UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6869105042

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2013**

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.

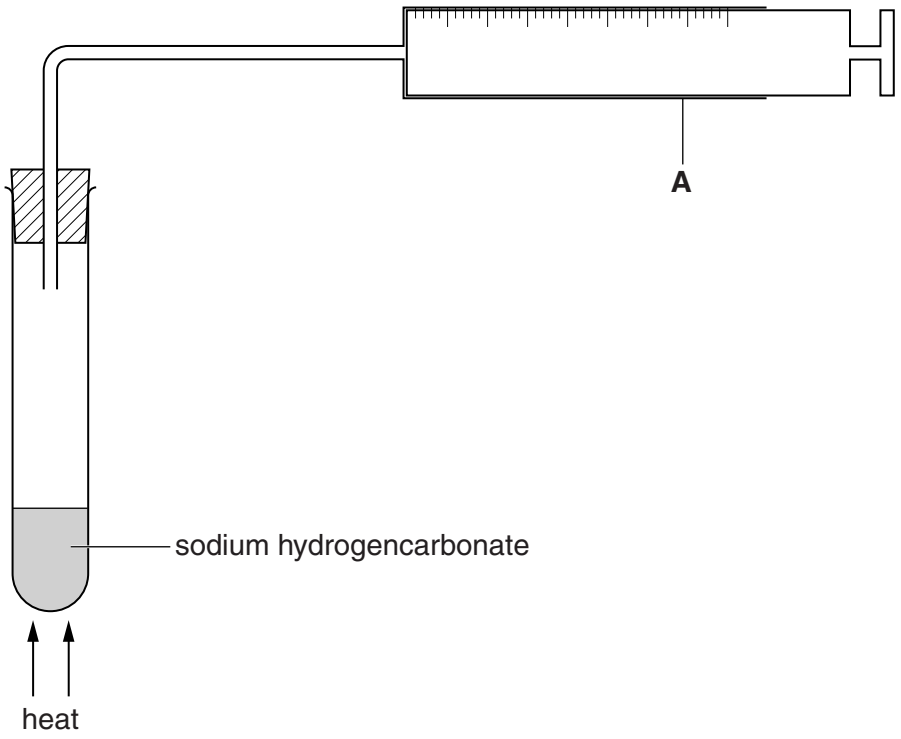
Answer **all** questions.
Electronic calculators may be used.
Write your answers in the spaces provided in the Question Paper.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

DC (LEO/CGW) 58057/5

UNIVERSITY of CAMBRIDGE International Examinations

1 A student heats some sodium hydrogencarbonate in the apparatus shown below. The reaction produces carbon dioxide.

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$



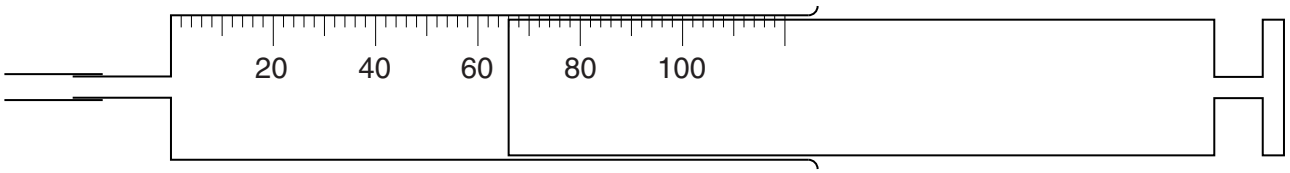
(a) Name apparatus **A**.

..... [1]

(b) Give a test for carbon dioxide.

.....[1]

(c) The diagram below shows apparatus **A** at the completion of the reaction. The carbon dioxide collected is at room temperature and pressure.



What volume of carbon dioxide is collected?

.....cm^3 [1]

(d) Using your answer to **(c)**, calculate the number of moles of carbon dioxide collected, measured at room temperature and pressure.
(One mole of a gas occupies 24 000 cm^3 at room temperature and pressure.)

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..... moles [1]

(e) **(i)** Using the equation for the reaction and your answer to **(d)** calculate the number of moles of sodium hydrogencarbonate used in the experiment.

..... moles [1]

(ii) Calculate the relative formula mass of sodium hydrogencarbonate.
[A_r: H,1; C,12; O,16; Na, 23]

.....[1]

(iii) Using your answers to **(e)(i)** and **(e)(ii)** calculate the mass of sodium hydrogencarbonate used in the experiment.

