UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2011**

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.
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.

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

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[Turn over

1

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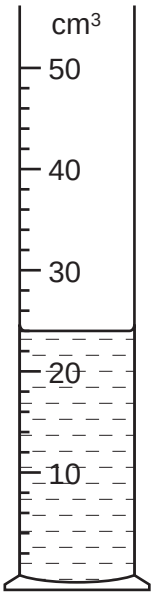

The apparatus shown above contains aqueous ethanoic acid.

(a) Name the apparatus.

..... [1]

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

..... cm^3 [1]

(c) What is observed when

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

..... [1]

(ii) aqueous ethanoic acid is added to a test-tube containing a few grams of solid calcium carbonate?

..... [1]

(d) Name and give the formula of the alcohol which, on oxidation, gives ethanoic acid.

name .....

formula ..... [1]

[Total: 5]

2 Calcium sulfate crystals have the formula $CaSO_4.\mathbf{x}H_2O$ where x is a whole number.

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(a) A student places some calcium sulfate crystals in a previously weighed crucible.

mass of crucible + crystals	=	11.20 g
mass of crucible	=	5.80 g

Calculate the mass of crystals used in the experiment.

..... g [1]

(b) The crucible is heated to remove all the water from the crystals.
The crucible and contents are allowed to cool and are then reweighed.

mass of crucible and contents after heating = 10.07 g

(i) Calculate the mass of calcium sulfate after heating.

..... g [1]

(ii) Calculate the mass of water removed by heating.

..... g [1]

(c) Calculate

(i) the formula mass, M_r, of $CaSO_4$,

(ii) the formula mass, M_r, of water H_2O.
[A_r: H,1; O,16; S, 32; Ca, 40]

$CaSO_4$ .....

H_2O ..... [1]

(d) In the formula $CaSO_4.\mathbf{x}H_2O$, **x** is a whole number.
Use the equation below to calculate the value of **x**.

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$$\mathbf{x} = \frac{\text{answer } \mathbf{(b)(ii)} \times M_r\ CaSO_4}{\text{answer } \mathbf{(b)(i)} \times M_r\ H_2O}$$

x = ... [1]

(e) What general name is given to compounds that have lost all their water of crystallisation?

..... [1]

[Total: 6]

3 The apparatus below is used to electrolyse water.

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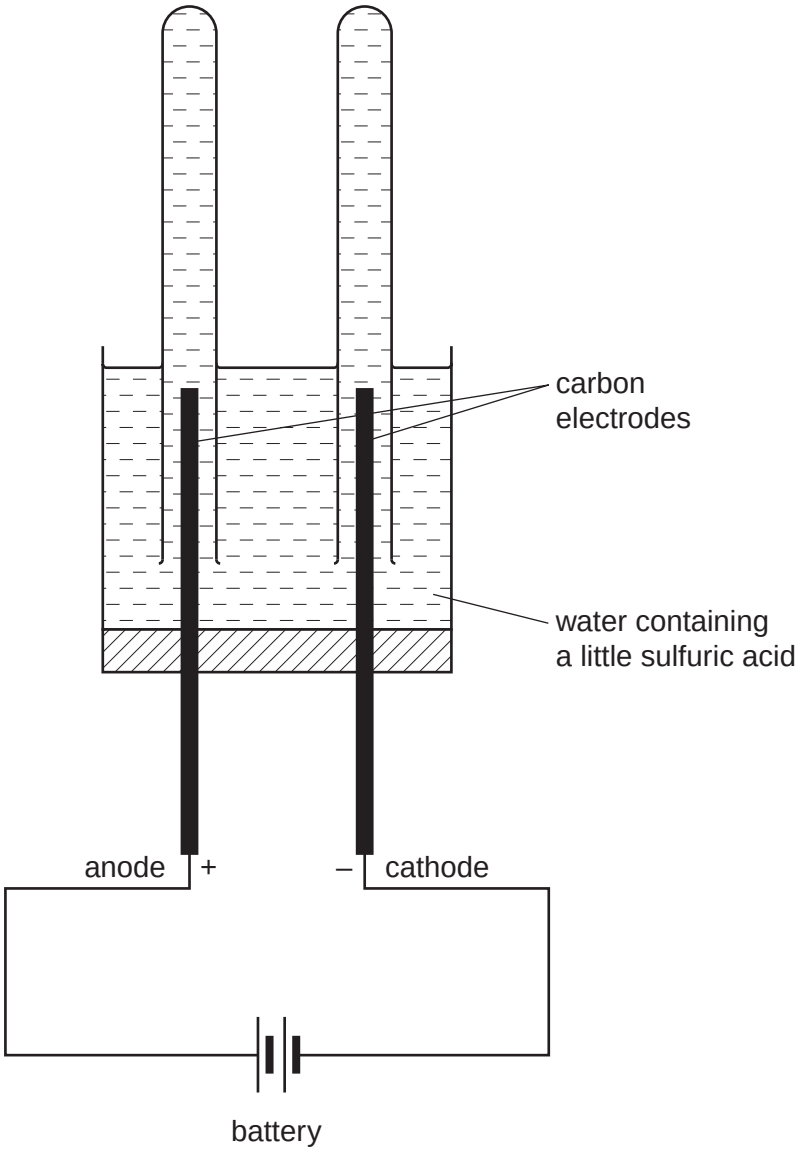

