Cambridge
O Level

**Cambridge Assessment International Education**
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*4576273223*

**CHEMISTRY** **5070/41**

Paper 4 Alternative to Practical **May/June 2019**

**1 hour**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

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Cambridge Assessment International Education

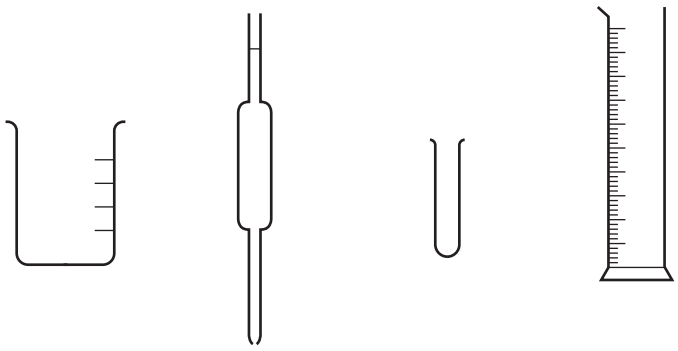
**[Turn over**

**1** Ammonium sulfate is a salt. It is used as a fertiliser.

A student prepares some ammonium sulfate crystals by neutralisation.

She uses dilute sulfuric acid and aqueous ammonia.

The diagrams show some of the apparatus the student can use.



**A** **B** **C** **D**

**(a)** The student measures 25.0 $cm^3$ of aqueous ammonia into a conical flask.

Write the letter of the piece of apparatus she should use to measure the aqueous ammonia. Name this piece of apparatus.

letter .....

name .....

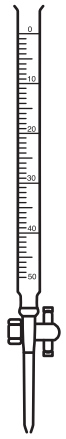
[1]

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**(b) (i)** The student:

- adds a few drops of methyl orange indicator to the aqueous ammonia in the conical flask
- adds dilute sulfuric acid until the indicator changes colour
- records the volume of dilute sulfuric acid added.

She uses the apparatus shown in the diagram to add the sulfuric acid.



Name this piece of apparatus.

..... [1]

**(ii)** What is the colour of methyl orange indicator:

- in aqueous ammonia .....
- in dilute sulfuric acid? .....

[2]

**(c)** At the end-point the student records that 12.5 $cm^3$ of 0.100 $mol/dm^3$ sulfuric acid has neutralised 25.0 $cm^3$ of 0.100 $mol/dm^3$ ammonia.

Plan an experiment to prepare a pure sample of ammonium sulfate crystals.

You should use:

- 0.100 $mol/dm^3$ sulfuric acid
- 0.100 $mol/dm^3$ ammonia
- the apparatus normally found in a chemistry laboratory.

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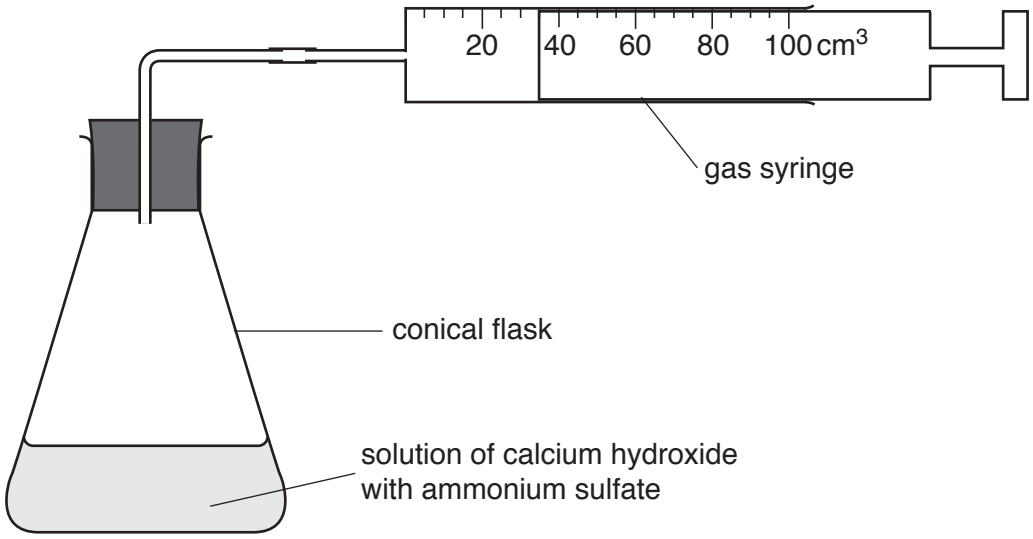
..... [6]

