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7450421190

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	
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Total	

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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 cm^3 of distilled water to the 5.25 g sample of ammonium chloride in the boiling tube.
- Clamp the boiling tube at an angle, as shown in Fig. 1.1.

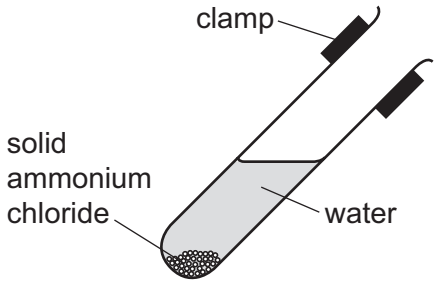

Fig. 1.1

- 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 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 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 cm^3 of distilled water to the mixture in the boiling tube from Experiment 3.

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Experiment 5

- Repeat Experiment 2 by using the burette to add another 0.5 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 / cm^3	temperature when a solid starts to form / °C
1		8.0	
2			
3			
4			
5			

[4]

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(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.

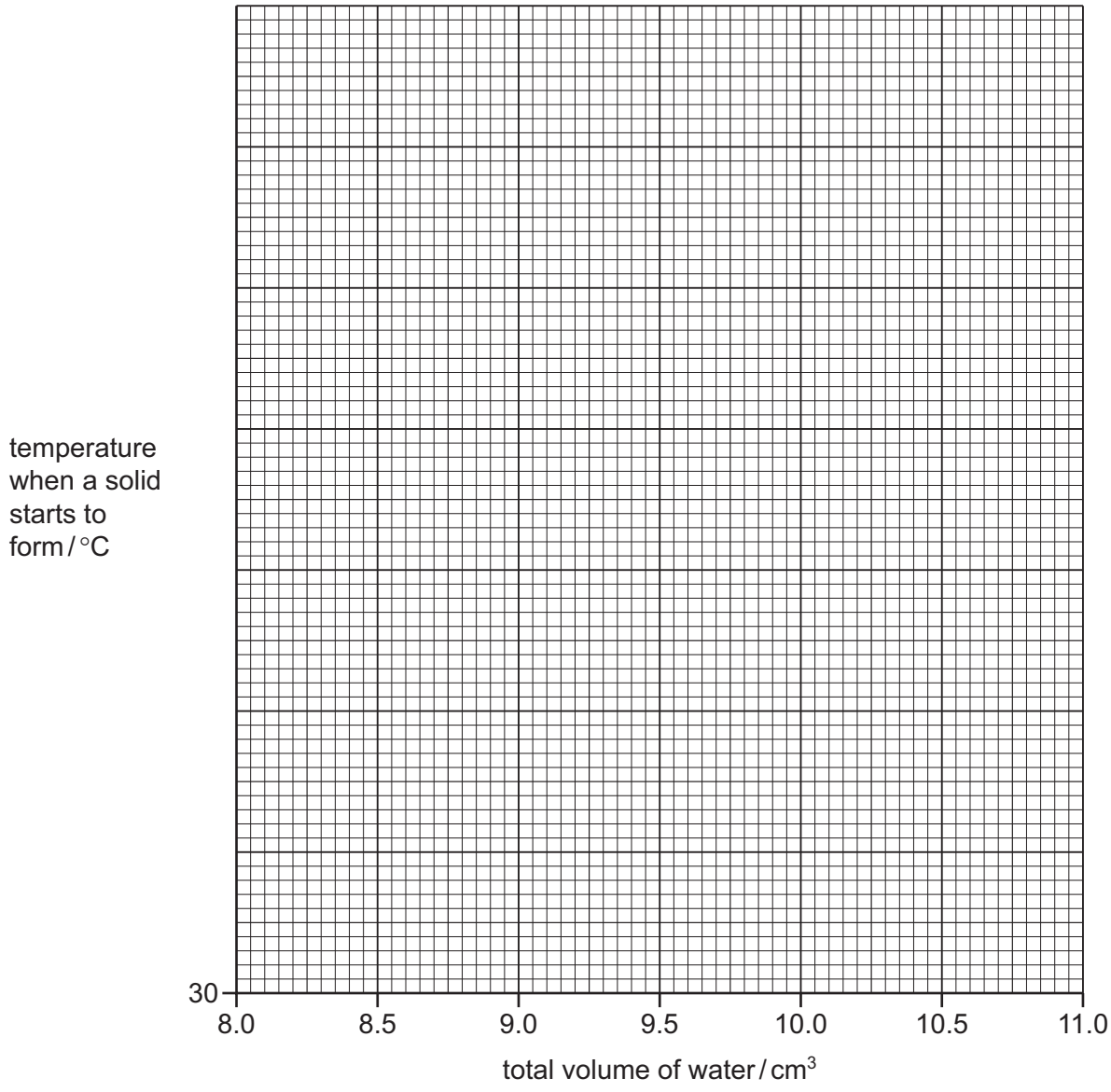

Fig. 1.2

[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^3 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]

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(d) Solubility, in g / 100 cm^3 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^3 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^3 of water was added to the original 8.0 cm^3 of water.

Explain the disadvantages of adding the 2.0 cm^3 of water in 1.0 cm^3 portions rather than 0.5 cm^3 portions.

.....

..... [2]

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

.....

..... [1]

[Total: 18]

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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]

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(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]

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3 Cadmium, cobalt and vanadium are all metals. They react with dilute hydrochloric acid to form hydrogen gas. These reactions are exothermic.

Plan an investigation to find the order of reactivity of the three metals.

Your plan must make it clear how your investigation will be a fair test and how you will use your results to place the metals in order of reactivity.

You are provided with powdered samples of each metal, dilute hydrochloric acid 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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