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CAMBRIDGE International Education

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CHEMISTRY **0620/61**

Paper 6 Alternative to Practical **May/June 2026**

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. Do **not** use correction fluid or tape.
- 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.

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[Turn over

1 A student tries to make crystals of hydrated copper(II) sulfate, $CuSO_4•5H_2O$. Crystals of hydrated copper(II) sulfate are blue.

The student makes aqueous copper(II) sulfate by reacting copper(II) carbonate with dilute sulfuric acid. The equation for the reaction is shown.

$$CuCO_3(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l) + CO_2(g)$$

The first three steps of the method the student uses are shown.

step 1 Pour 40 cm^3 of dilute sulfuric acid into a beaker.

step 2 Add copper(II) carbonate to the dilute sulfuric acid in the beaker until the copper(II) carbonate is in excess.

step 3 Remove the excess copper(II) carbonate from the reaction mixture.

(a) **(i)** In **step 2**, the student observes effervescence as the copper(II) carbonate reacts with the dilute sulfuric acid.

Describe **one** other observation that is made in **step 2 before** the copper(II) carbonate is in excess.

....

.... [1]

(ii) Explain why the copper(II) carbonate must be added in excess.

....

.... [1]

(b) Figure 1.1 shows the apparatus at the end of **step 3**.

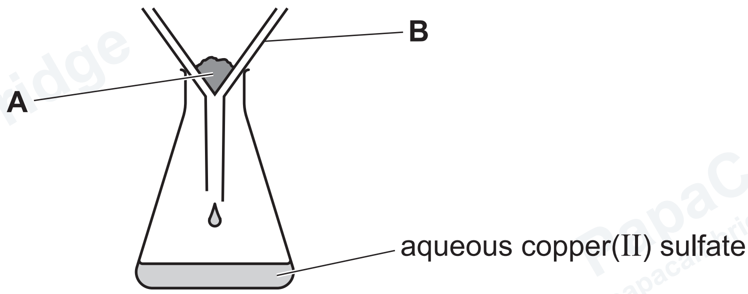

Figure 1.1

(i) Name the method of separation shown in Figure 1.1.

.... [1]

(ii) Identify the residue, **A**, in Figure 1.1.

.... [1]

(iii) Name the item of apparatus labelled **B** in Figure 1.1.

.... [1]

(c) The student heats the aqueous copper(II) sulfate collected in the conical flask in Figure 1.1 until **all** the water has evaporated.
The student obtains a white solid instead of blue hydrated copper(II) sulfate.

(i) Name the white solid the student obtains.

.... [1]

(ii) Describe what the student should do to get crystals of hydrated copper(II) sulfate from the aqueous copper(II) sulfate obtained in **step 3**.

....

....

....

.... [2]

[Total: 8]

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2 A student investigates the temperature change when citric acid reacts with sodium carbonate.

The student does five experiments.

Experiment 1

- Use a 10 cm^3 measuring cylinder to pour 1.0 cm^3 of distilled water into a boiling tube.
- Use a thermometer to measure the initial temperature of the distilled water.
- Record this temperature to the nearest 0.5 °C.
- Add 4 g of solid citric acid and 4 g of solid sodium carbonate to the boiling tube.
- Stir the contents of the boiling tube with the thermometer and measure the lowest temperature reached by the mixture.
- Record this temperature to the nearest 0.5 °C.
- Rinse out the boiling tube with distilled water.

Experiment 2

- Repeat Experiment 1 using 2.0 cm^3 of distilled water instead of 1.0 cm^3.

Experiment 3

- Repeat Experiment 1 using 4.0 cm^3 of distilled water instead of 1.0 cm^3.

Experiment 4

- Repeat Experiment 1 using 6.0 cm^3 of distilled water instead of 1.0 cm^3.

Experiment 5

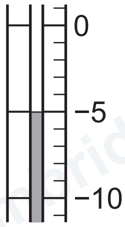
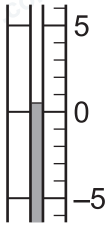
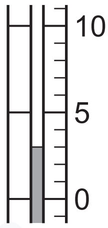
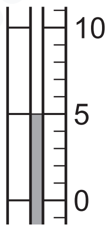
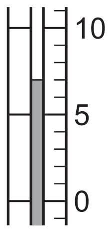
- Repeat Experiment 1 using 8.0 cm^3 of distilled water instead of 1.0 cm^3.

(a) Complete Table 2.1, using the information in the descriptions of the experiments and the thermometer diagrams.

Calculate the temperature decrease using the equation shown.

temperature decrease = initial temperature – lowest temperature

Table 2.1

experiment	volume of distilled water / cm^3	initial temperature / °C	thermometer diagram for lowest temperature	lowest temperature / °C	temperature decrease / °C
1	1.0	21.0			
2		21.0			
3		21.5			
4		21.5			
5		22.0			

[5]