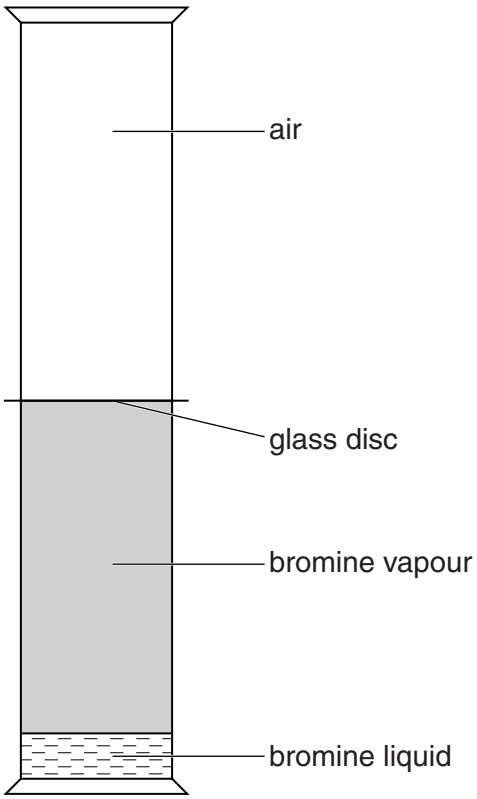
..... g [1]

[Total: 7]

[Turn over

2 A student does an experiment as shown in the diagram below.

For Examiner's Use



(a) What colour is bromine vapour?

..... [1]

(b) He carefully removes the glass disc to allow the contents to mix.

(i) What change, if any, is seen in the apparatus immediately after the disc is removed?

.....[1]

(ii) Describe the appearance of the contents of the gas jars after a few minutes.

.....[1]

(iii) Name the process taking place in the apparatus.

..... [1]

(c) (i) Draw an unbranched and a branched structure of the alkene, C_4H_8, showing all the bonds between the atoms.

unbranched

branched

[2]

(ii) How do the two structures in **(c)(i)** show that alkenes are unsaturated?

.....[1]

(d) (i) How will aqueous bromine show that a compound is unsaturated?

.....

.....

.....[1]

(ii) Construct an equation for the reaction between C_4H_8 and aqueous bromine.

.....[1]

[Total: 9]

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

For Examiner's Use

3 Which of the following reactions involving ethanol is **not** correct?

(a) Ethanol can be produced by the catalytic addition of steam to ethene. ☐

(b) Complete combustion of ethanol produces carbon dioxide and water. ☐

(c) Ethanoic acid is formed by the reduction of ethanol. ☐

(d) Ethanol reacts with carboxylic acids to produce esters. ☐

[Total: 1]

4 Which gas changes the colour of acidified potassium dichromate(VI) from orange to green?

(a) ammonia ☐

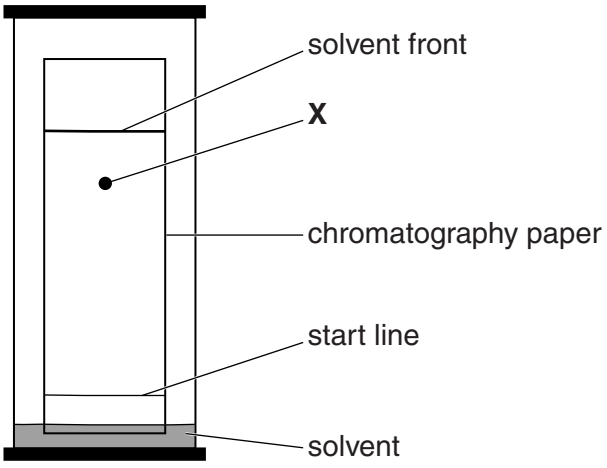
(b) chlorine ☐

(c) hydrogen ☐

(d) sulfur dioxide ☐

[Total: 1]

5 The diagram below shows the result of a paper chromatography experiment to find the R_f value of substance **X**.



From this experiment, the R_f value of **X** is approximately

(a) 0.2. ☐

(b) 0.5. ☐

(c) 0.8. ☐

(d) 1.0. ☐

[Total: 1]

6 A student finds that a hydrocarbon contains 88.9% by mass of carbon.
What is its empirical formula?
[A_r: H, 1; C, 12]

For Examiner's Use

(a) CH_2 ☐

(b) CH_3 ☐

(c) C_2H_3 ☐

(d) C_2H_5 ☐

[Total: 1]

7 Aqueous sodium hydroxide reacts with sulfuric acid.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

Which of the following aqueous solutions of sodium hydroxide will produce 1.42 g of sodium sulfate when reacting with excess sulfuric acid?
[M_r: Na_2SO_4, 142]

(a) 100 cm^3 of 0.100 mol / dm^3 of sodium hydroxide ☐

(b) 50 cm^3 of 0.200 mol / dm^3 of sodium hydroxide ☐

(c) 50 cm^3 of 0.400 mol / dm^3 of sodium hydroxide ☐

(d) 100 cm^3 of 0.050 mol / dm^3 of sodium hydroxide ☐

[Total: 1]

[Turn over

For Examiner's Use

8 Iron(II) sulfate crystals have the formula $FeSO_4.xH_2O$, where **x** is a whole number.

A student determines the value of **x** using aqueous 0.0200 mol/dm^3 potassium manganate(VII), **F**.

