UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8056288565

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2012**

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 **16** printed pages.

DC (SJF/SW) 42236/3

UNIVERSITY of CAMBRIDGE International Examinations

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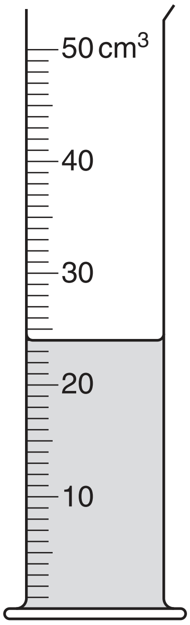
1



(a) Name the apparatus shown in the diagram.

.... [1]

(b) What is the volume of liquid in the apparatus?

.... cm^3 [1]

[Total: 2]

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2 When copper is heated in air it reacts with oxygen to form an oxide.

A student does an experiment to find the formula of copper oxide.

(a) Describe the appearance of copper.

.... [1]

(b) Some copper is placed in a previously weighed crucible and reweighed.

mass of crucible + copper = 5.92 g
mass of crucible = 4.65 g

Calculate the mass of copper used in the experiment.

.... g [1]

(c) The crucible containing the copper is heated and copper oxide is produced. The crucible with copper oxide is weighed.

mass of crucible + copper oxide = 6.24 g

Calculate the mass of copper oxide produced.

.... g [1]

(d) Using your answers to **(b)** and **(c)** calculate the mass of oxygen that combines with the copper.

.... g [1]

(e) Using your answers to **(b)** and **(d)** calculate the formula of copper oxide. Show your working.
[A_r : O, 16; Cu, 64]

.... [2]

[Total: 6]

3 A student does two experiments both involving a reaction between two compounds.

In each case the apparatus and contents are weighed at the start of the reaction and again after the reaction has finished.

(a) Powdered calcium carbonate is added to an excess of hydrochloric acid in a conical flask.

(i) Describe what is observed in the flask as the reaction progresses.

....

.... [1]

(ii) Construct the equation for the reaction.

.... [1]

(iii) Will the total mass of the flask and contents increase, decrease or remain the same after the reaction has finished?

Explain your answer.

....

....

.... [1]

(b) Dilute sulfuric acid is added to aqueous barium chloride in a beaker.

(i) Describe what is observed in the beaker.

....

.... [1]

(ii) Construct the equation for the reaction.

.... [1]

(iii) Will the total mass of the beaker and contents increase, decrease or remain the same after the reaction has finished?

Explain your answer.

....

....

....

.... [1]

[Total: 6]

