Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

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7401624526

CHEMISTRY **0620/63**

Paper 6 Alternative to Practical **October/November 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 **12** pages. Any blank pages are indicated.

1 Hydrated aluminium chloride is a white solid. When heated very strongly, hydrated aluminium chloride produces steam, hydrogen chloride gas and aluminium oxide. Hydrogen chloride gas is toxic and aluminium oxide is a white solid.

A teacher heats a sample of hydrated aluminium chloride using the apparatus shown in Fig. 1.1.

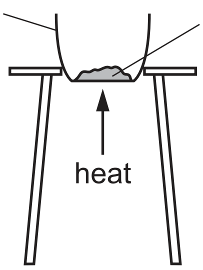

Fig. 1.1

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

.... [1]

(b) Explain why this experiment should be carried out in a fume cupboard.

....

.... [1]

(c) The hydrated aluminium chloride has to be heated very strongly.

Describe how a Bunsen burner is adjusted to make the flame as hot as possible.

....

.... [1]

(d) During the experiment, the mass of apparatus **A** and its contents decreases.

(i) Explain why the mass decreases.

....

.... [1]

(ii) Describe what the teacher can do to be sure all the hydrated aluminium chloride reacts.

....

....

.... [2]

(e) In a second experiment, the teacher uses the apparatus shown in Fig. 1.2 to collect the water made.

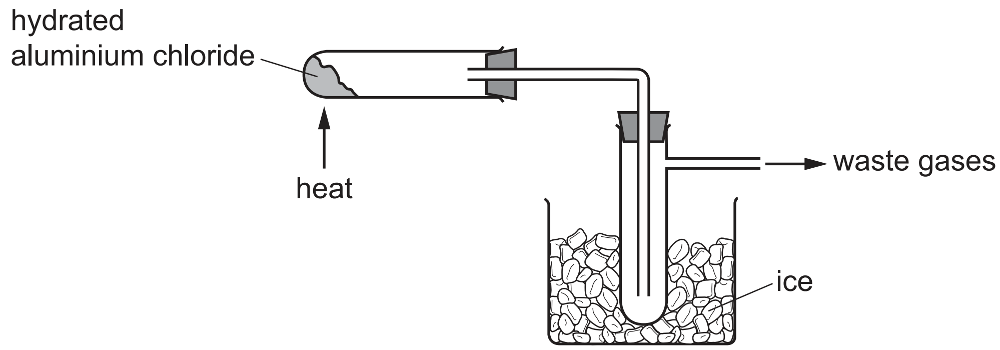

Fig. 1.2

(i) Explain the purpose of the ice.

....

.... [1]

(ii) The water collected is **not** pure.

Describe a test the teacher can do to show that the water collected is **not** pure.
State the result of the test if the water is **not** pure.

test ....

result ....
[2]

[Total: 9]

2 A student investigates the reaction between dilute hydrochloric acid and aqueous sodium hydroxide.

The student does two experiments.

Experiment 1

- Fill a burette with aqueous sodium hydroxide and run some of the aqueous sodium hydroxide out of the burette so that the level is on the burette scale.
- Record the initial burette reading.
- Use a measuring cylinder to pour 25 cm^3 of dilute hydrochloric acid into a conical flask.
- Stand the conical flask on a white tile.
- Add five drops of methyl orange indicator to the conical flask.
- Slowly add aqueous sodium hydroxide from the burette to the conical flask, while swirling the flask, until the solution just changes colour.
- Record the final burette reading.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Refill the burette with aqueous sodium hydroxide.
- Record the initial burette reading.
- Use the measuring cylinder to pour 25 cm^3 of dilute hydrochloric acid into the conical flask.
- Add 0.50 g of calcium carbonate powder to the conical flask and swirl the flask.
- Stand the conical flask on the white tile.
- Add five drops of methyl orange indicator to the conical flask.
- Slowly add aqueous sodium hydroxide from the burette to the conical flask, while swirling the flask, until the solution just changes colour.
- Record the final burette reading.

(a) Use the burette diagrams in Fig. 2.1 and Fig. 2.2 to record the readings for Experiment 1 and Experiment 2 in Table 2.1 and complete Table 2.1.

