Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

4398704233

CHEMISTRY **0971/51**

Paper 5 Practical Test **May/June 2024**

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	
3	
Total	

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

[Turn over

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1 You are going to investigate the temperature change when magnesium reacts with dilute sulfuric acid.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do five experiments.

(a) Experiment 1

- Use a 25 cm^3 measuring cylinder to pour 20 cm^3 of dilute sulfuric acid into a boiling tube.
- Use a thermometer to measure the initial temperature of the acid in the boiling tube. Record the initial temperature in Table 1.1.
- Add a coiled 5 cm length of magnesium ribbon to the acid in the boiling tube. At the same time start a timer.
- Continually stir the contents of the boiling tube using the thermometer.
- After 45 seconds, measure the temperature of the mixture in the boiling tube. Record this temperature in Table 1.1.
- Rinse the boiling tube with distilled water.

Experiment 2

- Use the 25 cm^3 measuring cylinder to pour 20 cm^3 of dilute sulfuric acid into the boiling tube.
- Use a 10 cm^3 measuring cylinder to add 2.0 cm^3 of distilled water to the acid in the boiling tube.
- Place a bung in the boiling tube and invert the tube to mix the acid and water.
- Use the thermometer to measure the initial temperature of the contents of the boiling tube. Record the initial temperature in Table 1.1.
- Add a coiled 5 cm length of magnesium ribbon to the contents of the boiling tube. At the same time start the timer.
- Continually stir the contents of the boiling tube using the thermometer.
- After 45 seconds, measure the temperature of the mixture. Record this temperature in Table 1.1.
- Rinse the boiling tube with distilled water.

Experiment 3

- Repeat Experiment 2, adding 4.0 cm^3 of distilled water instead of 2.0 cm^3.

Experiment 4

- Repeat Experiment 2, adding 6.0 cm^3 of distilled water instead of 2.0 cm^3.

Experiment 5

- Repeat Experiment 2, adding 10.0 cm^3 of distilled water instead of 2.0 cm^3.

[Turn over

Complete Table 1.1.

Table 1.1

experiment	volume of dilute sulfuric acid / cm^3	volume of distilled water / cm^3	initial temperature / °C	temperature after 45 s / °C	temperature increase / °C
1					
2					
3					
4					
5					

[5]

(b) (i) State which Experiment, 1, 2, 3, 4 or 5, had the smallest temperature change.

..... [1]

(ii) Explain why the temperature change was smallest in the experiment you have given in **(b)(i)**.

.....

..... [1]

(c) Complete 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.

