UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical **October/November 2008**

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

For Examiner's Use

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

1 A student found the composition of air using the apparatus shown below.

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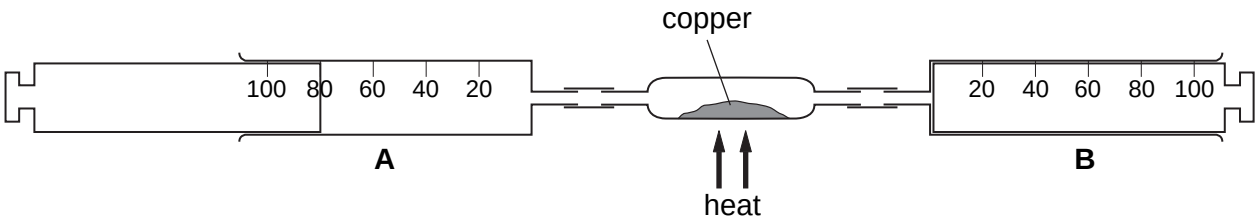
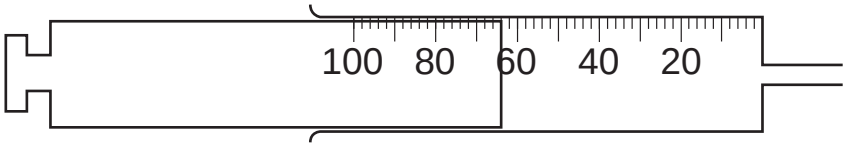


Syringe **A** contained 80 cm^3 of air. The air was forced over heated copper into syringe **B**. The air was then forced back into syringe **A**.

The process was repeated several times until the volume of gas forced back into syringe **A** was constant.

The diagram below shows the volume of gas in syringe **A** after the experiment was finished.



A

(a) (i) Name the major component of the gas remaining in syringe **A**.

.....[1]

(ii) What is the volume of gas remaining in syringe **A**?

.....[1]

(iii) Calculate the percentage of oxygen in the original sample of air.

.....[1]

(b) The copper reacted with oxygen in the air to produce copper(II) oxide.

(i) Write the equation for this reaction.

.....[1]

(ii) What colour is copper(II) oxide?

.....[1]

(c) In another experiment 0.16 g of copper was placed in the tube.

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(i) Calculate the number of moles of copper in the tube.
[A_r: Cu, 64]

.....[1]

(ii) Using your equation in **(b)(i)** deduce the number of moles of oxygen required to react with 0.16 g of copper.

.....[1]

(iii) Using your answer to **(c)(ii)** calculate the volume of oxygen required to react with 0.16 g of copper.
[1 mol of a gas measured at 25 °C occupies a volume of 24 dm^3.]

.....cm^3 [1]

(iv) Using your answers to **(a)(iii)** and **(c)(iii)** calculate the volume of air required to react with 0.16 g of copper.

.....cm^3 [1]

[Total: 9]

[Turn over

2 A student prepared a sample of propanoic acid by reacting an alcohol with acidified potassium dichromate(VI).

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(a) (i) What was the colour change of the mixture during the reaction?

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

(ii) What is the purpose of using potassium dichromate(VI) in this reaction?

.....[1]

(iii) Name a gas which would give the same colour change if passed through acidified potassium dichromate(VI).

.....[1]

(iv) Name the alcohol which was used to produce propanoic acid.

.....[1]

(b) Small volumes of this alcohol and propanoic acid were warmed with a few drops of concentrated sulphuric acid.

(i) Suggest the name of the organic product formed.

.....[1]

(ii) To which group of compounds does the product belong?

.....[1]

(iii) How was the presence of this product detected?

.....[1]

The properties of propanoic acid and sulphuric acid were compared.

(c) A few drops of universal indicator were added to 2 cm^3 of 0.01 mol/dm^3 solutions of each acid.

What were the final colours of the indicator?

Universal indicator in propanoic acid was .....

Universal indicator in sulphuric acid was ..... [1]

(d) A piece of magnesium ribbon was added to 2 cm^3 of each acid.

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(i) What observation was made in each reaction?

.....[1]

(ii) Compare the speeds of the two reactions.

.....[1]

(e) What conclusion about the relative strengths of the two acids may be made from the results of tests **(c)** and **(d)**?

