Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical

May/June 2004

1 hour

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
You should use names, not symbols, when describing all reacting chemicals and products formed.
You may use a calculator.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use

This document consists of **16** printed pages.

SP (SC/SLM) S60731/3

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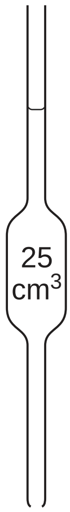
For Examiner's Use

1 (a) Name the apparatus shown below.



....[1]

(b) (i) What safety item should be used with this apparatus?

....

(ii) Why is this safety item used?

....[2]

2 A student was given a test-tube containing a small piece of sodium in oil.

(a) Why was the sodium in oil?

....[1]

The piece of sodium was transferred from the test-tube to a beaker half-filled with water. The reaction produced a gas.

(b) Name this gas and give a test to confirm the presence of this gas.

gas ………………………

test and observation

....[2]

(c) Give two observations that were made when the sodium reacted with the water.

1. ....

2. ....[2]

(d) Name the solution that remained in the beaker when the reaction had finished.

....[1]

(e) A piece of litmus paper was placed in this solution. What was the colour of the litmus paper in this solution?

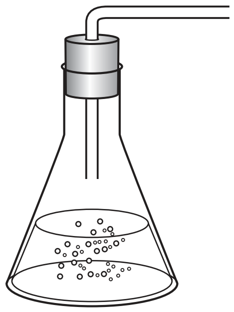
....[1]

(f) Write an equation for the reaction between sodium and water.

....[1]

3 A student added 100 cm^3 of 0.10 mol/dm^3 hydrochloric acid to 0.5 g of calcium carbonate contained in a conical flask. The reaction produced carbon dioxide. The equation for the reaction is shown.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$



(a) Name the piece of apparatus which should be attached to the flask, for collecting and measuring the volume of carbon dioxide produced.

....[1]

(b) Give a test to confirm the presence of carbon dioxide.

test and observation

....[1]

(c) **(i)** Calculate the number of moles of calcium carbonate in 0.5 g.
[A_r: Ca, 40; C, 12; O, 16]

....moles

(ii) Calculate the number of moles of hydrochloric acid in 100 cm^3 of 0.10 mol/dm^3.

....moles

(iii) Was one of the reagents in excess?

Explain your answer.

....[4]

(d) Using your answers in **(c)** calculate the volume of carbon dioxide produced when the reaction reached completion. (One mole of a gas occupies 24 dm^3 at room temperature and pressure).

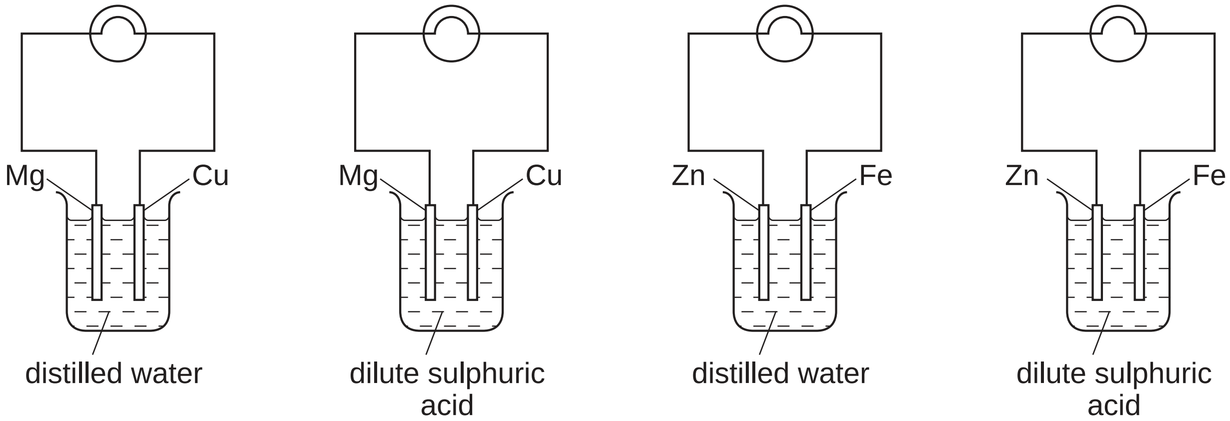
....dm^3 [1]

(e) The experiment was repeated using 0.5 g of magnesium carbonate instead of 0.5 g of calcium carbonate. Calculate the volume of carbon dioxide produced.
[A_r: Mg, 24; C, 12; O, 16]

....dm^3 [2]

In questions 4 to 8 inclusive, place a tick in the box against the best answer.

