Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1561931448

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **October/November 2017**

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.

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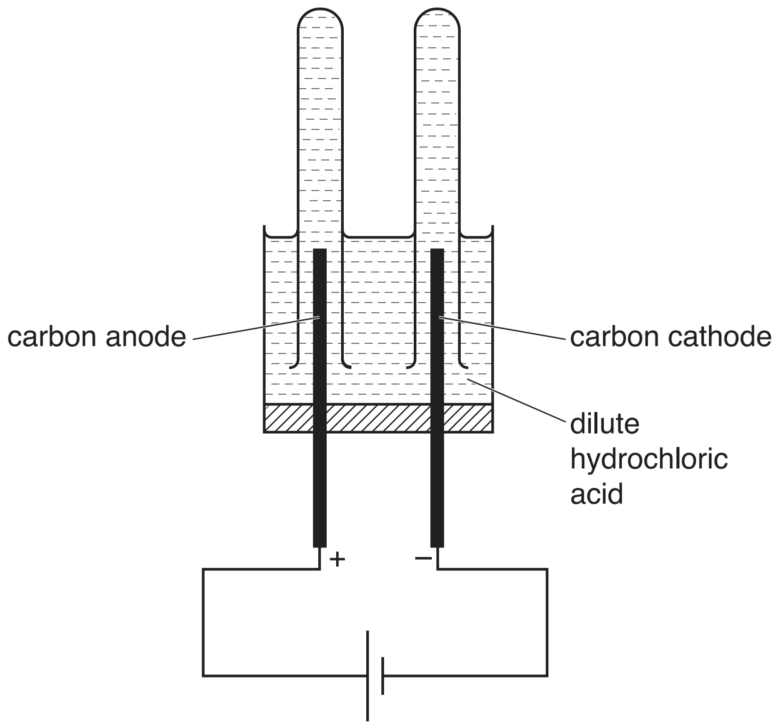
1 The apparatus shown is used to electrolyse dilute hydrochloric acid.



(a) Name the gas given off at the carbon anode. Give a test and observation to identify this gas.

name of gas ....

test and observation ....
[2]

(b) Name the gas given off at the carbon cathode. Give a test and observation to identify this gas.

name of gas ....

test and observation ....
[2]

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(c) The electrolyte, dilute hydrochloric acid, is replaced by another dilute acid. The gas given off at the carbon cathode is unchanged. At the carbon anode bubbles of another gas are seen.

(i) Suggest the name of the replacement electrolyte.

.... [1]

(ii) Name the gas given off at the carbon anode using the replacement electrolyte. Give a test and observation to identify this gas.

name ....

test ....

observation ....

[2]

[Total: 7]

2 Fullerenes are solid forms of carbon. Fullerenes are found in soot. Soot also contains other forms of carbon. Fullerenes are soluble in liquid hydrocarbons such as heptane. The other forms of carbon in soot are insoluble in heptane.

Describe how you could obtain a pure sample of solid fullerene from soot. You should explain what occurs at each stage of the process.

You are provided with all common laboratory apparatus.

....

....

....

....

....

.... [4]