.....[1]

[Total: 11]

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

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3 Ethanol may be made by growing yeast in sugar solution.
The process is called

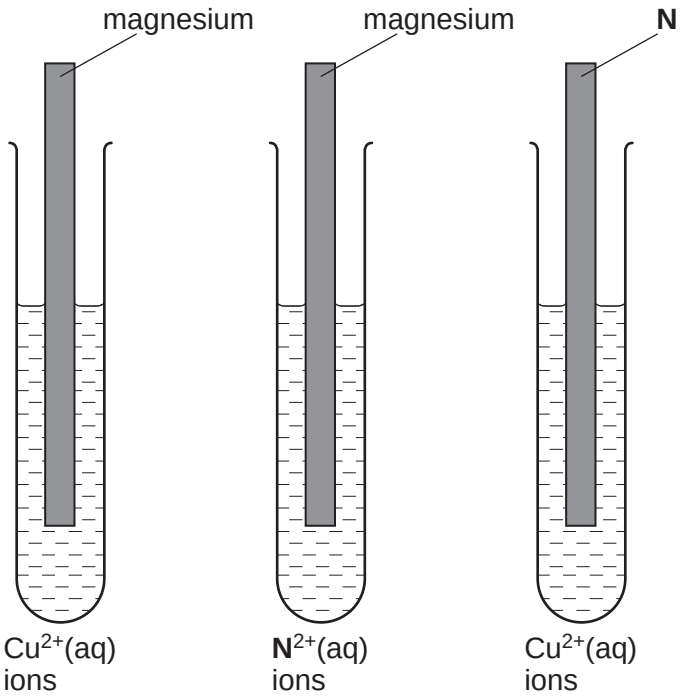
(a) combustion. ☐

(b) cracking. ☐

(c) fermentation. ☐

(d) hydrolysis. ☐ [Total: 1]

4 Three tubes were arranged as in the diagrams below. Each tube contained a piece of one metal, half-immersed in an aqueous solution containing the ions of one of the other two metals.
A deposit was formed in all three tubes.



Metal **N** could be

(a) aluminium. ☐

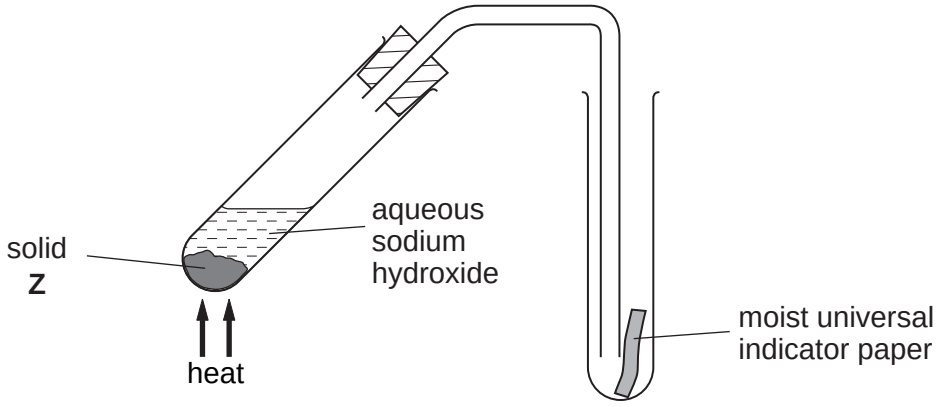
(b) calcium. ☐

(c) silver. ☐

(d) zinc. ☐ [Total: 1]

5 A student used the apparatus shown below to react solid **Z** with aqueous sodium hydroxide.

For Examiner's Use



When the tube was heated, the indicator paper turned blue.
Suggest the identity of **Z**.

(a) aluminium oxide ☐

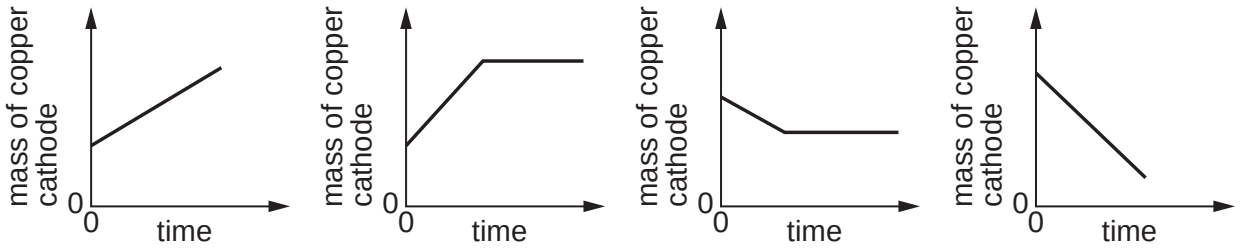
(b) ammonium sulphate ☐

(c) calcium hydroxide ☐

(d) sodium chloride ☐

[Total: 1]

6 A student electrolysed aqueous copper(II) sulphate using copper electrodes.
The electrolysis continued until no further change took place.
Which graph correctly shows how the mass of the copper cathode varied with time.