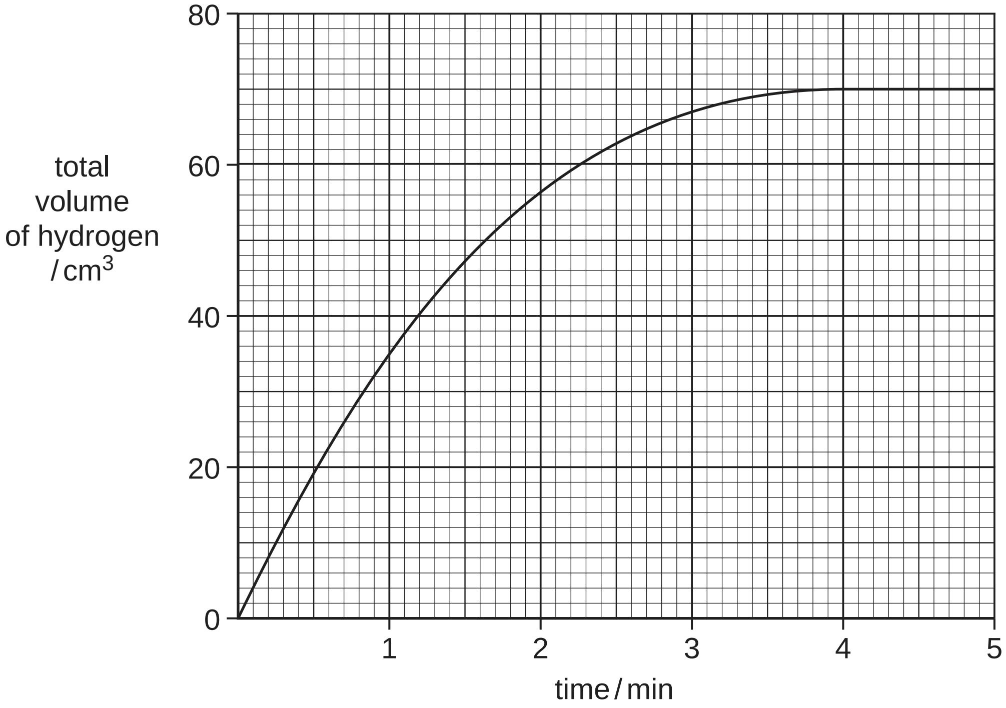
4 In which of the following cells will the current be the greatest?



(a) ☐ **(b)** ☐ **(c)** ☐ **(d)** ☐

[1]

5 A student measured the rate of reaction between a given mass of zinc and an excess of hydrochloric acid by recording the volume of hydrogen produced.
The results are shown in the graph below.



How long did it take for half of the zinc to react?

(a) 1.0 min

(b) 1.5 min

(c) 2.0 min

(d) 2.5 min

[1]

6 A student is asked to make copper(II) sulphate. Which of the following methods should he use?

(a) Add dilute sulphuric acid to copper.

(b) Add copper to aqueous zinc sulphate.

(c) Add dilute sulphuric acid to copper(II) oxide.

(d) Add copper(II) carbonate to aqueous sodium sulphate.

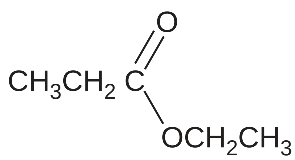
[1]

7 Samples of sulphur dioxide are passed through acidified potassium dichromate(VI) and aqueous potassium iodide. Which of the following results is obtained?

	acidified potassium dichromate (VI)	aqueous potassium iodide	
(a)	green to orange	brown to colourless	
(b)	orange to green	no change in colour	
(c)	no change in colour	colourless to brown	
(d)	no change in colour	no change in colour	

[1]

8 Which of the following pairs of substances produces the compound shown below?



(a) ethene and ethanoic acid

(b) methanol and ethanoic acid

(c) ethene and propanoic acid

(d) ethanol and propanoic acid

[1]

9 The formula for iron(II) sulphate crystals is $FeSO_4.xH_2O$ where x is a whole number.
A student determined the value of x using 0.0200 mol/dm^3 potassium manganate(VII). This was solution **G**.

