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9172375382

CHEMISTRY **0620/63**

Paper 6 Alternative to Practical **October/November 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.

[Turn over

1 A student uses the apparatus in Fig. 1.1 to show that water is formed as one of the products when a fuel is burned. The gases produced when the fuel is burned are passed through the apparatus using a suction pump.

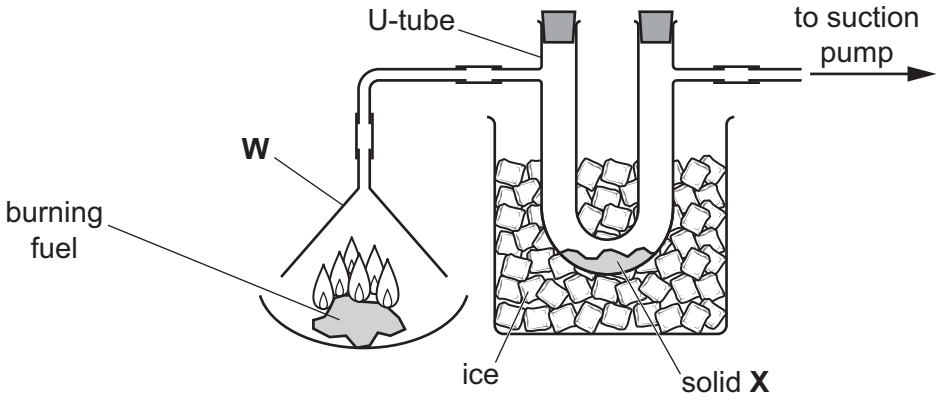

Fig. 1.1

(a) Identify the item of apparatus labelled **W** in Fig. 1.1.

..... [1]

(b) When the fuel is burned, the steam produced passes into the U-tube.

Suggest why the U-tube is surrounded by ice.

..... [1]

(c) Water causes solid **X** in the U-tube to change colour.

Name solid **X** and state the colour change seen.

solid **X** .....

colour change from ..... to .....
[2]

.

The student tries to use the apparatus in Fig. 1.2 to pass the gases produced through acidified aqueous potassium manganate(VII).

There is an error in the apparatus in Fig. 1.2 so that the gases produced will **not** pass through the acidified aqueous potassium manganate(VII).

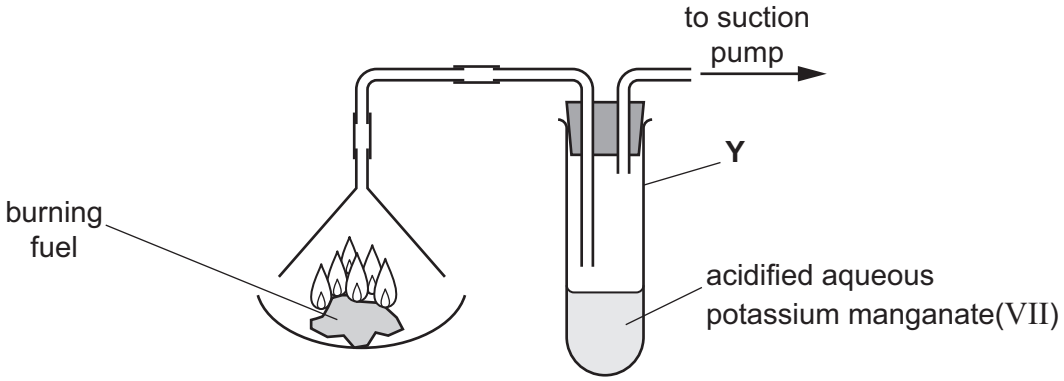

Fig. 1.2

(d) Identify the item of apparatus labelled **Y** in Fig. 1.2.

..... [1]

(e) **On Fig. 1.2**, draw a circle around the error in the apparatus. [1]

(f) The error in the apparatus in Fig. 1.2 is corrected.
The student observes that the acidified aqueous potassium manganate(VII) changes colour from purple to colourless.

Suggest why this colour change occurs.

.....

..... [1]

[Total: 7]

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2 A student investigates the temperature change when a 5 cm length of coiled magnesium ribbon reacts with excess dilute sulfuric acid.

The student does five experiments.

Experiment 1

- Rinse a 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 a thermometer to measure the initial temperature of the acid.
- Record the initial temperature.
- Add a coil of magnesium ribbon to the boiling tube. At the same time start a 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.

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.
- 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.

Experiment 3

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

Experiment 4

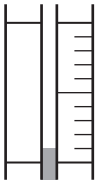
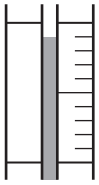
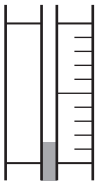
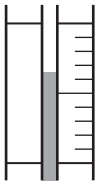
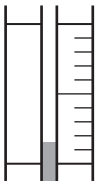
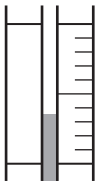
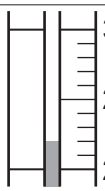
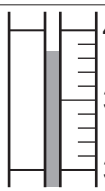
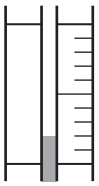
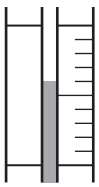
- Repeat Experiment 2, using 15.0 cm^3 of dilute sulfuric acid instead of 25.0 cm^3.

