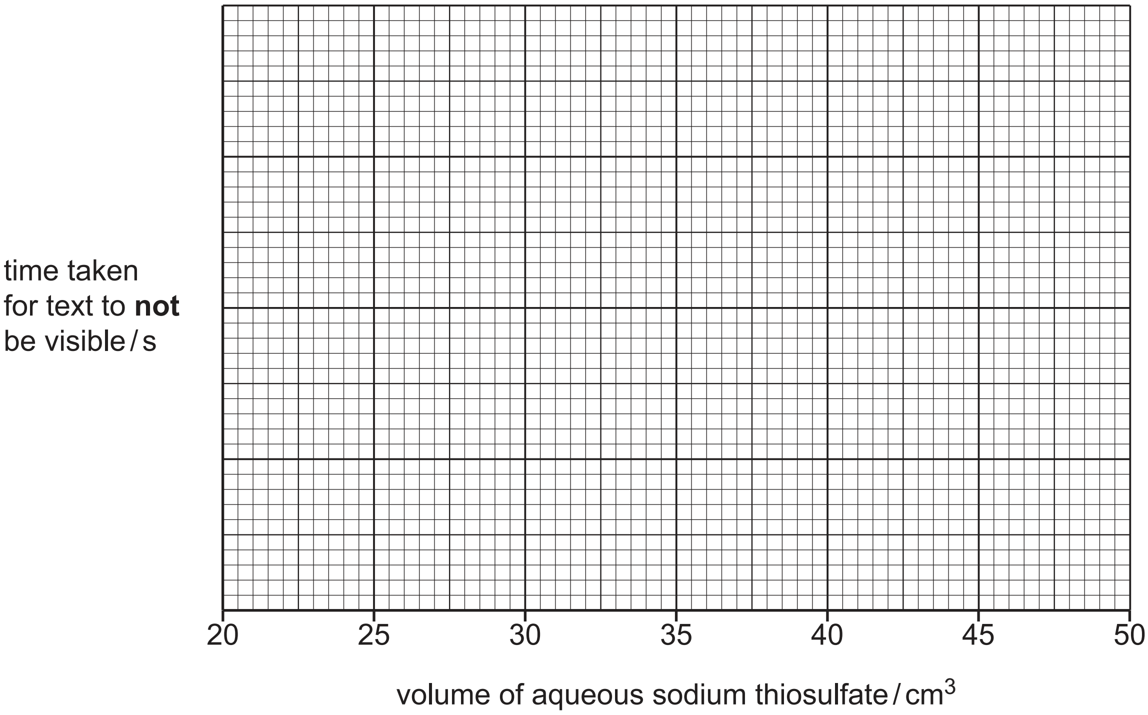


Fig. 2.2

[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]

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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]

4 Lead(II) chloride, $PbCl_2$, is an insoluble salt. Solid lead(II) chloride can be made by reacting aqueous sodium chloride with aqueous lead(II) nitrate.

$$2NaCl(aq) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbCl_2(s)$$

Describe how to make a pure, dry sample of solid lead(II) chloride.

You are provided with solid sodium chloride, solid lead(II) nitrate, distilled water and common laboratory apparatus.

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.... [6]

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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