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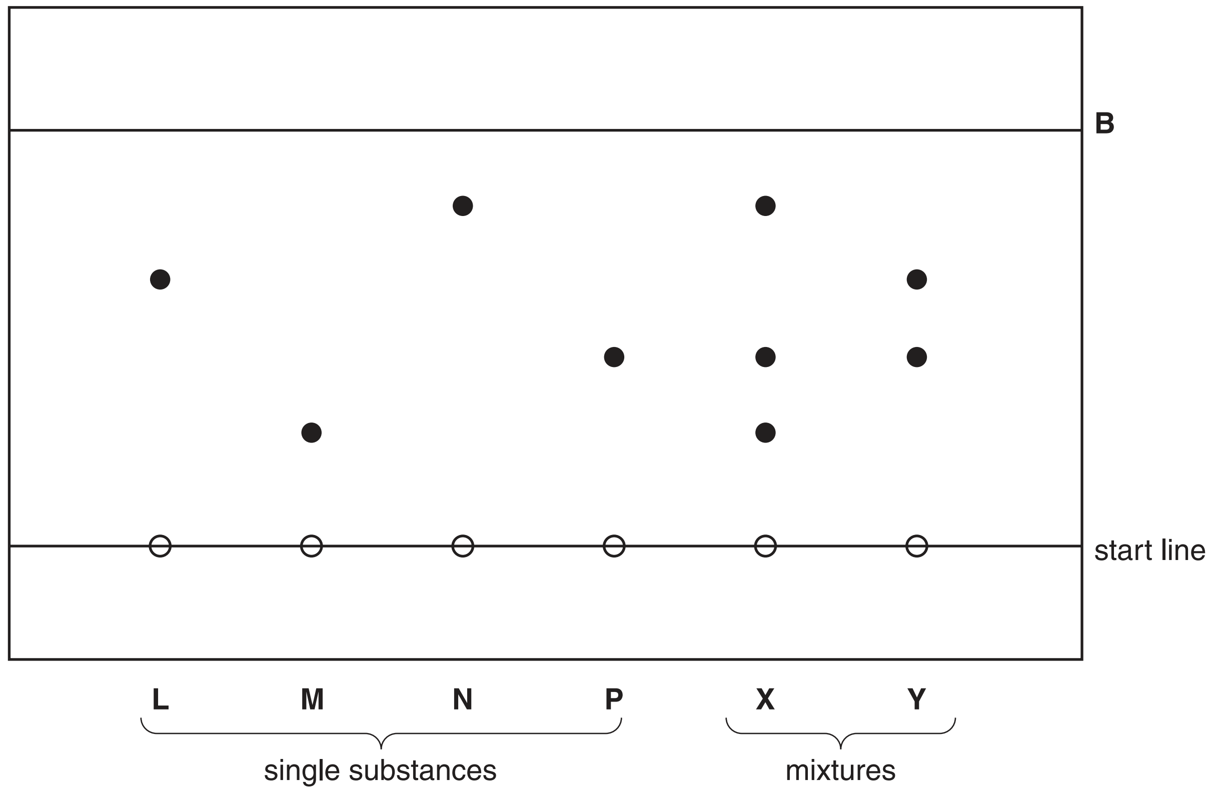
4 The diagram below shows the results of an experiment to identify the components of mixtures **X** and **Y**. Each mixture is known to contain one or more of the single substances **L**, **M**, **N** and **P** and no other substance.



(a) What name is given to this experiment?

.... [1]

(b) Draw a line on the diagram to show the solvent level at the beginning of the experiment. [1]

(c) What piece of apparatus does the student use to place spots of **L**, **M**, **N**, **P**, **X** and **Y** on the start line?

.... [1]

(d) In this experiment the substances **L**, **M**, **N** and **P** are not coloured.

What name is given to a substance which will change **L**, **M**, **N** and **P** into coloured spots?

.... [1]

(e) Use the diagram to deduce which of the substances **L**, **M**, **N** and **P** are present in

(i) mixture **X**, ...

(ii) mixture **Y**. .... [2]

(f) Line **B** shows the solvent front at the end of the experiment.

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Using a ruler to measure the distances travelled by substance **P** and the solvent front, calculate the R_f value of **P**.

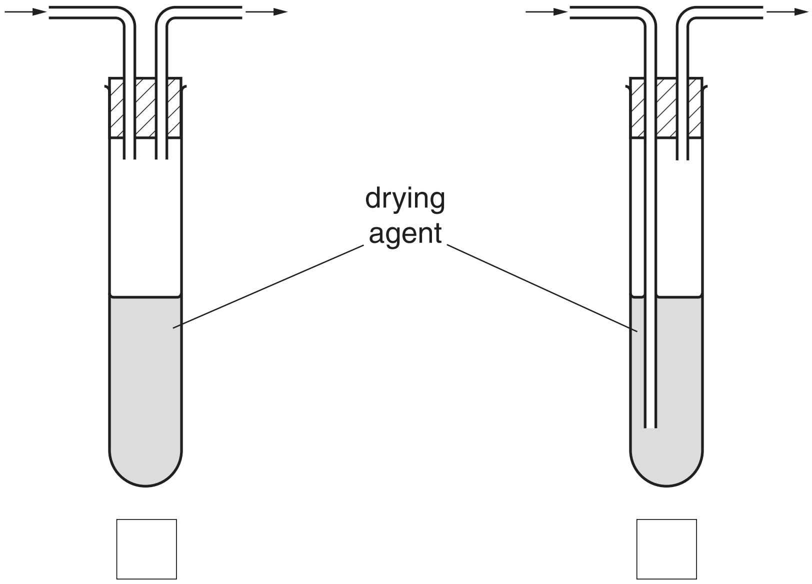
R_f value of **P** = ... [2]