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**(d)** Calcium hydroxide is used to neutralise soil acidity. It reacts with ammonium sulfate fertiliser in the soil.

The student investigates the reaction between these two compounds.

She uses the apparatus shown.




**(i)** What volume of gas is in the gas syringe?

.....cm$^3$ [1]

**(ii)** After the gas has been collected, a piece of damp blue litmus paper and a piece of damp red litmus paper are put in the gas.

What happens to the colour of:

- the damp blue litmus paper .....
- the damp red litmus paper? .....

[1]

[Total: 12]

**2** Iron rusts when in contact with air and water to form a solution containing aqueous iron(III) ions.

When an indicator is added to a solution containing aqueous iron(III) ions it turns dark blue.

A student investigates the effect of sodium chloride on the rate at which iron rusts.

The student:

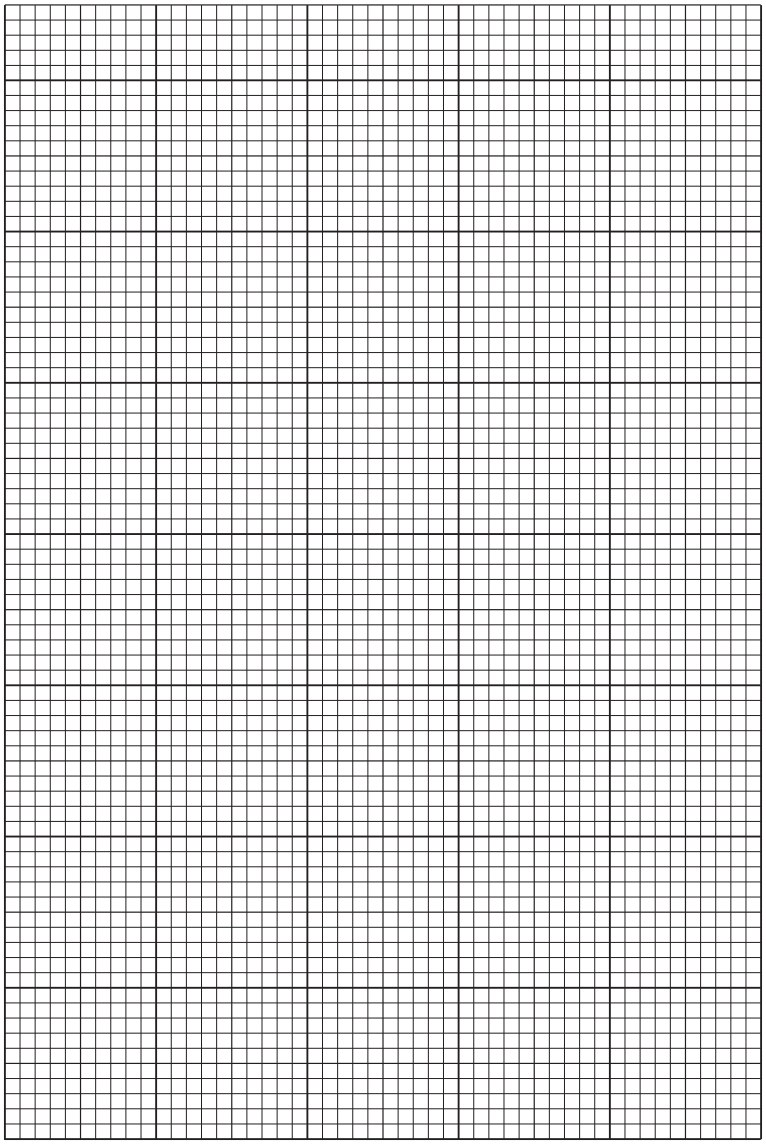
- places a piece of iron in a beaker containing 25 $cm^3$ of water and five drops of indicator
- starts the stop-watch
- stops the stop-watch when a blue colour is first seen in the mixture and records the time
- repeats the experiment five times, adding a different mass of solid sodium chloride each time.