(a) **A** ☐

(b) **B** ☐

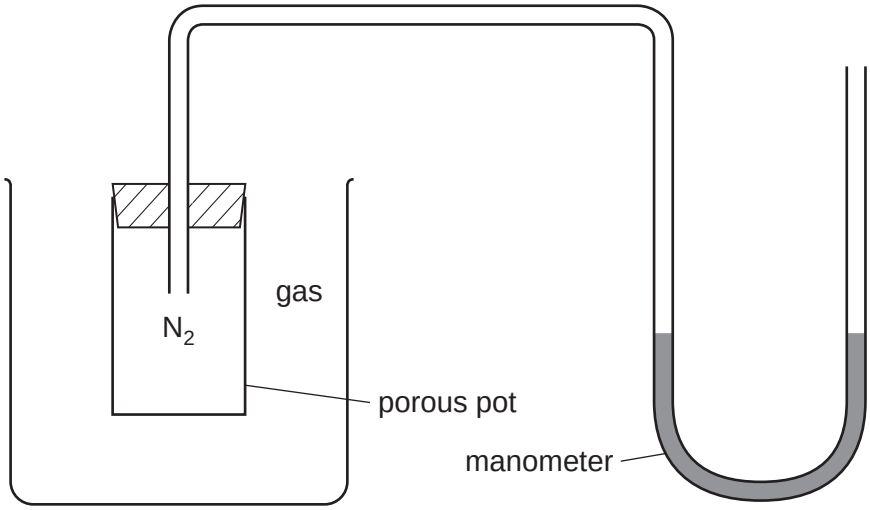
(c) **C** ☐

(d) **D** ☐

[Total: 1]

7 The apparatus shown below was used in experiments with four gases, Cl_2, CO, CH_4 and H_2. Each of the gases was put into the outer container in turn.

For Examiner's Use



Which gas did **not** cause a change in the level of the manometer?
[A_r: Cl, 35.5; C, 12; H, 1; O, 16; N, 14]

(a) Cl_2 ☐

(b) CO ☐

(c) CH_4 ☐

(d) H_2 ☐

[Total: 1]

8 A student determined the concentration of hydrochloric acid by titration with aqueous sodium carbonate, Na_2CO_3.

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The student made a solution of sodium carbonate by dissolving the solid sodium carbonate in water.

A quantity of sodium carbonate was placed in a previously weighed container, which was then reweighed.

mass of container + sodium carbonate = 7.61 g
mass of container = 6.29 g

(a) Calculate the mass of sodium carbonate used.

.....g [1]

The sodium carbonate was then dissolved in distilled water in a beaker. The resulting solution was transferred to a volumetric flask and made up to 250 cm^3 with distilled water.
This was solution **G**.

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

.....g [1]

(ii) Calculate the concentration of sodium carbonate in **G** in mol/dm^3.

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

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25.0 cm^3 of **G** was transferred to a conical flask and a few drops of methyl orange indicator were added.

(c) What colour was the methyl orange in the flask?

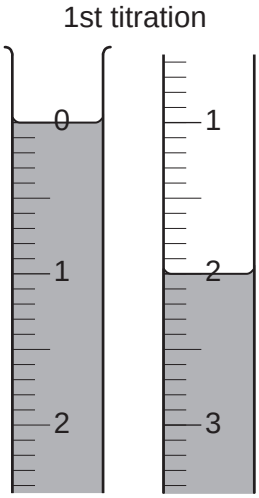
.....

A burette was filled with hydrochloric acid which was run into the conical flask until an end-point was reached.

What was the colour of the methyl orange when the end-point was reached?

.....
[1]

The diagrams below show the liquid levels before and after the titration.



(d) After looking at these results the student decided that the hydrochloric acid should be diluted. Explain why he came to this conclusion.

