Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **0971/62**

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 **12** pages. Any blank pages are indicated.

DC (IP/SG) 353458

[Turn over

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.

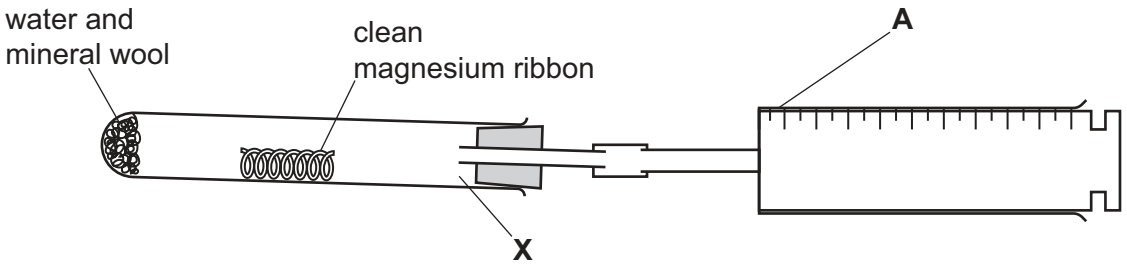


Fig. 1.1

(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 cm^3 measuring cylinder to pour 40 cm^3 of distilled water into a 100 cm^3 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 cm^3 of distilled water instead of 40 cm^3.

Experiment 3

- Repeat Experiment 1 using 25 cm^3 of distilled water instead of 40 cm^3.

Experiment 4

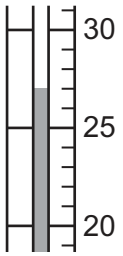
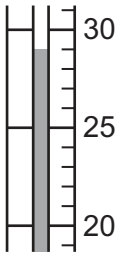
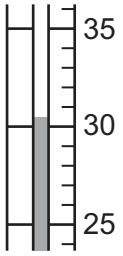
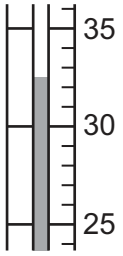
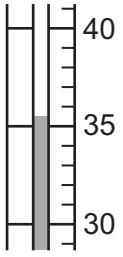
- Repeat Experiment 1 using 20 cm^3 of distilled water instead of 40 cm^3.

Experiment 5

- Repeat Experiment 1 using 15 cm^3 of distilled water instead of 40 cm^3.

(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.

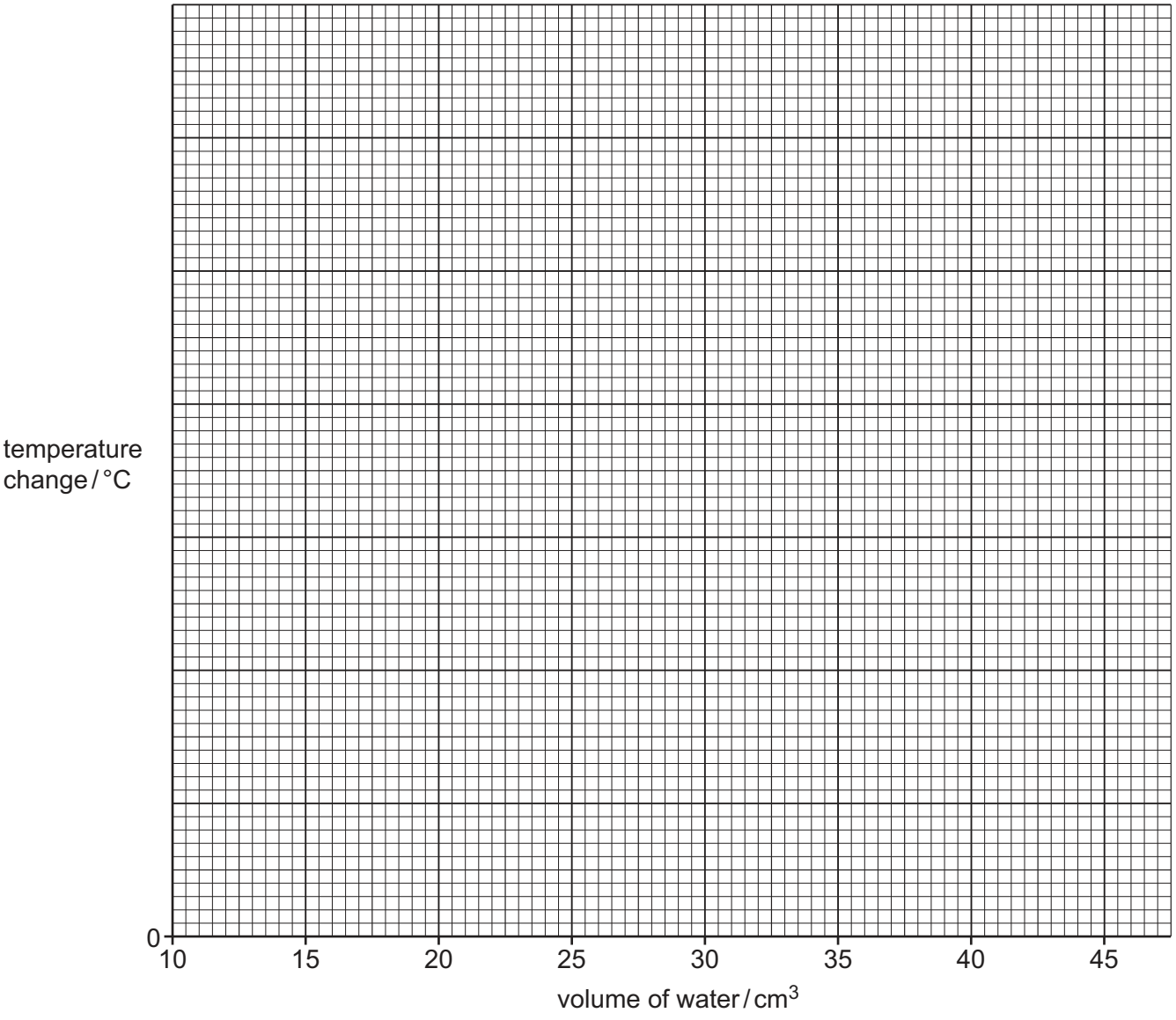


Fig. 2.1

[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 2.0 g of anhydrous lithium chloride dissolves is calculated using the equation shown.

energy given out = temperature change × 4.2 × volume of water

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

energy given out = ... J [1]

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

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 cm^3 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 cm^3 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 cm^3 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]

4 Magnesium sulfate is a salt. Magnesium sulfate is soluble in water.

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 cm^3 of water, can be found.

You are provided with solid magnesium sulfate, 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