(a) A sample of iron(II) sulphate crystals was added to a previously weighed container, which was then reweighed.

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

Mass of container + crystals	=	12.38 g
Mass of empty container	=	5.42 g
Mass of iron(II) sulphate crystals	=	……………… g

[1]

(b) The sample was dissolved in 100 cm^3 of dilute sulphuric acid and the solution was made up to 250 cm^3 with distilled water. This was solution **H**.

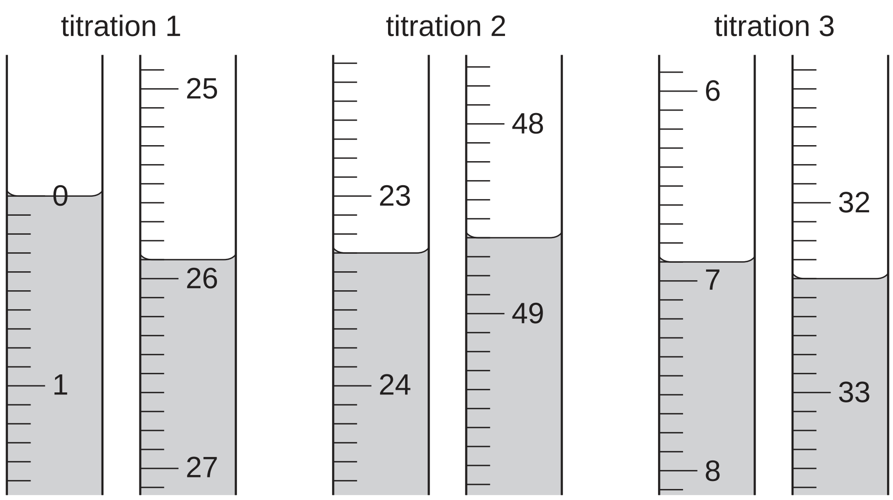
A 25.0 cm^3 sample of **H** was measured into a titration flask.

Solution **G** was run from a burette into the flask containing **H** until an end-point was reached. Potassium manganate(VII) is purple.

What was the colour change at the end-point?

from ....to ....[1]

(c) Three titrations were done. The diagrams below show parts of the burette before and after each titration.



Use these diagrams to complete the table of results.

titration number	1	2	3
final reading/cm^3			
first reading/cm^3			
volume of solution **G**/cm^3			
best titration results (✔)			

Summary.

Tick (✔) the best titration results. Using these results, the average volume of **G** was .... cm^3. [4]

(d) **G** is 0.0200 mol/dm^3 potassium manganate (VII).

Calculate how many moles of $KMnO_4$ were present in the titrated volume of **G** calculated in **(c)**.

....moles [1]

(e) Five moles of $FeSO_4$ react with one mole of $KMnO_4$.

Calculate how many moles of $FeSO_4$ were present in 25.0 cm^3 of **H**.

....moles [1]

(f) Calculate how many moles of $FeSO_4$ were present in the 250 cm^3 of **H**.

....moles [1]

(g) Using your answers to **(f)**, calculate the mass of $FeSO_4$ in the original sample of $FeSO_4.xH_2O$. [M_r: $FeSO_4$, 152.]

....g [1]

(h) Using your answer to **(a)** and **(g)** calculate the mass of water in the sample of $FeSO_4.xH_2O$.

....g [1]

(i) Using our answer to **(h)** calculate the number of moles of water in the sample of $FeSO_4.xH_2O$.
[A_r:H,1; O, 16]

....moles [1]

(j) Using your answers to **(f)** and **(i)** calculate the value of x in $FeSO_4.xH_2O$.

