Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 1 2 9 2 8 5 6 2 0 9 *

CHEMISTRY **0971/62**

Paper 6 Alternative to Practical **October/November 2025**

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.

1 Eggshells are made from a mixture of calcium carbonate and other insoluble substances.

Calcium carbonate reacts with dilute hydrochloric acid. The equation for the reaction is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

The other substances in eggshells do **not** react with dilute hydrochloric acid.

A student finds the percentage by mass of calcium carbonate in an eggshell.

Fig. 1.1 shows the first three steps of the method the student uses.

step 1
Grind the eggshell into small pieces.

step 2
Find the mass of the small pieces of eggshell.

step 3
Add the small pieces of eggshell to excess dilute hydrochloric acid and warm the mixture while stirring it with a glass rod.

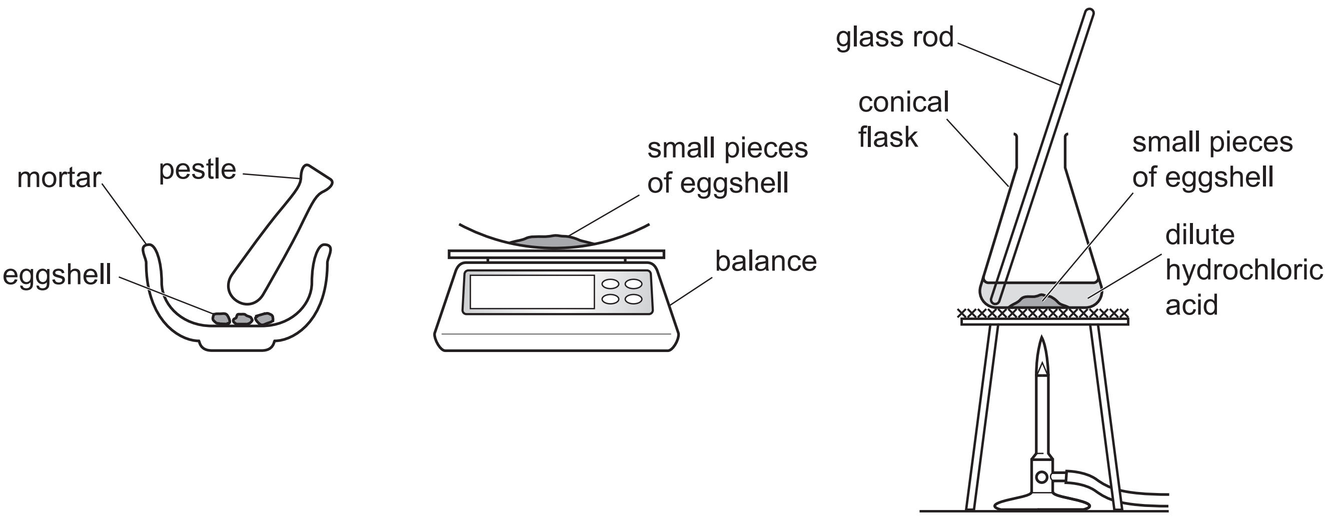

Fig. 1.1

(a) (i) Describe what is seen when the calcium carbonate in the eggshell reacts with dilute hydrochloric acid.

.... [1]

(ii) Describe what the student should do to make sure the acid is in excess and all of the calcium carbonate has reacted.

....

....

.... [2]

(b) After **step 3**, the student filters the mixture to obtain the unreacted solid left from the eggshell.

(i) Draw a labelled diagram of the apparatus the student should use to filter the mixture.

[2]

(ii) After the filtration, the student washes the residue.

Identify the **two** substances removed from the residue by washing.

substance 1 ....

substance 2 ....
[2]

(iii) After washing the residue, the student dries the residue in an oven.
The student then measures the mass of the dry residue.

The masses the student records are shown in Table 1.1.

Table 1.1

mass of small pieces of eggshell / g	2.00
mass of dry residue after filtration / g	0.11

Use the data in Table 1.1 to calculate the percentage by mass of calcium carbonate in the eggshell.

percentage of calcium carbonate = ... [2]

[Total: 9]

BLANK PAGE

2 A student investigates the reaction between acidic solution **B** and two different solutions of aqueous sodium hydroxide, solution **C** and solution **D**, using two different indicators.

