Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8708262312

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2022**

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

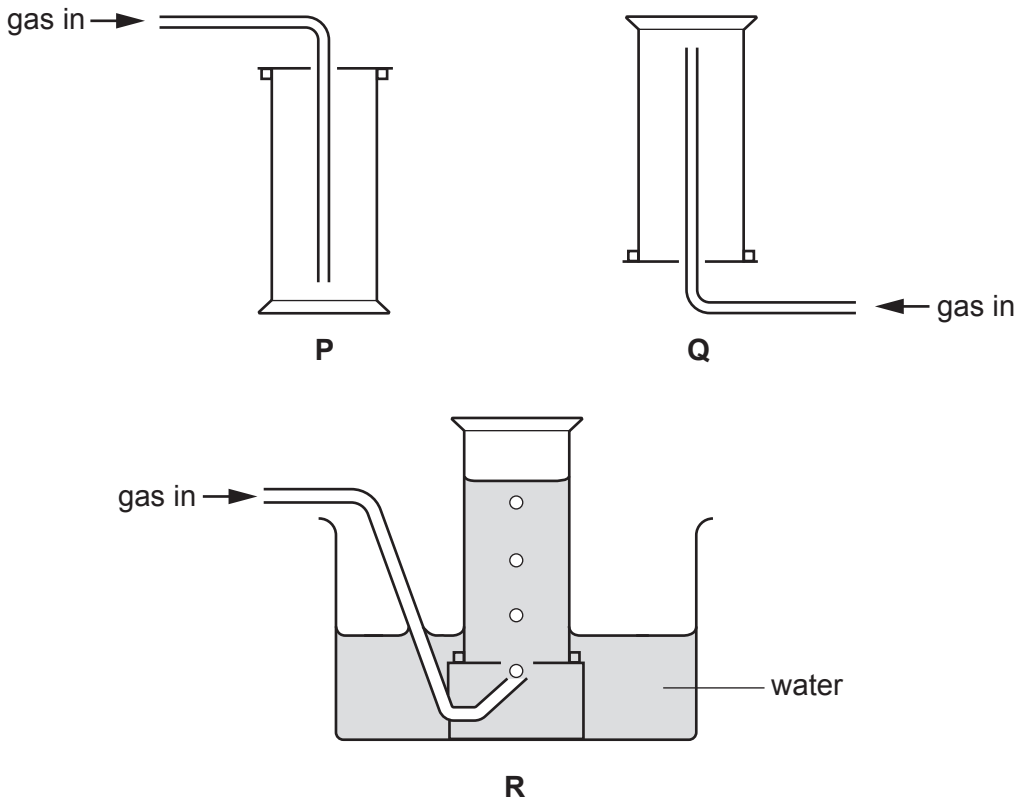
- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

1 Three colourless gases **A**, **B** and **C** have the properties shown.

gas	density	solubility in water
A	more dense than air	soluble
B	more dense than air	insoluble
C	less dense than air	soluble

Some sets of apparatus, **P**, **Q** and **R**, used to collect gases are shown.



(a) State which set of apparatus **P**, **Q** or **R** is most suitable to collect gas **A**.

..... [1]

(b) **R** is used to collect gas **B**.

(i) State why **Q** is **not** used to collect gas **B**.

..... [1]

(ii) State why **R** is more suitable than **P** to collect gas **B**.

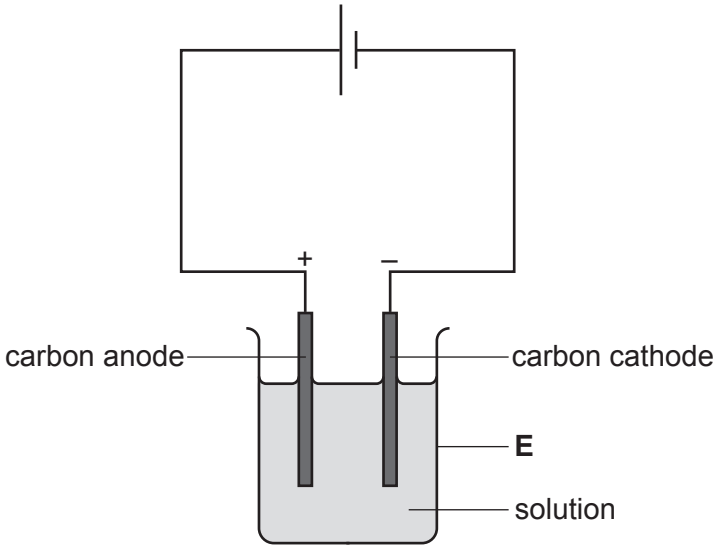
..... [1]

