Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3816441587

CHEMISTRY **5070/31**

Paper 3 Practical Test **October/November 2023**

1 hour 30 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.

1 Hydrochloric acid, HC*l*, is neutralised when it is added to aqueous potassium hydroxide, KOH.

$$KOH + HCl \rightarrow KCl + H_2O$$

The reaction is exothermic.

P is aqueous potassium hydroxide.
Q is 2.24 mol / dm^3 hydrochloric acid.

Read all the instructions carefully before starting the experiments.

Instructions

You are going to do **six** experiments.

(a) Experiment 1

- Rinse and fill a burette with **Q**.
- Place the plastic cup into a beaker.
- Use a volumetric pipette to add 25.0 cm^3 of **P** to the plastic cup.
- Use a measuring cylinder to add 20 cm^3 of water to the plastic cup.
- Stir the mixture in the cup with the thermometer and measure its temperature to the nearest 0.5 °C.
- Record this initial temperature in column E of Table 1.1.
- Use the burette to add 5.0 cm^3 of **Q** to the plastic cup whilst stirring.
- Measure the highest temperature reached.
- Record this value in column F of Table 1.1.
- Empty the plastic cup and rinse it with water.

Experiments 2 – 6

- Repeat Experiment 1 using the volumes of water and **Q** shown in columns C and D of the table. Refill the burette as necessary.
- Calculate the temperature rise for each of Experiments 1 – 6 and record them in column G of Table 1.1.

Table 1.1

A	B	C	D	E	F	G
experiment number	volume of **P** / cm^3	volume of water / cm^3	volume of **Q** / cm^3	initial temperature of mixture / °C	highest temperature reached / °C	temperature rise / °C
1	25.0	20	5.0			
2	25.0	15	10.0			
3	25.0	10	15.0			
4	25.0	7	18.0			
5	25.0	5	20.0			
6	25.0	0	25.0			

[8]

(b) Draw a graph of temperature rise against volume of **Q** on the grid in Fig. 1.1.

You should:
- plot the point (0,0) as there is no temperature rise when no **Q** is added
- plot temperature rise (column G) against volume of **Q** (column D) from Experiments 1–6
- draw a straight line of best fit for the first three points
- draw a straight line of best fit for the last four points
- extend the lines so that they intersect.