The results are shown in the table.

| experiment | mass of sodium chloride /g | time for first blue colour to appear /s |
|---|---|---|
| 1 | 0.00 | 1450 |
| 2 | 0.25 | 800 |
| 3 | 0.50 | 550 |
| 4 | 1.00 | 300 |
| 5 | 1.50 | 300 |
| 6 | 2.00 | 100 |

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**(a) (i)** On the grid, plot a graph of time for first blue colour to appear on the *y*-axis against mass of sodium chloride on the *x*-axis. Label the axes. Plot the points and draw a smooth curve of best-fit.



[3]

**(ii)** Use the graph to predict the time it takes for the blue colour to appear if 0.7 g of sodium chloride is used.

time ..... s [1]

**(b)** The teacher suggests that the student repeats one of the experiments.

**(i)** Which number experiment is repeated?

..... [1]

**(ii)** Why is this experiment repeated?

.....

..... [1]

**(c)** Use your graph to deduce the effect of sodium chloride on the rate at which the iron rusts.

.....

..... [1]

**(d)** The student repeats all six experiments using pieces of iron which have been painted. The other variables remain the same.

Describe the effect this change has on the time for the blue colour to appear and explain your answer.

effect .....

explanation .....

.....
[2]

**(e)** A class of students repeat the first six experiments. They all use identical pieces of apparatus and the same indicator. They measure all volumes and masses correctly.

The times measured by each student are different but each student produces a graph of the same shape.

**(i)** Suggest why the times measured by each student are different.

.....

..... [1]

**(ii)** Suggest why all the graphs are the same shape.

..... [1]

[Total: 11]

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**3** A student is given three colourless liquids, **A**, **B** and **C**.
She knows that the liquids are hexene, ethanol and ethanoic acid.
She needs to identify **A**, **B** and **C**.
She does some tests by adding the reagents in the table to **A**, **B** and **C**.
Some of her results are recorded in the table.

| test | observations | | |
|---|---|---|---|
| | **A** | **B** | **C** |
| Add aqueous bromine. | | The mixture turns from orange to colourless. | The mixture remains orange. |
| Add solid calcium carbonate. | No visible change. | No visible change. | |
| Add dilute sulfuric acid and a few drops of aqueous potassium manganate(VII). | | The mixture turns from purple to colourless. | The mixture remains purple. |

**(a)** Use the observations in the table to identify liquids **A**, **B** and **C**.

**A** .....

**B** .....

**C** .....
[2]

**(b)** Complete the table. [3]

**(c)** The student mixes two of the three liquids together, adds a few drops of concentrated sulfuric acid as a catalyst and warms the mixture. A sweet smell is produced.

**(i)** Name the two liquids that the student mixes.

..... [1]

**(ii)** Suggest a safety precaution the student should take when doing this experiment. Give a reason for your answer.

precaution .....

reason .....
[1]

[Total: 7]

