Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2014**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

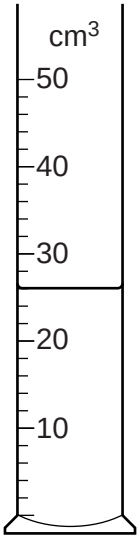
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

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.

This document consists of **14** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

1 The apparatus shown below contains aqueous propanoic acid.



(a) Name the apparatus.

..... [1]

(b) What is the volume of aqueous propanoic acid in the apparatus?

..... cm^3 [1]

(c) What is observed when

(i) a few drops of litmus solution are added to aqueous propanoic acid,

.....[1]

(ii) aqueous propanoic acid is added to a test-tube containing solid magnesium carbonate until no further reaction occurs?

.....[1]

(d) Name the alcohol which, on oxidation, gives propanoic acid.

.....[1]

(e) Name, and give the structure of, the ester formed when propanoic acid reacts with ethanol.

name .....

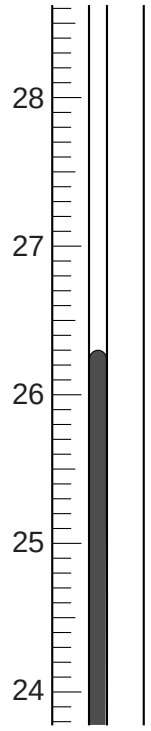
structure .....
[2]

[Total: 7]

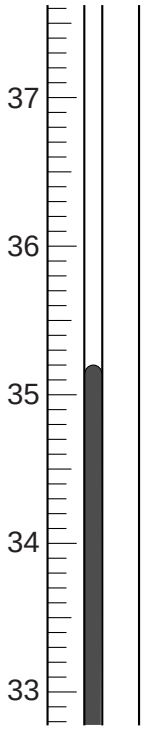
2 A student adds magnesium ribbon to dilute hydrochloric acid. The temperature of the dilute hydrochloric acid changes.

The diagrams below show parts of the thermometer stem giving the temperatures of the dilute hydrochloric acid both before and after the addition of magnesium ribbon.

initial temperature



final temperature



(a) A gas is produced during the reaction.
Name this gas. Give a test and observation to identify the gas.

name of gas .....

test and observation .....[2]

(b) Construct the equation for the reaction between magnesium and dilute hydrochloric acid.

.....[1]

(c) Complete the following table and calculate the change in temperature.

final temperature of the acid / °C	
initial temperature of the acid / °C	
change in temperature / °C	

[2]

(d) What type of reaction does this temperature change indicate?

.....[1]

[Total: 6]

3 A student heats 0.336 g of a metal carbonate, MCO_3. The sample decomposes according to the equation shown.

$$MCO_3 \rightarrow MO + CO_2$$

0.176 g of carbon dioxide is produced.

(a) Describe a test for carbon dioxide gas.

.....[1]

(b) How can the student be sure that **all** the MCO_3 decomposes?

.....

.....[1]

(c) **(i)** Calculate the mass of MO produced.

..... g [1]

(ii) Calculate the number of moles in 0.176 g of carbon dioxide.
[A_r: C, 12; O, 16]

..... moles [1]

(iii) Use the equation

$$MCO_3 \rightarrow MO + CO_2$$

and your answer to **(c)(ii)** to deduce the number of moles of MO produced.

..... moles [1]

(iv) Using your answers to **(c)(i)** and **(c)(iii)**, calculate the relative formula mass of MO.

relative formula mass ..... [1]

(v) Calculate the relative atomic mass of M.
[A_r: O, 16]

.....[1]

[Total: 7]

In questions **4** to **8** inclusive, place a tick (✓) in the box against the correct answer.

4 A compound **Q** contains 0.69 g of sodium, 1.92 g of sulfur and 1.44 g of oxygen.
[A_r: Na, 23; S, 32; O, 16]

Its empirical formula is

(a) Na_2SO_3 ☐

(b) Na_2SO_4 ☐

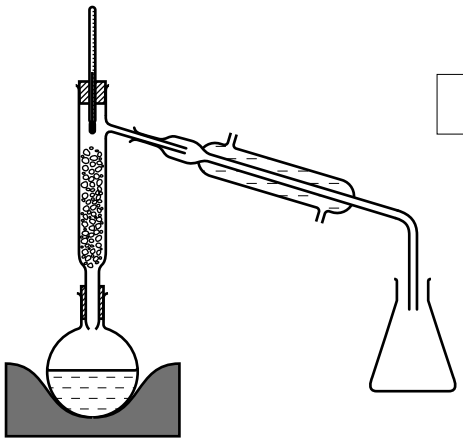
(c) $Na_2S_2O_3$ ☐

(d) NaS_2O_3 ☐

[Total: 1]