(c) State why **R** is **not** used to collect gas **C**.

..... [1]

[Total: 4]

2 A student electrolyses two aqueous solutions using the apparatus shown.



(a) Name apparatus **E**.

..... [1]

(b) Complete the table.

	anode (+)		cathode (–)	
solution	name of product	observation	name of product	observation
aqueous potassium iodide	iodine		hydrogen	
dilute sulfuric acid	oxygen			bubbles of colourless gas

[4]

(c) Describe the test used to identify oxygen gas.

test .....

observation .....

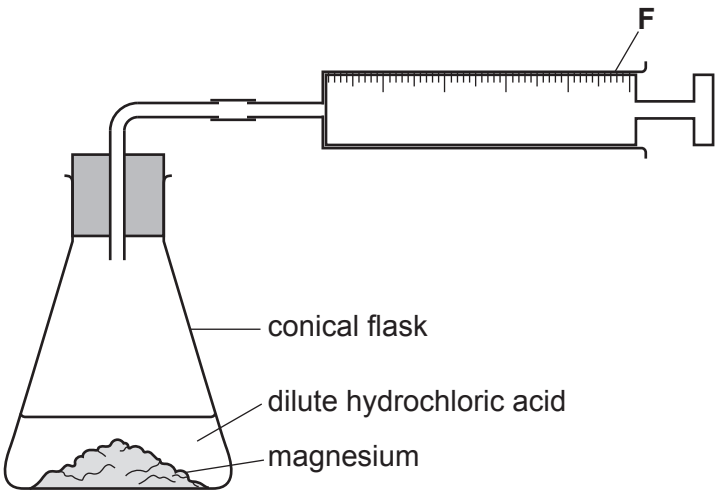
[2]

[Total: 7]

3 The equation for the reaction of magnesium with dilute hydrochloric acid is shown.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

A student investigates the rate of this reaction at three different temperatures.



In each experiment the student adds dilute hydrochloric acid to magnesium. The volume of hydrogen in apparatus **F** is recorded every 30 seconds.

(a) Name apparatus **F**.

..... [1]

(b) Name a piece of apparatus that the student could use to keep the temperature of the conical flask and its contents constant.

..... [1]

(c) Hydrogen gas is a product of the reaction.

(i) Describe the test used to identify hydrogen.

test .....

observation .....
[2]

(ii) The student uses the measurement of volume as time increases to determine the rate of this reaction.

State a **different** measurement that the student could make as time increases to determine the rate of this reaction.

..... [1]

(d) In each of the three experiments the contents of the flask are at a different temperature.

All other variables are kept constant.

The three experiments are labelled **X**, **Y** and **Z**.

experiment	temperature / °C
X	20
Y	40
Z	60

The hydrochloric acid is in excess in each of the three experiments.