[Total: 8]

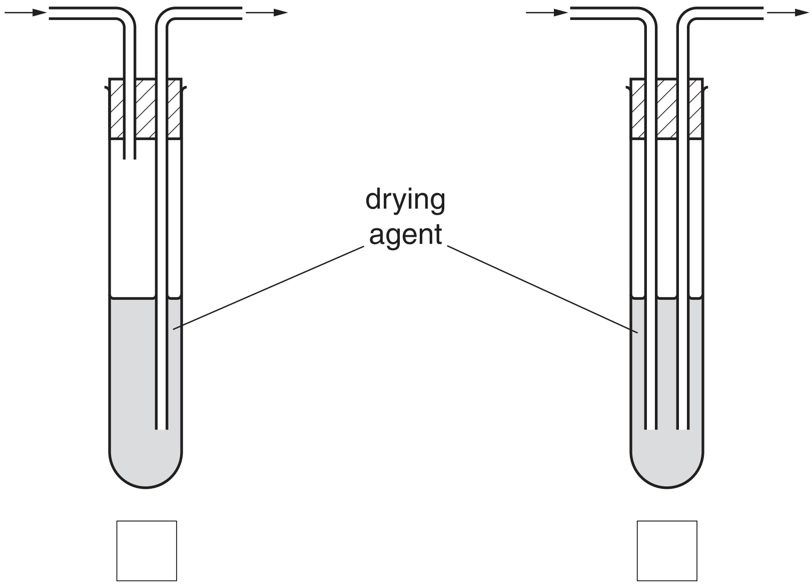
In questions **5** to **9** inclusive place a tick (✓) in the box against the correct answer.

5 A student wishes to dry a sample of a gas by passing it through a drying agent.

Which apparatus should he use to dry the gas?



(a) **(b)**



(c) **(d)**

[1]

[Total: 1]

6 Which of the following pairs of substances reacts to produce the compound shown below?

$$C_2H_5CO_2C_3H_7$$

(a) propene and ethanoic acid ☐

(b) propanol and propanoic acid ☐

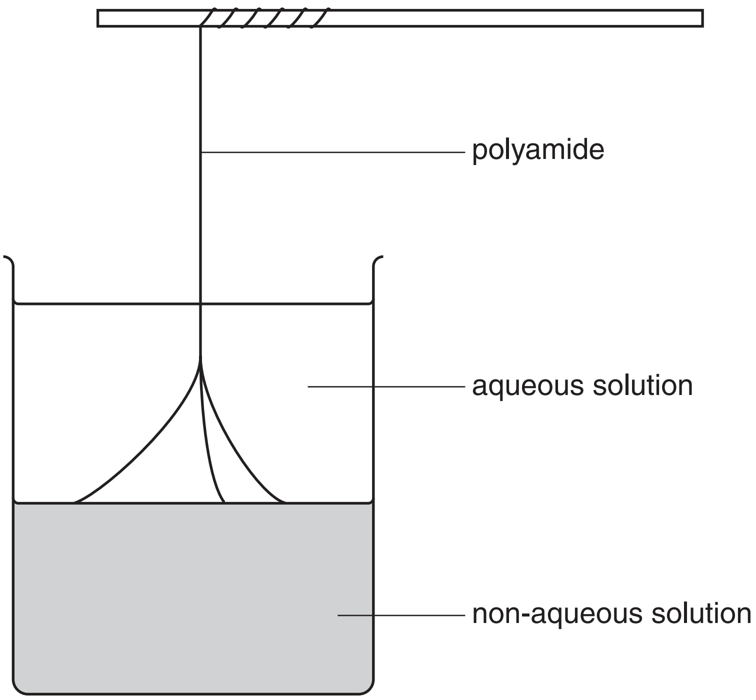
(c) ethanol and butanoic acid ☐

(d) ethene and propanoic acid ☐ [1]

[Total: 1]

7 A student makes a polyamide using the apparatus below.

The polyamide is formed at the junction of the two liquids.



