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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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| CANDIDATE NAME | |

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| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | | |

*9870939960*

**CHEMISTRY** **5070/42**

Paper 4 Alternative to Practical **October/November 2010**

**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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
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.

| For Examiner's Use |
|---|
| |

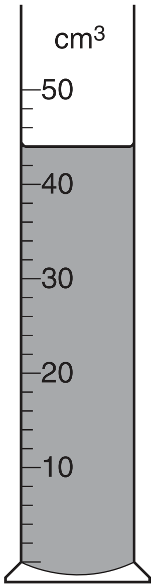
This document consists of **15** printed pages and **1** blank page.

DC (LEO/KN) 21338/3


UNIVERSITY *of* CAMBRIDGE
International Examinations

**[Turn over**

1 The apparatus below contains 0.100 mol/$dm^3$ sulfuric acid.




**(a)** **(i)** Name the apparatus.

........................................................ [1]

**(ii)** What is the volume of 0.100 mol/$dm^3$ sulfuric acid?

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

**(iii)** Using your answer to **(a)(ii)**, calculate the number of moles of 0.100 mol/$dm^3$ sulfuric acid.

....................................... moles [1]

**(b)** **(i)** The sulfuric acid was poured into a beaker and 0.12 g of magnesium was added. The magnesium reacted with the sulfuric acid and hydrogen was produced.

How many moles of magnesium were added?
[$A_r$: Mg, 24]

....................................... moles [1]

**(ii)** Write the equation for the reaction between magnesium and sulfuric acid.

................................................................................................................................ [1]

**(iii)** Using your answers to **(a)(iii)**, **(b)(i)** and **(b)(ii)**, suggest which reagent was in excess, magnesium or sulfuric acid?
Explain your answer.

.................................................................................................................................. [1]

**(c)** **(i)** Give a positive test for hydrogen gas.

test ..................................................................................................................................

observation ......................................................................................................... [1]

**(ii)** Calculate the volume of hydrogen gas produced in this reaction.
[1 mol of a gas measured at 25 °C occupies a volume of 24 $dm^3$.]

.......................................... $dm^3$ [1]

[Total: 8]

2 A student used the apparatus shown below to find the energy released by the combustion of each of the alcohols, **X**, **Y** and **Z**.

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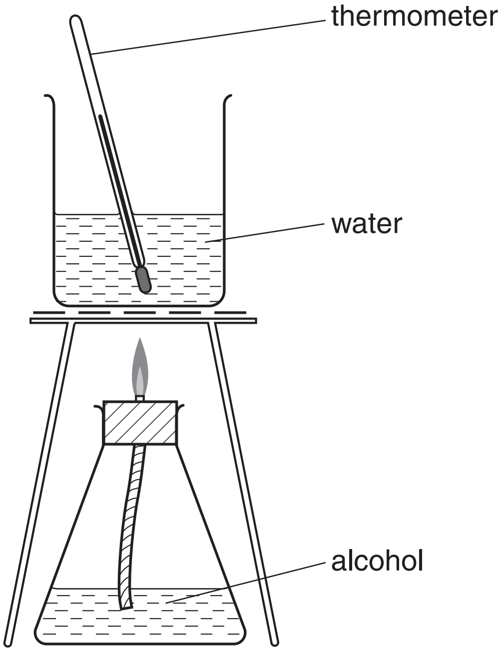
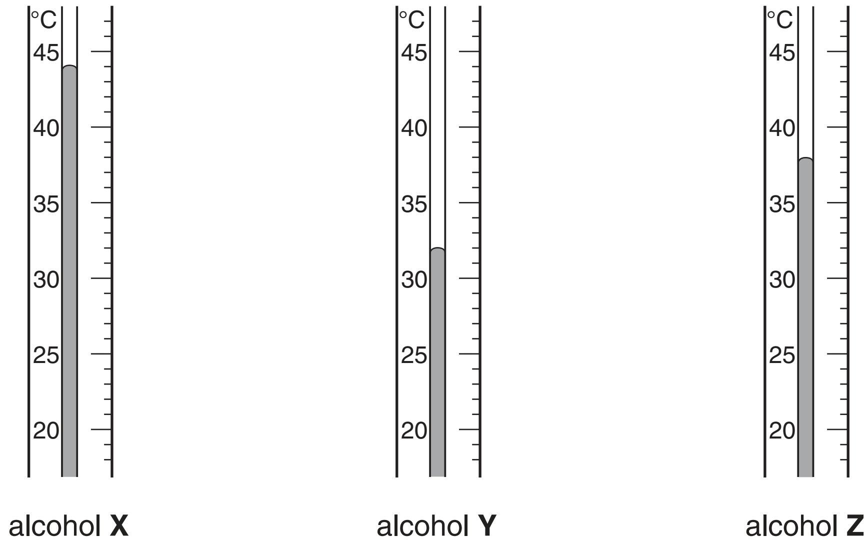



