Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
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0123456789

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical **For examination from 2023**

SPECIMEN PAPER **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 Liquid **Q** is a fraction from petroleum containing large alkane molecules.

Fig. 1.1 shows the apparatus used to crack liquid **Q**. The vapour from liquid **Q** is passed over heated aluminium oxide to produce a mixture of hydrocarbons that includes alkenes.

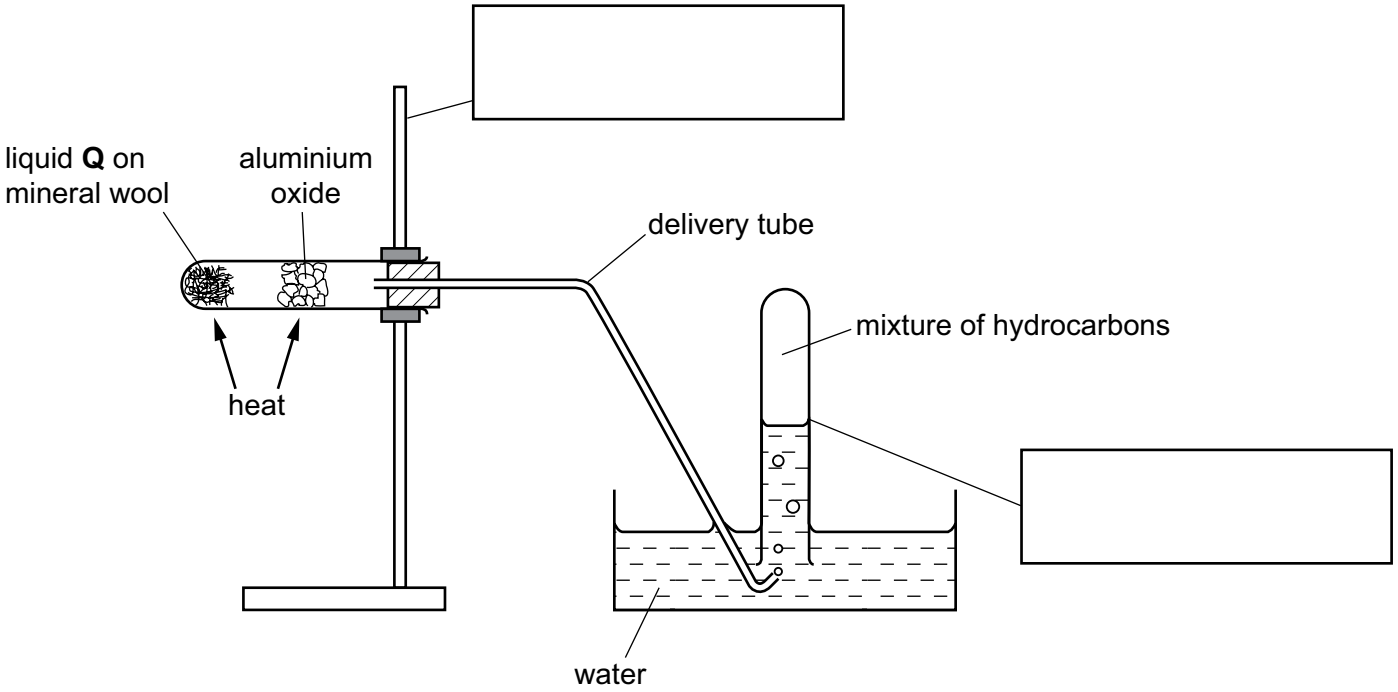

Fig. 1.1

(a) Identify the **two** pieces of apparatus by completing the boxes in Fig. 1.1. [2]

(b) State the purpose of the mineral wool.

.....

..... [1]

(c) Give a test and the result that shows the presence of an alkene.

test .....

result .....
[2]

(d) State why the delivery tube must be removed from the water when the heating stops.

..... [1]

[Total: 6]

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2 A student investigates the reaction between aqueous sodium carbonate and two different solutions of dilute hydrochloric acid, labelled solution **A** and solution **B**.

The equation for the reaction is given.

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

The student follows the instructions for three experiments.

Experiment 1

- Use a volumetric pipette to add 25.0 cm^3 of aqueous sodium carbonate to a conical flask.
- Add thymolphthalein indicator.
- Fill a burette with solution **A**.
- Record the initial burette reading.
- Add solution **A** from the burette until the solution turns colourless.
- Record the final burette reading.

(a) Table 2.1 shows the student's results.