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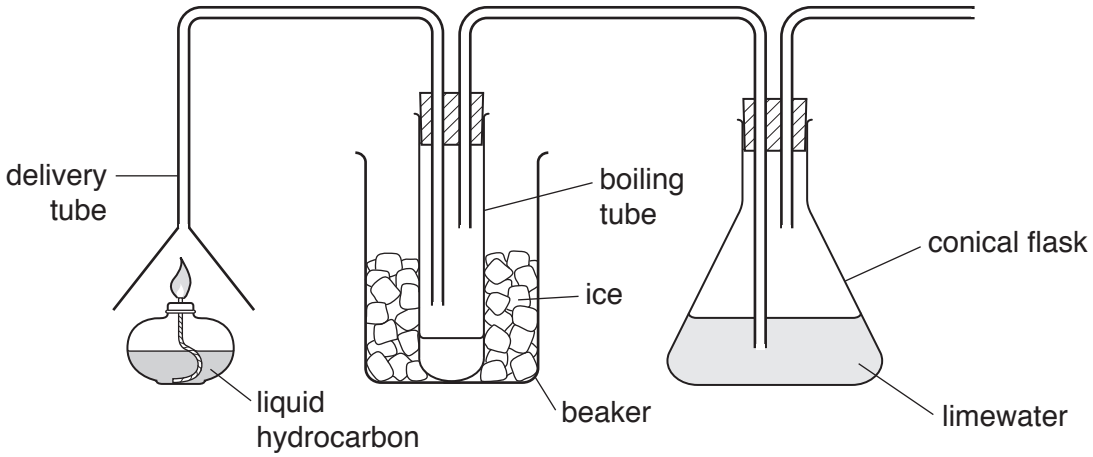
**4** A sample of river water is tested for pollutants.

Complete the table to show the tests, observations and pollutant ions present in the sample.

| test | observations | pollutant ions present in sample |
|---|---|---|
| | White precipitate, soluble in excess giving a colourless solution. | $Al^{3+}$ |
| Acidify with dilute nitric acid, then add aqueous silver nitrate. | | $Cl^{-}$ |
| Add aqueous ammonia. | Light blue precipitate, soluble in excess, giving a dark blue solution. | |
| | | $SO_4^{2-}$ |

[5]

**5** A liquid hydrocarbon is burnt using the apparatus shown.




**(a)** The gases produced by burning the hydrocarbon move along the delivery tubes and through the boiling tube and conical flask.

A colourless liquid is formed in the boiling tube.

Describe a chemical test which can be used to show that the liquid is water.

test .....

observation .....
[2]

**(b)** Suggest why the boiling tube is placed in a beaker of ice.

.....

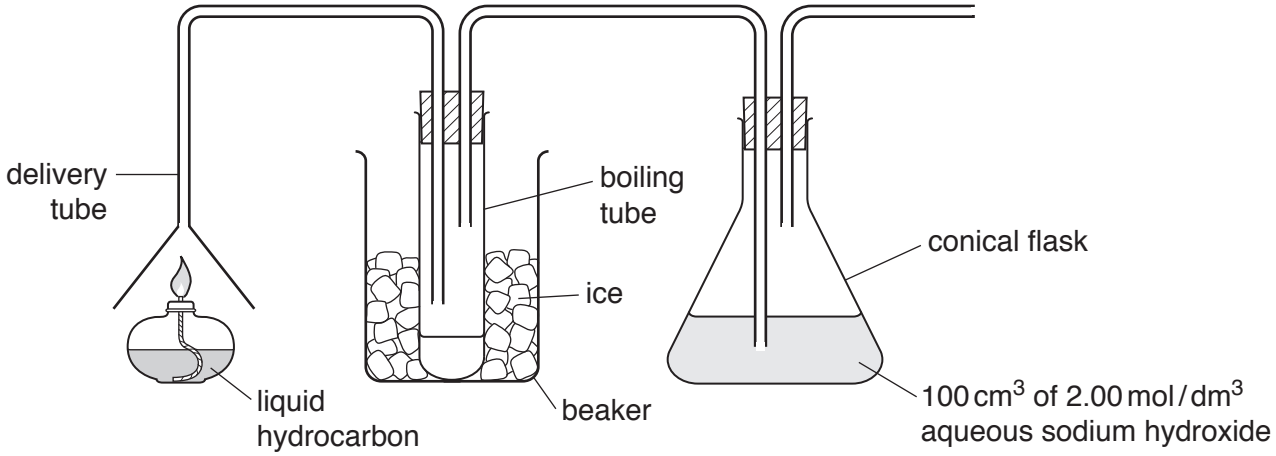
..... [1]

**(c)** Carbon dioxide is also produced by burning the hydrocarbon.

What effect does carbon dioxide have on the limewater in the conical flask?

