Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8246073252

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2016**

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.

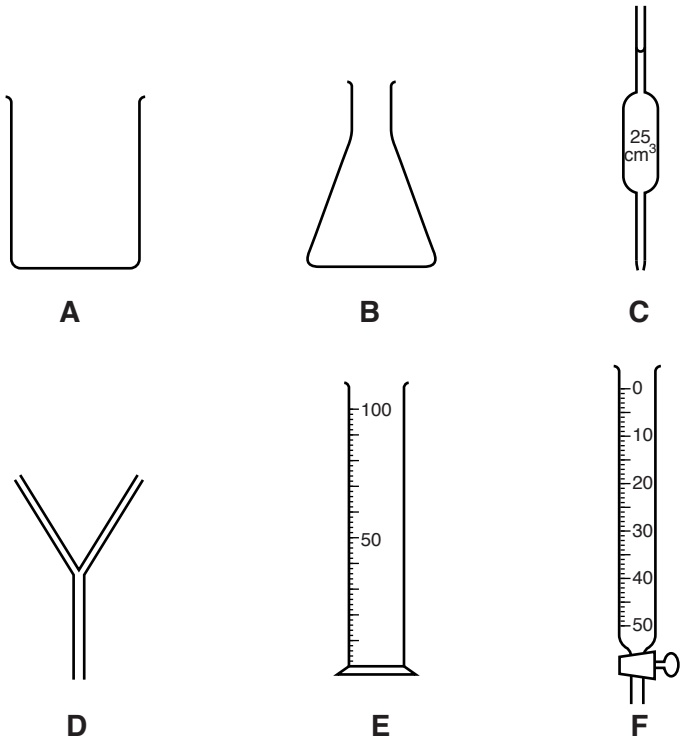
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

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 **16** printed pages.

CAMBRIDGE International Examinations

1 **(a)** The following apparatus is found in a laboratory.



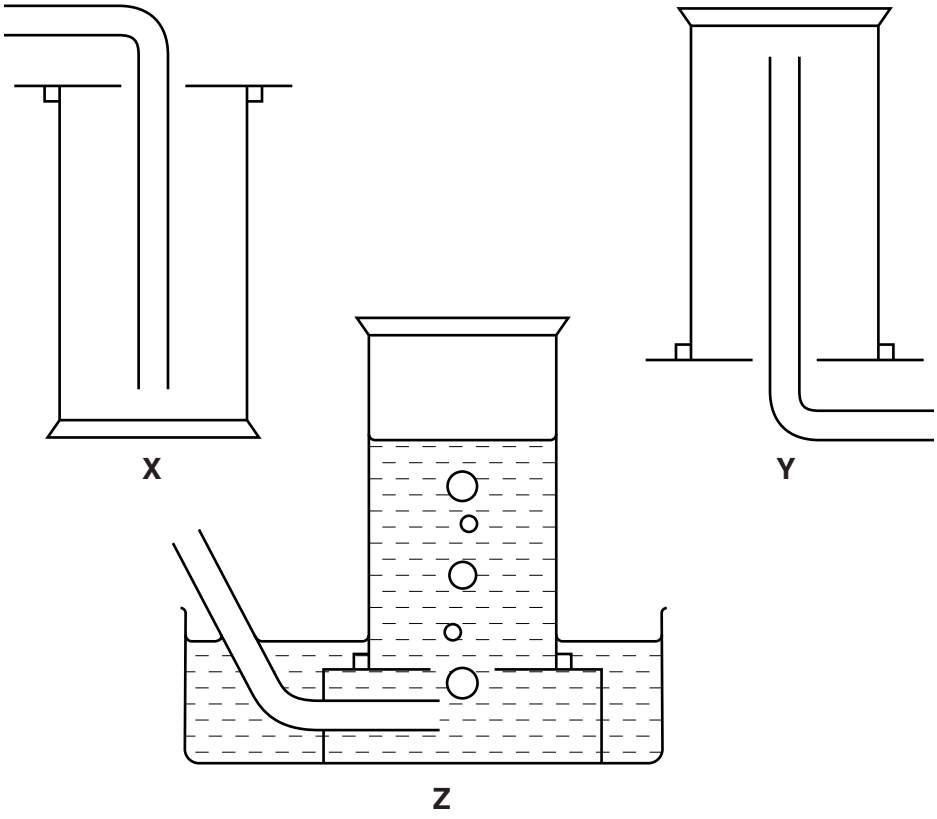
A B C D E F

Write in the table the letter of the apparatus most suitable for the purpose.

purpose	apparatus
removing 25.0 cm^3 of a liquid from a container	
measuring 60 cm^3 of a liquid	
as a titrating flask	
separating a precipitate from a solution	

[4]

(b) The diagrams show three methods for collecting gases.