The polyamide is:

(a) nylon ☐

(b) poly(ethene) ☐

(c) starch ☐

(d) *Terylene* ☐ [1]

[Total: 1]

8 Which of the following compounds is unsaturated?

(a) CH_4 ☐

(b) C_2H_6 ☐

(c) C_4H_8 ☐

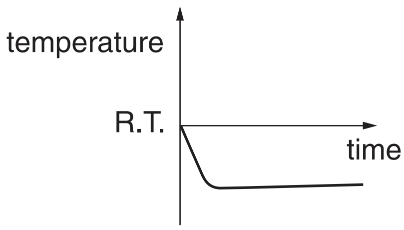
(d) C_5H_{12} ☐ [1]

[Total: 1]

9 Dissolving potassium iodide in water is an endothermic process.

Which of the graphs below shows how the temperature changes when potassium iodide is stirred with water until there is no further change of temperature?
[R.T. = room temperature]

(a)



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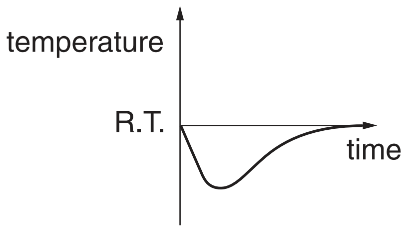
(b)



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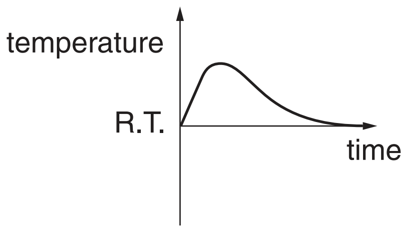
(c)



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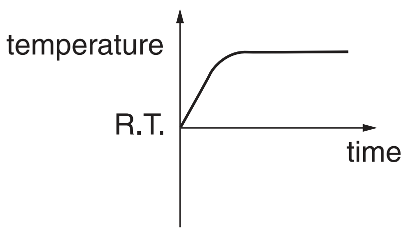
(d)



☐

[1]

[Total: 1]

10 Washing soda is hydrated sodium carbonate, $Na_2CO_3.\mathbf{x}H_2O$, where **x** is a whole number.

A student determines the value of **x** in the formula by titration with 0.100 mol / dm^3 hydrochloric acid, solution **S**.

(a) A sample of $Na_2CO_3.\mathbf{x}H_2O$ is placed in a previously weighed container which is then reweighed.

mass of container + $Na_2CO_3.\mathbf{x}H_2O$ = 8.31 g
mass of container = 4.79 g

Calculate the mass of $Na_2CO_3.\mathbf{x}H_2O$.

.... g [1]

(b) The student transfers the sample of $Na_2CO_3.\mathbf{x}H_2O$ to a beaker, adds about 100 cm^3 of distilled water and stirs the mixture until all the solid has dissolved. The contents of the beaker are then transferred to a volumetric flask.
The solution is made up to 250 cm^3 with distilled water.
This is solution **T**.
25.0 cm^3 of **T** is transferred into a conical flask.

Name the apparatus used to transfer this volume of **T**.

.... [1]

(c) A few drops of methyl orange indicator are added to the conical flask. **S** is put into a burette and added to the solution in the conical flask until an end-point is reached.

What is the colour of the solution in the flask

(i) before **S** is added, ...