..... [1]

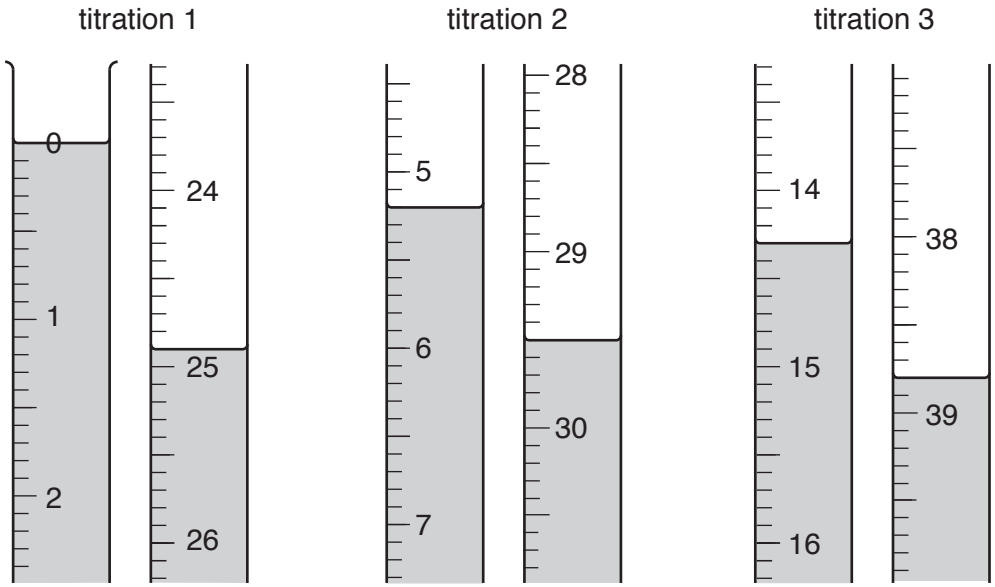
**(d)** The experiment is repeated with 100 $cm^3$ of 2.00 $mol/dm^3$ sodium hydroxide instead of limewater, as shown in the diagram.




The carbon dioxide produced by burning the hydrocarbon reacts with the sodium hydroxide in the conical flask.

After the hydrocarbon has been burnt, the mixture in the conical flask is solution **Q**. Solution **Q** is titrated with 1.00 $mol/dm^3$ hydrochloric acid, HC*l*.

**(i)** The initial and final readings for three titrations are shown in the diagram.




Use the information in the diagram to complete the results table.

| titration number | 1 | 2 | 3 |
|---|---|---|---|
| final reading/$cm^3$ | | | |
| initial reading/$cm^3$ | | | |
| volume of 1.00 $mol/dm^3$ HC*l*/$cm^3$ | | | |
| best titration results (✓) | | | |

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In the table, tick the best titration results (✓).

Use these best results to calculate the average volume of 1.00 mol / $dm^3$ HC$l$ used.

..... $cm^3$ [4]

**(ii)** Calculate the number of moles of HC$l$ in the average volume of 1.00 mol / $dm^3$ HC$l$.

..... moles [1]

**(iii)** Use the equation and your answer to **(ii)** to calculate the number of moles of sodium hydroxide, NaOH, in 25.0 $cm^3$ of **Q**.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

..... moles [1]

**(iv)** Calculate the number of moles of NaOH in 100 $cm^3$ of **Q**.

..... moles [1]

**(v)** Calculate the number of moles of NaOH in the original 100 $cm^3$ of 2.00 mol / $dm^3$ NaOH.

..... moles [1]

**(vi)** Use your answers to **(iv)** and **(v)** to calculate the number of moles of NaOH which reacted with the carbon dioxide produced by burning the hydrocarbon.

..... moles [1]

**(vii)** Use the equation and your answer to **(vi)** to calculate the number of moles of carbon dioxide produced by burning the hydrocarbon.

$$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$$

..... moles [1]

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**[Turn over**

**(viii)** The mass of hydrocarbon burnt is 0.73 g. The $M_r$ of the hydrocarbon is 86.

Calculate the number of moles of hydrocarbon burnt.