**(a) (i)** The initial temperature of the water was, in each case, 20 °C.
The diagrams below show parts of the thermometer stem giving the temperature of the water after the burning of each alcohol.




Use the thermometer readings to complete the following table and calculate the rise in temperature for each alcohol.

| | alcohol **X** | alcohol **Y** | alcohol **Z** |
|---|---|---|---|
| final temperature / °C | | | |
| initial temperature / °C | 20 | 20 | 20 |
| rise in temperature / °C | | | |

[3]

(ii) How do these results show that all the reactions are exothermic?

............................................................................................................................ [1]

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The three alcohols are ethanol, $C_2H_5OH$, propanol, $C_3H_7OH$, and butanol, $C_4H_9OH$.
In each case 0.01 mol of alcohol was burnt.

**(b)** Deduce which alcohol is **X**, **Y**, and **Z**.

alcohol **X** is ................................................

alcohol **Y** is ................................................

alcohol **Z** is ................................................ [2]

**(c)** **(i)** The student oxidised one of the alcohols to prepare an acid of formula $C_2H_5CO_2H$.

Which alcohol was used?

...................................................... [1]

**(ii)** Suggest both the name of an oxidising agent that could be used and the colour change of the mixture that is seen during the reaction.

oxidising agent ..........................................................................................................

the colour changes from ....................................... to ....................................... [2]

**(d)** **(i)** Which alcohol was reacted with the acid $C_2H_5CO_2H$ to produce $C_2H_5CO_2C_4H_9$ ?

...................................................... [1]

**(ii)** What type of compound is $C_2H_5CO_2C_4H_9$?

...................................................... [1]

[Total: 11]

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In questions **3** to **7** inclusive, place a tick (✓) in the box against the best answer.