Which method **X**, **Y** or **Z** is suitable for collecting a gas which is

(i) less dense than air and soluble in water,

..... [1]

(ii) more dense than air and soluble in water,

..... [1]

(iii) insoluble in water?

..... [1]

[Total: 7]

2 **(a)** **(i)** What colour is litmus paper when dipped in hydrochloric acid?

..... [1]

(ii) Suggest two ways by which the pH of dilute hydrochloric acid can be measured.

.....

.....

.....[2]

(iii) Suggest a value for the pH of dilute hydrochloric acid.

..... [1]

(b) A student adds an equal volume of aqueous sodium carbonate separately to dilute ethanoic acid and dilute hydrochloric acid.

(i) What does the student observe in both reactions?

.....[1]

(ii) Compare the rates of the two reactions and explain the difference.

.....

.....

.....

.....[2]

(c) **(i)** A small amount of magnesium ribbon is added to a test-tube containing dilute hydrochloric acid. A gas is produced.

Name the gas. Give a test and observation to identify the gas.

name .....

test and observation .....
[2]

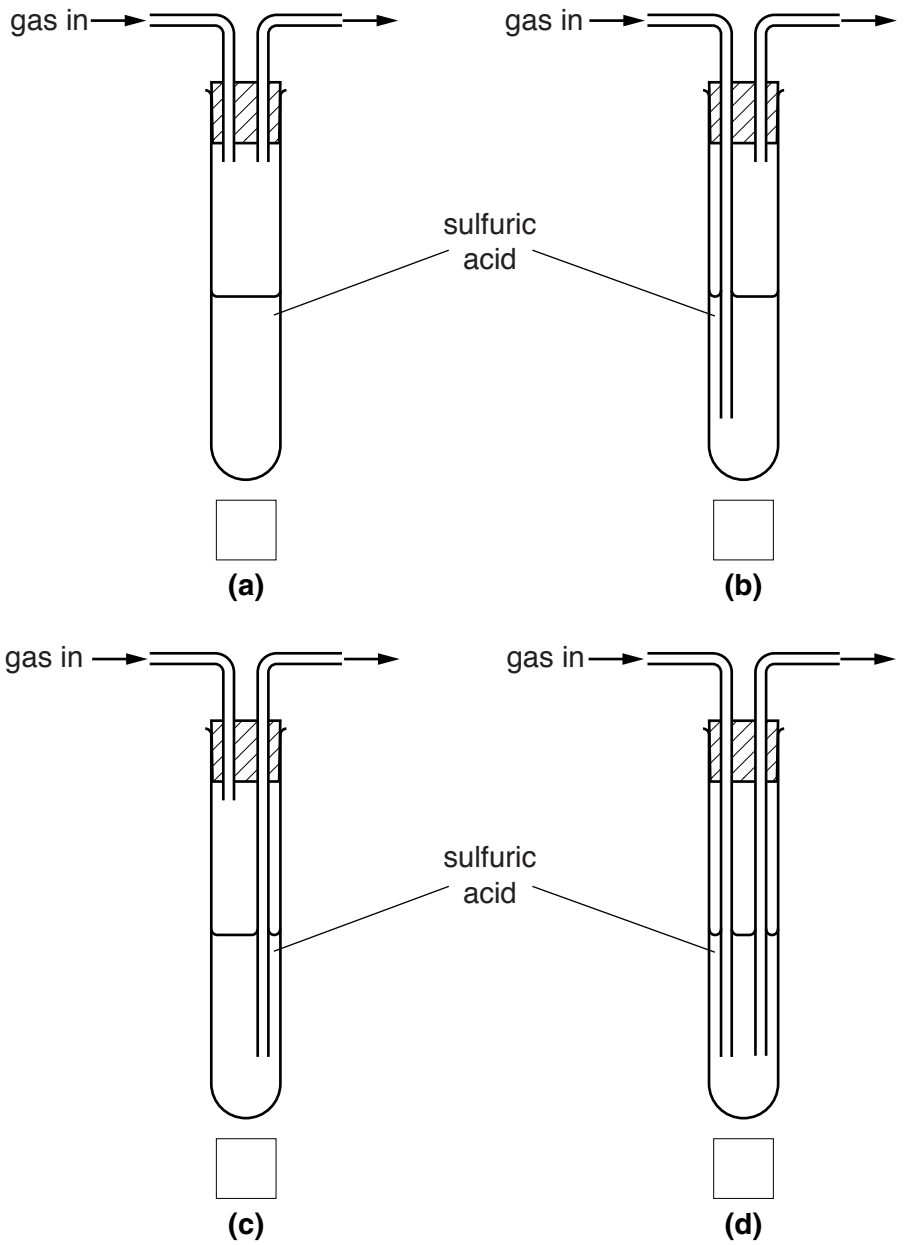
(ii) Construct the equation for the reaction.