5 Which apparatus is used to separate a mixture of ethanol and water?

(a)



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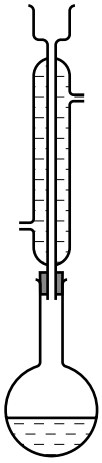
(b)



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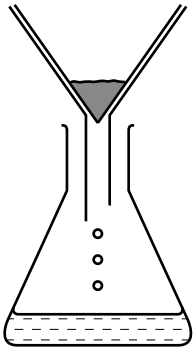
(c)



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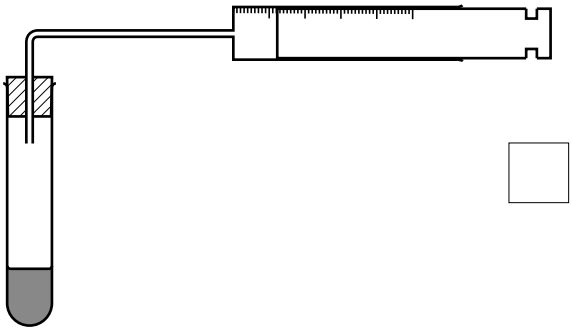
(d)



☐

[Total: 1]

6 A student adds a solid to dilute hydrochloric acid. The solid dissolves and bubbles of a gas are evolved.

The solid could be

(a) copper. ☐

(b) copper(II) oxide. ☐

(c) copper(II) hydroxide. ☐

(d) copper(II) carbonate. ☐

[Total: 1]

7 Which **two** of the following compounds will decolourise bromine water?

A C_2H_4

B C_2H_6

C C_3H_6

D C_3H_8

(a) **A** and **B** ☐

(b) **A** and **C** ☐

(c) **B** and **C** ☐

(d) **B** and **D** ☐

[Total: 1]

8 Which of the pairs, on mixing, does **not** produce a precipitate?

(a) aqueous barium chloride and aqueous sulfuric acid ☐

(b) aqueous silver nitrate and aqueous hydrochloric acid ☐

(c) aqueous sodium hydroxide and aqueous sulfuric acid ☐

(d) aqueous lead nitrate and aqueous hydrochloric acid ☐

[Total: 1]

9 A student is asked to determine the value of **x** in the formula $Na_2CO_3.\mathbf{x}H_2O$.

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

mass of container + $Na_2CO_3.\mathbf{x}H_2O$ = 10.84 g

mass of container = 7.49 g

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

..... g [1]

(b) The sample is dissolved in distilled water and the solution made up to 250.0 cm^3. This is **H**.

In which apparatus should the solution be made up to 250.0 cm^3?

.....[1]

(c) A 25.0 cm^3 sample of **H** is transferred into a conical flask and a few drops of methyl orange indicator are added.

(i) Name the apparatus used to transfer 25.0 cm^3 of **H** into the conical flask.

.....[1]

(ii) A burette is filled with 0.100 mol/dm^3 hydrochloric acid.

The hydrochloric acid is added to **H** until the end-point is reached.

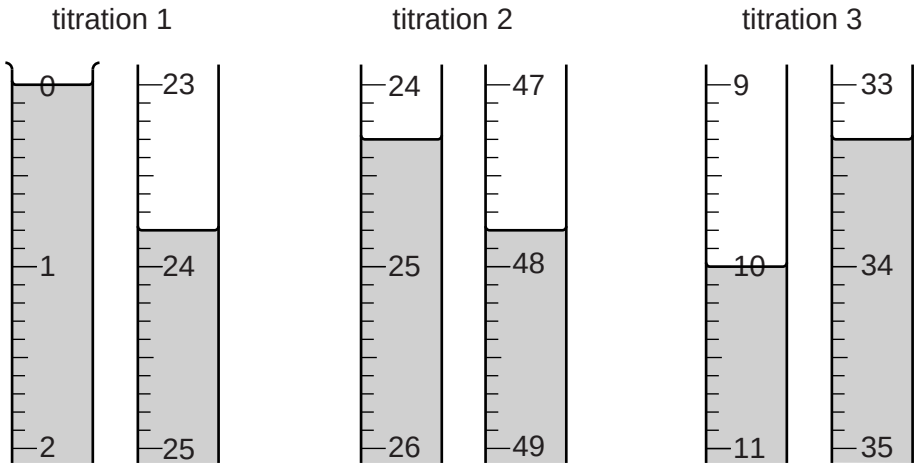
What is the colour of the solution in the conical flask

before the hydrochloric acid is added, ...