The student does two experiments.

Experiment 1

- Rinse a burette with distilled water and then with solution **C**.
- Fill the burette with solution **C**. Run some of solution **C** out of the burette so that the level of the solution is on the burette scale.
- Record the initial burette reading.
- Use a measuring cylinder to pour $25\,cm^3$ of solution **B** into a conical flask.
- Add five drops of methyl orange indicator **and** five drops of thymolphthalein indicator to the conical flask.
- Stand the conical flask on a white tile.
- Slowly add solution **C** from the burette to the conical flask, while swirling the flask, until the solution changes colour from red to orange. This is the first end-point.
- Record the burette reading at the first end-point.
- Continue to add solution **C** from the burette to the conical flask while swirling the flask. The solution changes colour from orange to yellow.
- Continue to add solution **C**, while swirling the flask, until the solution changes colour from yellow to green. This is the second end-point.
- Record the burette reading at the second end-point.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Repeat Experiment 1 using solution **D** instead of solution **C**.

(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. Complete Table 2.1.

Experiment 1

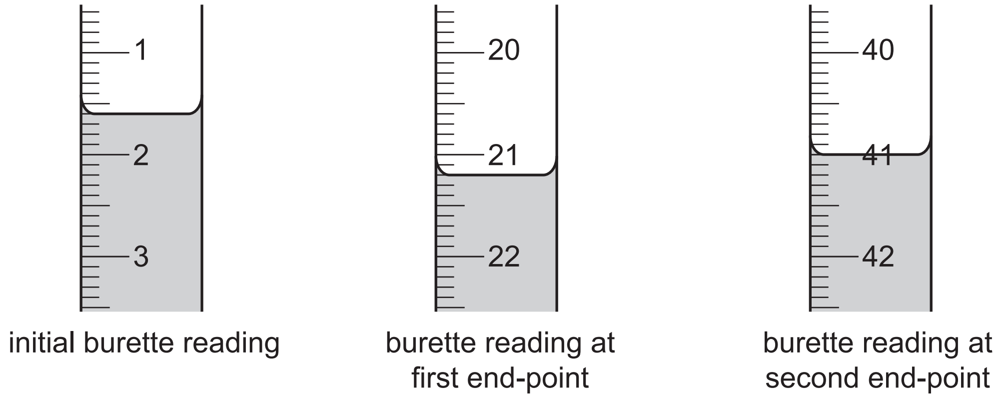

Fig. 2.1

Experiment 2

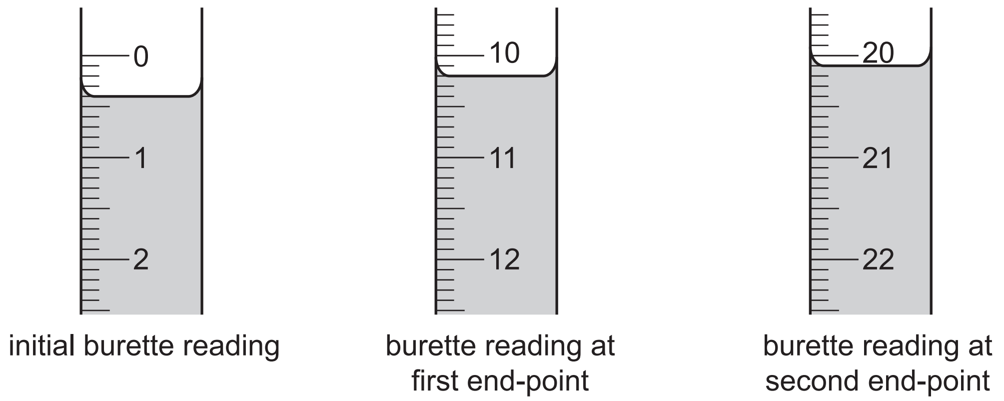

Fig. 2.2

Table 2.1

	Experiment 1 using solution **C**	Experiment 2 using solution **D**
burette reading at first end-point / cm^3		
burette reading at second end-point / cm^3		
initial burette reading / cm^3		
volume added from burette to reach first end-point / cm^3		
total volume added from burette to reach second end-point / cm^3		

[5]

(b) **(i)** Explain why the conical flask is rinsed with distilled water at the start of Experiment 2.