Experiment 5

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

(a) Use the thermometer diagrams to complete Table 2.1.

Table 2.1

experiment	volume of dilute sulfuric acid / cm^3	thermometer diagram for initial temperature / °C	initial temperature / °C	thermometer diagram for temperature after 1 minute / °C	temperature after 1 minute / °C	temperature increase / °C
1	30.0					
2	25.0					
3	20.0					
4	15.0					
5	10.0					

[4]

(b) On Fig. 2.1, complete a suitable scale on the *y*-axis and plot the results from Experiments 1 to 5. Draw a line of best fit.

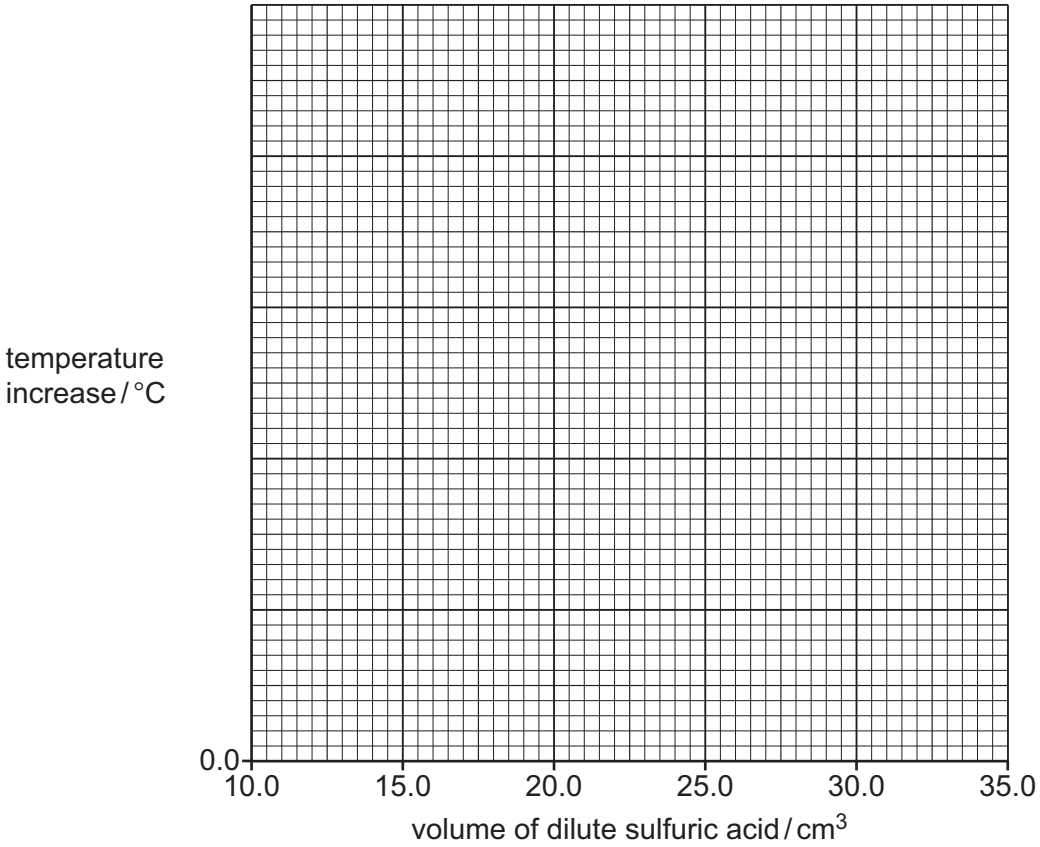


Fig. 2.1

[4]

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

.....

.....

..... [2]

(d) Extrapolate the line of best fit on your graph in Fig. 2.1 to deduce the temperature increase if 33.0 cm^3 of dilute sulfuric acid is used.

Show clearly **on Fig. 2.1** 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. 2.1, 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: 18]

3 A student tests two substances: solution **A** and solid **B**.

Tests on solution A

Solution **A** is aqueous iron(III) nitrate.

Record the expected observations.

The student divides solution **A** into three approximately equal portions.

(a) To the first portion of solution **A**, the student adds aqueous ammonia dropwise and then in excess.

observations when added dropwise .....

observations in excess .....

[2]

(b) (i) To the second portion of solution **A**, the student adds excess aqueous sodium hydroxide.

observations .....

..... [1]

(ii) To the product from **(b)(i)**, the student adds a small piece of aluminium foil. The student gently warms the mixture formed and tests any gas produced.

observations .....

..... [1]

(iii) Identify the gas produced in **(b)(ii)**.

..... [1]

(c) To the third portion of solution **A**, 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 B

Table 3.1 shows the tests and the student's observations for solid **B**.

Table 3.1

tests	observations
test 1 Do a flame test on solid **B**.	light green flame colour
test 2 Add the remaining solid **B** to dilute hydrochloric acid. Test any gas produced.	effervescence and a colourless solution forms limewater turns milky

(d) Identify the gas produced in **test 2**.

..... [1]

(e) Identify solid **B**.

.....

..... [2]

[Total: 9]

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

Table 4.1 gives some information about the four metals in *duralumin*.

Table 4.1

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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..... [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