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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

5388245127

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 2021**

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.

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1 Hydrated magnesium sulfate has the formula $MgSO_4 \cdot \mathbf{x}H_2O$.

When hydrated magnesium sulfate is heated, it loses the water of crystallisation to form anhydrous magnesium sulfate.

$$MgSO_4 \cdot \mathbf{x}H_2O(s) \longrightarrow MgSO_4(s) + \mathbf{x}H_2O(g)$$

(a) A student does an experiment to find the value of **x** in $MgSO_4 \cdot \mathbf{x}H_2O$.

The student:

1 records the mass of a crucible

2 adds hydrated magnesium sulfate to the crucible and records the mass again

3 heats the crucible strongly

4 allows the crucible and contents to cool and then records the mass again

5 repeats **3** and **4** until the same mass is recorded twice

6 uses the results to calculate the initial mass of $MgSO_4 \cdot \mathbf{x}H_2O$ and the final mass of $MgSO_4$.

(i) Suggest why a crucible is used instead of a glass beaker.

.....

..... [1]

(ii) Suggest why **3** and **4** are repeated until the same mass is recorded twice.

.....

..... [1]

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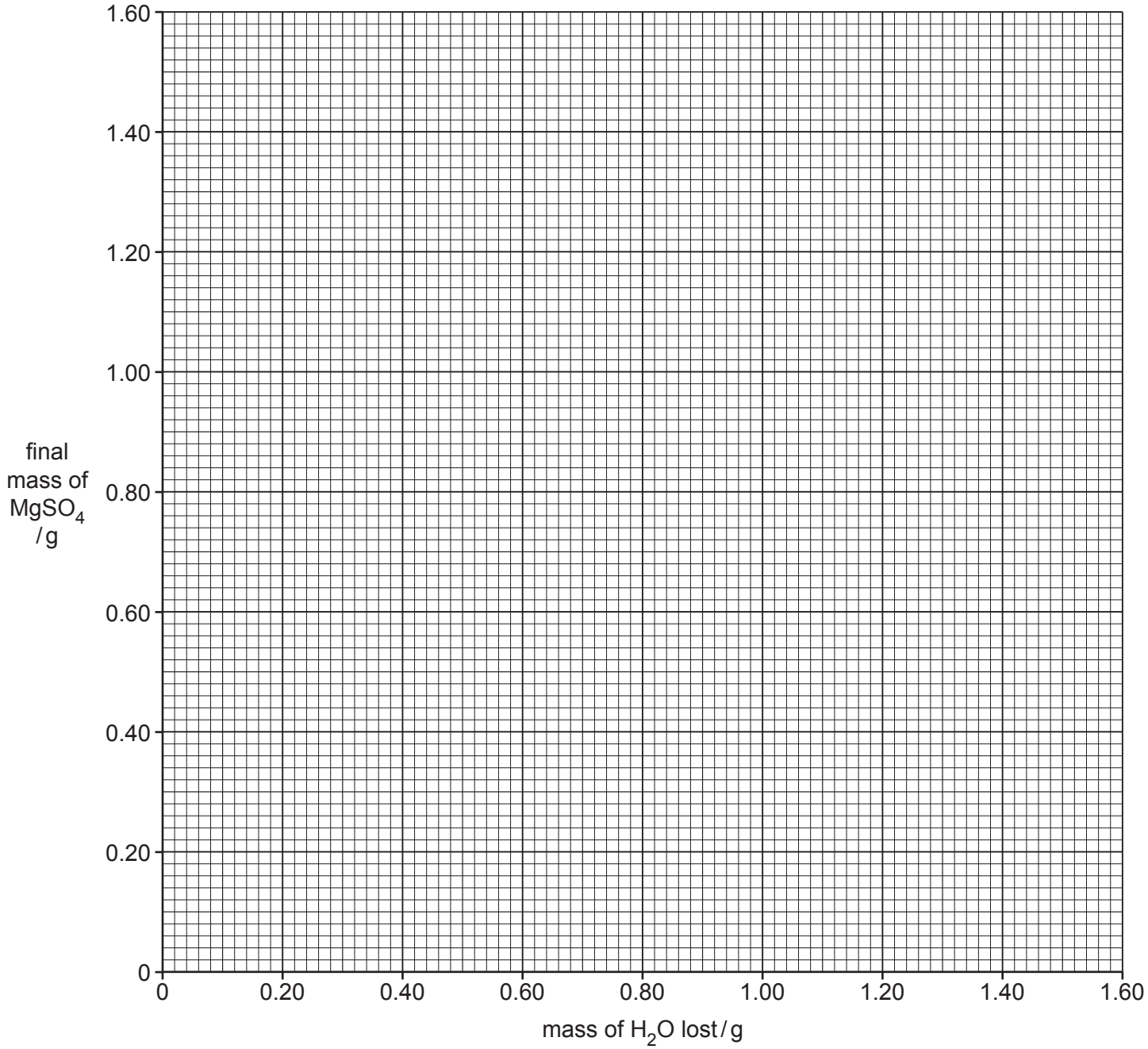
(b) Several students do the same experiment with different initial masses of $MgSO_4 \cdot \mathbf{x}H_2O$.

