



# Cambridge IGCSE™

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## CHEMISTRY

**0620/52**

Paper 5 Practical Test

**February/March 2023**

**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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<b>Total</b>	

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



- 1 You are going to investigate the solubility of ammonium chloride in water at different temperatures.

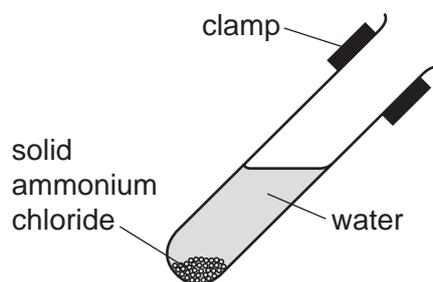
**Read all of the instructions carefully before starting the experiments.**

### Instructions

You are going to do five experiments.

#### Experiment 1

- Fill a burette with distilled water. Run some of the water out of the burette so that the level of the water is on the burette scale.
- Use the burette to add  $8.0\text{ cm}^3$  of distilled water to the  $5.25\text{ g}$  sample of ammonium chloride in the boiling tube.
- Clamp the boiling tube at an angle, as shown in Fig. 1.1.



**Fig. 1.1**

- Gently heat the bottom of the boiling tube while stirring the contents with a thermometer.
- Stop heating as soon as all the solid has dissolved. Do not allow the solution to boil.
- Continuously stir the solution with the thermometer while it cools.
- As soon as the solution starts to become cloudy and a solid starts to form, measure the temperature of the solution and record the temperature in Table 1.1.
- **Keep the contents of the boiling tube for Experiment 2.**

#### Experiment 2

- Use the burette to add  $0.5\text{ cm}^3$  of distilled water to the mixture in the boiling tube from the previous experiment.
- Clamp the boiling tube as shown in Fig. 1.1.
- Gently heat the bottom of the boiling tube while stirring the contents with a thermometer.
- Stop heating as soon as all the solid has dissolved. Do not allow the solution to boil.
- Continuously stir the solution with the thermometer while it cools.
- As soon as the solution starts to become cloudy and a solid starts to form, measure the temperature of the solution and record the temperature in Table 1.1.
- **Keep the contents of the boiling tube for the next experiment.**

#### Experiment 3

- Repeat Experiment 2 by using the burette to add another  $0.5\text{ cm}^3$  of distilled water to the mixture in the boiling tube from Experiment 2.

#### Experiment 4

- Repeat Experiment 2 by using the burette to add another  $0.5\text{ cm}^3$  of distilled water to the mixture in the boiling tube from Experiment 3.

## Experiment 5

- Repeat Experiment 2 by using the burette to add another  $0.5\text{ cm}^3$  of distilled water to the mixture in the boiling tube from Experiment 4.

(a) Complete Table 1.1.