(a) Why is a small volume of sulfuric acid added to the water?

..... [1]

(b) **(i)** Name the gas collected at the anode**.**

gas ..... [1]

(ii) Give a test for this gas.

test .....

observation ..... [1]

(iii) Write the ionic equation for the reaction taking place at the anode.

..... [2]

(c) **(i)** Name the gas collected at the cathode.

gas ..... [1]

(ii) Give a test for this gas.

test .....

observation ..... [1]

(iii) Write the ionic equation for the reaction taking place at the cathode.

..... [1]

(d) When 20 cm^3 of gas has been collected at the anode, what volume of gas will have been collected at the cathode?

..... cm^3 [1]

[Total: 9]

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

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4 Which of the following is a property of hydrochloric acid?

(a) It turns litmus paper blue. ☐

(b) It reacts with any metal to give hydrogen. ☐

(c) It liberates ammonia from ammonium salts. ☐

(d) It reacts with any base to give a salt. ☐ [1]

[Total: 1]

5 A student adds a small piece of sodium to a beaker half-filled with water.
Which of the following is **not** correct?

(a) Sodium reacts vigorously on the surface of the water. ☐

(b) The temperature of the water increases during the reaction. ☐

(c) Oxygen is produced during the reaction. ☐

(d) The resulting solution is aqueous sodium hydroxide. ☐ [1]

[Total: 1]

6 Metal **R** displaces metal **S** from a solution of its ions. Metal **S** displaces metal **T** from a solution of its ions.

What could **R**, **S** and **T** be?

	R	**S**	**T**	
(a)	calcium	silver	zinc	☐
(b)	calcium	zinc	silver	☐
(c)	silver	calcium	zinc	☐
(d)	zinc	silver	calcium	☐

[1]

[Total: 1]

7 A student adds an excess of zinc to 50 cm^3 of 1.00 mol/dm^3 hydrochloric acid at 20 °C. Hydrogen is produced. The experiment is repeated at 30 °C and 40 °C. In each case the volume of hydrogen collected is plotted against time.

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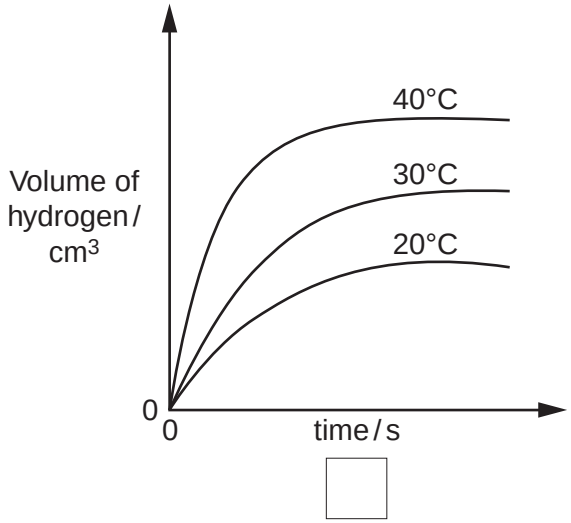
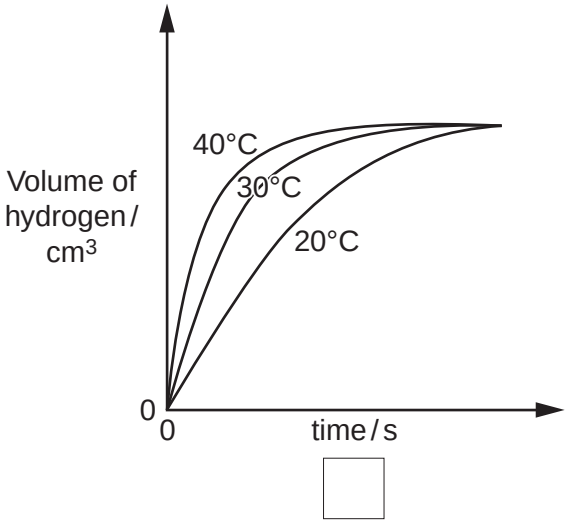
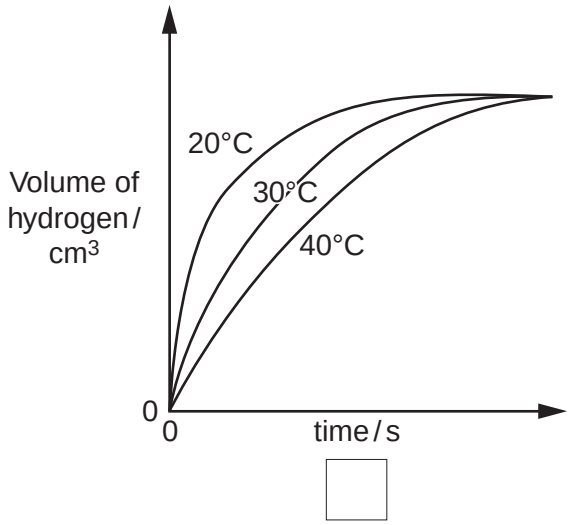
Which one of the following represents the volumes of hydrogen produced in the three experiments?