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

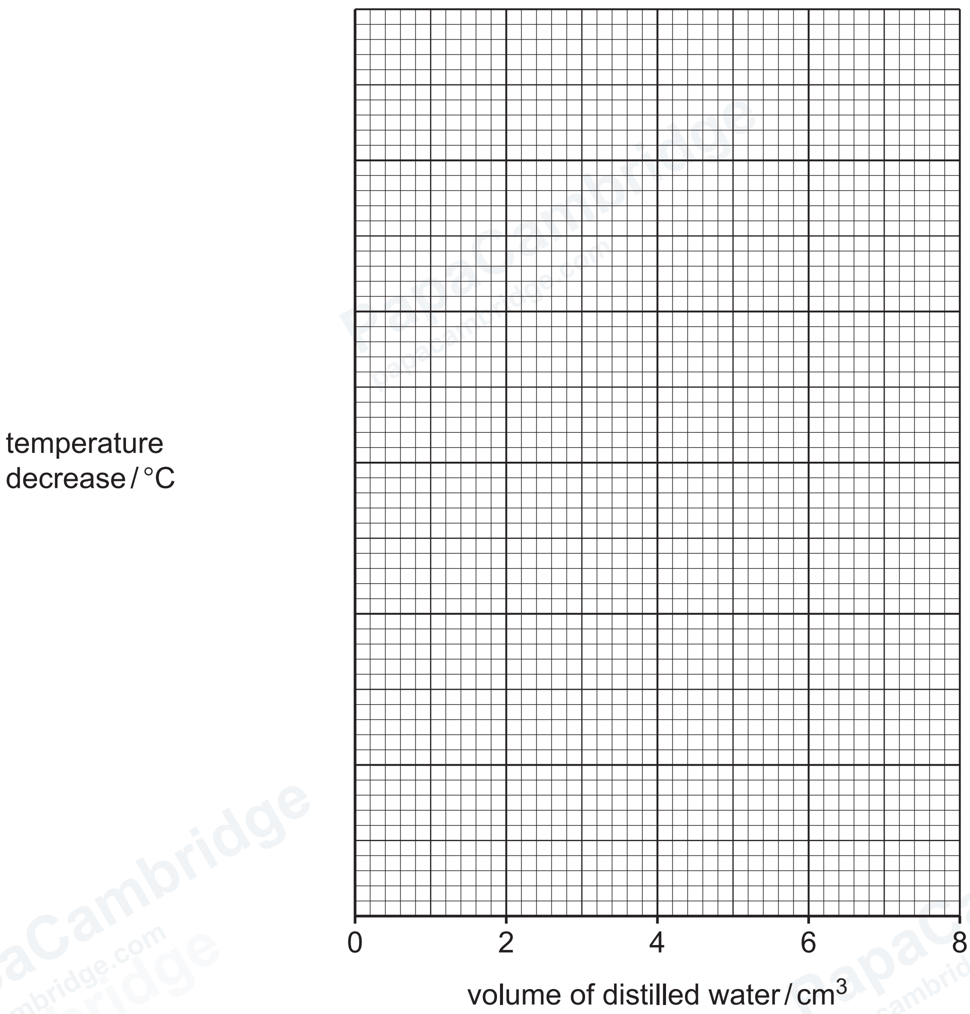


Figure 2.1

[4]

(c) State if the energy change in the reaction is exothermic or endothermic.

Use the results in Table 2.1 to explain your answer.

energy change ....

explanation ....

....
[1]

(d) Use your graph in Figure 2.1 to predict the temperature decrease if the experiment is repeated using 5.5 cm^3 of distilled water.

Show your working on Figure 2.1.

temperature decrease = ... °C [2]

(e) Describe the relationship between the volume of distilled water and the temperature decrease.

....

.... [1]

(f) **(i)** Explain why wrapping the boiling tube in cotton wool would improve the accuracy of the results.

....

....

.... [2]

(ii) Explain why placing the boiling tube in a water-bath at room temperature would **not** improve the accuracy of the results.

....

.... [1]

(g) Explain why the volume of distilled water was measured using a 10 cm^3 measuring cylinder rather than a 25 cm^3 measuring cylinder.

....

.... [1]

(h) On Figure 2.1, sketch the graph obtained if all of the experiments were repeated using 2 g of solid citric acid and 2 g of solid sodium carbonate. [1]

[Total: 18]

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

Tests on solid A

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

Table 3.1

tests	observations
test 1 Add 10 cm^3 of water to a boiling tube containing solid **A**. Place a stopper in the boiling tube and shake the boiling tube to dissolve solid **A** and form solution **A**. Divide solution **A** into two approximately equal portions. To the first portion of solution **A**, add aqueous sodium hydroxide dropwise and then in excess.	 green precipitate the precipitate remains
test 2 To the product from **test 1**, add about a 4 cm depth of aqueous hydrogen peroxide. Test any gas given off.	 brown precipitate and effervescence the gas relights a glowing splint
test 3 To the second portion of solution **A**, add about a 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.	 white precipitate

(a) Identify the gas given off in **test 2**.

....

.... [1]

(b) Identify solid **A**.

....

.... [2]

Tests on solution B

Solution **B** is aqueous aluminium nitrate.

The student divides solution **B** into two approximately equal portions.

Record the expected observations.

(c) To the first portion of solution **B**, the student adds aqueous ammonia dropwise until it is in excess.

observations ....

.... [2]

(d) **(i)** To the second portion of solution **B**, the student adds aqueous sodium hydroxide dropwise until it is in excess.

observations ....

.... [2]

(ii) To the product from **3(d)(i)**, the student adds a piece of aluminium foil and warms the mixture gently. Any gas given off is tested.

observations ....

.... [1]

[Total: 8]

4 Iron nails rust slowly in the presence of water and air.
When an iron nail rusts, insoluble solid hydrated iron(III) oxide forms.
The solid hydrated iron(III) oxide falls off the iron nail.

The rusting of iron nails is slowed down by coating the nails with oil or paint.

Plan an investigation to show which of the two coatings, oil or paint, slows down rusting the most.
Your plan must include how the results will show which coating slows down rusting the most.

You are provided with iron nails, oil, paint, water and common laboratory apparatus.

[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