**3** A student sterilised a sample of water by bubbling a gas through it.

The gas was

**(a)** carbon dioxide

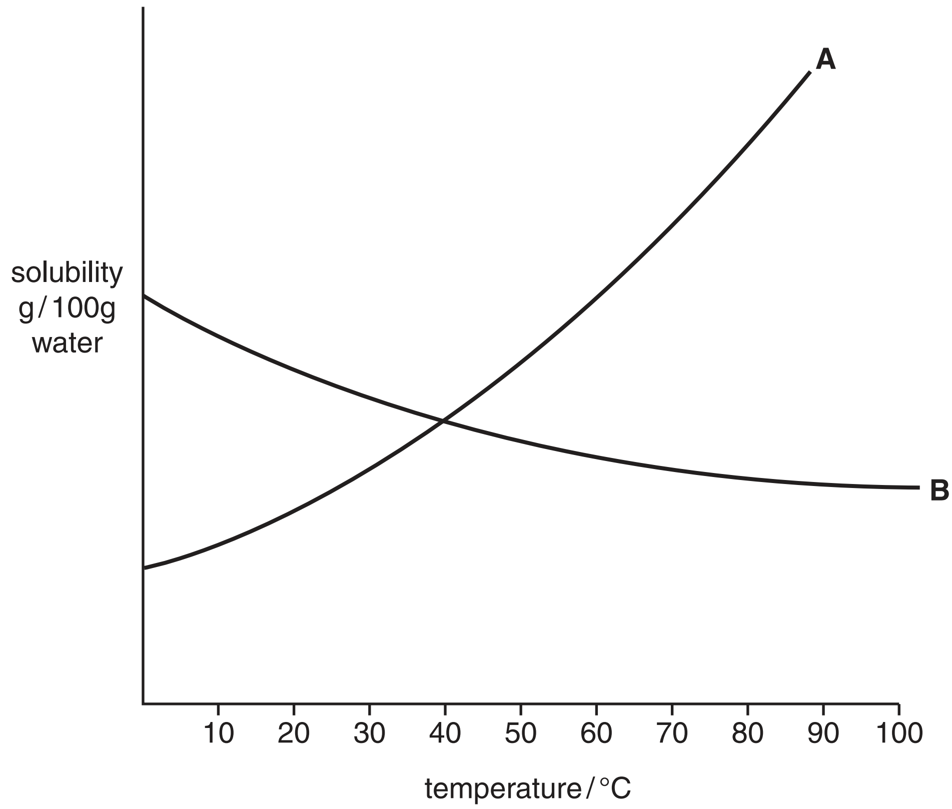
**(b)** chlorine

**(c)** ethane

**(d)** nitrogen [1]

[Total: 1]

**4** A student did two experiments to find how the solubility of salts **A** and **B** varied with temperature. The results are shown on the graph below.




Which one of the following conclusions is correct?

**(a)** **A** is more soluble than **B** at all temperatures.

**(b)** **B** is more soluble than **A** below 40 °C.

**(c)** **A** is less soluble than **B** above 40 °C.

**(d)** The solubility of both salts increases with increasing temperature. [1]

[Total: 1]

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5 A student prepared some salts by adding two chemicals together. Which of the following produced a salt which could be collected as a residue by filtration?

**(a)** aqueous barium chloride and aqueous sulfuric acid ☐

**(b)** aqueous potassium hydroxide and aqueous nitric acid ☐

**(c)** solid copper(II) carbonate and aqueous hydrochloric acid ☐

**(d)** aqueous calcium chloride and aqueous potassium nitrate ☐ [1]

[Total: 1]

6 In an experiment to find the formula of the oxide of element *M*, 2.0 g of the element was burnt in oxygen.
The mass of metal oxide obtained was 2.8 g.
[$A_r$: *M*, 40; O,16]

What was the formula of the metal oxide?

**(a)** $M_2O$ ☐

**(b)** $MO$ ☐

**(c)** $MO_2$ ☐

**(d)** $MO_3$ ☐ [1]

[Total: 1]

