Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

1780936797

CHEMISTRY **0620/62**

Paper 6 Alternative to Practical **February/March 2023**

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.

IB23 03_0620_62/3RP

1 Long-chain alkanes can be broken down into shorter chain alkanes and gaseous alkenes. Vapour from a long-chain alkane is passed over a very hot catalyst and the gases formed are collected over water. The apparatus used is shown in Fig. 1.1.

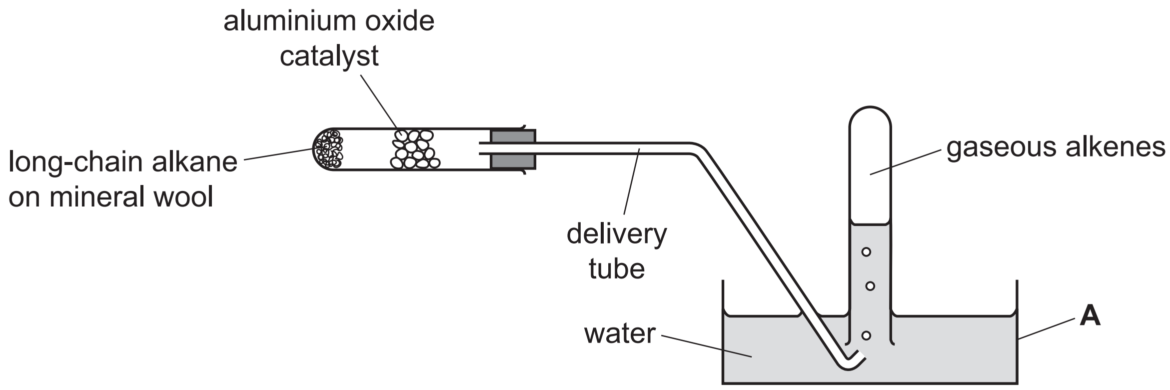

Fig. 1.1

(a) Name the item of apparatus labelled **A** in Fig. 1.1.

.... [1]

(b) The catalyst is small pieces of aluminium oxide.

Explain why several small pieces of aluminium oxide speed up the reaction more than one large piece of aluminium oxide.

....

.... [1]

(c) **(i)** Name the item of apparatus that can be used to heat the long-chain alkane and catalyst.

.... [1]

(ii) Add **two** arrows to Fig. 1.1 to show where the apparatus should be heated. [1]

(d) The gas collected is tested using aqueous bromine. Alkenes turn aqueous bromine from orange to colourless.
When the first few bubbles of gas collected are tested, the aqueous bromine does **not** change colour.

Explain why the aqueous bromine does **not** change colour.

....

.... [1]

(e) As soon as the experiment is over and the heating is stopped, the delivery tube must be removed from the water.

Explain what happens if the delivery tube is **not** removed from the water as soon as the heating is stopped.

....

.... [2]

[Total: 7]

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2 A student investigates the solubility of ammonium chloride in water at different temperatures.

The student does five experiments using the following instructions.

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 a 5.25 g sample of ammonium chloride in a boiling tube.
- Clamp the boiling tube at an angle, as shown in Fig. 2.1.

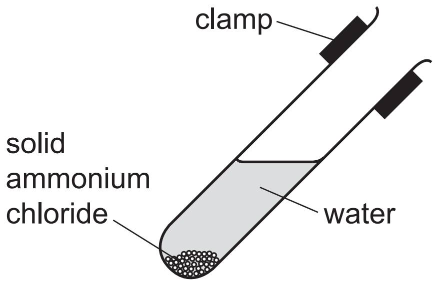


Fig. 2.1

- 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.
- Continuously stir the solution with the thermometer while it cools.
- Measure the temperature of the solution as soon as the solution becomes cloudy and a solid starts to form.

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. 2.1.
- 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.
- Continuously stir the solution with the thermometer while it cools.
- Measure the temperature of the solution as soon as the solution becomes cloudy and a solid starts to form.

Experiment 3

- Repeat Experiment 2.

Experiment 4

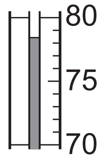
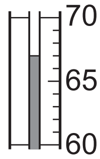
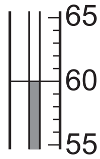
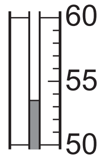
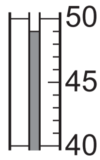
- Repeat Experiment 2.

Experiment 5

- Repeat Experiment 2.

(a) Use the information in the description of the experiments and the thermometer diagrams to complete Table 2.1.

Table 2.1

experiment	mass of ammonium chloride / g	total volume of water / cm^3	thermometer diagram when a solid starts to form	temperature when a solid starts to form / °C
1		8.0		
2				
3				
4				
5				

[4]

(b) Complete a suitable scale on the *y*-axis of Fig. 2.2 and plot your results from Experiments 1 to 5 on Fig. 2.2.

