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CHEMISTRY **0620/53**

Paper 5 Practical Test **October/November 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	
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1 You are going to investigate the temperature change when a 5 cm length of coiled magnesium ribbon reacts with excess dilute sulfuric acid.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do five experiments.

Experiment 1

- Rinse the burette with distilled water and then with dilute sulfuric acid.
- Fill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 30.0 cm^3 of dilute sulfuric acid to a boiling tube.
- Use the thermometer to measure the initial temperature of the acid.
- Record the initial temperature in Table 1.1.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start the stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature in Table 1.1.

Experiment 2

- Refill the burette with dilute sulfuric acid. Run some of the dilute sulfuric acid out of the burette so that the level of the dilute sulfuric acid is on the 0.0 cm^3 mark.
- Use the burette to add 25.0 cm^3 of dilute sulfuric acid to a new boiling tube.
- Use the thermometer to measure the initial temperature of the acid.
- Record the initial temperature in Table 1.1.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start the stop-watch.
- Continually stir the contents of the boiling tube using the thermometer.
- After 1 minute, measure the temperature of the mixture in the boiling tube.
- Record this temperature in Table 1.1.

Experiment 3

- Repeat Experiment 2, using 20.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 4

- Repeat Experiment 2, using 15.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 5

- Repeat Experiment 2, using 10.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

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(a) Complete Table 1.1.

Table 1.1

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

[5]

(b) On Fig. 1.1, complete a suitable scale on the *y*-axis and plot your results from Experiments 1 to 5. Draw a line of best fit.

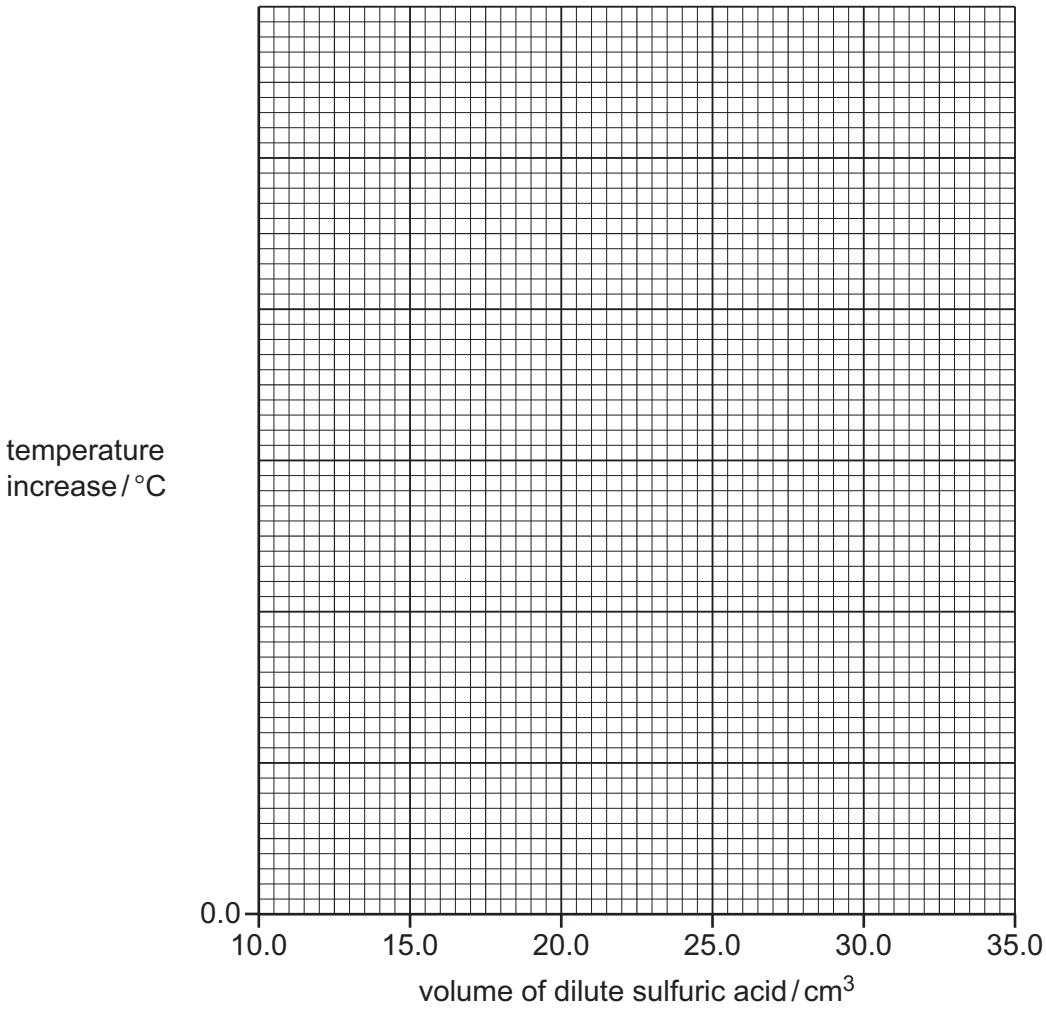

Fig. 1.1

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(c) Explain why the temperature increase changes as the volume of dilute sulfuric acid changes.