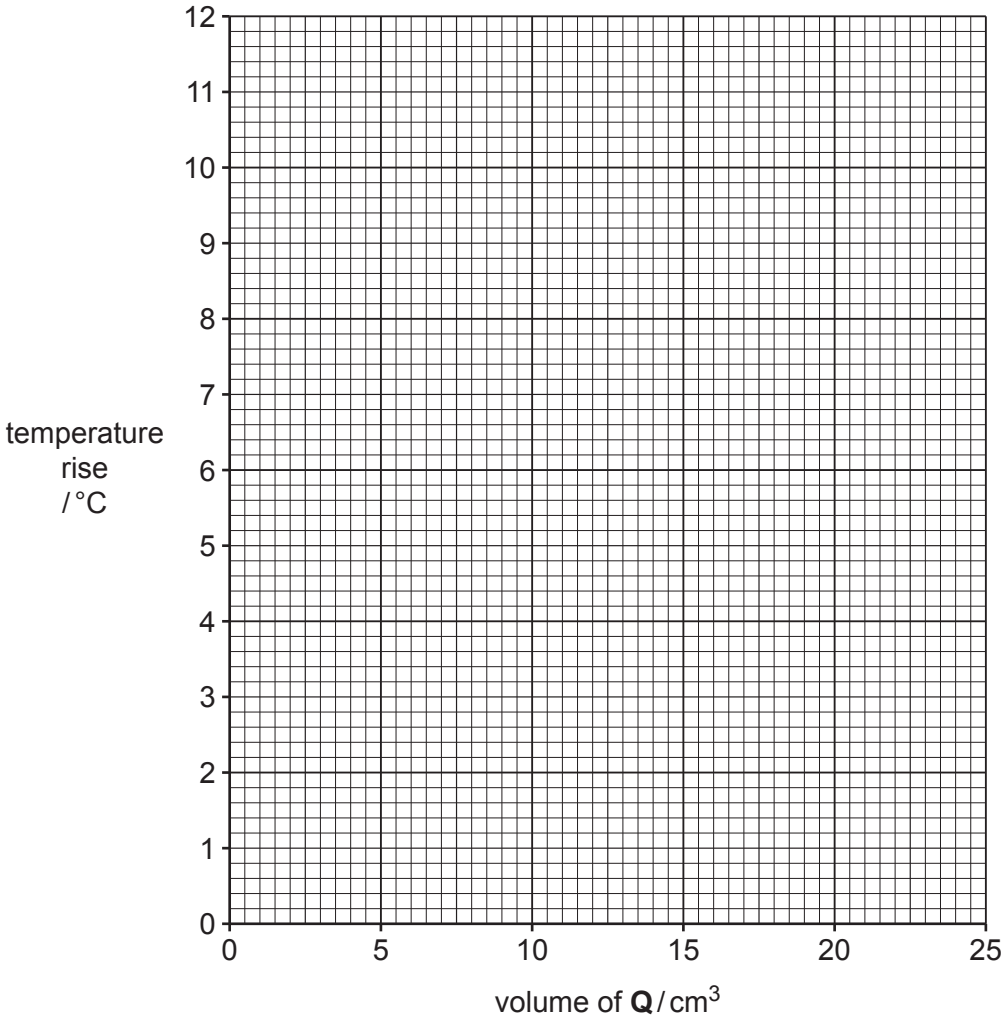

Fig. 1.1

[3]

(c) The point where the two lines intersect indicates the volume of **Q** that exactly neutralises 25.0 cm^3 of **P**.

Determine the volume of **Q** where the two lines on the graph intersect.

volume of **Q** ..... cm^3 [1]

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(d) **Q** is 2.24 mol / dm^3 hydrochloric acid.

Use your answer to **(c)** to calculate the concentration of potassium hydroxide in **P**.

$$KOH + HCl \rightarrow KCl + H_2O$$

concentration of potassium hydroxide in **P** ..... mol / dm^3 [2]

(e) State and explain why a plastic cup rather than a metal cup is used in these experiments.

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..... [2]

(f) A measuring cylinder is used to measure the volumes of water.

Suggest why the volumes of water in Table 1.1 are **not** given to one decimal place.

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..... [1]

[Total: 17]

2 You are provided with solution **X** and solution **Y**.

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

Tests on solution X

(a) Put 1 cm depth of **X** into a boiling tube. Add aqueous sodium hydroxide drop by drop until a change is seen.

Then add a further 2 cm depth of aqueous sodium hydroxide.

Record your observations.

Keep the mixture for use in **(b)**.

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..... [3]

(b) Gently warm the mixture from **(a)** in the boiling tube.

Test the gas given off.

Describe the test and its result.

Identify the gas.

test for gas and result .....

.....

identity of gas .....

[3]

(c) Put 1 cm depth of **X** into a test-tube. Add aqueous ammonia drop by drop until a change is seen.

Then add a further 2 cm depth of aqueous ammonia.

Record your observations.

.....

..... [2]

(d) Identify the **two** cations in **X**.

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

Tests on solution Y

(e) Put a piece of magnesium into a test-tube. Add 1 cm depth of solution **Y**.

Record your observations.

Test the gas given off.

Describe the test and its result.

Identify the gas.

observations .....

.....

test for gas and result .....

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identity of gas .....

[4]

(f) Put 1 cm depth of **Y** into a test-tube. Add 1 cm depth of dilute nitric acid.

Then add 1 cm depth of aqueous silver nitrate.

Record your observations.

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..... [1]

(g) Identify the cation and the anion in **Y**.

cation ..... anion ..... [2]

[Total: 17]

3 You are not expected to do any experimental work for this question.

Ammonium sulfate is a salt used in fertilisers.

Ammonium sulfate is prepared by neutralising dilute sulfuric acid with aqueous ammonia.

Plan an experiment to prepare pure dry crystals of ammonium sulfate.

Your plan should include the use of:
- common laboratory apparatus
- dilute sulfuric acid
- aqueous ammonia
- methyl orange indicator.

No other chemicals should be used.

Your plan should include:
- the apparatus needed
- the method to use.

You may draw a diagram to help answer the question.

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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
copper(II), Cu^{2+}	blue-green
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green