The results are shown in the table.

initial mass of $MgSO_4 \cdot \mathbf{x}H_2O$ / g	0.52	0.98	1.50	2.04	2.53	2.99
final mass of $MgSO_4$ / g	0.25	0.48	0.83	1.00	1.23	1.46
mass of H_2O lost / g		0.50	0.67		1.30	1.53

(i) Complete the table. [1]

(ii) On the grid, plot the final mass of $MgSO_4$ against the mass of H_2O lost. [2]



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(iii) Draw a circle around the anomalous result on your graph. [1]

(iv) Suggest a reason for the anomalous result.

.....

..... [1]

(v) Draw a straight line of best fit. [1]

(c) (i) In another experiment, the final mass of $MgSO_4$ is 1.20 g.

Use your graph to determine the mass of H_2O lost.

..... g [1]

(ii) Calculate the number of moles of water in your answer to **(i)**.

[A_r; H, 1; O, 16]

..... mol [2]

(iii) 1.20 g of $MgSO_4$ contains 0.01 mol of $MgSO_4$.

Calculate the value of **x** in $MgSO_4 \cdot \mathbf{x}H_2O$.

x ..... [1]

[Total: 12]

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2 **(a)** A solution contains two different cations and one anion.

Complete the table.

Name any gases formed and describe the tests used to identify these gases.

test	observations	conclusions
Add aqueous sodium hydroxide to the solution in a boiling tube.	a pale green precipitate forms	
(i) To the same boiling tube, continue adding aqueous sodium hydroxide until in excess. Keep the contents of the boiling tube for test **(ii)**.	a green precipitate dissolves to form a green solution a white precipitate remains	cation 1 is ..... cation 2 is .....
(ii)	....	..... anion is NO_3^-

[2]

[4]

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(b) Ammonium sulfite, $(NH_4)_2SO_3$, is a water-soluble compound.

Aqueous ammonium sulfite is slowly oxidised by oxygen in air.

This means aqueous ammonium sulfite will also contain some sulfate ions, SO_4^{2-}.

Describe a series of tests, and the observations, to show the presence of ammonium ions, sulfite ions and sulfate ions in this solution.

It must be clear in your answer which ion is identified by each test.

.....

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..... [6]

[Total: 12]