Potassium manganate(VII), which is purple, oxidises iron(II) ions to iron(III) ions.

(a) A sample of iron(II) sulfate crystals is added to a previously weighed container which is then reweighed.

mass of container + crystals = 10.94 g
mass of container = 5.98 g

Calculate the mass of iron(II) sulfate crystals used in the experiment.

..... g [1]

(b) The student transfers the sample of iron(II) sulfate crystals to a beaker and adds 100 cm^3 of dilute sulfuric acid. The solution is made up to 250 cm^3 with distilled water and mixed well.

This is solution **G**.

Using a pipette, 25.0 cm^3 of **G** is measured into a conical flask.

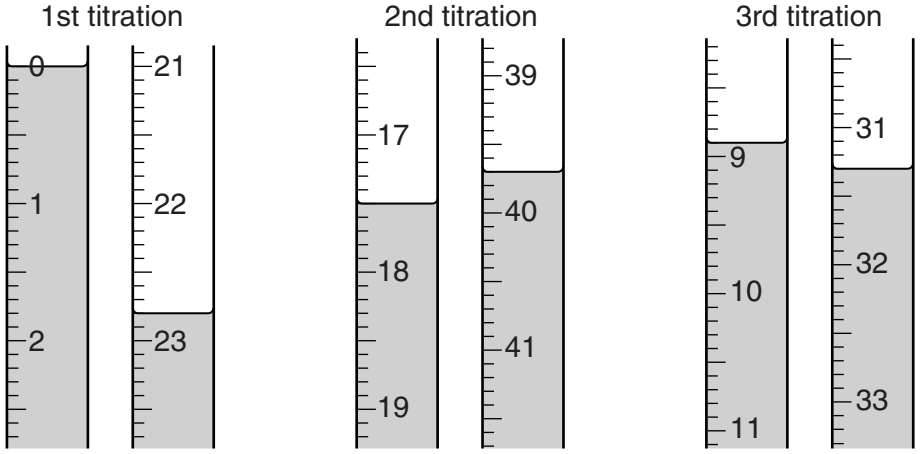
F is put into a burette and run into the conical flask containing **G**.

What is the colour of the solution in the flask

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

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

(c) 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.



Use the diagrams to complete the results table.

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

Summary

Tick (✓) the best titration results.
Using these results, the average volume of **F** is ..... cm^3. [4]

F is 0.0200 mol / dm^3 potassium manganate(VII), $KMnO_4$.

(d) Calculate the number of moles of $KMnO_4$ present in the average volume of **F**.

..... moles [1]

(e) Five moles of $FeSO_4$ react with one mole of $KMnO_4$.
Calculate the number of moles of $FeSO_4$ present in 25.0 cm^3 of **G**.

..... moles [1]

(f) Calculate the number of moles of $FeSO_4$ present in 250 cm^3 of **G**.

..... moles [1]

(g) Using your answer to **(f)**, calculate the mass of $FeSO_4$ in the original sample of $FeSO_4.\mathbf{x}H_2O$.
[A_r: O, 16; S, 32; Fe, 56]

..... g [1]

[Turn over

(h) Using your answers to **(a)** and **(g)**, calculate the mass of water in the sample of $FeSO_4.\mathbf{x}H_2O$.

..... g [1]

(i) Using your answer to **(h)**, calculate the number of moles of water in the sample of $FeSO_4.\mathbf{x}H_2O$.
[A_r: H, 1; O, 16]

..... moles [1]

(j) Using your answers to **(f)** and **(i)**, calculate the number of moles of water combined with one mole of $FeSO_4$.

..... moles [1]

(k) State the value of **x** in the formula of $FeSO_4.\mathbf{x}H_2O$.

.....[1]

(l) When iron(II) sulfate crystals are left to stand in air a yellow solid forms on the surface of the crystals.

(i) Suggest the identity of the yellow solid.

.....[1]

(ii) Why is it formed?

.....[1]

(iii) The yellow solid is dissolved in water. Aqueous sodium hydroxide is added.
What is seen?