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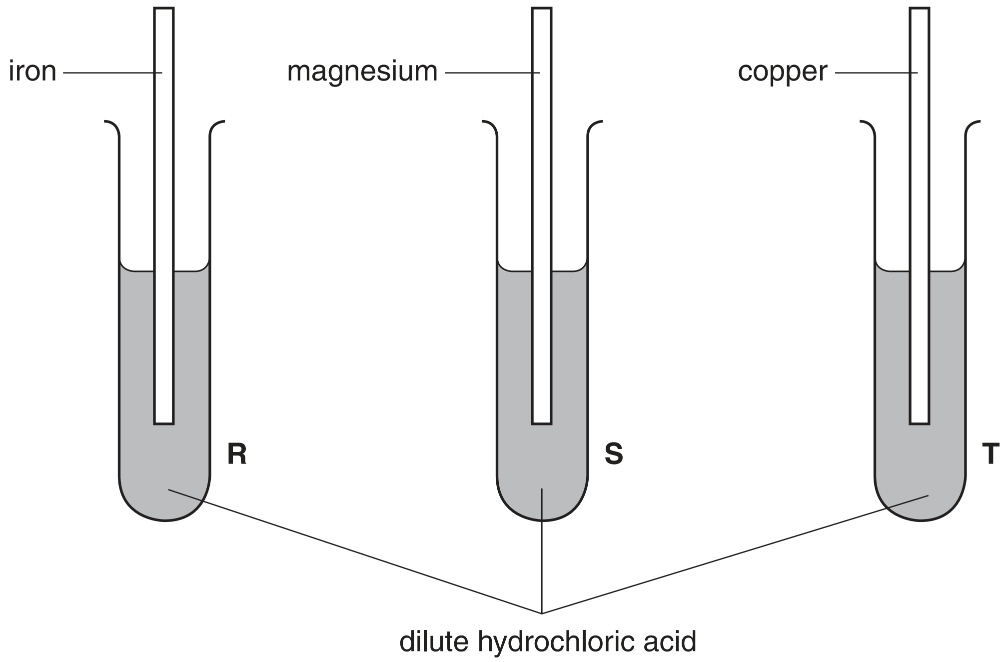
7 Strips of different metals were placed in test-tubes half-filled with dilute hydrochloric acid.




In which test-tubes was hydrogen gas produced?

**(a)** **R** and **S** only ☐

**(b)** **R** and **T** only ☐

**(c)** **S** and **T** only ☐

**(d)** **R** and **S** and **T** ☐ [1]

[Total: 1]

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**8** A student was given a sample of an organic acid **V** and asked to

- determine its relative molecular mass, and
- suggest its molecular formula.

A sample of **V** was placed in a previously weighed container and reweighed.

| | | |
|---|---|---|
| mass of container + **V** | = | 9.06 g |
| mass of container | = | 5.94 g |

**(a)** Calculate the mass of **V** used in the experiment.

.............................................. g [1]

The student transferred the sample of **V** to a beaker and added 50.0 $cm^3$ of 1.00 $mol/dm^3$ sodium hydroxide, an excess.
The contents of the beaker were allowed to react and then transferred to a volumetric flask. The solution was made up to 250 $cm^3$ with distilled water. This was solution **W**.

25.0 $cm^3$ of **W** was transferred into a conical flask.

A few drops of phenolphthalein indicator were added to the flask.
0.100 $mol/dm^3$ hydrochloric acid was poured into a burette and added to the solution in the conical flask until an end-point was reached.
Phenolphthalein is colourless in acid solution and pink in alkaline solution.

**(b)** What was the colour of the solution in the conical flask

**(i)** before the hydrochloric acid was added,

.......................................................

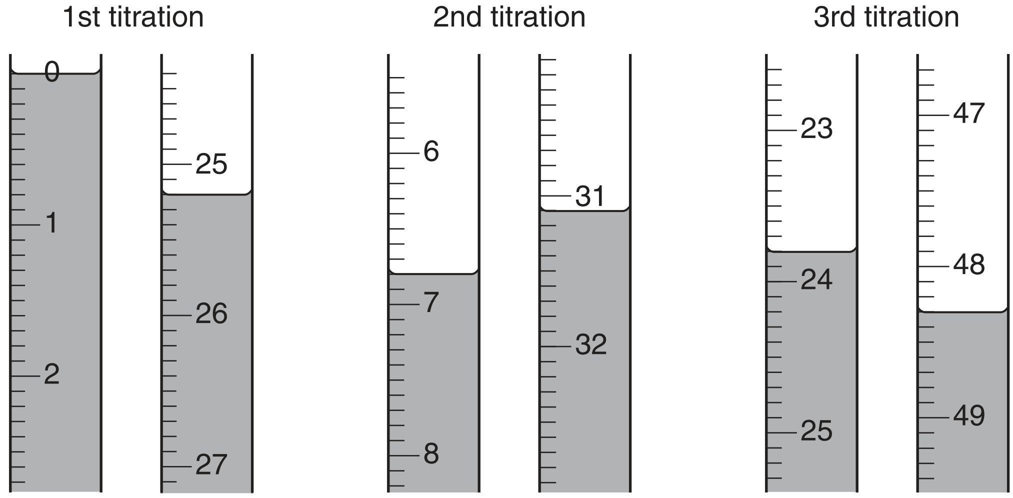
**(ii)** at the end-point?