(ii) at the end-point? .... [1]

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

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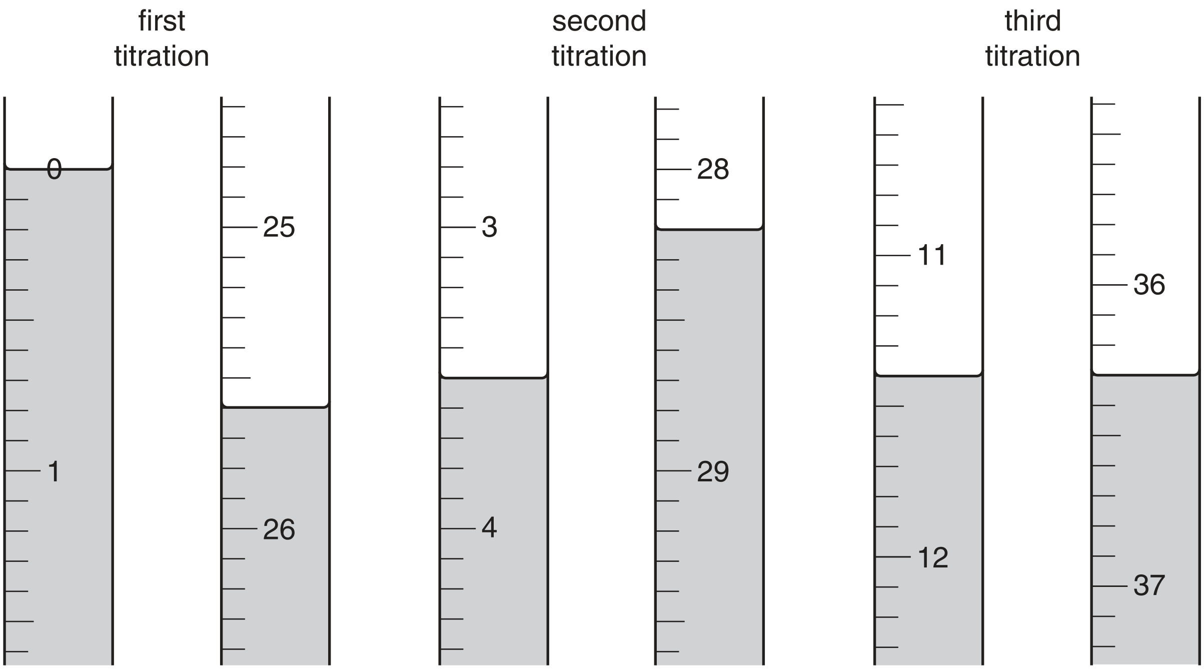

Use the diagrams to complete the following table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of **S** / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **S** is

.... cm^3 [4]

(e) **S** is 0.100 mol / dm^3 hydrochloric acid.

Calculate the number of moles of hydrochloric acid in the average volume of **S** from **(d)**.

.... moles [1]

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(f) One mole of sodium carbonate reacts with two moles of hydrochloric acid.

Deduce the number of moles of sodium carbonate which reacts with the number of moles of hydrochloric acid from **(e)**.

.... moles [1]

(g) Using your answer to **(f)**, calculate the number of moles of sodium carbonate in 250 cm^3 of **T**.

.... moles [1]

(h) Calculate the relative formula mass of sodium carbonate, Na_2CO_3.
[A_r: C, 12; O, 16; Na, 23]

.... [1]

(i) Using your answers to **(g)** and **(h)**, calculate the mass of sodium carbonate, Na_2CO_3, in 250 cm^3 of **T**.

.... g [1]

(j) By subtracting your answer in **(i)** from your answer in **(a)**, calculate the mass of water in the original sample of hydrated sodium carbonate.

.... g [1]

(k) Using your answers to **(h), (i)** and **(j)** in the following formula, calculate the value of **x** and write the formula for hydrated sodium carbonate.

$$\mathbf{x} = \frac{\text{answer to } \mathbf{(h)} \times \text{answer to } \mathbf{(j)}}{18 \times \text{answer to } \mathbf{(i)}}$$

x = ...

formula for hydrated sodium carbonate .... [2]

[Total: 15]

11 **G** is a compound which contains two ions.