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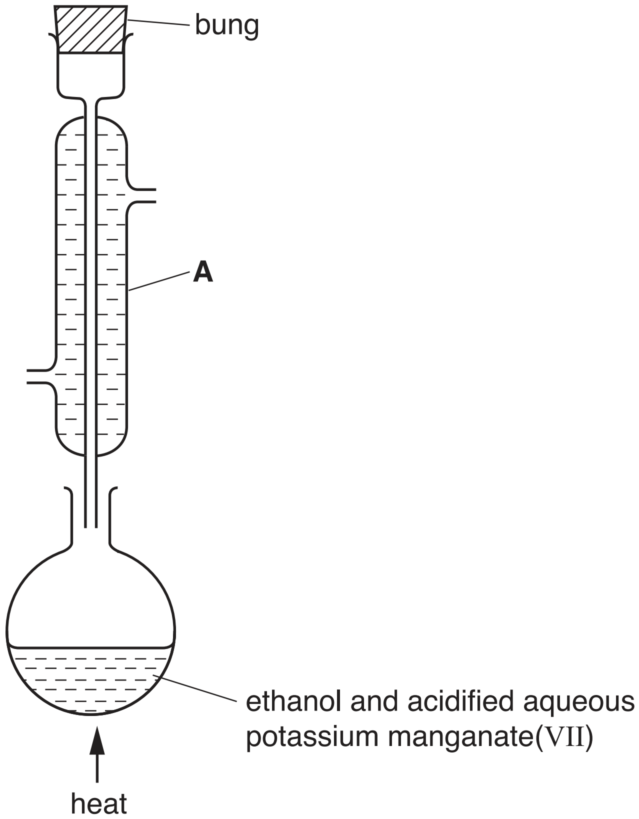
3 Ethanol can be oxidised to ethanoic acid using acidified aqueous potassium manganate(VII) in the apparatus shown. There are errors in the diagram.



(a) **(i)** Add labels to the diagram to show where water goes into and out of apparatus **A**. [1]

(ii) State two errors in the diagram.

1 ....

2 ....

[2]

(b) Heating with apparatus **A** in the vertical position is known as heating under reflux.

(i) Name apparatus **A**.

.... [1]

(ii) Why is apparatus **A** in the vertical position?

.... [1]

[Total: 5]

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4 A student is given an impure sample of magnesium carbonate, $MgCO_3$. The student determines the percentage of magnesium carbonate by mass in the sample.

(a) The student adds a sample of the impure magnesium carbonate to a previously weighed beaker.

mass of beaker + sample = 53.28 g

mass of beaker = 52.86 g

Calculate the mass of the sample used in the experiment.

.... g [1]

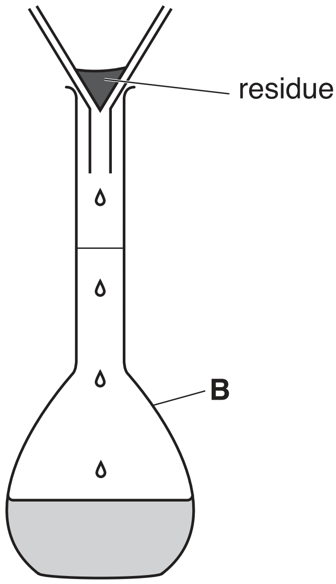
(b) 25.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid, HCl, (an excess) is added to the beaker using a pipette. The contents of the beaker are stirred.

Magnesium carbonate reacts with hydrochloric acid.

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$$

The impurities do not react with hydrochloric acid and remain undissolved.

After reaction, the mixture is filtered into apparatus **B**. The student washes the residue on the filter paper with distilled water, which also passes into apparatus **B**.



The student then makes up the solution to the 250 cm^3 mark with distilled water. This is solution **C**.

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(i) Name apparatus **B**.

.... [1]

(ii) Why does the student wash the residue with distilled water?

.... [1]

(c) The student transfers 25.0 cm^3 of **C** into a conical flask and adds three drops of methyl orange indicator.

A solution of 0.100 mol/dm^3 sodium hydroxide, NaOH, is put into a burette and run into the conical flask until the end-point is reached.

The sodium hydroxide reacts with the hydrochloric acid that remains after reaction with magnesium hydroxide. The equation for the reaction is shown.

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

What is the colour change of the methyl orange indicator at the end-point?