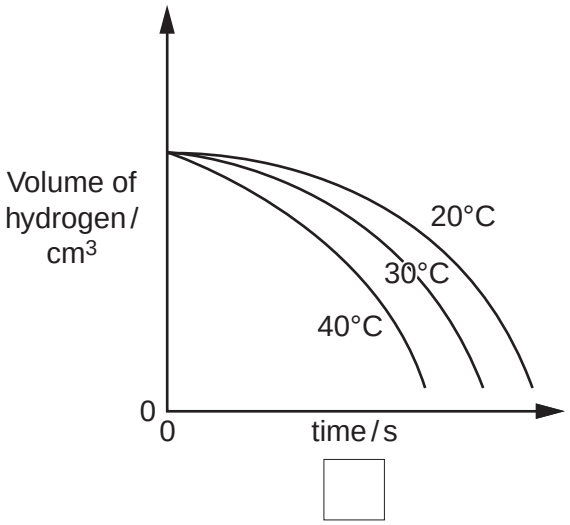
(a) ☐



(b) ☐



(c) ☐



(d) ☐

[Total: 1]

8 Which of the following is **not** a reaction of ethene?

(a) Ethene reacts with ethanoic acid to form an ester. ☐

(b) Ethene polymerises into a material which is used to make plastic bags. ☐

(c) Ethene burns to form carbon dioxide and water. ☐

(d) Ethene decolourises aqueous bromine. ☐

[Total: 1]

9 Substance **F** is a fertiliser containing ammonium sulfate.
A student determines the mass of ammonia produced from 1000 g of **F**.

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(a) A sample of **F** is added to a previously weighed container which is then reweighed.

mass of container + **F** = 9.22 g
mass of container = 7.46 g

Calculate the mass of **F** used in the experiment.

..... g [1]

The sample of **F** is placed in a beaker and 50 cm^3 of 1.00 mol/dm^3 sodium hydroxide, an excess, is added.

The mixture is heated until all the ammonia gas has evolved.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O + 2NH_3$$

After cooling, the remaining mixture, which contains excess sodium hydroxide, is transferred to a graduated flask and made up to 250 cm^3 with distilled water. This is solution **G**.

25.0 cm^3 of **G** is transferred to a conical flask and a few drops of phenolphthalein indicator are added.

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

0.100 mol/dm^3 hydrochloric acid is added to **G** until an end-point is reached.

Phenolphthalein is colourless in acid solution and pink in alkaline solution.

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

(i) before hydrochloric acid is added,

.....

(ii) at the end-point?

..... [1]

(c) Three titrations are done.
The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.