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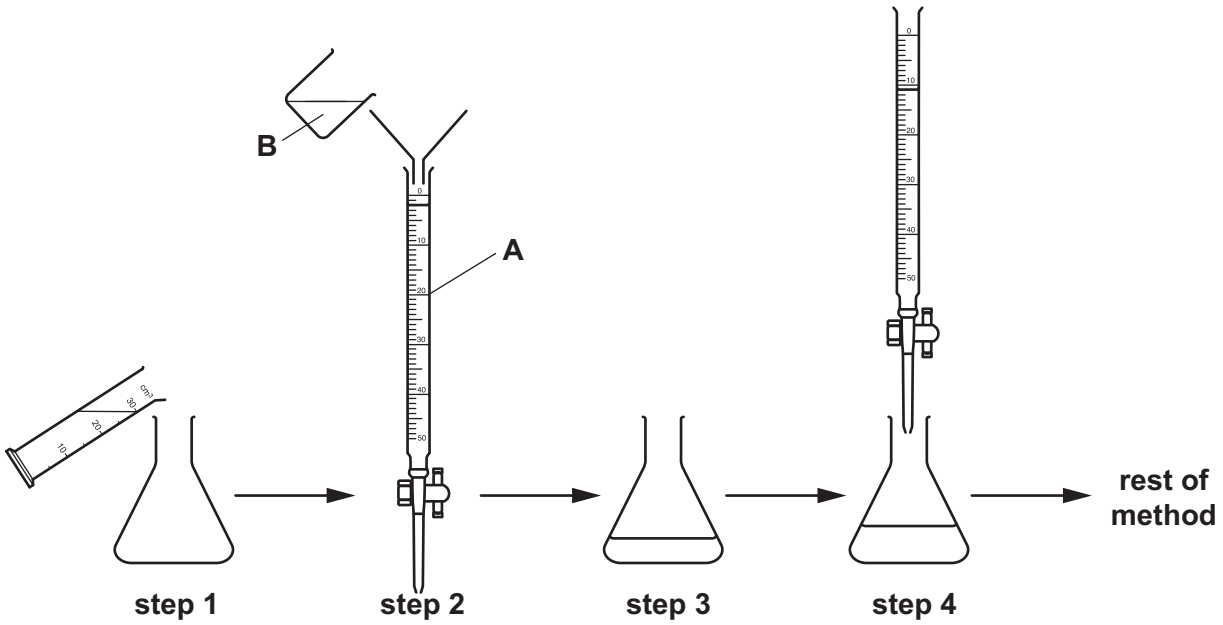
3 A titration method can be used to make soluble salts.

A student does an experiment to prepare a pure sample of sodium chloride.

Part of the method is shown in the diagram.



(a) In **step 1** the student uses a measuring cylinder to add 25 cm^3 of aqueous sodium hydroxide to the conical flask.

State how the accuracy of the experiment could be improved in **step 1**.

..... [1]

(b) Describe what the student does in **step 2** of the method.

Include the names of apparatus **A** and solution **B**.

.....

.....

.....

.....

..... [3]

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(c) Identify what is added to the flask in **step 3** before starting the titration.

..... [1]

(d) In **step 4** the student adds solution **B** to the aqueous sodium hydroxide in the conical flask until the end-point is reached.

The student records the volume of solution **B** added.

State how the student knows when the end-point is reached.

..... [1]

(e) The rest of the method involves adding the recorded volume of solution **B** to another 25 cm^3 of aqueous sodium hydroxide.

The substance added in **step 3** of the first titration is not added.

(i) State why this substance is not added.

..... [1]

(ii) Describe how the student obtains pure crystals of sodium chloride from the solution in the conical flask.

.....

.....

..... [3]

[Total: 10]

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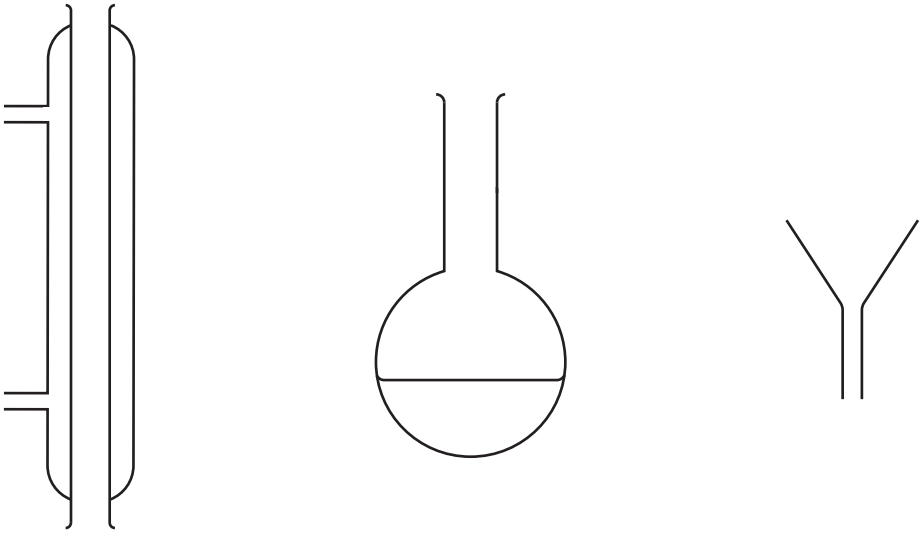
4 A student oxidises a sample of ethanol.