....................................................... [1]



[Turn over

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and the end of each titration.

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**(c)** 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 hydrochloric acid / $cm^3$ | | | |
| best titration results (✓) | | | |

**Summary**

Tick (✓) the best titration results.
Using these results, the average volume of hydrochloric acid was

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

**(d)** Calculate the number of moles of hydrochloric acid in the average volume of 0.100 mol/$dm^3$ hydrochloric acid calculated in **(c)**.

...................................... moles [1]

**(e)** Hydrochloric acid reacts with sodium hydroxide according to the following equation.

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

Deduce the number of moles of sodium hydroxide present in 25.0 $cm^3$ of **W**.

......................................moles [1]

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**(f)** Using your answer to **(e)**, calculate the number of moles of sodium hydroxide in 250 $cm^3$ of **W**.

.................................... moles [1]

**(g)** Calculate the number of moles of sodium hydroxide in 50.0 $cm^3$ of 1.00 $mol/dm^3$ sodium hydroxide.

.................................... moles [1]

**(h)** By subtracting your answer in **(f)** from your answer in **(g)**, calculate the number of moles of sodium hydroxide that reacted with the original sample of the organic acid, **V**.

.................................... moles [1]

**(i)** Given that **one** mole of **V** reacted with **one** mole of sodium hydroxide, calculate the number of moles of **V** in the sample.

.................................... moles [1]

**(j)** Using your answers to **(a)** and **(i)** calculate the relative molecular mass of the acid **V**.

............................................. [1]

**(k)** The acid **V** has the formula $C_{\mathbf{n}}H_5CO_2H$, where **n** is a whole number.

Deduce the value of **n** and hence write the formula of acid **V**.
[$A_r$: C,12; O,16; H,1]

**n** ..................................................

formula for **V** ............................................. [2]

[Total: 15]

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**9** The following table shows the tests a student did on compound **H**. Any gas produced was tested.
Complete the table by describing the observations in tests **(a)**, **(b)** and **(c)** and the test and observations in test **(d)**.

| test | observations | conclusions |
|---|---|---|
| **(a)** **H** was dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**. | | **H** is a compound of a transition element. |
| **(b)** **(i)** To the first part aqueous sodium hydroxide was added until a change was seen.<br>**(ii)** An excess of aqueous sodium hydroxide was added to the mixture from **(i)**. | | **H** may contain $Cu^{2+}$ ions. |
| **(c)** **(i)** To the second part aqueous ammonia was added until a change was seen.<br>**(ii)** An excess of aqueous ammonia was added to the mixture from **(i)**. | | The presence of $Cu^{2+}$ ions is confirmed. |
| **(d)** | | **H** contains $NO_3^-$ ions. |

Conclusion: the formula of compound **H** is ....................................................................

[Total: 10]