.....[1]

[Total: 10]

In questions **3** to **6** inclusive, place a tick (✓) in the box against the correct answer.

3 A gas may be dried by passing it through concentrated sulfuric acid.
Which method should be used?



[Total: 1]

4 What volume of carbon dioxide gas, measured at room temperature and pressure, is produced when 9.2 g of ethanol is burned in an excess of oxygen?

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

[A_r: H, 1; C, 12; O, 16]
[1 mole of a gas occupies a volume of 24 000 cm^3 at room temperature and pressure.]

(a) 240 cm^3 ☐

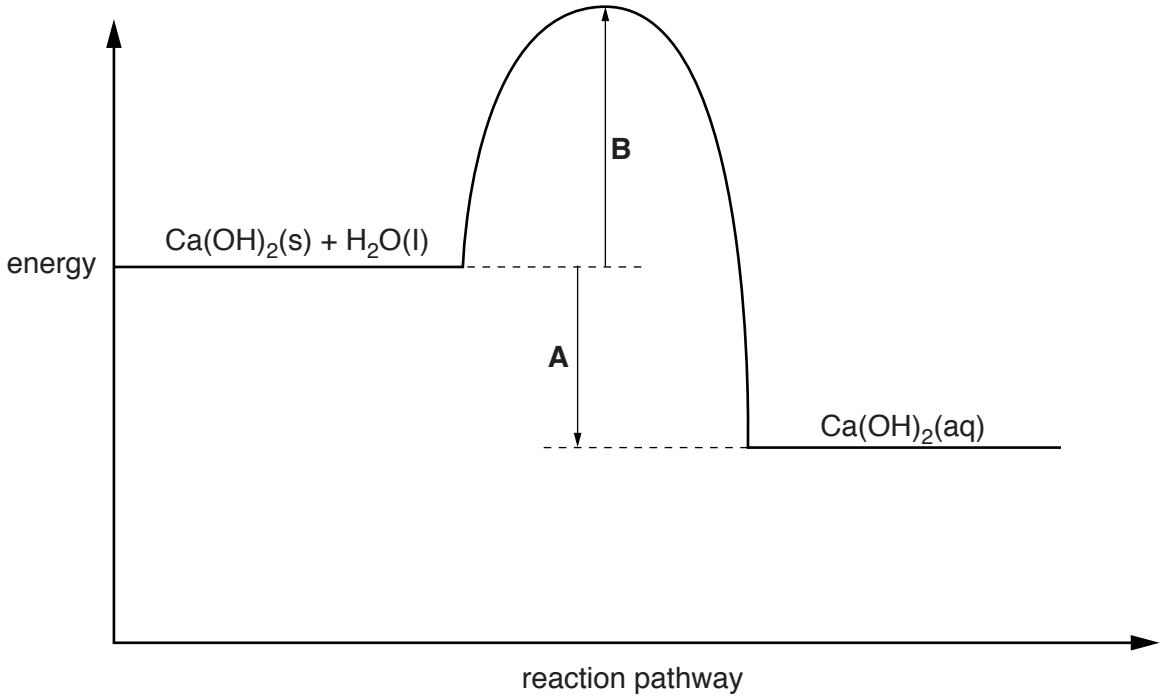
(b) 480 cm^3 ☐

(c) 960 cm^3 ☐

(d) 9 600 cm^3 ☐

[Total: 1]