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.



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 0.100 mol / dm^3 hydrochloric acid / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of 0.100 mol / dm^3 hydrochloric acid required is

..... cm^3 [4]

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

..... moles [1]

(f) Using the equation and your answer to **(e)**, deduce the number of moles of sodium carbonate, Na_2CO_3, in 25.0 cm^3 of **H**.

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

..... moles [1]

(g) Calculate the number of moles of sodium carbonate, Na_2CO_3, in 250 cm^3 of **H**.

..... moles [1]

(h) 1 mole of Na_2CO_3 is produced from 1 mole of $Na_2CO_3.\mathbf{x}H_2O$.

Use this information and your answers to **(a)** and **(g)** to calculate the relative formula mass of $Na_2CO_3.\mathbf{x}H_2O$.

.....[1]

(i) Use your answer to **(h)** to calculate the value of **x** in $Na_2CO_3.\mathbf{x}H_2O$.
[A_r: H, 1; C, 12; O, 16; Na, 23]

x = ...[2]

[Total: 14]

10 The following table shows the tests a student does on compound **Z**. Complete the table by adding the conclusion for **(a)**, the observations for tests **(b)** and **(c)** and both the test and observation which lead to the conclusion for test **(d)**.

test	observations	conclusions
(a) **Z** 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. **(ii)** An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		**Z** contains Fe^{2+} ions.
(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 Fe^{2+} ions is confirmed.
(d)		**Z** contains SO_4^{2-} ions.

Conclusion

The formula for **Z** is .....

[Total: 9]

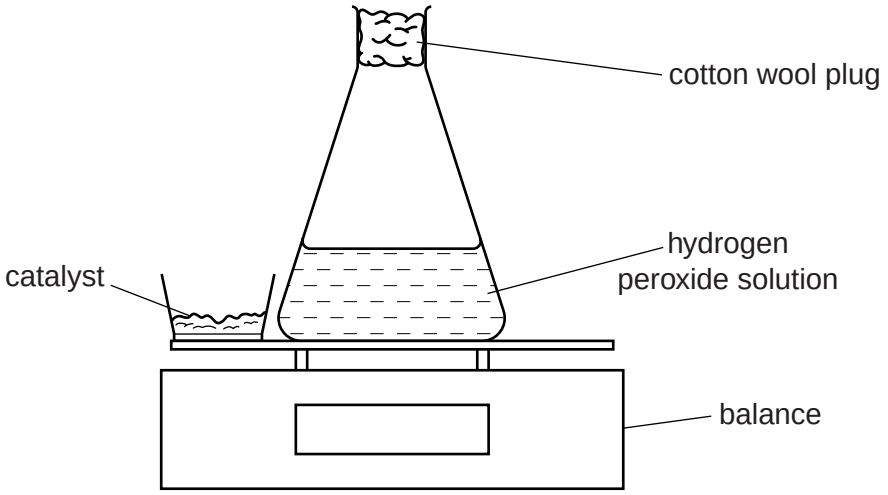
Question 11 begins on page 12.

11 Hydrogen peroxide decomposes slowly at room temperature to form water and oxygen.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

A student uses the apparatus shown below to investigate how the rate of decomposition changes when using two different catalysts, manganese(IV) oxide and copper(II) oxide.

The student does two experiments using the same volume and concentration of hydrogen peroxide solution but with the same mass of a different catalyst in each experiment.



The manganese(IV) oxide is added to the hydrogen peroxide solution and the mass of the flask and contents recorded every 30 seconds. This is **experiment 1**.

(a) Why does the mass of the flask and contents decrease during the reaction?

.....[1]

(b) Give two reasons for using the loosely fitting cotton wool plug.

reason 1 .....