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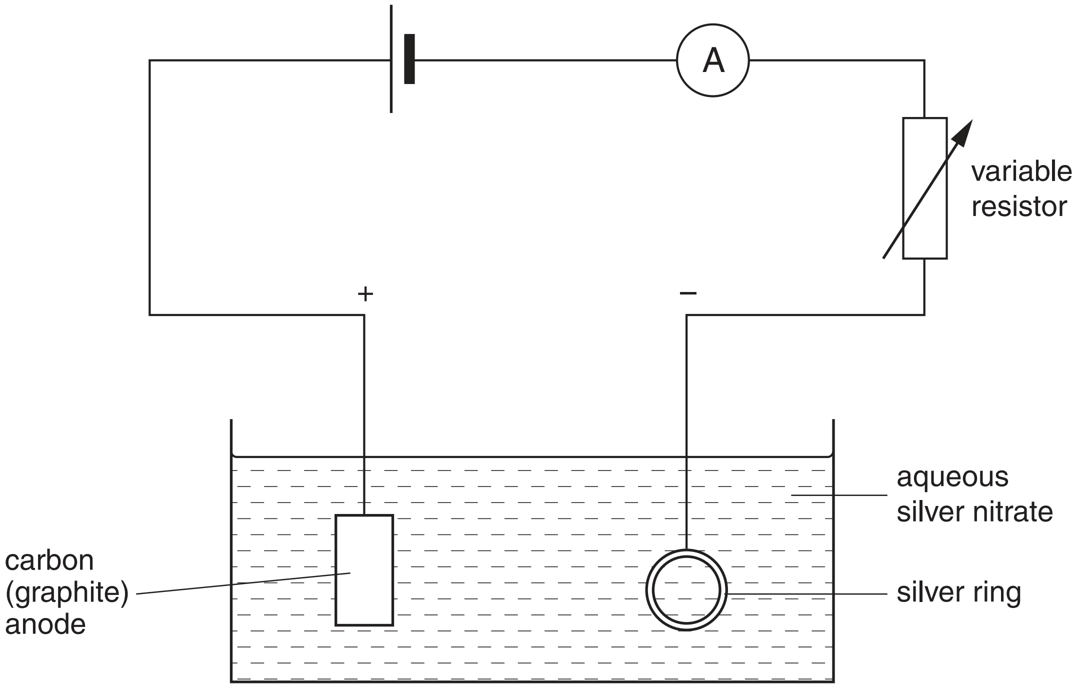
**10** A student plated a silver ring using the apparatus shown below.




The ring, which was the cathode, was weighed before it was placed in the aqueous silver nitrate. The circuit was completed and a current of 1.0 A was allowed to flow.

The ring was removed every ten minutes, washed, dried and weighed before being returned to the solution and reconnected to the circuit.
This was experiment **1**.

The experiment was repeated using a current of 1.5 A. This was experiment **2**.

The results from both experiments are shown in the table below.

**(a)** Complete the table by calculating the total increase in mass after each ten minute period in both experiments.

| | experiment **1** | | experiment **2** | |
|---|---|---|---|---|
| | current 1.0 A | | current 1.5 A | |
| time / mins | mass of ring / g | total increase in mass / g | mass of ring / g | total increase in mass / g |
| 0 | 8.80 | 0.00 | 8.80 | 0.00 |
| 10 | 9.10 | 0.30 | 9.20 | 0.40 |
| 20 | 9.40 | 0.60 | 9.60 | |
| 30 | 9.70 | | 10.00 | |
| 40 | 10.00 | | 10.40 | |
| 50 | 10.30 | | 10.40 | |

[1]

**(b)** Plot the two sets of results on the grid below. Join the points in experiment **1** by a straight line and the points in experiment **2** by two intersecting straight lines. Label the lines **1** and **2** corresponding to the two experiments.