5 The diagram shows the energy profile for calcium hydroxide dissolving in water.

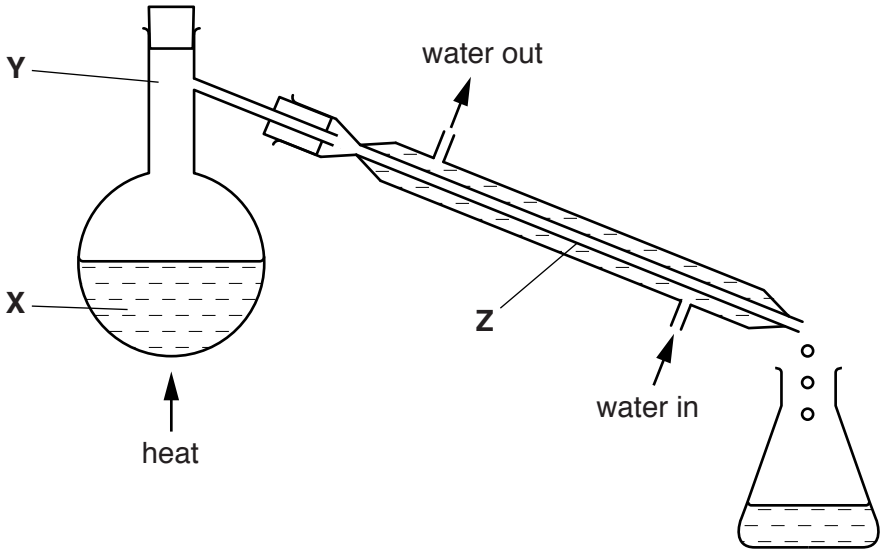


Which of the following is correct?

(a)	**A** is the activation energy.	**B** is the enthalpy change.	Reaction is exothermic.	☐
(b)	**A** is the enthalpy change.	**B** is the activation energy.	Reaction is exothermic.	☐
(c)	**A** is the activation energy.	**B** is the enthalpy change.	Reaction is endothermic.	☐
(d)	**A** is the enthalpy change.	**B** is the activation energy.	Reaction is endothermic.	☐

[Total: 1]

6 The diagram shows the apparatus used to distil seawater.



While water is being collected, at which point(s) is the temperature 100°C?

(a) **X** only ☐

(b) **Y** only ☐

(c) **X** and **Y** only ☐

(d) **Y** and **Z** only ☐

(e) **X** and **Y** and **Z** ☐

[Total: 1]

7 A student is given a sample of an organic acid, **V**, and asked to

- determine its relative molecular mass,
- suggest its molecular formula.

A sample of the acid is placed in a previously weighed container and reweighed.

mass of container + **V** = 8.38 g
mass of container = 6.92 g

(a) Calculate the mass of **V** used in the experiment.

..... g [1]

The student transfers the sample to a beaker and adds 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide, an excess. The contents are allowed to react and are then transferred to a volumetric flask.

The solution is made up to 250 cm^3 with distilled water. This is solution **W**.

25.0 cm^3 of **W** is transferred into a conical flask. A few drops of thymolphthalein indicator are added to the conical flask. Thymolphthalein is colourless in acidic solution and blue in alkaline solution.

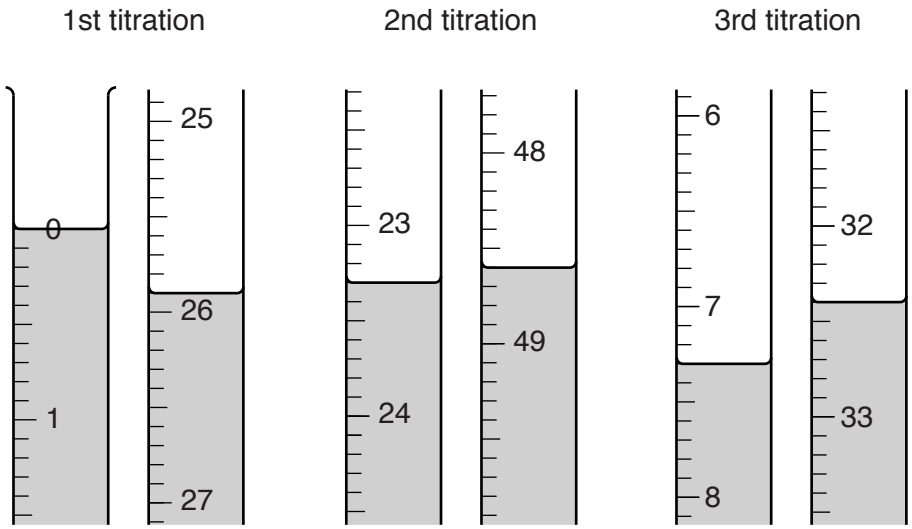
0.100 mol/dm^3 hydrochloric acid is put into a burette and added to the solution in the conical flask until an end-point is reached.

(b) What is the colour of the solution in the conical flask

- before the acid is added, ...
- at the end-point? .....