..... moles [1]

**(ix)** This hydrocarbon is an alkane. The general formula of alkanes is $C_nH_{2n+2}$.

Use your answers to **(vii)** and **(viii)** to calculate the value of n in this hydrocarbon.

n = ..... [1]

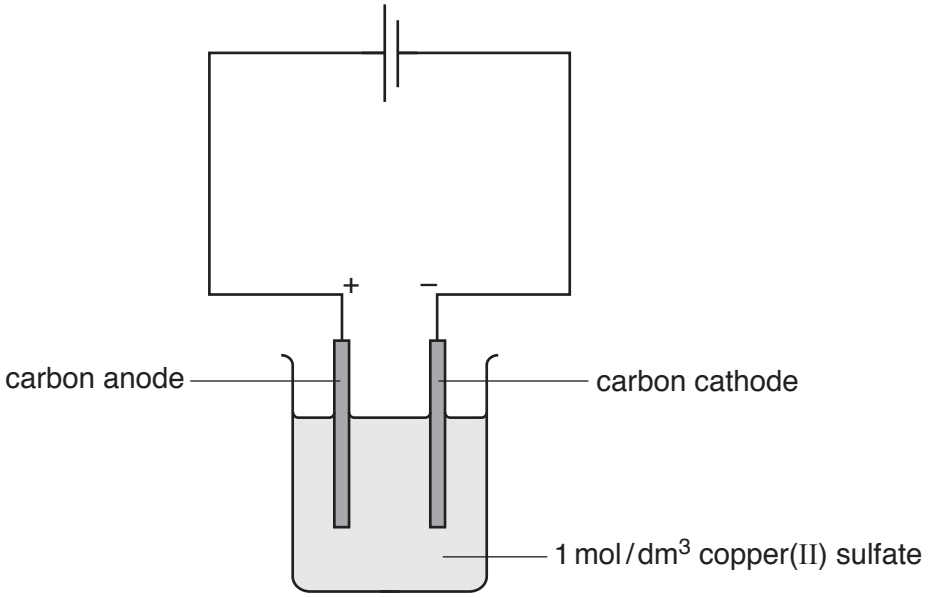
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**6** A student does an electrolysis experiment to investigate how the length of time an electric current is passed through 1 mol / $dm^3$ copper(II) sulfate affects the mass of the cathode.

He weighs a carbon electrode to use as a cathode and records its mass.

He sets up the apparatus shown.




The student:

- passes a current of 2 amps through the circuit for 5 minutes
- removes the cathode, dries it and weighs it
- records the new mass of the cathode
- replaces the cathode into the circuit.

This process is repeated until the current has been passed for a total of 25 minutes.

The results are shown in the table.

| time the current is passed / min | mass of cathode / g | increase in mass / g |
|---|---|---|
| 0 | 4.63 | 0.00 |
| 5 | 4.82 | 0.19 |
| 10 | 5.01 | |
| 15 | 5.20 | 0.57 |
| 20 | 5.39 | |
| 25 | 5.58 | 0.95 |