Draw a line of best fit through your points.

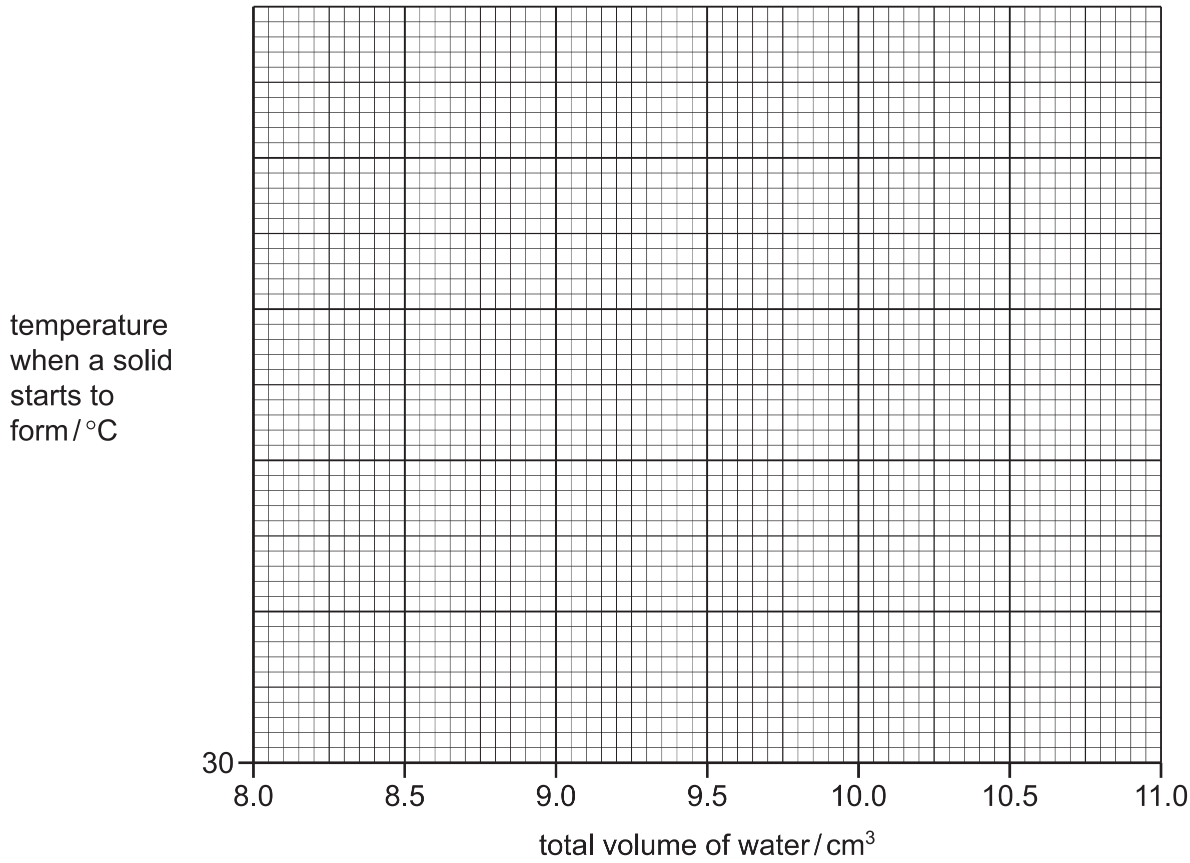


Fig. 2.2

[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. 2.2** how you worked out your answer.

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

(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]

3 A student tests two solutions: solution **C** and solution **D**.

Tests on solution C

Solution **C** is aqueous calcium nitrate.

Complete the expected observations.

The student divides solution **C** into three portions.

(a) The student carries out a flame test on the first portion of solution **C**.

observations .... [1]

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

observations adding dropwise ....

observations in excess ....
[2]

(c) To the product from **(b)**, the student adds a piece of aluminium foil and warms the mixture gently. Any gas produced is tested.

observations ....

.... [1]

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

observations ....

.... [1]

tests on solution D

Table 3.1 shows the tests and the student's observations for solution **D**. The student divides solution **D** into four portions.

Table 3.1

tests	observations
test 1 Use a glass rod to transfer one drop of the first portion of solution **D** onto a piece of universal indicator paper.	the universal indicator paper turns red
test 2 To the second portion of solution **D**, add solid sodium carbonate. Test any gas produced.	the solid sodium carbonate disappears and there is effervescence the gas turns limewater milky
test 3 To the third portion of solution **D**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.	no change
test 4 To the fourth portion of solution **D**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.	white precipitate

(e) Deduce the pH of solution **D**.

pH = ... [1]

(f) Identify the gas made when sodium carbonate is added to solution **D**.

.... [1]

(g) Identify the **two** ions in solution **D**.

....

.... [2]

[Total: 9]

4 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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.... [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