.....[1]

The student transferred 25.0 cm^3 of the acid to a volumetric flask and made it up to 250 cm^3 with distilled water. This was solution **H**.

The student poured away the acid that was left in the burette.

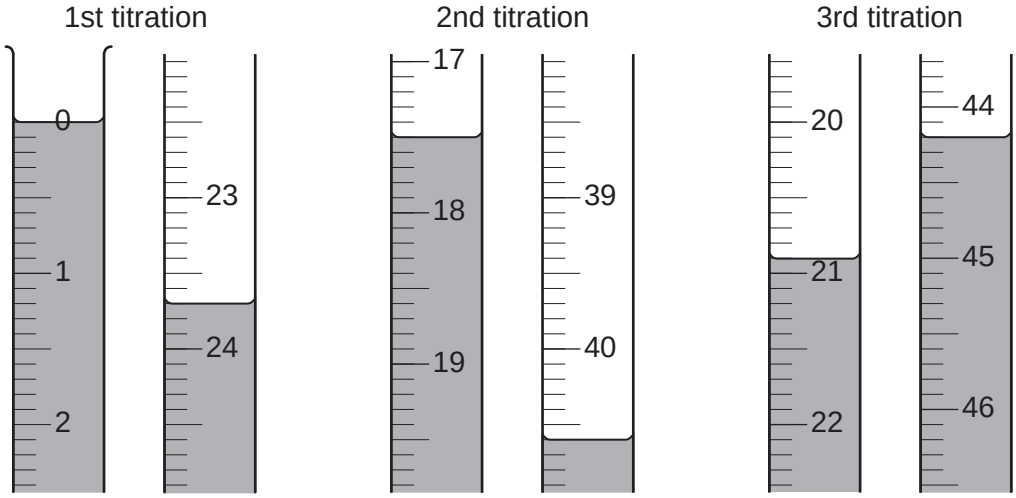
(e) Before refilling the burette with **H**, the burette was washed with two different liquids. Which two liquids did the student use to wash out the burette?

first liquid .....

second liquid.....[2]

Three further titrations were done, this time using solution **H**. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.

For Examiner's Use



(f) 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 **H** used / cm^3			
best titration results (✓)			

Summary
Tick (✓) the best titration results.
Using these results the average volume of **H** used was ..... cm^3.

[4]

(g) Using your answer to **(b)(ii)** calculate the number of moles of sodium carbonate in 25.0 cm^3 of **G**.

.....moles [1]

Sodium carbonate reacts with hydrochloric acid according to the following equation.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$$

(h) Calculate the number of moles of hydrochloric acid in the average volume of **H** used.

.....moles [1]

(i) Calculate the concentration of hydrochloric acid in **H**.

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

(j) Calculate the concentration of the hydrochloric acid used to prepare **H**.

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

(k) A second student repeated the experiment using a different mass of sodium carbonate. He obtained the same titration results but did not dilute the hydrochloric acid.

Explain how he did this.

.....

.....[2]

[Total: 17]

9 The following table shows the tests a student did on compound **T** and the conclusions made from the observations.

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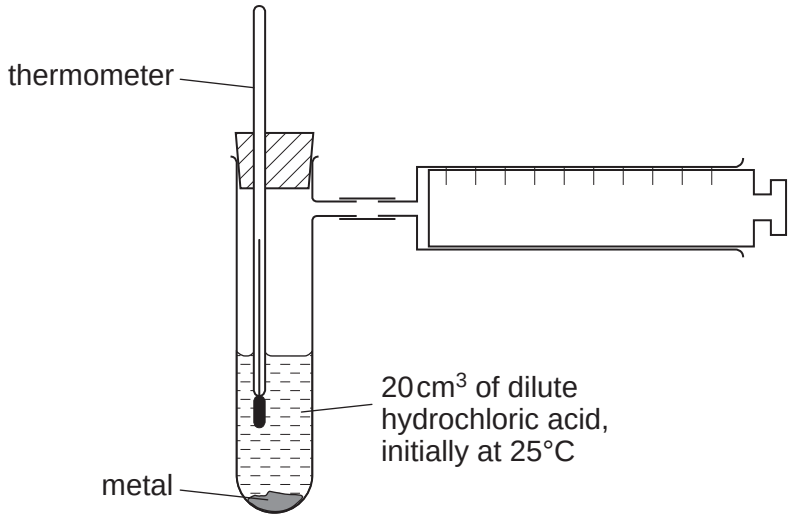
Complete the table by describing the observations in tests **(a)** and **(c)**, the test and observations in test **(d)** and complete the conclusions in test **(b)(i)**.