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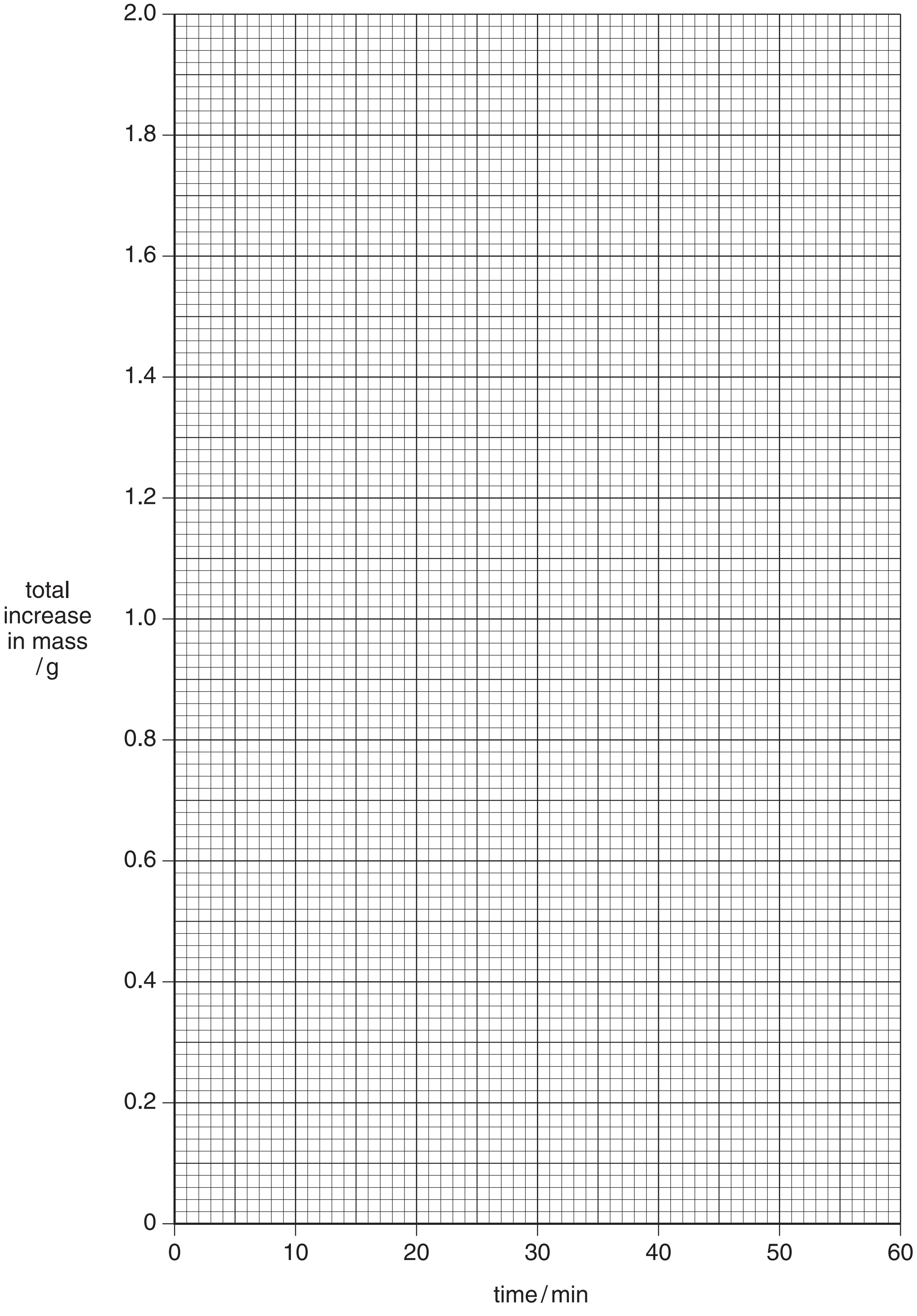


[4]

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**(c)** What was the time taken to deposit 1.00 g of silver in each experiment?

**1** ........................................ mins [1]

**2** ........................................ mins [1]

**(d)** Calculate how much more silver was deposited after 35 minutes in experiment **2** than in experiment **1**.

mass of silver deposited in 35 minutes in **2** ............................................................. g

mass of silver deposited in 35 minutes in **1** ............................................................. g

difference in mass = ............................................................. g [2]

**(e)** The results for experiment **2** indicate that all the silver had been deposited after 40 minutes. By extending your line for experiment **1** suggest, after how many minutes, all the silver had been deposited in this experiment.

........................................ mins [1]

**(f)** Suggest what change should be made to the experiment so that more silver could be deposited on the ring.

.......................................................................................................................................... [1]

[Total: 11]

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