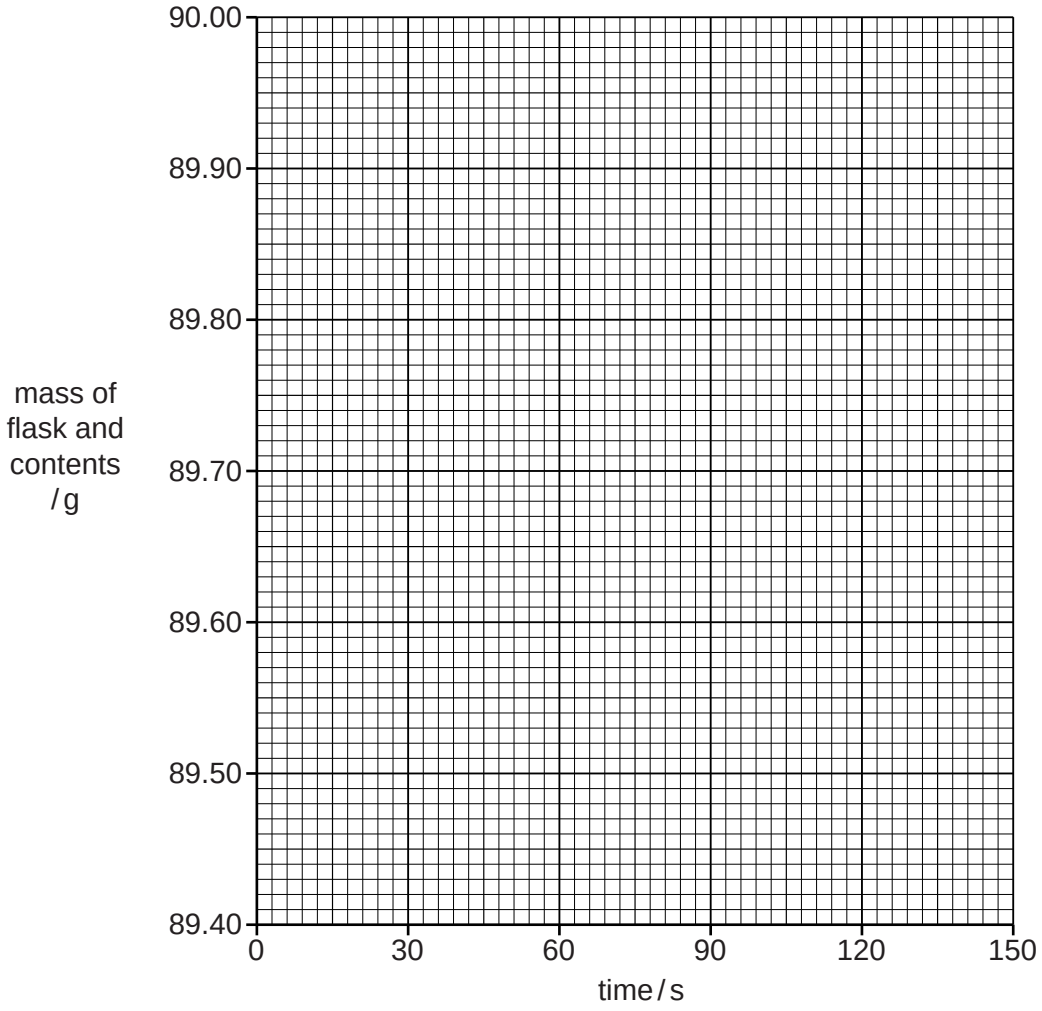
reason 2 .....[2]

The experiment is repeated using the catalyst copper(II) oxide instead of manganese(IV) oxide. All other experimental conditions are the same. This is **experiment 2**.

The results of the two experiments are recorded in the table below.

time / s	**experiment 1** mass of flask and contents / g	**experiment 2** mass of flask and contents / g
0	90.00	90.00
30	89.63	89.71
60	89.48	89.58
90	89.46	89.52
120	89.45	89.47
150	89.45	89.45

(c) Plot the results for both **experiment 1** and **experiment 2** on the grid below and draw a smooth curve through each set of points. Label the curves '**experiment 1**' and '**experiment 2**'.



[3]

(d) **Use your graphs** to answer the following questions.

(i) What is the total loss in mass in **experiment 1** after 45 seconds?

..... g [1]

(ii) How much greater is the loss in mass after 75 seconds in **experiment 1** than in **experiment 2**? Show your working.

..... g [2]

(iii) Which of the two catalysts is the more effective? **Use your graphs** to explain your answer.

.....[1]

(e) Why are the last two masses in the table the same in **experiment 1**?

.....[1]

(f) Predict what the mass of the flask and contents would have been if **experiment 2** had been carried out for another 30 seconds.

.....g [1]

[Total: 12]

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