.....[1]

[Total: 17]

9 **W** is a compound which contains two ions.
Complete the table by adding the conclusion for test **(a)**, the observations for tests **(b)** and **(c)** and both the test and observation for test **(d)**.

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test	observations	conclusions
(a) **W** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A coloured solution is formed.	
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen.		**W** contains Cu^{2+} ions.
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		
(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 Cu^{2+} ions is confirmed.
(d)		**W** contains Cl^- ions.

Conclusion: the formula of **W** is .....

[Total: 9]

10 A student investigates the rise in temperature when different masses of magnesium are added to 50 cm^3 of hydrochloric acid.

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The equation for the reaction is

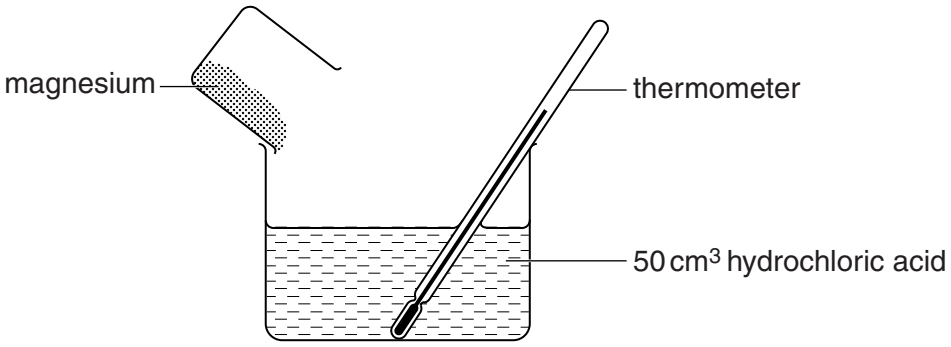
$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

(a) What general name is given to reactions in which there is a rise in temperature?

.....[1]

50 cm^3 of hydrochloric acid is poured into a beaker. A thermometer is placed in the acid. The initial temperature of the acid is 20.0 °C.

0.10 g of magnesium is added to the hydrochloric acid and the highest temperature reached is recorded.



The experiment is repeated for different masses of magnesium.

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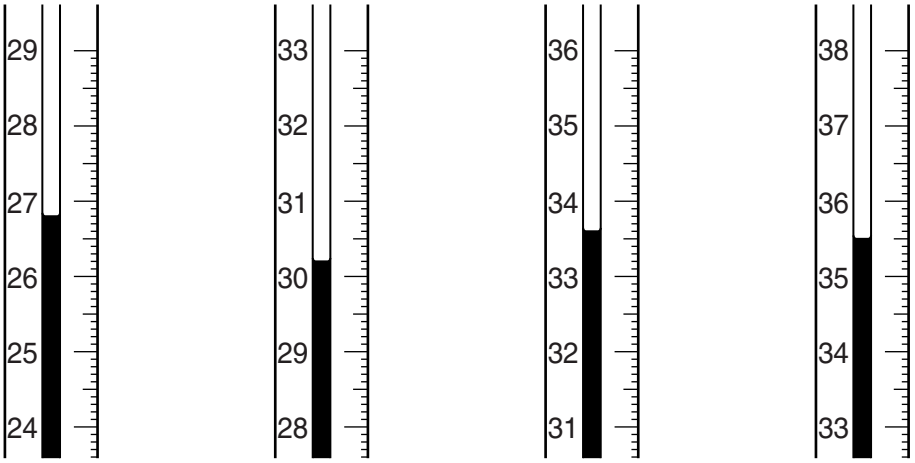
The diagrams below show parts of the thermometer stem giving the highest temperature reached after each addition of magnesium.



0.20 g Mg | 0.30 g Mg | 0.40 g Mg | 0.50 g Mg

(b) Use the thermometer readings to complete the following table.