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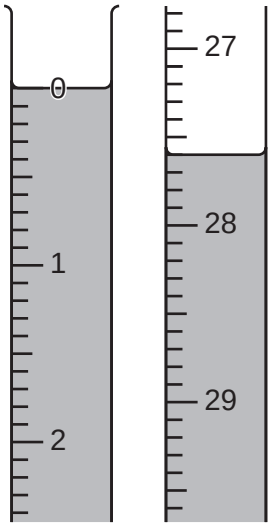
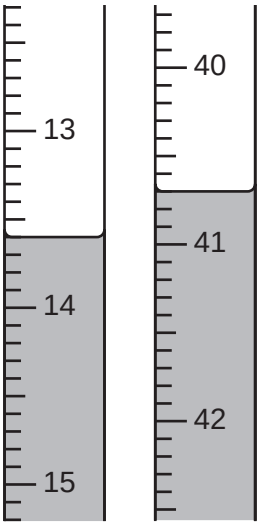
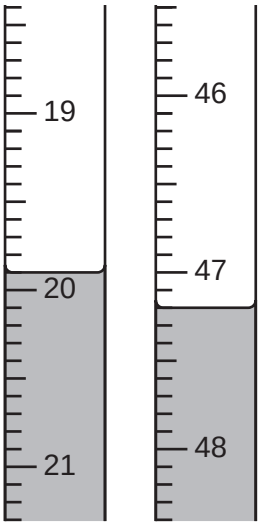
1st titration



2nd titration



3rd titration



Use the diagrams to complete the following table.

titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume of hydrochloric acid used / cm^3			
best titration results (✓)			

Summary:
Tick (✓) the best titration results.
Using these results, the average volume of 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 in **(c)**.

..... moles [1]

(e) Using the equation

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

deduce the number of moles of sodium hydroxide in 25.0 cm^3 of **G**.

..... moles [1]

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

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..... 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 which reacts with the sample **F**.

..... moles [1]

(i) Given that 1 mole of sodium hydroxide produces 17 g of ammonia.
Calculate

(i) the mass of ammonia produced from the original sample of **F**,

..... g NH_3 [1]

(ii) the mass of ammonia produced from 1000 g of **F**.

..... g NH_3 / 1000 g fertiliser **F** [1]

(j) Like ammonium sulfate, ammonium nitrate NH_4NO_3, is a 'nitrogenous fertiliser' which is used to promote plant growth and increase crop yield.

Which two compounds will react together to form aqueous ammonium nitrate?

..... and ..... [1]

[Turn over

(k) Calculate the mass of nitrogen in 1000 g of ammonium nitrate.
[A_r : H,1; N,14; O,16]

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..... g / 1000 g [1]

[Total: 15]

10 The following table shows the tests a student does on compound **Y** and the conclusions made from observations.

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Complete the table by stating the observations in tests **(a)**, **(b)(ii)** and **(c)(ii)**, the conclusions in tests **(b)** and **(c)** and both the test and observation in test **(d)**.

test	observation	conclusion
(a) **Y** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.		**Y** is a compound of a transition metal.
(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 **(b)(i)**.	A red-brown precipitate is formed.	
(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 **(c)(i)**.	A red-brown precipitate is formed.	
(d)		**Y** contains NO_3^- ions.

Conclusion: the formula for **Y** is .....

[Total: 8]

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

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Experiment 1

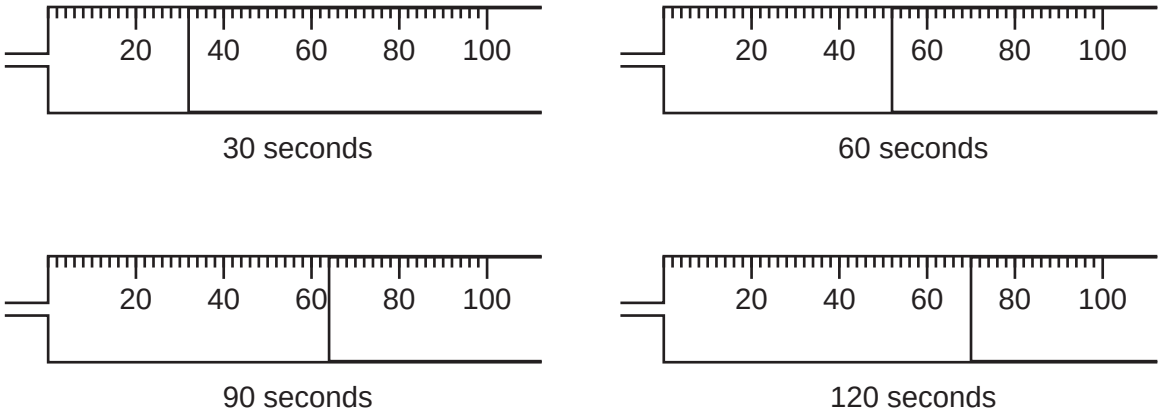
A student heats a sample of potassium chlorate(V) for three minutes. The volume of oxygen produced is measured in the syringe.

