Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

CHEMISTRY **5070/31**

Paper 3 Practical Test **May/June 2025**

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 Solid **A** is impure calcium carbonate.

You are going to determine the number of moles of calcium carbonate in **A** by reacting it with excess 0.250 mol / dm^3 hydrochloric acid.

The unreacted acid in this mixture is then titrated with 0.100 mol / dm^3 sodium hydroxide.

You are provided with a sample of **A**.

Read all the instructions carefully before starting the experiments.

Instructions

(a) Preparation of mixture **B**

- Place the sample of **A** in a 250 cm^3 beaker.
- Use a measuring cylinder to add 100 cm^3 of 0.250 mol / dm^3 hydrochloric acid, HC*l*, to the beaker.
- Stir the mixture until no further effervescence is observed.
- Label this mixture **B**.

Calculate the number of moles of HC*l* added to the beaker.

number of moles .... [1]

(b) Titration of **B** with 0.100 mol / dm^3 sodium hydroxide

- Rinse a burette with water and then with 0.100 mol / dm^3 sodium hydroxide.
- Fill the burette with 0.100 mol / dm^3 sodium hydroxide.
- Record in Table 1.1 the initial burette reading.
- Use a volumetric pipette to add 25.0 cm^3 of **B** to a conical flask.
- Add five drops of methyl orange indicator to the conical flask.
- Add aqueous sodium hydroxide from the burette while swirling the flask, adding drop by drop near the end-point, until the solution just changes colour.
- Record in Table 1.1 the final burette reading.
- Repeat this titration two more times.

(i) Record in Table 1.1 the burette readings from your titrations and complete the table with the volume used in each titration.

Tick (✓) the best titration results.

Table 1.1

	titration 1	titration 2	titration 3
final burette reading / cm^3			
initial burette reading / cm^3			
volume used / cm^3			
best titration results (✓)			

[5]

(ii) Use the best titration results (✓) to calculate the average volume of sodium hydroxide, NaOH, used.

average volume .... cm^3 [1]

(c) The acid used in **(a)** to prepare mixture **B** is in excess.

Use your answer to **(b)(ii)** to calculate the number of moles of 0.100 mol / dm^3 NaOH that react with 25.0 cm^3 of **B**.

number of moles .... [1]

(d) Calculate the number of moles of NaOH that react with 100 cm^3 of **B**.

number of moles .... [1]

(e) The answer to **(d)** is equal to the number of moles of HC*l* that remain in the beaker after the acid reacts with the calcium carbonate in the sample of **A**.

Use your answers to **(a)** and **(d)** to calculate the number of moles of HC*l* that react with the calcium carbonate in the sample of **A**.

number of moles .... [1]

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(f) The equation for the reaction between hydrochloric acid and calcium carbonate is shown.

$$2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$$

Calculate the number of moles of calcium carbonate in the sample of **A**.

number of moles .... [1]

(g) In **(a)** the mixture of **A** and acid is stirred until effervescence stops.

(i) Give a reason for mixing the reactants by stirring.

.... [1]

(ii) Give a reason for waiting for the effervescence to stop.

.... [1]

(h) In **(a)** a measuring cylinder is used to add $100\,cm^3$ of $0.250\,mol/dm^3$ HCl to the beaker.

Explain why using the measuring cylinder makes the volume of HCl used inaccurate. Suggest an improvement.

explanation ....

....

improvement ....

[2]

(i) In **(b)** the burette is rinsed with water and then with $0.100\,mol/dm^3$ NaOH.

Suggest and explain the effect on the titration results if the burette is **not** rinsed with NaOH after rinsing with water.

effect ....

explanation ....

....

[2]

[Total: 17]

2 You are provided with solutions **W** and **X**.

Do the following tests on **W** and **X**.

Record your observations and conclusions for these tests.

(a) Do a flame test on solution **W**. Describe the method you use.

method ....

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observations ....

....

conclusion ....

....

[4]

(b) **(i)** To 1 cm depth of **W** in a test-tube, add 1 cm depth of aqueous chlorine. Keep this mixture for use in **(b)(ii)**.

observations ....

....

conclusion ....

....

[2]

(ii) Add 1 cm depth of starch solution to the contents of the solution from **(b)(i)**.

observations ....

.... [1]

(c) Test **W** for the presence of sulfate ions. Describe how you do the test and record your observations.

test ....

....

observations ....

....

[2]

(d) To 1 cm depth of **W** in a test-tube, add 1 cm depth of dilute nitric acid and 1 cm depth of aqueous silver nitrate.

observations ....

....

conclusion ....

.... [2]

(e) To 1 cm depth of **W** in a test-tube, add 1 cm depth of aqueous iron(III) nitrate.

observations ....

.... [1]

(f) **(i)** Put 1 cm depth of **X** into a boiling tube.

Add aqueous sodium hydroxide until no further change is seen.

Keep the mixture for use in **(f)(ii)**.

observation ....

....

conclusion about solution **X** ....

.... [3]

(ii) Put a 1 cm depth of the mixture from **(f)(i)** into a clean boiling tube.

Add a small piece of aluminium foil to the mixture and warm gently.

Test any gas evolved.

observations ....

....

....

conclusion about solution **X** ....

.... [2]

[Total: 17]

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

Q is a mixture of solid magnesium oxide and solid barium sulfate.

Magnesium oxide is insoluble in water. It reacts with dilute hydrochloric acid to make a solution of magnesium chloride.

Barium sulfate is insoluble in water and does **not** react with dilute hydrochloric acid.

Plan an investigation to obtain pure magnesium chloride crystals and pure barium sulfate solid from **Q**.

Your plan should describe the use of common laboratory apparatus, dilute hydrochloric acid and **Q**. No other chemicals should be used.

Your plan should include:

- the apparatus needed
- the preparation of magnesium chloride solution
- the method to obtain pure magnesium chloride crystals
- the method to obtain pure barium sulfate solid
- how to test that the barium sulfate is pure.

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