Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1076582816

CHEMISTRY **5070/31**

Paper 3 Practical Test **October/November 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 You are going to measure the temperature changes when an acid neutralises aqueous sodium hydroxide.

The ionic equation for the reaction is shown.

$$H^+ + OH^- \rightarrow H_2O$$

The reaction is exothermic.

The temperature changes can be used to determine the concentration of hydrogen ions in an acid.

X is 1.60 mol / dm^3 sodium hydroxide solution
Y is an acid of concentration 2.00 mol / dm^3

(a) **Read all the instructions carefully before starting the experiment.**

All temperatures and temperature changes should be recorded to +/– 0.5 °C.

step 1. Fill the burette with **Y**.
step 2. Stand a plastic cup inside a beaker.
step 3. Use a volumetric pipette to put 25.0 cm^3 of **X** into the plastic cup.
step 4. Measure the initial temperature of **X** and record it in Table 1.1.
step 5. Add 5.0 cm^3 of **Y** from the burette to the plastic cup.
step 6. Stir the mixture for 30 seconds and record in Table 1.1 the temperature of the mixture.
step 7. Repeat steps 5 and 6 until a total of 40.0 cm^3 of **Y** has been added.

Subtract the initial temperature of **X** from each temperature recorded to determine the temperature change.

Complete Table 1.1 with these temperature changes.

Table 1.1

volume of **Y** / cm^3	temperature / °C	temperature change / °C
0.0		0.0
5.0		
10.0		
15.0		
20.0		
25.0		
30.0		
35.0		
40.0		

[7]

(b) Plot a graph of the temperature change (*y*-axis) against the volume of **Y** (*x*-axis) on Fig. 1.1.

Draw a line of best fit through the points where the temperature change is increasing.

Draw a line of best fit through the points where the temperature change is decreasing.

Extend both lines so that they cross.

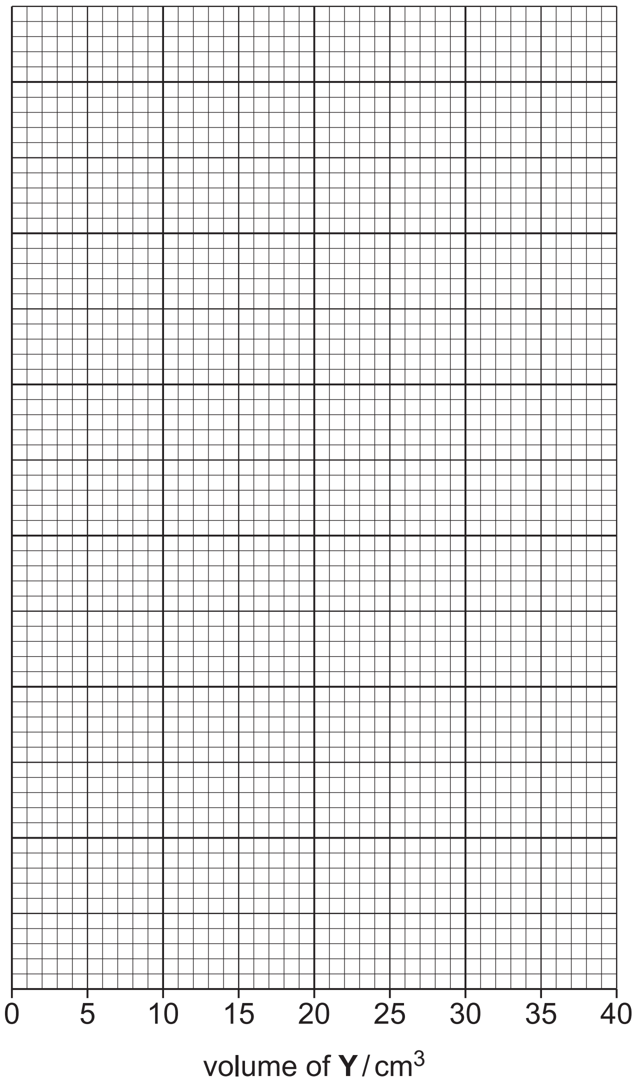

Fig. 1.1

[5]

(c) Find the point on the graph where the two lines cross.

Determine the volume of **Y** at this point.

volume .... cm^3 [1]

(d) **X** is 1.60 mol / dm^3 sodium hydroxide solution.

The formula of sodium hydroxide is NaOH.

Calculate the number of moles of hydroxide ions, OH^-, in 25.0 cm^3 of **X**.

number of moles .... [1]

(e) The volume of **Y** in **(c)** is the volume needed to completely neutralise 25.0 cm^3 of **X**.

Use your answers to **(c)** and **(d)** to calculate the concentration of hydrogen ions, H^+, in **Y**.

$$H^+ + OH^- \rightarrow H_2O$$

concentration .... mol / dm^3 [1]

(f) Suggest why **Y** is added to **X** using a burette and **not** a measuring cylinder.

....

.... [1]

(g) Suggest why the temperatures are recorded after 30 seconds and **not** immediately after mixing.

....

.... [1]

[Total: 17]

Question 2 starts on page 6.

2 You are provided with aqueous solution **Q** and aqueous solution **R**.

You will do a series of tests using **Q** and **R**.

Tests using solution Q

You should:

- record your observations for each of these tests
- test and name any gases evolved.

(a) To a 1 cm depth of **Q** in a test-tube, add five drops of universal indicator.

observations ....

.... [1]

(b) To a 2 cm depth of **Q** in a test-tube, add a piece of magnesium ribbon.

observations ....

....

....

conclusion ....
[5]

Allow the reaction to finish.

Divide the solution equally between two test-tubes for use in **(c)** and **(d)**.

(c) To one of the samples from **(b)**, add aqueous sodium hydroxide drop by drop until a change is seen.

Then add excess aqueous sodium hydroxide.

observations ....

.... [2]

(d) To the other sample from **(b)**, add a few drops of dilute nitric acid followed by 1 cm depth of aqueous silver nitrate.

observations ....

.... [1]

(e) **Q** contains one cation and one anion.

Identify the cation and the anion in **Q**.

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

Tests using solution R

Record your observations for each of these tests.

(f) Put 3 cm depth of dilute hydrochloric acid in a test-tube.

Dip a wooden splint or flame test wire into this test-tube.

Place the damp end of the wooden splint or flame test wire into **R**.

Place the damp end of the wooden splint or flame test wire into the flame of a Bunsen burner with the air-hole open.

(i) Record the first flame colour seen.

.... [1]

(ii) State why the air-hole on the Bunsen burner needs to be open.

.... [1]

(g) To 1 cm depth of **R** in a test-tube, add aqueous ammonia drop by drop until a change is seen.

Then add excess aqueous ammonia.

observations ....

....

.... [3]

(h) Identify the cation in **R**.

cation .... [1]

[Total: 17]

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

Alcohols are used as fuels to heat water.

Plan an experiment to determine which alcohol, methanol or ethanol, releases more thermal energy per gram of alcohol burned.

Your plan should describe the use of an alcohol burner, as shown in Fig. 3.1, to heat water. You should use water, methanol, ethanol and common laboratory apparatus. No other chemicals should be used.

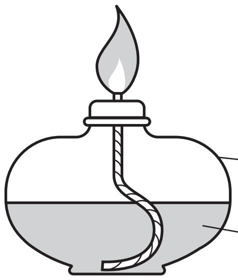

Fig. 3.1

Your plan should include:

- the additional apparatus needed
- the method to use and the measurements to take
- how the measurements are used to determine which alcohol releases more thermal energy per gram burned.

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