Calculate the initial burette reading for Experiment 1 and record it in Table 2.1.

Table 2.1

	Experiment 1
final burette reading / cm^3	13.2
initial burette reading / cm^3	
volume used / cm^3	13.2

[1]

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Repeat the method in Experiment 1 with methyl orange indicator instead of thymolphthalein indicator.

(b) Fig. 2.1 shows the initial and final burette readings for Experiment 2.

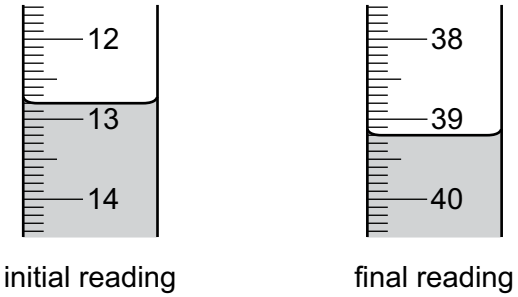

Fig. 2.1

Use Fig. 2.1 to complete Table 2.2 for Experiment 2.

Table 2.2

	Experiment 2
final burette reading / cm^3	
initial burette reading / cm^3	
volume used / cm^3	

[2]

(c) Methyl orange indicator is red-orange in acidic solutions and yellow in alkaline solutions.

State the colour change observed in the conical flask in Experiment 2.

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

(d) Suggest **one** observation, other than colour change, that is made when dilute hydrochloric acid reacts with aqueous sodium carbonate in Experiment 2.

..... [1]

Experiment 3

- Empty the conical flask and rinse it with distilled water.
- Empty the burette.
- Repeat the method in Experiment 1 with solution **B** instead of solution **A**. Use thymolphthalein indicator.

Table 2.3 shows the student's results for Experiment 3.

Table 2.3

	Experiment 3
final burette reading / cm^3	9.9
initial burette reading / cm^3	16.5
volume used / cm^3	6.6

(e) Complete the sentence.

Experiment ..... uses the largest volume of dilute hydrochloric acid to change the colour of the indicator. [1]

(f) State the effect on the volume of solution **B** used in Experiment 3 if the aqueous sodium carbonate is warmed before adding solution **B**.

Give a reason for your answer.

effect on volume used .....

reason .....

[2]

(g) **(i)** Calculate the simplest whole number ratio of volume of solution **A** used in Experiment 1 : volume of solution **B** used in Experiment 3.

..... [1]

(ii) Calculate the simplest whole number ratio of concentration of solution **A** : concentration of solution **B**.

..... [1]

(h) The burette is emptied and re-used in Experiment 3.

Suggest an additional step after emptying the burette which would improve the accuracy of the results.

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..... [2]

(i) Titrations often give inaccurate results if done only once.

Suggest how repeating each experiment several times produces more accurate values.

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..... [2]

[Total: 14]

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3 A student tests two solids, solid **C** and solid **D**.

tests on solid C

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

Table 3.1

tests	observations
appearance	green solid
test 1 Heat.	 the solid turns black
test 2 Add dilute sulfuric acid. Test the gas produced.	 rapid effervescence limewater turns milky
test 3 To the solution produced in **test 2**, add aqueous ammonia dropwise and then in excess.	 a light blue precipitate forms, which dissolves to form a dark blue solution

(a) **Test 1** states that the solid is heated.

Suggest why it is necessary to heat gently at first.

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..... [1]

(b) Describe how you would use limewater to test the gas produced in **test 2**.

.....

.....

..... [3]

(c) Identify the gas produced in **test 2**.

..... [1]

(d) Identify solid **C**.

..... [2]

tests on solid D

Solid **D** is potassium iodide.

The student makes an aqueous solution, solution **D**, using solid **D**, and divides it into two portions.

(e) To the first portion of solution **D**, the student adds an excess of aqueous sodium hydroxide.

Complete the expected observations.

observations ..... [1]

(f) The student tests the second portion of solution **D** to show the presence of iodide ions.

Give the test and the result that shows the presence of iodide ions.

test .....

result .....
[2]

(g) The student does a flame test on solid **D**.

Complete the expected observations.

observations ..... [1]

(h) Describe how to do a flame test.

.....

.....

..... [3]

[Total: 14]

4 Plant leaves contain a mixture of coloured substances.

Plan an experiment to find the R_f values of the coloured substances present in plant leaves.

Your plan should describe the use of common laboratory apparatus, plant leaves, sand, ethanol as the solvent and absorbent paper.

You may draw a diagram to help answer the question.

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[6]

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	grey-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