test	observation	conclusion
(a) **T** was dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.		**T** is not a compound of a transition metal.
(b) **(i)** To the first part aqueous sodium hydroxide was added until a change was seen.	A white precipitate was produced.	**T** may contain the ions Ca^{2+} or .....or ..... .
(ii) An excess of aqueous sodium hydroxide was added to the mixture from **(i)**.	The white precipitate did **not** dissolve.	**T** contains Ca^{2+} ions.
(c) To the second part aqueous ammonia was added.		The presence of Ca^{2+} ions in **T** is confirmed.
(d)		**T** contains I^- ions.

Conclusion: the formula for compound **T** is ..... [Total: 8]

10 A student did a series of experiments in which a known mass of a metal was added to 20 cm^3 of 0.5 mol/dm^3 hydrochloric acid (an excess), initially at 25°C, in the apparatus shown below.

For Examiner's Use



Four metals were used, calcium, magnesium, iron and zinc. In each experiment, the initial temperature of the acid was 25°C.
0.05g of the metal was added. When all the metal had dissolved the following measurements were made.

- the volume of hydrogen collected in the syringe
- the highest temperature reached

The diagrams below show parts of the syringe and the thermometer stem for each experiment.

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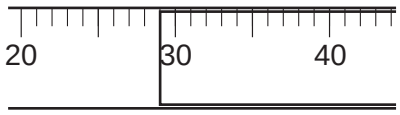
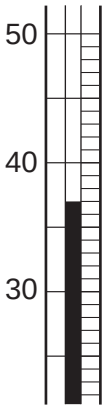
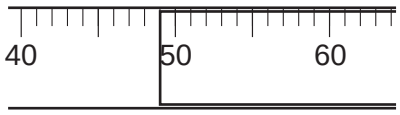
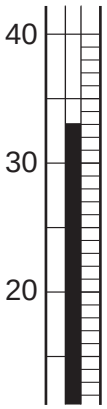
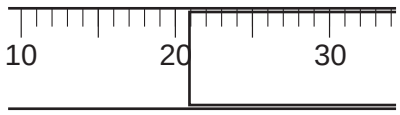
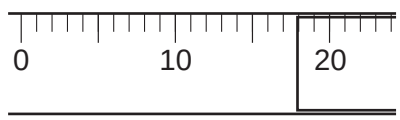
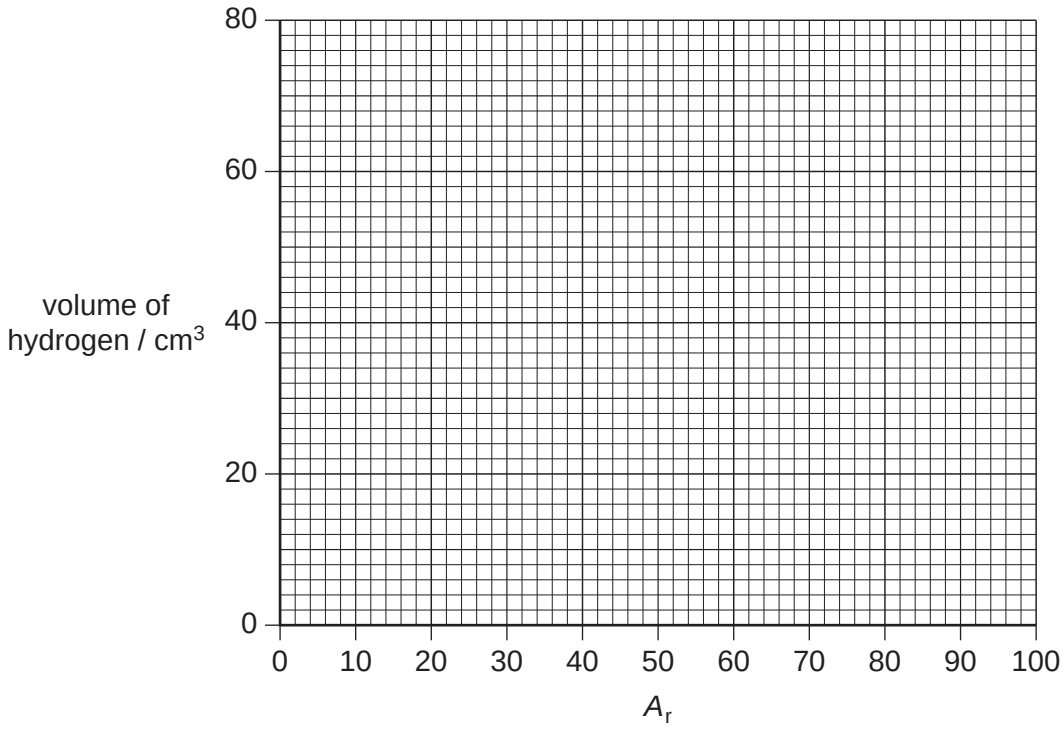
metal	syringe / cm^3	highest temperature / °C
calcium		
magnesium		
iron		
zinc		