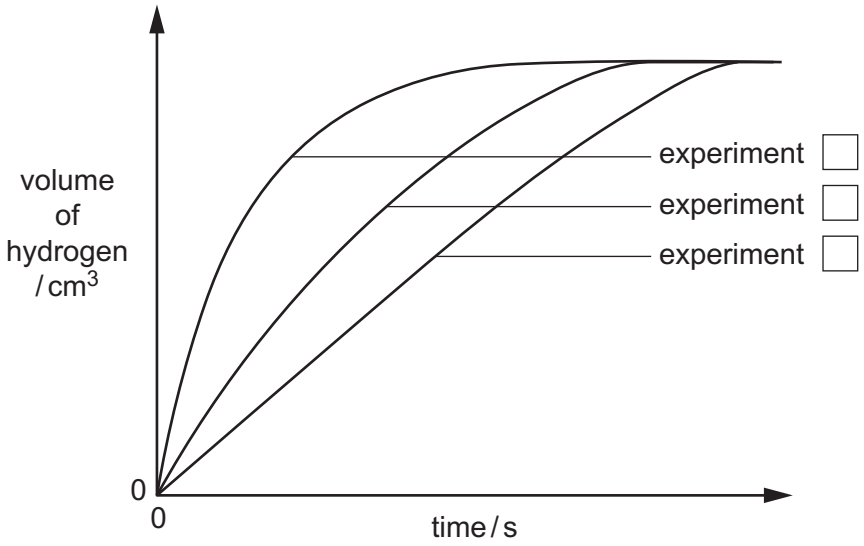
A catalyst is not used.

Identify two variables that are kept constant in this investigation.

1 .....

2 ..... [2]

(e) The student plots a graph of the results.



(i) Describe how the graph is used to decide which experiment has the greatest rate.

.....

..... [1]

(ii) Write a letter in each box on the graph to identify experiments **X**, **Y** and **Z**. [1]

(iii) Describe how the graph shows that the reactions stop.

..... [1]

(iv) Explain why the reactions stop.

..... [1]

[Total: 11]

4 A student is provided with two bottles labelled **A** and **B** and a supply of water.

One of the bottles contains 1.00 g of solid potassium chloride, KC*l*.

The other bottle contains 1.00 g of solid calcium chloride, $CaCl_2$.

When potassium chloride dissolves in water the change is endothermic.

When calcium chloride dissolves in water the change is exothermic.

Plan experiments, based on dissolving the solids in water, to decide:

- which compound is in each bottle
- which compound produces the greatest heat change per gram of solid.

Your plan may use any of the apparatus normally found in a chemistry laboratory but no other chemicals.

Your plan must state all the measurements you need to make.

Your plan must use the same experimental procedure for each solid.

.....

.....

.....

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.....

.....

[6]

5 Solution **K** is dilute sulfuric acid, H_2SO_4.

A student determines the concentration of solution **K** using a method that involves titration.

The student measures 20.0 cm^3 of solution **K** using a pipette.

The student makes up the solution to 250 cm^3 with distilled water. This is solution **L**.

(a) Name another piece of apparatus that could be used instead of a pipette to accurately measure 20.0 cm^3 of solution **K**.

..... [1]

(b) Name the container in which solution **L** is made.

..... [1]

(c) A pipette is used to transfer 25.0 cm^3 of solution **L** into a conical flask.

Name the other piece of apparatus that is used with the pipette.

..... [1]

(d) The student adds three drops of methyl orange to solution **L** in the conical flask and then places the flask on a white tile.

The student fills a burette with 0.100 mol/dm^3 potassium hydroxide, KOH(aq).

The KOH(aq) is added to the flask until there is a colour change.

(i) State which liquid should be used to wash out the burette before filling the burette with KOH(aq) for use in the titration.

..... [1]

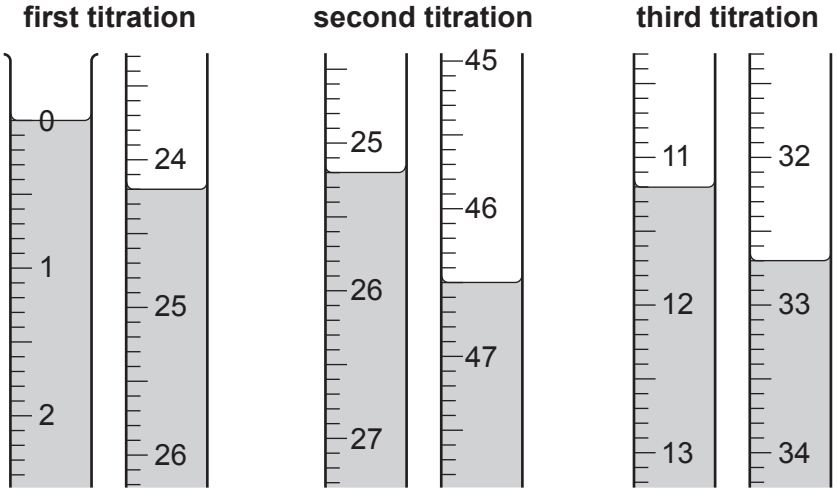
(ii) Explain why the conical flask is placed on a white tile.