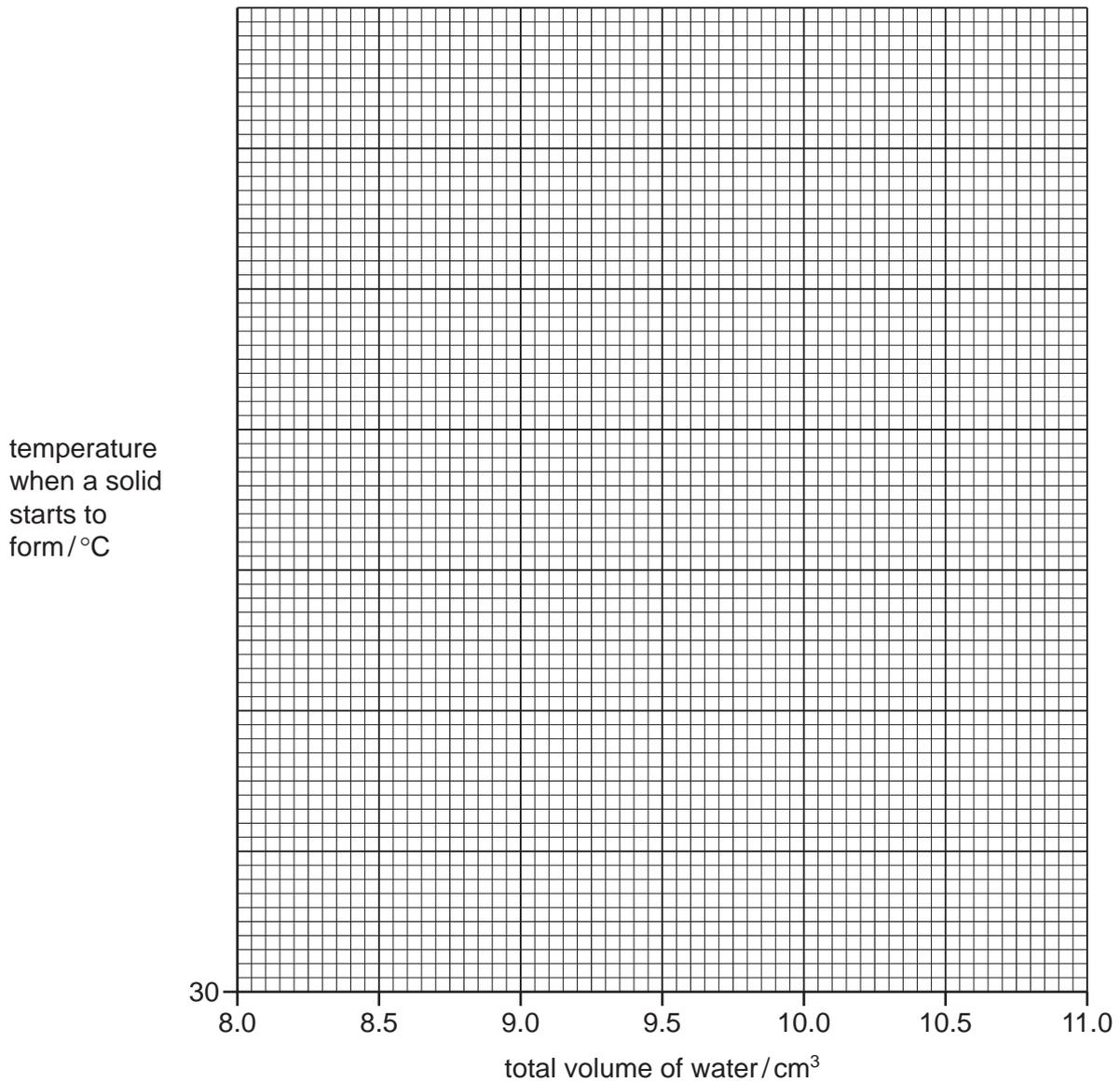
**Table 1.1**

experiment	mass of ammonium chloride/g	total volume of water/ $\text{cm}^3$	temperature when a solid starts to form/ $^{\circ}\text{C}$
1		8.0	
2			
3			
4			
5			

[4]

- (b) Complete a suitable scale on the  $y$ -axis in Fig. 1.2 and plot your results from Experiments 1 to 5 on Fig. 1.2.

Draw a line of best fit through your points.



**Fig. 1.2**

[4]

- (c) Extrapolate the line on your graph and deduce the temperature when a solid starts to form when a total volume of 10.5 cm<sup>3</sup> of water is used.

Show clearly **on Fig. 1.2** how you worked out your answer.

temperature when a solid starts to form = ..... °C [3]

- (d) Solubility, in g/100 cm<sup>3</sup> of water, is calculated using the equation shown.

$$\text{solubility} = \frac{\text{mass of solid dissolved} \times 100}{\text{volume of water used}}$$

Use this equation to calculate the solubility of ammonium chloride in Experiment 1.

solubility = ..... g/100 cm<sup>3</sup> of water [1]

- (e) Describe how the solubility of ammonium chloride changes as the temperature changes.

.....  
 ..... [1]

- (f) In this experiment the volume of water was measured using a burette.