The results are shown in the table below.

Experiment 2

The experiment is repeated 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.

The diagram shows the volume of oxygen produced in this experiment after 30, 60, 90 and 120 seconds.



(a) Complete the table using the volumes of oxygen as shown in the diagrams.

time / s	volume of oxygen collected / cm^3 **experiment 1**	volume of oxygen collected / cm^3 **experiment 2**
30	22	
60	40	
90	54	
120	64	
150	70	72
180	72	72

[1]

(b) 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**'.

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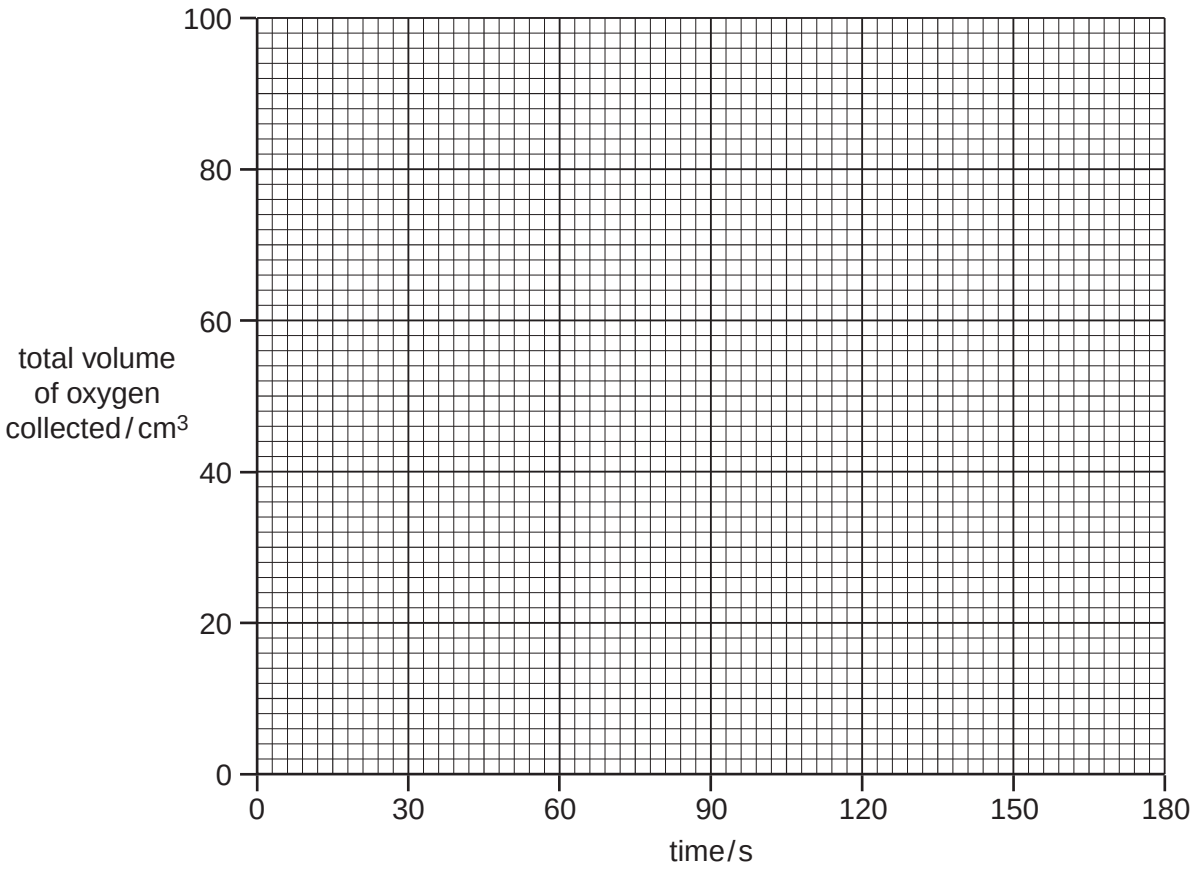

[3]

(c) Use your graphs to answer the following questions.

(i) What volume of oxygen is produced in **experiment 1** after 45 seconds?

..... cm^3 [1]

(ii) How much more oxygen is produced after 75 seconds in **experiment 2** than in **experiment 1**? Show your working.

..... cm^3 [2]

(d) Suggest the function of copper(II) oxide in the **experiment 2**.

..... [1]

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

..... [1]

(f) The equation for the reaction is

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

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

..... g [3]

[Total: 12]