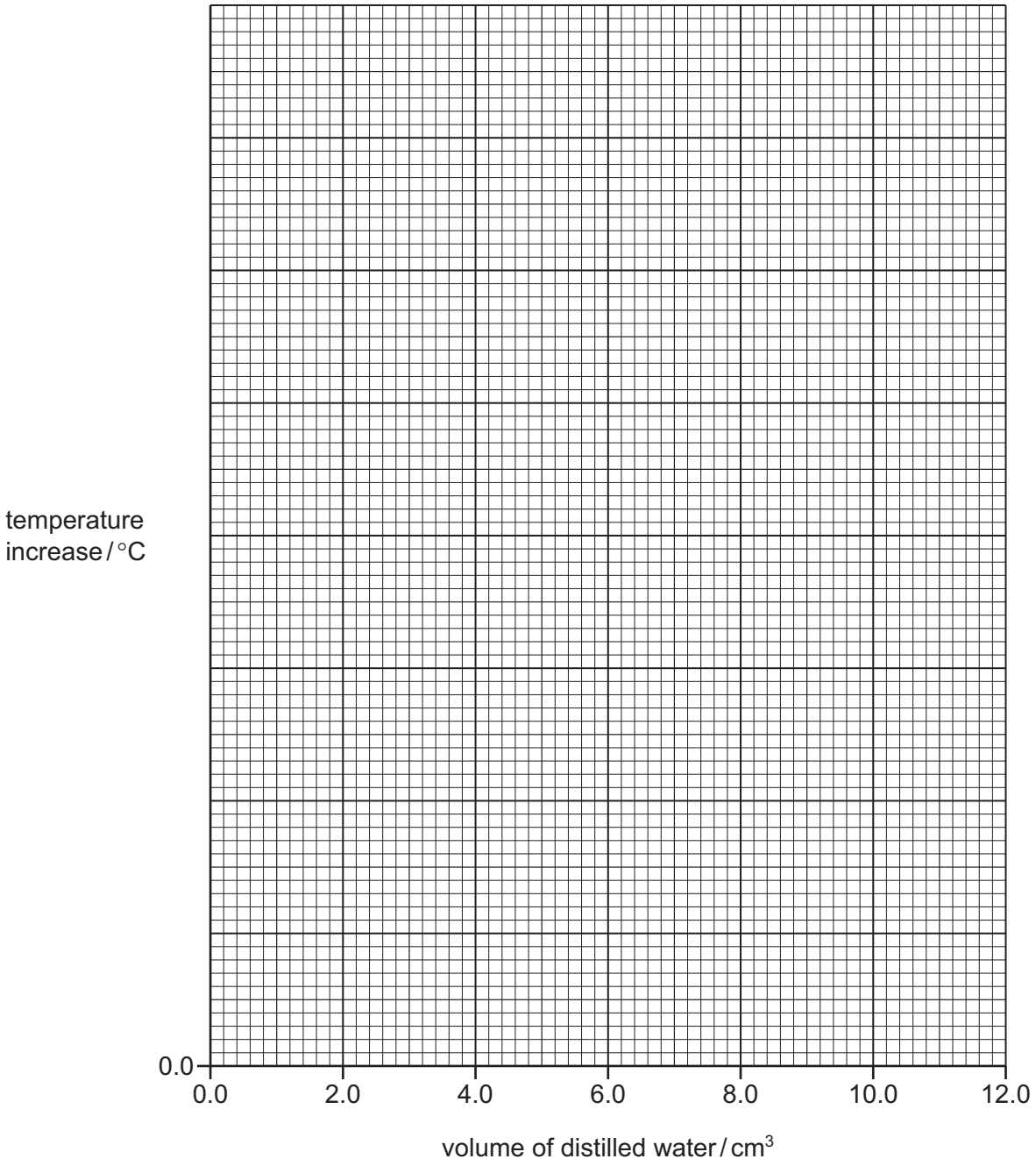

Fig. 1.1

[4]

(d) Use your graph in Fig. 1.1 to deduce the temperature increase if Experiment 2 is repeated with 7.5 cm^3 of distilled water instead of 2.0 cm^3.

Show clearly **on Fig. 1.1** how you worked out your answer.

..... °C
[2]

(e) The average rate of temperature increase in each experiment is calculated using the equation shown.

$$\text{average rate of temperature increase} = \frac{\text{temperature increase}}{45 \text{ seconds}}$$

Calculate the average rate of temperature increase in Experiment 1. Give units for the rate you have calculated.

average rate of temperature increase = ...

units = ...
[2]

(f) **(i)** Explain why the results of the experiment are more accurate if the boiling tube is wrapped in cotton wool.

.....

.....

..... [2]

(ii) Explain why a 25.0 cm^3 volumetric pipette **cannot** be used to accurately measure the volume of the distilled water added.

.....

..... [1]

(iii) State one **other** way in which the **apparatus** can be changed to give more accurate results.

.....

.....

..... [1]

(g) Sketch **on Fig. 1.1** the graph you would expect if all of the experiments were repeated using a 2 cm length of magnesium ribbon instead of the 5 cm length.

Label your line **g**. [1]

[Total: 20]

Question 2 starts on the next page.

2 You are provided with one solid: solid **E**.
Do the following tests on solid **E**, recording all of your observations at each stage.

Tests on solid E

Divide solid **E** into two approximately equal portions in two boiling tubes.

(a) Gently heat the first portion of solid **E**.

Record your observations.

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..... [2]

To the remaining portion of solid **E**, add about 5 cm depth of distilled water. Place a stopper in the boiling tube and shake to dissolve solid **E** and form solution **E**. Divide solution **E** into four approximately equal portions in one boiling tube and three test-tubes.

(b) (i) To the first portion of solution **E** in the boiling tube, add aqueous sodium hydroxide dropwise and then in excess.

Keep the product formed for use in (b)(ii).

Record your observations.

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..... [2]

(ii) Transfer about 2 cm depth of the product from **(b)(i)** to another boiling tube. Gently warm the mixture and test any gas given off.

Record your observations.

.....

..... [1]

(iii) Identify the gas given off in **(b)(ii)**.

..... [1]

(c) To the second portion of solution **E**, add about 4 cm depth of aqueous sodium hydrogencarbonate.

Record your observations.

.....

..... [2]

(d) (i) To the third portion of solution **E**, add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

.....

..... [1]

(ii) State the conclusion that can be made from the result of the test in **(d)(i)**.

.....

..... [1]

(e) To the fourth portion of solution **E**, add about 1 cm depth of dilute nitric acid and a few drops of aqueous barium nitrate. Leave the mixture to stand for about two minutes.

Record your observations.

.....

..... [1]

(f) Identify the **three** ions in solid **E**.

.....

.....

..... [3]

[Total: 14]

[Turn over

3 A **mixture** contains three compounds:

- liquid ethanol
- solid sodium chloride
- solid zinc carbonate.

Table 3.1 gives some information about these three compounds.

Table 3.1

name of compound	solubility in water	solubility in ethanol
ethanol	soluble	
sodium chloride	soluble	insoluble
zinc carbonate	insoluble	insoluble

Describe how to obtain a pure sample of each of the three compounds, ethanol, sodium chloride and zinc carbonate, from the mixture.

You are provided with common laboratory apparatus.

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..... [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