Experiment 1

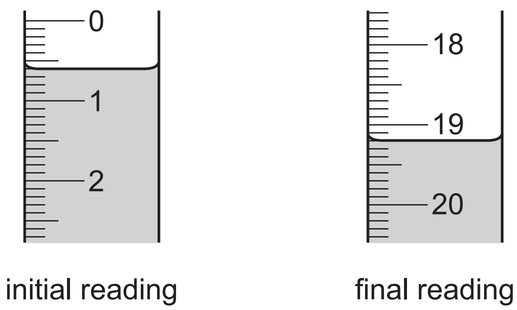

Fig. 2.1

Experiment 2

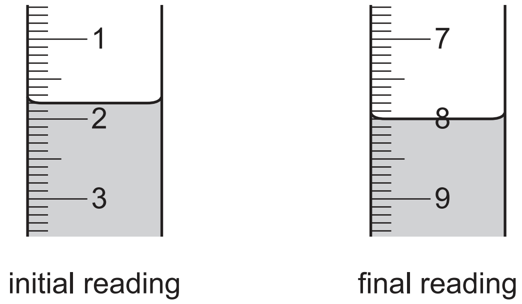

Fig. 2.2

Table 2.1

	Experiment 1	Experiment 2
final burette reading / cm^3		
initial burette reading / cm^3		
volume of aqueous sodium hydroxide added / cm^3		

[4]

(b) State the colour change observed in the conical flask at the end-point in both experiments.

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

(c) When 0.50 g of calcium carbonate is added to the conical flask in Experiment 2, a gas is produced.

Suggest the identity of the gas.

.... [1]

(d) In Experiment 2, the conical flask is rinsed with water but the burette is **not** rinsed with water.

(i) State why there is no need to rinse the burette with water.

.... [1]

(ii) Explain why the conical flask is rinsed with water.

....

.... [1]

(iii) The conical flask is **not** dried after being rinsed with water.

State how drying the conical flask affects the volume of aqueous sodium hydroxide needed to reach the end-point. Explain your answer.

....

....

.... [2]

(e) **(i)** Compare the volumes of aqueous sodium hydroxide needed to reach the end-point in Experiment 1 and Experiment 2.

....

.... [2]

(ii) Explain why different volumes of aqueous sodium hydroxide are needed in Experiment 1 and Experiment 2.

....

.... [1]

(iii) Calculate the volume of aqueous sodium hydroxide needed to reach the end-point if Experiment 2 is repeated using 0.25 g of calcium carbonate instead of 0.50 g.

volume of aqueous sodium hydroxide = ... [2]

(f) Describe how the reliability of the results obtained can be confirmed.

....

.... [1]

[Total: 16]

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

Tests on solid I

Solid **I** is chromium(III) sulfate.

The student dissolves solid **I** in water to form solution **I**. The student divides solution **I** into three portions.

Complete the expected observations.

(a) To the first portion of solution **I**, the student adds aqueous sodium hydroxide dropwise until it is in excess.

observations adding dropwise ....

observations in excess ....
[2]

(b) To the second portion of solution **I**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations ....

.... [1]

(c) To the third portion of solution **I**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations ....

.... [1]

Tests on solution J

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

Table 3.1

tests	observations
test 1 Use a glass rod to transfer one drop of the first portion of solution **J** onto a piece of universal indicator paper.	the universal indicator paper turns red
test 2 To the second portion of solution **J**, add a piece of magnesium ribbon. Test any gas produced.	the piece of magnesium ribbon disappears and effervescence is seen the gas produces a pop when tested with a lighted splint
test 3 To the third portion of solution **J**, add about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.	white precipitate
test 4 To the fourth portion of solution **J**, add about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.	no change
test 5 Do a flame test on the fifth portion of solution **J**.	lilac coloured flame

(d) Suggest the pH of solution **J**.

pH = ... [1]

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

.... [1]

(f) Identify the **three** ions in solution **J**.

....

....

.... [3]

[Total: 9]

4 You are asked to investigate the effect of temperature on the rate of decomposition of aqueous hydrogen peroxide.

Aqueous hydrogen peroxide decomposes to make oxygen gas.

hydrogen peroxide → water + oxygen

The reaction is very slow unless a catalyst is added to the hydrogen peroxide.
Manganese(IV) oxide is a catalyst for this reaction.

Plan an investigation to find how the **temperature** of the aqueous hydrogen peroxide affects the rate of the catalysed reaction. Your answer should include an explanation of how your results will tell you how the rate of reaction has changed.

You are provided with aqueous hydrogen peroxide, manganese(IV) oxide 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