..... [1]

(iii) State the colour change of the methyl orange indicator at the end-point.

The colour changes from ..... to ..... . [1]

(e) The student does three titrations. The diagrams below show parts of the burette with the liquid levels both at the beginning and at the end of each titration.



Use the diagrams to complete the following table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of KOH(aq) added / cm^3			
best titration results (✓)			

Tick (✓) the best titration results in the table.

Use the best titration results to calculate the average volume of KOH(aq) used.

..... cm^3
[4]

(f) Calculate the number of moles of KOH in the average volume of 0.100 mol / dm^3 of KOH(aq) used in **(e)**.

..... mol [1]

(g) The equation for the reaction of potassium hydroxide with sulfuric acid is shown.

$$2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$$

Use this equation to calculate the number of moles of H_2SO_4 in 25.0 cm^3 of solution **L**.

..... mol [1]

(h) Calculate the number of moles of H_2SO_4 in 250 cm^3 of solution **L**.

..... mol [1]

(i) Deduce the number of moles of H_2SO_4 in 20.0 cm^3 of solution **K**.

..... mol [1]

(j) Calculate the concentration of solution **K** in mol / dm^3.

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

(k) A different student does the same experiment using 30 drops of methyl orange instead of 3 drops of methyl orange.

Methyl orange is acidic.

State if the average titration volume of KOH(aq) is smaller, larger, or unchanged when 30 drops of methyl orange are used.

Explain your answer.

.....

.....

..... [2]

[Total: 17]

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6 A student is provided with aqueous copper(II) chloride, aqueous zinc sulfate and an aqueous solution labelled **X**.

The student tests the three solutions by adding each reagent shown in the table.

(a) Complete the table with the expected observations.

aqueous solutions			
reagents	copper(II) chloride	zinc sulfate	**X**
aqueous sodium hydroxide	....	....	green precipitate
aqueous sodium hydroxide in excess	....	....	precipitate remains
aqueous ammonia	....	....	green precipitate
aqueous ammonia in excess	....	....	precipitate remains
aqueous silver nitrate and dilute nitric acid	....	....	yellow precipitate
aqueous barium nitrate and dilute nitric acid	....	....	no change

[7]

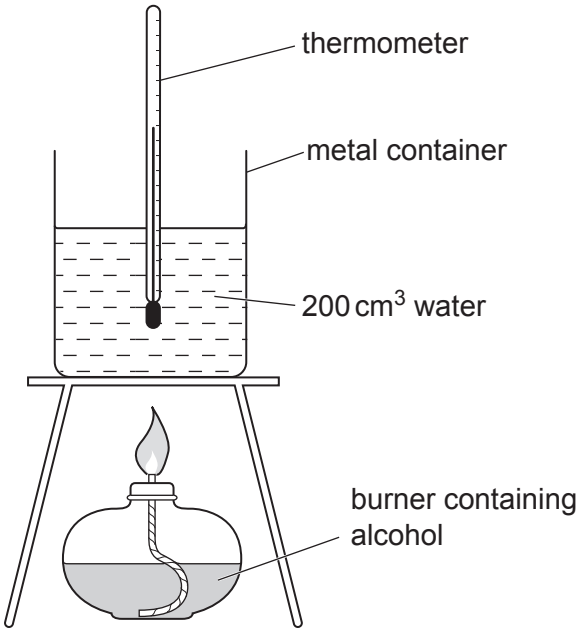
(b) Identify **X**.

..... [2]

[Total: 9]

7 When alcohols burn they release heat.

A student uses the apparatus shown to investigate the amount of heat released when five different alcohols burn.



The student determines the temperature rise of 200 cm^3 of water when an alcohol burns.