Some of the apparatus the student uses is shown.



P **Q** **R**

(a) Name the three pieces of apparatus.

P .....

Q .....

R .....

[3]

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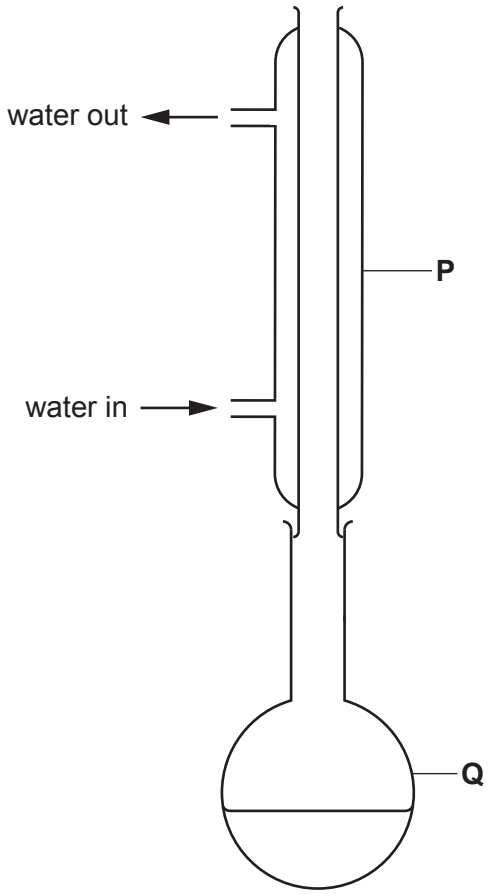
(b) The student:

- transfers 25.0 cm^3 of ethanol into apparatus **Q**
- adds an oxidising agent
- assembles the apparatus as shown



- heats apparatus **Q** gently until all the oxidising agent has changed colour.

(i) Name a suitable piece of apparatus to measure 25.0 cm^3 of ethanol.

..... [1]

(ii) Name a suitable oxidising agent.

..... [2]

(iii) State the colour change that would be seen with this oxidising agent.

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

(iv) Suggest a reason for placing apparatus **P** vertically.

.....

..... [1]

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(c) After all the oxidising agent reacts, apparatus **Q** contains a mixture of ethanol, water and the product of the oxidation.

(i) Name the product of the oxidation.

..... [1]

(ii) Name the process used to separate the three liquids in apparatus **Q**.

..... [1]

(iii) State why this process is suitable.

You should refer to a physical property of the liquids.

.....

..... [1]

[Total: 11]

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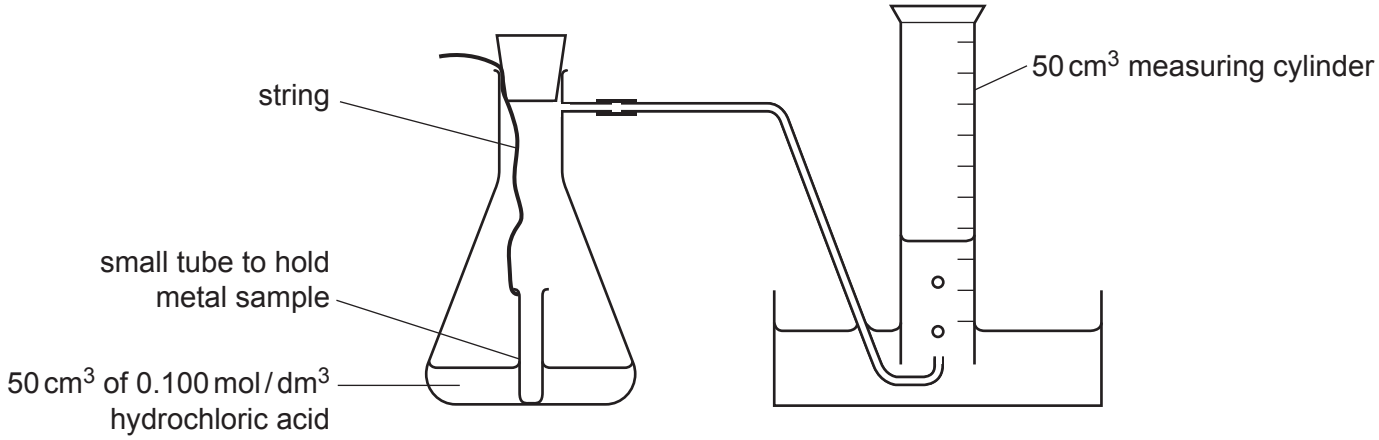
5 The apparatus shown is used to compare the rates of reaction of different metals with hydrochloric acid.