[1]

(c) The student does three titrations. The diagrams 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 used / 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 used is

..... cm^3. [4]

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

..... moles [1]

The equation for the reaction between hydrochloric acid and sodium hydroxide is shown.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

(e) Using the equation and your answer from **(d)**, deduce the number of moles of sodium hydroxide in 25.0 cm^3 of **W**.

..... moles [1]

(f) Using your answer from **(e)**, calculate the number of moles of sodium hydroxide in 250 cm^3 of **W**.

..... moles [1]

(g) Calculate the number of moles of sodium hydroxide in 50 cm^3 of 1.00 mol/dm^3 sodium hydroxide.

..... moles [1]

(h) By subtracting your answer in **(f)** from your answer in **(g)**, calculate the number of moles of sodium hydroxide that reacted with the original sample of the organic acid, **V**.

..... moles [1]

(i) **One** mole of **V** reacts with **two** moles of sodium hydroxide.
Deduce the number of moles of **V** in the sample.

..... moles [1]

(j) Using your answers from **(a)** and **(i)** calculate the relative molecular mass of the acid **V**.

.....[1]

(k) The acid **V** contains two carboxylic acid groups and has the molecular formula

$$HO_2CC_xH_yCO_2H$$

where **x** and **y** are whole numbers.

Deduce the values of **x** and **y** in the molecular formula.
[A_r: H, 1; C, 12; O, 16]

x .....

y .....
[2]

(l) Give the structure of the ester produced when **V** reacts with two molecules of ethanol under suitable conditions.

.....[1]

[Total: 16]

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

test	observations	conclusions	
(a) **L** is dissolved in water and the resulting solution is divided into three parts for tests **(b)**, **(c)** and **(d)**.		**L** is not a compound of a transition metal.	[1]
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen.		Al^{3+}, Zn^{2+} or Ca^{2+} ions present.	
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		Al^{3+} ions or Zn^{2+} ions present.	[2]
(c) **(i)** To the second part, aqueous ammonia is added until a change is seen.		Al^{3+} or Zn^{2+} ions present.	
(ii) An excess of aqueous ammonia is added to the mixture from **(i)**.		Al^{3+} ions present.	[2]
(d)		**L** contains I^- ions.	[3]

(e) Conclusion: the formula of **L** is ..... . [1]

(f) Referring to test **(c)(ii)**, what change in the observations is seen if Zn^{2+} ions are present instead of Al^{3+} ions?

.....[1]

[Total: 10]

Question 9 begins on page 14.

9 When potassium chlorate(V) is heated, it decomposes and oxygen is evolved.

Experiment 1

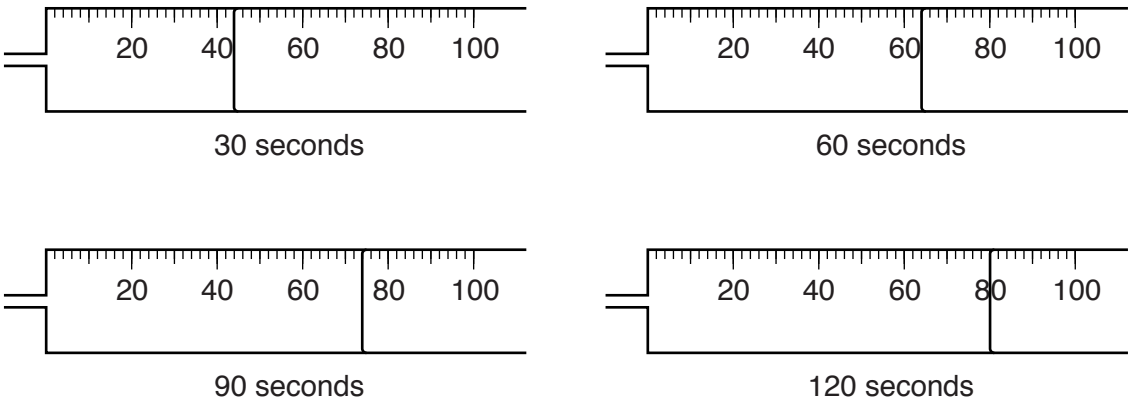
A student heats a sample of potassium chlorate(V) for 180 seconds. The volume of oxygen collected is measured in a gas syringe every 30 seconds.

Experiment 2

The student repeats the experiment using the same mass of potassium chlorate(V) to which a small amount of copper(II) oxide is added.

All other conditions are the same.