**(a)** Complete the table by calculating the missing increases in mass. [1]

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**[Turn over**

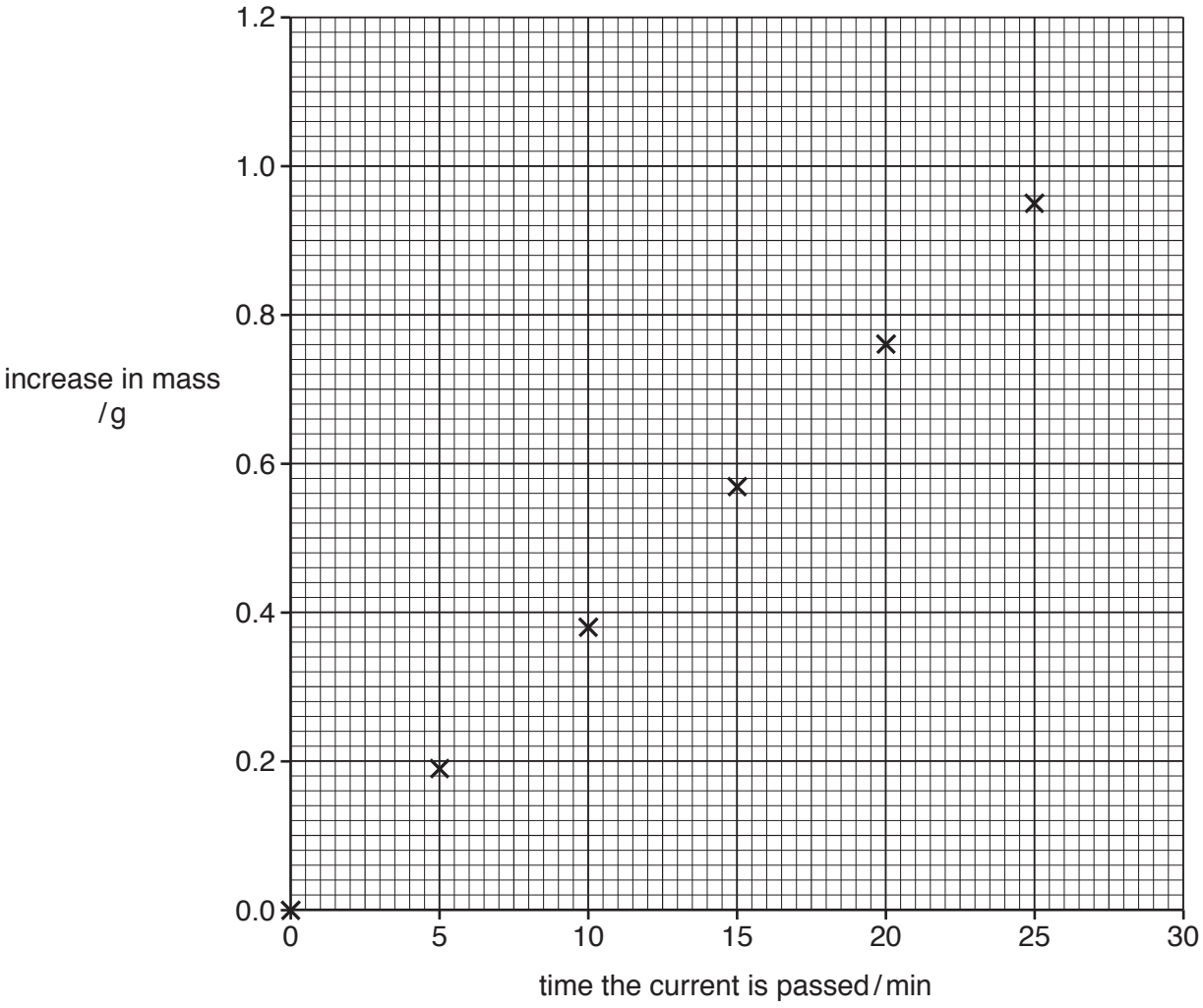
**(b)** **(i)** Describe the appearance of the cathode when the current has been passed for 25 minutes.

..... [1]

**(ii)** Explain this observation.

..... [1]

The student plots the points on a grid.




**(c)** Predict the increase in mass if a current of 2 amps is passed for 28 minutes.

Show on the grid how you have made your prediction.

increase in mass ..... g [2]

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**(d)** The student calculates the theoretical increase in mass of the cathode.

He notices that the theoretical increase is greater than the actual increase.

Suggest a reason for this.

.....

..... [1]

**(e)** The experiment is repeated using copper electrodes instead of carbon.

**(i)** What happens to the mass of the anode in this experiment?

..... [1]

**(ii)** The initial mass of the copper anode is 4.00 g.

Use the information in the table to predict the mass of the anode after 2 amps has been passed through 1 mol / $dm^3$ copper(II) sulfate for 15 minutes.

mass .....g [2]

[Total: 9]

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