* 0019655415701 *

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6589543782

CHEMISTRY **0620/52**

Paper 5 Practical Test **May/June 2024**

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	
3	
Total	

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

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1 You are going to investigate the reaction between aqueous aluminium chloride and two aqueous solutions of sodium hydroxide, solution **F** and solution **G**. Solution **F** and solution **G** have different concentrations.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do three experiments.

(a) Experiment 1

- Rinse a burette with distilled water and then with aqueous aluminium chloride.
- Rinse a conical flask with distilled water.
- Fill the burette with aqueous aluminium chloride. Run some of the aqueous aluminium chloride out of the burette so that the level of the aqueous aluminium chloride is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Use a measuring cylinder to pour $25\,cm^3$ of solution **F** into the conical flask.
- Stand the conical flask on a black or dark-coloured sheet of paper.
- Slowly add aqueous aluminium chloride from the burette to the conical flask, while swirling the flask, until the mixture in the conical flask just starts to become cloudy.
- Record the final burette reading in Table 1.1.

Experiment 2

- Refill the burette with aqueous aluminium chloride. Run some of the aqueous aluminium chloride out of the burette so that the level of the aqueous aluminium chloride is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Rinse the conical flask with distilled water.
- Rinse the measuring cylinder with distilled water and then with solution **G**.
- Use the measuring cylinder to pour $25\,cm^3$ of solution **G** into the conical flask.
- Stand the conical flask on a black or dark-coloured sheet of paper.
- Slowly add aqueous aluminium chloride from the burette to the conical flask, while swirling the flask, until the mixture in the conical flask just starts to become cloudy.
- Record the final burette reading in Table 1.1.

Experiment 3

- Refill the burette with aqueous aluminium chloride. Run some of the aqueous aluminium chloride out of the burette so that the level of the aqueous aluminium chloride is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Rinse the conical flask with distilled water.
- Use the measuring cylinder to pour $25\,cm^3$ of solution **G** into the conical flask.
- Add 5 drops of thymolphthalein indicator to the conical flask.
- Stand the conical flask on a **white tile**.
- Slowly add aqueous aluminium chloride from the burette to the conical flask, while swirling the flask, until the thymolphthalein indicator changes colour.
- Record the final burette reading in Table 1.1.

Complete Table 1.1.

Table 1.1

	Experiment 1	Experiment 2	Experiment 3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of aqueous aluminium chloride added / cm^3			

[5]

(b) State the colour change seen at the end-point in Experiment 3.

from .... to .... [1]

(c) State why the conical flask is swirled as solution **F** is added in Experiment 1.

....

.... [1]

(d) Suggest why the conical flask is placed on black or dark-coloured paper in Experiments 1 and 2.

....

.... [1]

(e) **(i)** Explain why the measuring cylinder is rinsed between Experiment 1 and Experiment 2.

.... [1]

(ii) Explain why the measuring cylinder does **not** need rinsing between Experiment 2 and Experiment 3.

.... [1]

(f) Compare the concentration of solution **F** used in Experiment 1 with the concentration of solution **G** used in Experiment 2.

Explain your answer.

....

....

.... [3]

(g) Calculate the volume of aqueous aluminium chloride required when Experiment 1 is carried out with 10 cm^3 of aqueous sodium hydroxide instead of 25 cm^3.

.... [2]

(h) In all three experiments it is more accurate to measure the volume of the aqueous sodium hydroxide using a volumetric pipette instead of a measuring cylinder.

Explain why it is **not** possible to use a volumetric pipette to measure the volume of aqueous aluminium chloride in these experiments.

....

.... [1]

[Total: 16]

2 You are provided with two substances: solid **H** and solid **I**.

Do the following tests on the substances, recording all of your observations at each stage.

Tests on solid H

(a) **(i)** Add about 10 cm^3 of dilute hydrochloric acid to the sample of solid **H** in the boiling tube. Test any gas produced.

Keep the solution produced for use in (b), (c), (d) and (e).

Record your observations.

....

....

.... [3]

(ii) Identify the gas made in **(a)(i)**.

.... [1]

The solution produced in **(a)(i)** is solution **J**. Divide solution **J** into four approximately equal portions in four test-tubes.

(b) Carry out a flame test on the first portion of solution **J**.

Record your observations.

.... [1]

(c) **(i)** To the second portion of solution **J**, add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

....

.... [1]

(ii) State what conclusion can be made from the result in **(c)(i)**.

....

.... [1]

(d) To the third portion of solution **J**, add a few drops of dilute sulfuric acid.

Record your observations.

....

.... [1]

(e) To the fourth portion of solution **J**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

....

.... [1]

(f) Identify solid **H**.

....

.... [2]

Tests on solid I

Add about 5 cm depth of distilled water to the sample of solid **I** in the boiling tube. Replace the stopper in the boiling tube and shake to dissolve and form solution **I**. Divide solution **I** into three approximately equal portions in two boiling tubes and one test-tube.

(g) To the first portion of solution **I** in a boiling tube, add about 2 cm depth of aqueous sodium hydroxide and warm the mixture. Test any gas produced, using damp red litmus paper and damp blue litmus paper.

Record your observations.

damp red litmus paper ....

damp blue litmus paper ....
[2]

(h) **(i)** To the second portion of solution **I** in a boiling tube, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Keep the product for use in (h)(ii).

Record your observations.

....

.... [1]

(ii) To the product from **(h)(i)**, add about 4 cm depth of aqueous ammonia. Place a stopper in the boiling tube and shake to mix.

Pour the product away and rinse the boiling tube and bung as soon as you have made your observations.

Record your observations.

....

.... [1]

(i) Test the pH of the third portion of solution **I**.

pH = ... [1]

(j) Identify solid **I**.

....

.... [2]

[Total: 18]

3 Bismuth is a metal that has a reactivity similar to that of copper. The ore bismite contains the compound bismuth(III) oxide, Bi_2O_3.

Bismuth(III) oxide is insoluble in water and reacts with dilute acids to form an aqueous solution of a salt. The ore bismite contains no other compounds that are insoluble in water and no other compounds that react with acids to form aqueous solutions.

Describe how you could obtain a sample of bismuth metal starting with a large lump of the ore bismite.

You have access to common laboratory apparatus and chemicals.

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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