* 0000800000001 *

Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

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CHEMISTRY **0971/51**

Paper 5 Practical Test **May/June 2025**

1 hour 15 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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.

For Examiner's use	
1	
2	
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Total	

This document has **12** pages. Any blank pages are indicated.

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1 You are going to investigate how the rate of reaction of magnesium ribbon with dilute acid changes as the concentration of the acid is changed. You will use 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.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do five experiments.

(a) Experiment 1

- Use the 50 cm^3 measuring cylinder to pour 30 cm^3 of acid **A** into the 100 cm^3 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 in Table 1.1.
- Empty and rinse the conical flask with distilled water.

Experiment 2

- Repeat Experiment 1 using 30 cm^3 of acid **B** instead of acid **A**.

Experiment 3

- Repeat Experiment 1 using 30 cm^3 of acid **C** instead of acid **A**.

Experiment 4

- Repeat Experiment 1 using 30 cm^3 of acid **D** instead of acid **A**.

Experiment 5

- Repeat Experiment 1 using 30 cm^3 of acid **E** instead of acid **A**.

Complete Table 1.1.

Table 1.1

experiment	acid	concentration of acid in mol/dm^3	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	

[4]

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(b) Write a suitable scale on the *y*-axis and plot your results from Experiments 1 to 5 on Fig. 1.1.

Draw a line of best fit.

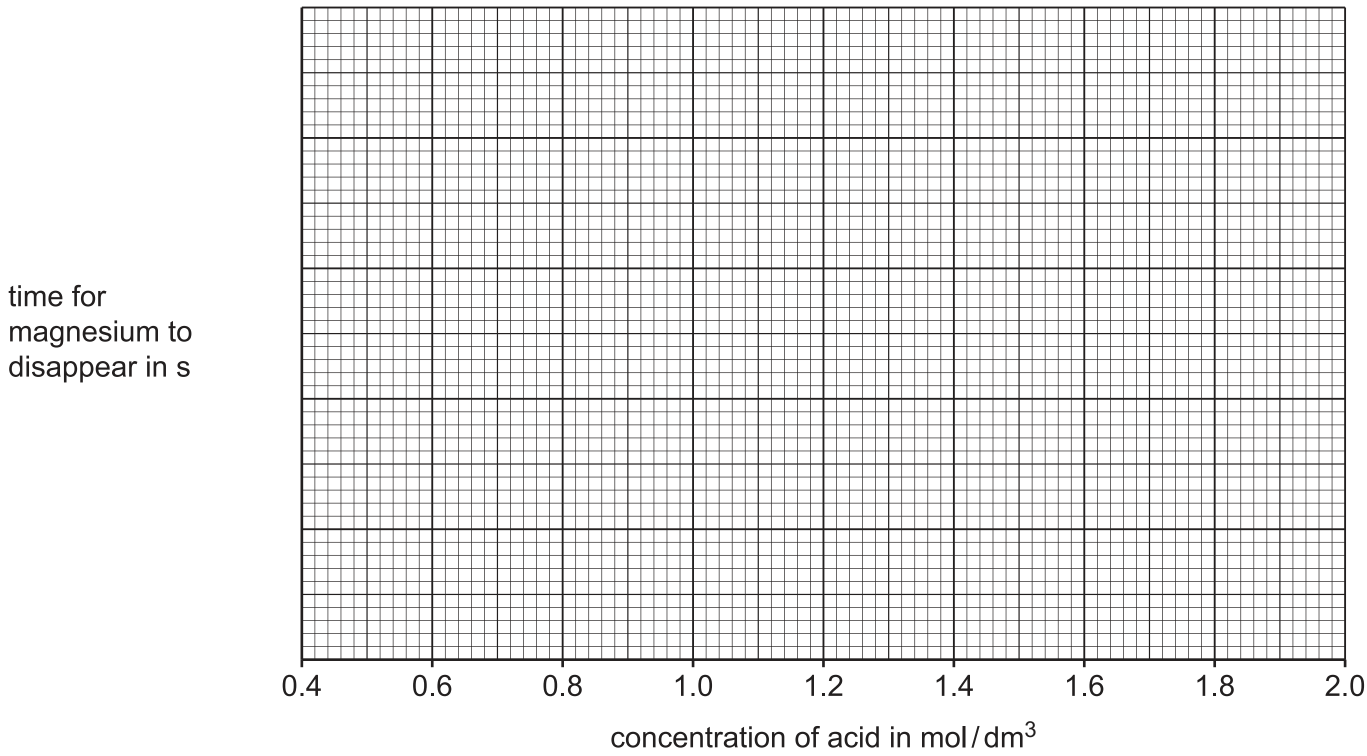

Fig. 1.1

[4]

(c) From your graph in Fig. 1.1, deduce the time for the magnesium to disappear when the concentration of the acid is 1.3 mol / dm^3.

Show clearly on Fig. 1.1 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 was the slowest.

.... [1]

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

....

.... [1]

(f) **(i)** You are going to carry out an experiment to find the temperature change when the magnesium reacts with the acid.

- 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. Record the initial temperature in Table 1.2.
- 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. Record the final temperature in Table 1.2 and complete Table 1.2.

Table 1.2

initial temperature of acid / °C	final temperature of acid / °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: 19]

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2 You are provided with two solids: solid **F** and solid **G**.

Do the following tests on solid **F** and solid **G**. Record all of your observations at each stage.

Tests on solid F

(a) **(i)** To the boiling tube containing solid **F**, add about 15 cm^3 of dilute hydrochloric acid. Test any gas produced.

Keep the product for use in (b).

Record your observations.

....

....

.... [3]

(ii) Identify the gas made in **(a)(i)**.

.... [1]

(b) Filter the product from **(a)(i)** to obtain solution **H** as the filtrate. Carry out the tests on solid **G** while the mixture is filtering. Stop filtering after you have completed the tests on solid **G**.

Divide solution **H** into three approximately equal portions in three test-tubes.

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

Record your observations.

....

.... [1]

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

Record your observations.

dropwise ....

in excess ....

[2]

(iii) To the third portion of solution **H**, add about 1 cm depth of aqueous sodium carbonate.

Record your observations.

....

.... [1]

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(c) Identify solid **F**.

....

.... [2]

Tests on solid G

(d) Carry out a flame test on solid **G**.

Record your observations.

.... [1]

(e) Put the remaining solid **G** in a boiling tube. Add about 5 cm depth of water to the boiling tube. Put a stopper in the boiling tube and shake the boiling tube to dissolve solid **G** and form solution **G**. Divide solution **G** into two approximately equal portions in two test-tubes.

(i) To the first portion of solution **G**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

....

.... [1]

(ii) To the second portion of solution **G**, add all of the sample of aqueous chlorine.

Record your observations.

....

.... [1]

(f) Identify solid **G**.

....

.... [2]

[Total: 15]

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3 Solid sodium hydrogencarbonate, $NaHCO_3$, reacts with dilute hydrochloric acid and with dilute ethanoic acid.

$$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + CO_2(g) + H_2O(l)$$

$$NaHCO_3(s) + CH_3COOH(aq) \rightarrow CH_3COONa(aq) + CO_2(g) + H_2O(l)$$

These two reactions are endothermic.

Plan an investigation to find which of the two reactions is the most endothermic. Your plan must include how you can use the results to find which reaction is the most endothermic.

You are provided with solid sodium hydrogencarbonate, dilute hydrochloric acid, dilute ethanoic acid and common laboratory apparatus.

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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

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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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