(a) Use the diagrams on the previous page to complete the following table.

metal	relative atomic mass, A_r	volume of hydrogen collected / cm^3	initial temperature of acid / °C	highest temperature / °C	temperature change / °C
calcium	40		25		
magnesium	24		25		
iron	56		25		
zinc	65		25		

[3]

(b) Plot the volume of hydrogen collected in cm^3 against the relative atomic mass, A_r, of the metal on the grid below. Draw a smooth curve through the points.



[1]

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

.....cm^3 [1]

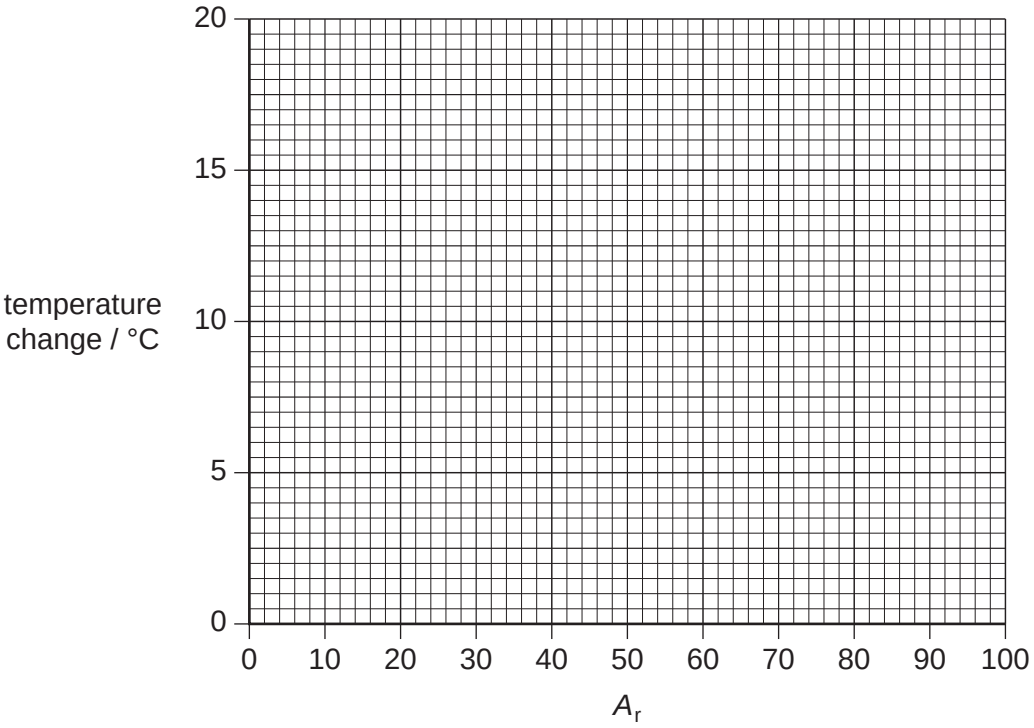
(ii) Suggest why the volume of hydrogen produced decreased as the relative atomic mass of the element increased.

.....

.....[1]

(d) Plot the temperature change in °C against relative atomic mass, A_r, of the metal on the grid below. Connect the points with a series of straight lines.

For Examiner's Use



[2]

(e) Explain why the temperature rise for the addition of strontium cannot be predicted from the graph.

.....

.....[1]

(f) Suggest why copper was not used in this experiment.

.....

.....[1]

[Total: 10]

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