....[1]

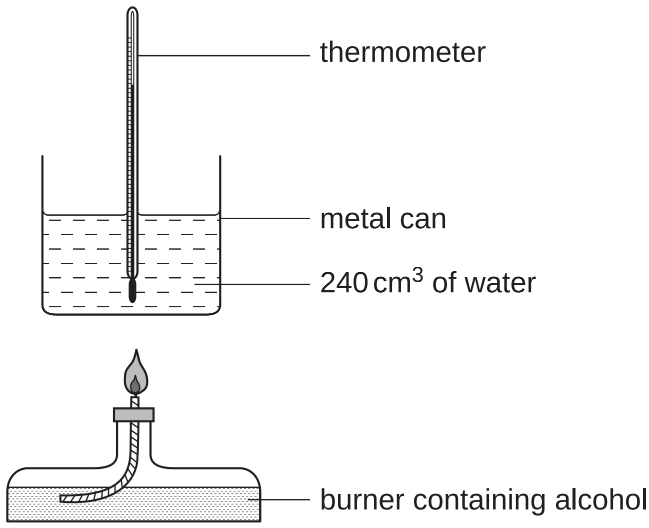
10 The following table shows the tests a student did on substance **T** and the conclusions made from the observations. Complete the table by describing these observations and suggest the test and observations which lead to the conclusion from test **4**.

test	observation	conclusion
1 **T** was dissolved in water and the solution divided into three parts for tests **2**, **3** and **4**		**T** contains a transition metal
2 **(a)** To the first part, aqueous sodium hydroxide was added until a change was seen **(b)** An excess of aqueous sodium hydroxide was added to the mixture from **(a)**		**T** may contain Cu^{2+} ions.
3 **(a)** To the second part, aqueous ammonia was added until a change was seen. **(b)** An excess of aqueous ammonia was added to the mixture from **(a)**		The presence of Cu^{2+} ions is confirmed.
4		**T** contains Cl^{-} ions.

Conclusion: the formula for substance **T** is ....[10]

11 The alcohol butan-1-ol has the formula C_4H_9OH. When it is burnt it gives out heat.

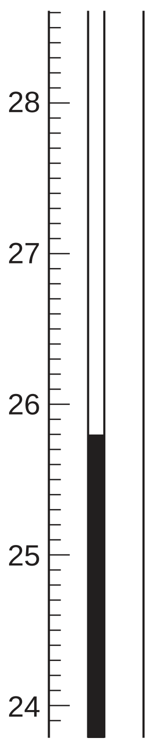
A student used the apparatus shown below to find the amount of heat produced when butan-1-ol was burnt.



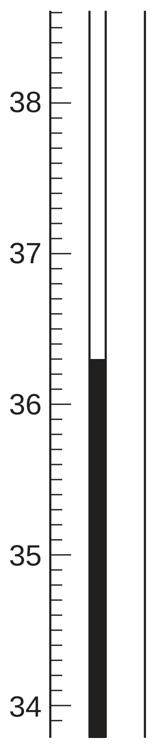
Some butan-1-ol was put into the burner, which was weighed. The temperature of the water was noted. The burner was lit and allowed to burn for several minutes. The flame was extinguished and the final temperature of the water was noted. The burner was reweighed.

The diagrams below show parts of the thermometer stem for each of the temperature readings.

initial temperature



final temperature



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(a) Use the weighings and the thermometer readings to complete the following tables.

(i) initial mass of burner + butan-1-ol = 14.34 g

final mass of burner + butan-1-ol = 13.88 g

mass of butan-1-ol burnt = ………..g

(ii) final temperature of water = ………..°C

initial temperature of the water = ………..°C

rise in temperature = ………..°C [3]

(b) **(i)** Draw the structure of butan-1-ol, C_4H_9OH.

(ii) Calculate the relative molecular mass of butan-1-ol.
[A_r: C, 12; H, 1; O, 16.]

....moles

(iii) Using your answers to **(a)(i)**, calculate the number of moles of butan-1-ol burnt in the experiment.