The metals used and the mass of each are shown.

metal used	calcium	iron	magnesium	zinc
mass / g	0.080	0.112	0.048	0.130

(a) The student:

- places a sample of one of the metals in the small tube
- transfers 50 cm^3 of 0.100 mol / dm^3 hydrochloric acid into the conical flask
- places the small tube into the apparatus as shown in the diagram
- tips the flask so that the small tube falls over and the metal and acid come into contact
- starts a timer
- records the total volume of gas formed at regular time intervals until the reaction finishes
- repeats the method with each metal.

(i) Name an alternative piece of apparatus that could be used, instead of the measuring cylinder, to collect the gas and measure its volume.

..... [1]

(ii) The gas collected in the measuring cylinder is hydrogen.

Give a test and its result to show that this gas is hydrogen.

test .....

result .....
[2]

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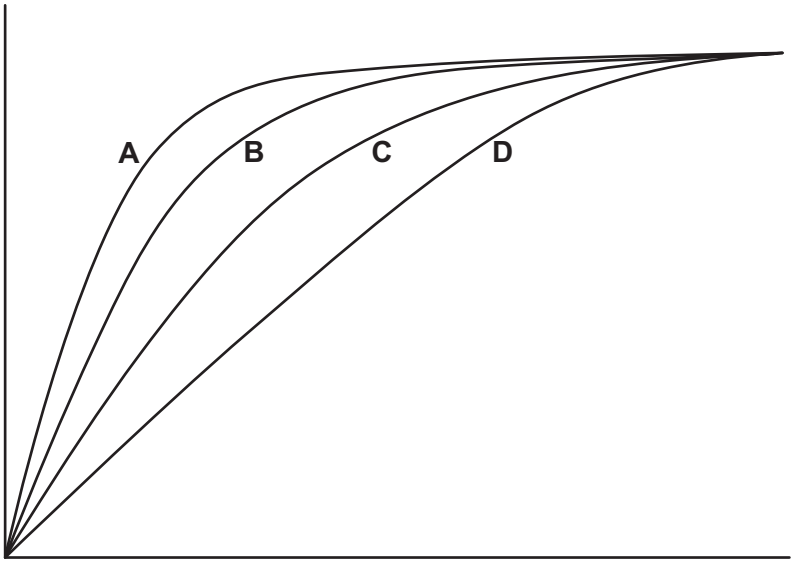
(b) Another student thinks it would be easier to remove the bung from the flask, add the metal directly to the acid and then replace the bung.

State **two** disadvantages of this method compared with the one described.

1 .....

2 .....
[2]

(c) A graph representing the results is shown.



(i) Give the correct labels for each axis of the graph.

x-axis .....

y-axis .....
[2]

(ii) State why curve **A** starts steep, gradually levels off and then becomes horizontal.

.....

.....

.....

..... [3]

(iii) Identify which of the metals gives each of the curves **A**, **B**, **C** and **D**.

A .....

B .....

C .....

D .....
[1]

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(iv) Different masses of each metal are used for the four experiments.

State **three** variables that must be kept constant for the experiments.

.....

.....

.....

.....

.....

..... [3]

(v) Suggest why different masses of each metal are used for the four experiments.

.....

..... [1]

[Total: 15]

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