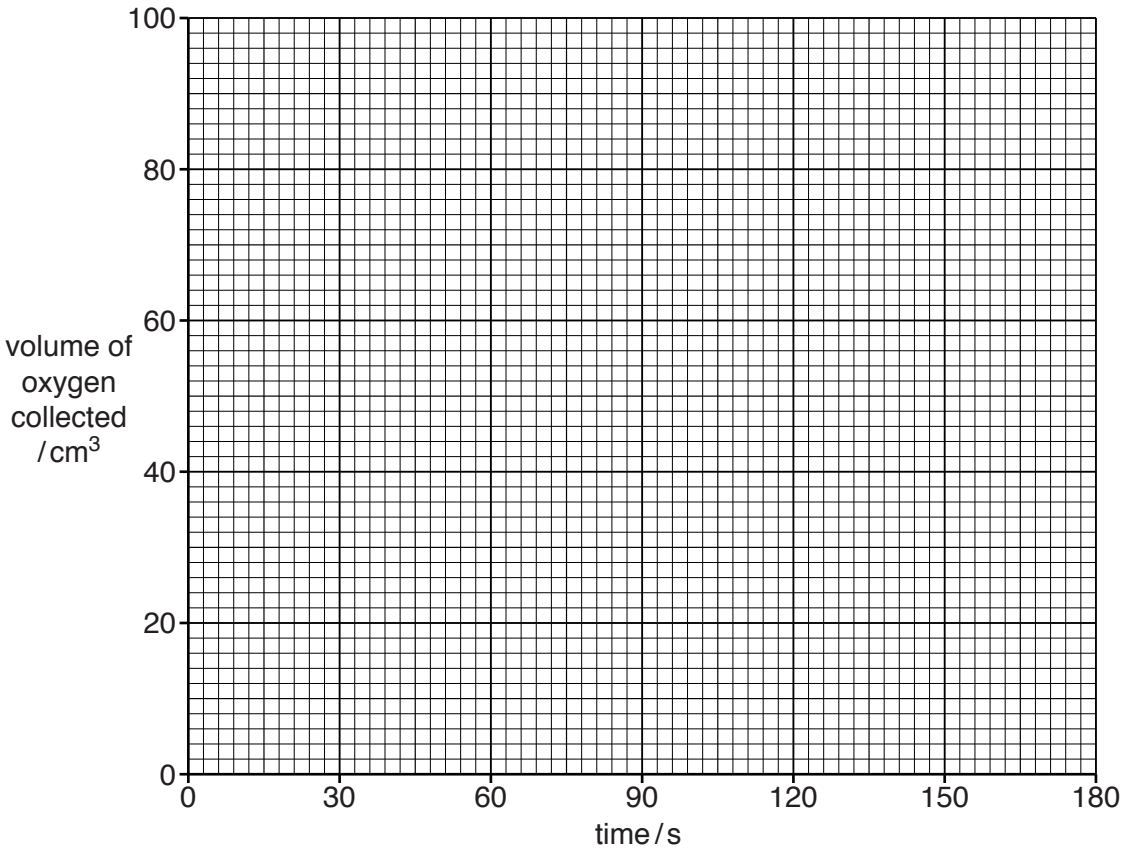
(a) Complete the table for **experiment 2** using the volumes of oxygen shown in the diagrams.



time/s	**experiment 1** volume of oxygen collected/cm^3	**experiment 2** volume of oxygen collected/cm^3
30	30	
60	50	
90	64	
120	74	
150	80	84
180	84	84

[1]

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



[3]

Use your graphs to answer the following questions.

(c) What volume of oxygen is produced in **experiment 2** after 75 seconds?

..... cm^3 [1]

(d) The rate of reaction = $\frac{\text{volume of gas in } cm^3}{\text{time in seconds}}$

Calculate the rate of reaction in each experiment after 45 seconds.

experiment 1

..... cm^3/s

experiment 2

..... cm^3/s
[2]

(e) Use your answers to **(d)** to suggest the function of copper(II) oxide in **experiment 2**. Explain your answer.

.....

.....

.....[2]

(f) Why are the final two readings recorded in the table for **experiment 2** the same?

.....[1]

(g) The equation for the reaction is shown.

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

By referring to the table in **(a)**, calculate the mass of potassium chlorate(V) used in the experiment.
Show your working.
[A_r: K, 39; C*l*, 35.5; O, 16]
[1 mole of a gas occupies a volume of 24 000 cm^3 at room temperature and pressure.]

..... g [3]

[Total: 13]