Complete the table by adding the observations for **(a)**, **(c)(i)** and **(c)(ii)**, the test and observation for **(d)** and complete the conclusions for **(b)(i)** and **(b)(ii)**.

test	observation	conclusion
(a) **G** is dissolved in water and the solution is divided into three parts for use in **(b)**, **(c)** and **(d)**.		**G** is probably not a compound of a transition metal.
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen.	A white precipitate is formed.	**G** may contain the ions Al^{3+} or …………… or ……………
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.	The white precipitate dissolves.	**G** may contain the ions Al^{3+} or …………… .
(c) **(i)** To the second part, aqueous ammonia is added until a change is seen.		
(ii) An excess of aqueous ammonia is added to the mixture from **(i)**.		The presence of Al^{3+} in **G** is confirmed.
(d)		**G** contains NO_3^- ions.

(e) Conclusion: The formula of **G** is …………………………… .

[Total: 10]

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12 A student does a series of experiments in which a known mass of a metal is added to $20\,cm^3$ of $0.5\,mol/dm^3$ hydrochloric acid (an excess), in the apparatus shown below.

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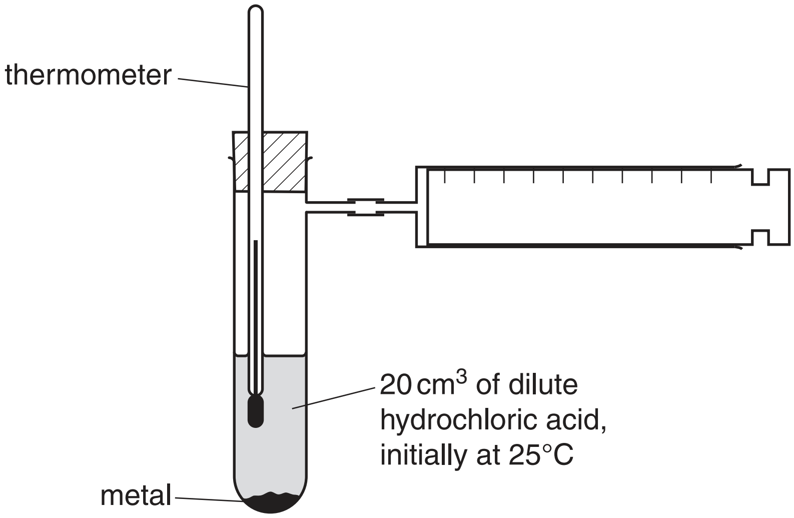
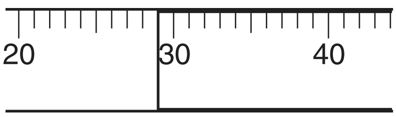
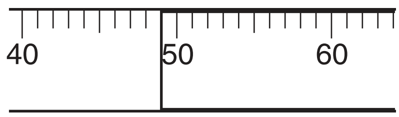


Four metals are used, calcium, magnesium, iron and zinc.
In each experiment 0.05 g of the metal is added.
When all the metal has dissolved the volume of hydrogen which collects in the syringe is measured.

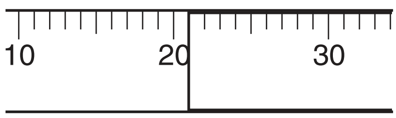
(a) The diagrams below show parts of the gas syringe indicating the volumes of hydrogen produced from each metal.



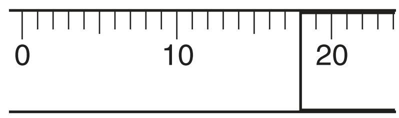
calcium



magnesium



iron



zinc

Use the diagrams to complete the following table.

metal	relative atomic mass, A_r	volume of hydrogen collected / cm^3
calcium	40	
magnesium	24	
iron	56	
zinc	65	

[1]

(b) Plot the volume of hydrogen against relative atomic mass, A_r, of the metal on the grid below. Draw a smooth curve through the points.