....

.... [1]

(ii) At the start of Experiment 1, the burette is rinsed with distilled water and then with solution **C**.

Explain how the volume added from the burette to reach the first end-point would be different if the burette was **not** rinsed with solution **C**.

....

....

....

.... [2]

(iii) Explain why the conical flask is placed on a white tile during the titration.

....

.... [1]

(c) Compare the concentration of solution **C** used in Experiment 1 with the concentration of solution **D** used in Experiment 2.

Explain your answer.

....

....

....

.... [3]

(d) **(i)** Deduce the volume of solution **C** required to reach the **first** end-point if Experiment 1 is repeated using 50 cm^3 of solution **B** instead of 25 cm^3.

volume of solution **C** = ... [2]

(ii) State why using 50 cm^3 of solution **B** would cause a problem when finding the volume of solution **C** needed to reach the **second** end-point in Experiment 1.

....

.... [1]

(e) A student repeats Experiment 2.

The student warms solution **B** in the conical flask before carrying out the titration.

State the effect, if any, on the volume of solution **D** required to reach the **second** end-point in Experiment 2.

Explain your answer.

effect on volume of solution **D** ....

explanation ....

.... [2]

(f) State **one** change to the **apparatus** that will improve the accuracy of the results.

.... [1]

[Total: 18]

3 A student tests two solids: solid **E** and solid **F**.

Tests on solid E

Solid **E** is ammonium sulfate.

Record the expected observations.

The student dissolves solid **E** in distilled water to form solution **E**. The student divides solution **E** into three approximately equal portions.

(a) **(i)** To the first portion of solution **E**, the student adds about 2 cm^3 of aqueous sodium hydroxide. The student warms the mixture gently and tests any gas produced.

observations ....

.... [1]

(ii) Identify the gas given off in **(a)(i)**.

.... [1]

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

observations ....

.... [1]

(c) To the third portion of solution **E**, the student adds a few drops of acidified aqueous potassium manganate(VII).

observations ....

.... [1]

Tests on solid F

Table 3.1 shows the tests and the student's observations for solid **F**.

Table 3.1

tests	observations
test 1 Carry out a flame test on solid **F**.	yellow flame
test 2 Dissolve the remaining solid **F** in distilled water to form solution **F**. Divide solution **F** into three portions. To the first portion of solution **F**, add about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.	yellow precipitate forms
test 3 To the second portion of solution **F**, add aqueous sodium hydroxide dropwise until in excess.	white precipitate forms the precipitate dissolves in excess aqueous sodium hydroxide to form a colourless solution
test 4 To the third portion of solution **F**, add aqueous ammonia dropwise until in excess.	white precipitate forms the precipitate dissolves in excess aqueous ammonia to form a colourless solution

(d) Identify the **three** ions in solid **F**.

....

....

.... [3]

[Total: 7]

4 Liquid alcohols can be burned as fuels in spirit burners. The energy given out can be used to heat water in a boiling tube as shown in Fig. 4.1.

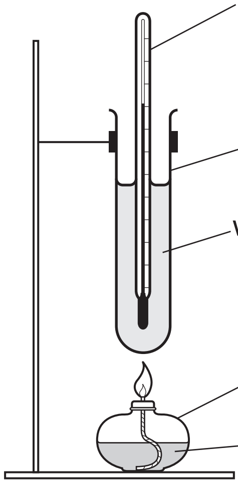

Fig. 4.1

Describe how to investigate which of three liquid alcohols, ethanol, propanol and butanol, heats the water in the boiling tube the fastest.

You are provided with three spirit burners, samples of the three alcohols, water and common laboratory apparatus.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [6]

BLANK PAGE

BLANK PAGE

BLANK PAGE

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

DO NOT WRITE IN THIS MARGIN

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