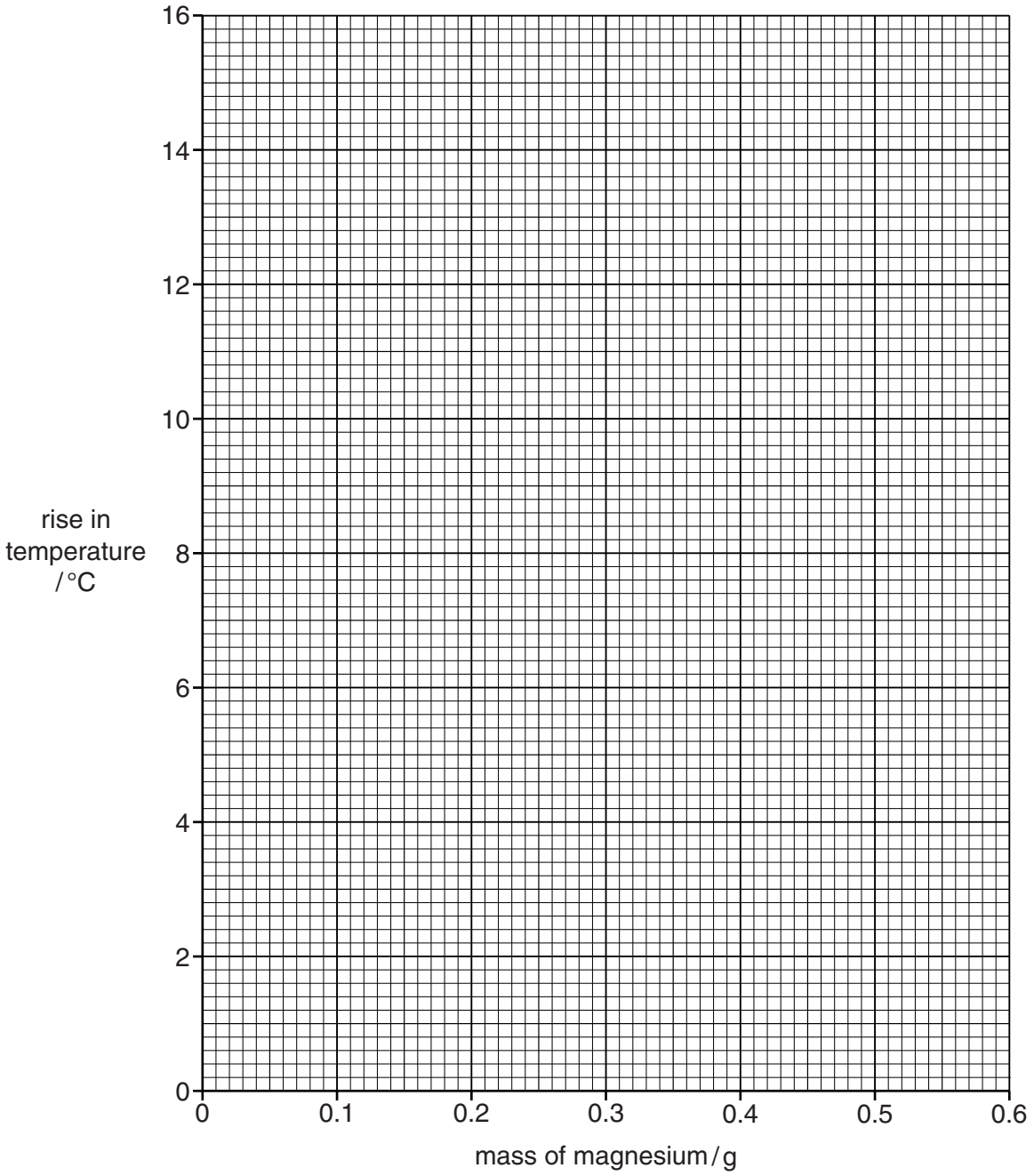
mass of magnesium / g	initial temperature of hydrochloric acid / °C	highest temperature of mixture / °C	rise in temperature / °C
0.10	20.0	23.4	3.4
0.20	20.0		
0.30	20.0		
0.40	20.0		
0.50	20.0		
0.60	20.0	35.5	15.5

[2]

[Turn over

(c) Plot the results on the grid.
Draw two intersecting straight lines through the points.

For Examiner's Use



[3]

Use your graph to answer the following questions.

(d) (i) What is the rise in temperature when 0.25 g of magnesium is added to 50 cm^3 of hydrochloric acid?

..... °C [1]

(ii) What is the highest temperature of the solution when 0.35 g of magnesium is added to 50 cm^3 of hydrochloric acid?

..... °C [1]

(e) Why are the last two rises in temperature the same?

.....[1]

For Examiner's Use

(f) **(i)** From your graph, what mass of magnesium is required to neutralise 50 cm^3 of the hydrochloric acid used in the experiment?

..... g [1]

(ii) Using your answer to **(f)(i)**, calculate the number of moles of magnesium required to neutralise the hydrochloric acid.
[A_r: Mg, 24]

..... moles [1]

(iii) Using your answer to **(f)(ii)** and the equation for the reaction, calculate the concentration in mol/dm^3 of the hydrochloric acid used in the experiment.

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

..... mol/dm^3 [2]

[Total: 13]

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