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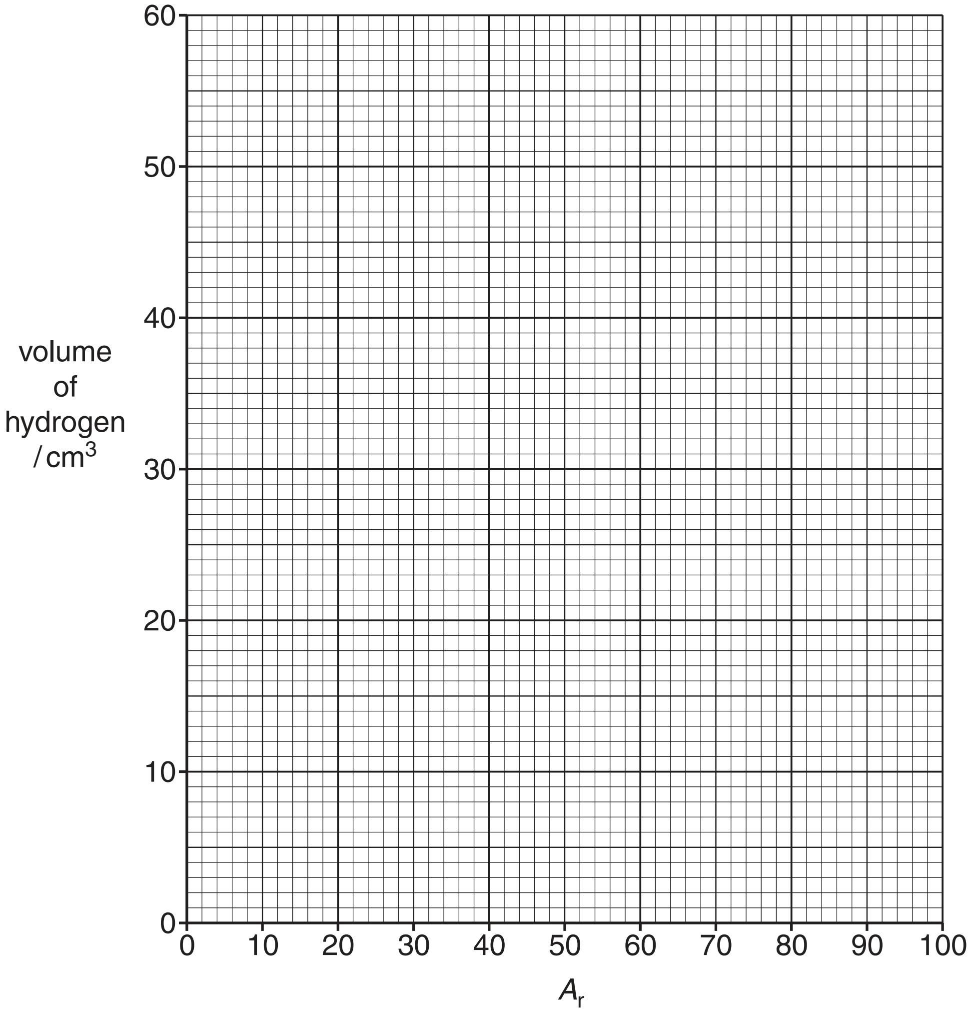

[2]

(c) By extending the curve, predict the volume of hydrogen that would be produced when 0.05 g of strontium is added to 20 cm^3 of 0.5 mol / dm^3 hydrochloric acid.
[A_r: Sr, 88]

.... cm^3 [1]

(d) Suggest why the volume of hydrogen produced decreases as the relative atomic mass of the element increases.

....

....[1]

[Turn over

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(e) (i) When 0.05 g of aluminium is added to 20 cm^3 of 0.5 mol/dm^3 hydrochloric acid, 66 cm^3 of hydrogen is produced.

Explain why this volume is greater than the volume that can be predicted from your graph.
[A_r : Al, 27]

....

....

....

.... [2]

(ii) Explain why the speed at the beginning of the reaction between aluminium and hydrochloric acid is very slow.

....

.... [1]

[Total: 8]