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.....

..... [2]

(d) Extrapolate the line of best fit on your graph in Fig. 1.1 to deduce the temperature increase if 33.0 cm^3 of dilute sulfuric acid is used.

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

temperature increase = ... [3]

(e) The investigation is repeated using 2.5 cm lengths of coiled magnesium ribbon instead of 5 cm lengths.

On Fig. 1.1, sketch a line to show the results you would expect. Label this line **E**. [1]

(f) **(i)** Give **one** reason why a burette, rather than a measuring cylinder, is used to measure the volume of the dilute sulfuric acid.

.....

..... [1]

(ii) Explain why the contents of the boiling tube are stirred during each experiment.

.....

..... [1]

(g) Describe **one** change to the apparatus that will give more accurate results.

Explain your answer.

change to apparatus .....

.....

explanation .....

.....

[2]

[Total: 19]

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2 You are provided with one solid: solid **A**.

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

Tests on solid A

Add about 5 cm depth of distilled water to the boiling tube containing solid **A**. Replace the stopper in the boiling tube and shake the boiling tube to dissolve solid **A** and form solution **A**.
Divide solution **A** into six approximately equal portions in four test-tubes and two boiling tubes.

In (a) and (b)(i), the contents of the test-tube need to be left to stand for about 5 minutes.

You should continue with the remaining parts of this question while the test-tubes in **(a)** and **(b)(i)** are standing.

(a) To the first portion of solution **A** in a test-tube, add about 1 cm depth of aqueous sodium thiosulfate.
Leave the test-tube to stand for about 5 minutes.

Record your observations.

.....

.....

..... [2]

(b) **(i)** To the second portion of solution **A** in a test-tube, add about 1 cm depth of dilute sulfuric acid and then add the zinc powder.
Leave the test-tube to stand for about 5 minutes.

Keep the contents of the test-tube for use in (b)(ii).

Record your observations.

.....

.....

..... [2]

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(ii) Pour the solution left in the test-tube from **(b)(i)** into a clean test-tube, leaving behind any solid. This is solution **B**.

To the test-tube containing solution **B**, add about 4 cm depth of aqueous sodium hydroxide.

Record your observations.

.....

..... [1]

(c) To the third portion of solution **A** in a test-tube, add aqueous ammonia dropwise and then in excess.

Record your observations.

dropwise .....

in excess .....

[2]

(d) To the fourth portion of solution **A** in a test-tube, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

.....

..... [1]

(e) To the fifth portion of solution **A** in a boiling tube, add about 1 cm depth of aqueous sodium hydroxide and a small piece of aluminium foil.

Gently warm the mixture and test any gas given off.

Record your observations.

.....

.....

..... [2]

(f) **(i)** To the sixth portion of solution **A** in a boiling tube, add about 1 cm depth of aqueous potassium iodide.

Keep the product for use in (f)(ii).

Record your observations.

.....

..... [1]

(ii) To the product from **(f)(i)**, add about 1 cm depth of starch solution.

Keep the product for use in (f)(iii).

Record your observations.

.....

..... [1]

(iii) To the product from **(f)(ii)**, add about 2 cm depth of aqueous sodium thiosulfate. Place a stopper in the boiling tube and shake the boiling tube.

Record your observations.

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..... [1]

(g) Identify the anion and the cation in solid **A**.

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..... [2]

[Total: 15]

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3 *Duralumin* is an alloy containing a mixture of the metals aluminium, copper, magnesium and manganese only.

Table 3.1 gives some information about the four metals in *duralumin*.

Table 3.1

metal	reaction with dilute hydrochloric acid	reaction with dilute nitric acid
aluminium	reacts to form a soluble salt	does **not** react
copper	does **not** react	reacts very slowly at room temperature and quickly when heated to form a soluble salt
magnesium	reacts quickly to form a soluble salt	reacts quickly to form a soluble salt
manganese	reacts quickly to form a soluble salt	reacts quickly to form a soluble salt

Plan an investigation to find the percentage by mass of aluminium in a sample of *duralumin*. Your plan must include how you will calculate the percentage by mass of aluminium in *duralumin*.

You are provided with a powdered sample of the alloy *duralumin*, dilute hydrochloric acid, dilute nitric acid, distilled water 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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