The student repeats the experiment using the same amount of each alcohol.

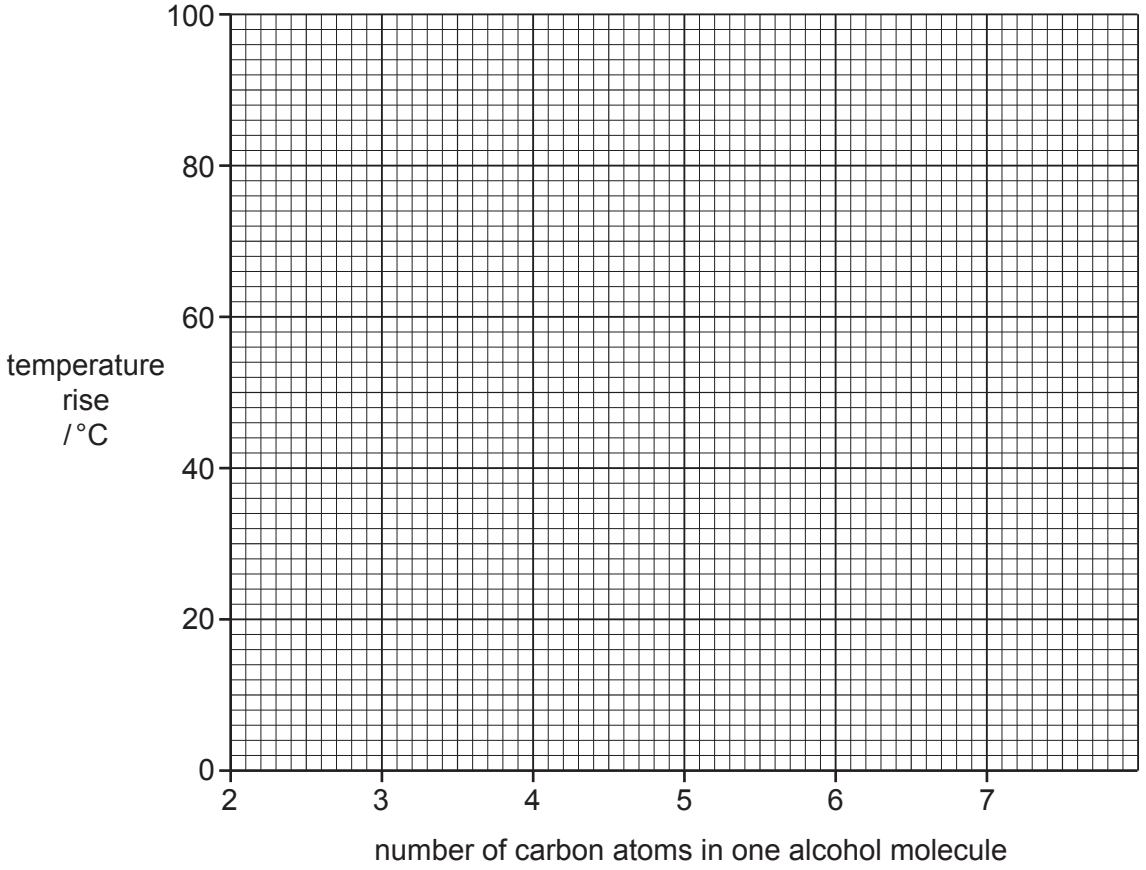
number of carbon atoms in one alcohol molecule	temperature rise / °C
2	25
3	46
4	53
5	67
6	81

(a) Plot the results on the grid.

Circle the anomalous point on the grid.

Draw a straight line of best fit.

[3]



(b) (i) Extend the line of best fit on your graph.

Use the extended line to deduce the expected temperature rise if an alcohol with seven carbon atoms is used in the experiment.

..... °C [1]

(ii) The initial temperature of the water is 15 °C.

Explain why this means it is **not** possible for the student to obtain the temperature rise in **(b)(i)**.

..... [1]

(iii) Suggest one change that can be made to the experiment that would make it possible to obtain the temperature rise in **(b)(i)**.

..... [1]

[Total: 6]

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