- (i) State the advantage of using a burette rather than a measuring cylinder to measure the volume of water.

.....  
 ..... [1]

- (ii) State the advantage of using a burette rather than a volumetric pipette to measure the volume of water.

.....  
 ..... [1]

- (g) A total volume of 2.0 cm<sup>3</sup> of water was added to the original 8.0 cm<sup>3</sup> of water.

Explain the disadvantages of adding the 2.0 cm<sup>3</sup> of water in 1.0 cm<sup>3</sup> portions rather than 0.5 cm<sup>3</sup> portions.

.....  
 ..... [2]

- (h) Suggest why it would **not** be possible to use 6.0 cm<sup>3</sup> of water instead of 8.0 cm<sup>3</sup> of water in Experiment 1.

.....  
 ..... [1]

[Total: 18]

- 2 You are provided with two solutions: solution **C** and solution **D**.  
Do the following tests on the solutions, recording all of your observations at each stage.

**Tests on solution C**

- (a) Carry out a flame test on solution **C**.

Record your observations.

..... [1]

Divide the remaining solution **C** into three approximately equal portions in one boiling tube and two test-tubes.

- (b) To the first portion of solution **C** in a boiling tube, add aqueous sodium hydroxide dropwise until it is in excess.

**Keep the product for the test in (c).**

Record your observations.

dropwise .....

in excess .....

[2]

- (c) (i) Transfer about 2 cm depth of the product from (b) into a clean boiling tube. Add a piece of aluminium foil. Warm the mixture gently. Test any gas produced.

Record your observations.

.....  
..... [2]

- (ii) Identify the gas produced in (c)(i).

..... [1]

- (d) To the second portion of solution **C**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

.....  
..... [1]

- (e) To the third portion of solution **C**, add about 1 cm depth of aqueous sodium carbonate.

Record your observations.

.....  
 ..... [1]

- (f) Identify solution **C**.

.....  
 ..... [2]

**tests on solution D**

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

- (g) Test the pH of the first portion of solution **D**.

pH = ..... [1]

- (h) To the second portion of solution **D**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

.....  
 ..... [1]

- (i) To the third portion of solution **D**, add a spatula full of solid sodium carbonate. Test any gas produced.

Record your observations.

.....  
 ..... [2]

- (j) Identify the **two** ions in solution **D**.

.....  
 ..... [2]

[Total: 16]





## Notes for use in qualitative analysis

## Tests for anions

anion	test	test result
carbonate, $\text{CO}_3^{2-}$	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, $\text{Cl}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, $\text{Br}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, $\text{I}^-$ [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, $\text{NO}_3^-$ [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, $\text{SO}_4^{2-}$ [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, $\text{SO}_3^{2-}$	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, $\text{Al}^{3+}$	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, $\text{NH}_4^+$	ammonia produced on warming	–
calcium, $\text{Ca}^{2+}$	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), $\text{Cr}^{3+}$	green ppt., soluble in excess	green ppt., insoluble in excess
copper(II), $\text{Cu}^{2+}$	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II), $\text{Fe}^{2+}$	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), $\text{Fe}^{3+}$	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc, $\text{Zn}^{2+}$	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, $\text{NH}_3$	turns damp red litmus paper blue
carbon dioxide, $\text{CO}_2$	turns limewater milky
chlorine, $\text{Cl}_2$	bleaches damp litmus paper
hydrogen, $\text{H}_2$	'pops' with a lighted splint
oxygen, $\text{O}_2$	relights a glowing splint
sulfur dioxide, $\text{SO}_2$	turns acidified aqueous potassium manganate(VII) from purple to colourless

**Flame tests for metal ions**

metal ion	flame colour
lithium, $\text{Li}^+$	red
sodium, $\text{Na}^+$	yellow
potassium, $\text{K}^+$	lilac
calcium, $\text{Ca}^{2+}$	orange-red
barium, $\text{Ba}^{2+}$	light green
copper(II), $\text{Cu}^{2+}$	blue-green

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