....moles

(iv) Using your answers to **(a)(ii)** and **(b)(iii)**, calculate ΔH, the heat produced when one mole of butan-1-ol was burnt. Use the formula.

$$\Delta H = \frac{\text{rise in temperature}}{\text{number of moles of butan-1-ol burnt}} \quad \text{kJ/mol}$$

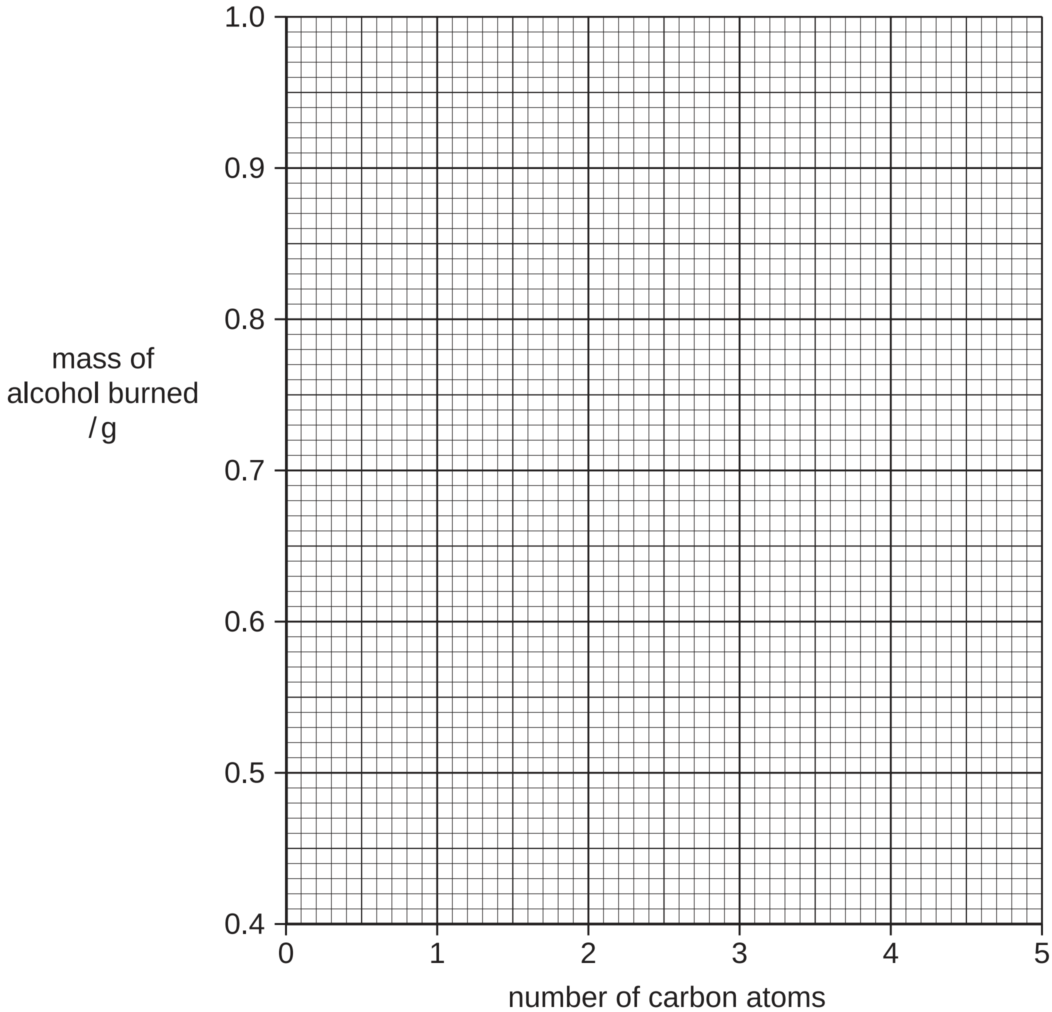
....kJ/mol [4]

(c) A similar experiment was done to compare 5 different alcohols. The mass of alcohol which burned to increase the temperature by 15 °C was measured.

The following results were obtained.

alcohol	formula	mass of alcohol burned / g
methanol	CH_3OH	0.96
ethanol	C_2H_5OH	0.74
propan-1-ol	C_3H_7OH	
butan-1-ol	C_4H_9OH	0.54
pentan-1-ol	$C_5H_{11}OH$	0.50

Plot the points on the grid below, connecting the points with a smooth curve.



[2]

[Turn over

(d) **(i)** Using your graph suggest the mass of propan-1-ol required to raise the temperature by 15 °C.

....g

(ii) The actual mass was found to be 0.66 g, which was higher than the mass of propan-1-ol required on the graph. The student accidentally used a different isomer of propanol.
Give the structure of this isomer.

....[2]

(e) Suggest a reason why the same temperature rise was used in each experiment.

....[1]