The colour changes from .... to .... [1]

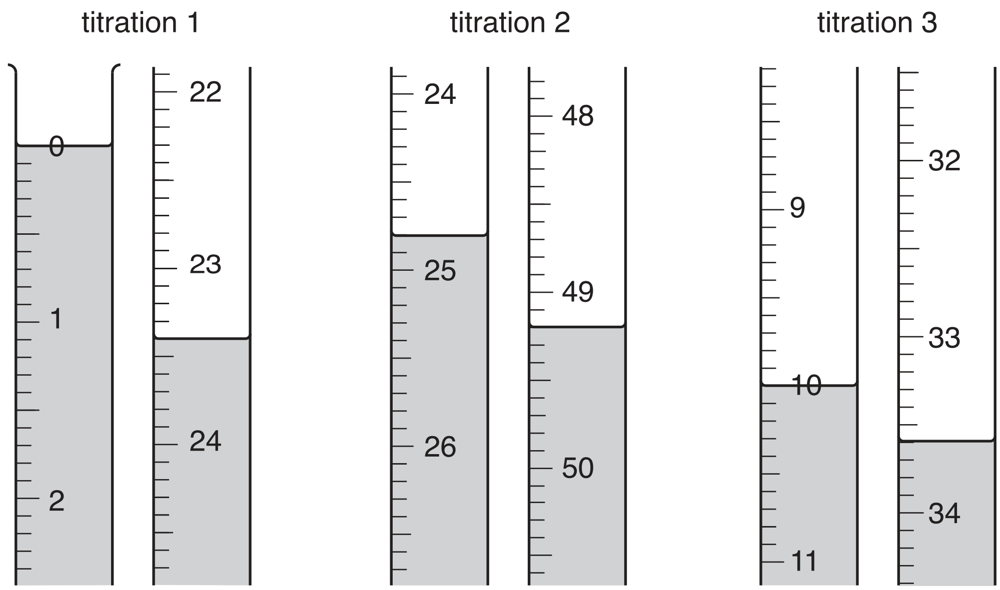
(d) The student does three titrations, using 25.0 cm^3 of **C** in each case.

(i) Give two reasons why the student does three titrations using 25.0 cm^3 of **C**, rather than carrying out one titration using 250 cm^3 of **C**.

1 ....

2 ....
[2]

(ii) The diagrams show parts of the burette with the liquid levels both at the beginning and at the end of each titration.



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Use the diagrams to complete the table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of 0.100 mol / dm^3 sodium hydroxide used / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these best titration results, the average volume of 0.100 mol / dm^3 sodium hydroxide used is

.... cm^3. [4]

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

.... moles [1]

(f) Using your answer to **(e)** and the equation

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

calculate the number of moles of hydrochloric acid in 25.0 cm^3 of **C**.

.... moles [1]

(g) Calculate the number of moles of hydrochloric acid in 250 cm^3 of **C**.

.... moles [1]

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(h) Calculate the number of moles of hydrochloric acid in 25.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid.

.... moles [1]

(i) Using your answers to both **(g)** and **(h)**, calculate the number of moles of hydrochloric acid that react with the magnesium carbonate in the sample.

.... moles [1]

(j) Using your answer to **(i)** and the equation

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$$

calculate the number of moles of magnesium carbonate in the sample.

.... moles [1]

(k) Calculate the mass of magnesium carbonate in the sample.

[A_r: Mg, 24; C, 12; O, 16]

.... g [1]

(l) Using your answers to **(a)** and **(k)**, calculate the percentage by mass of magnesium carbonate in the sample.

....% [1]

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(m) In the experiment the student uses a clean, dry flask for each titration.

Another student carries out the same experiment. This student uses one conical flask only. Between titrations, she washes the flask with water and does not dry it.

State whether the average titration volume of aqueous sodium hydroxide would be smaller, larger or unchanged, if the conical flask is washed with water and not dried between titrations. Explain your answer.

....

....

.... [2]

[Total: 20]

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5 The following table shows the tests a student does on compound **L**. 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	observation	conclusion	
(a) **L** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A coloured solution is formed.		[1]
(b) **(i)** To the first part, aqueous ammonia is added until a change is seen. **(ii)** An excess of aqueous ammonia is added to the mixture from **(i)**.		**L** may contain Cr^{3+} or Fe^{2+} ions. **L** contains Cr^{3+} or Fe^{2+} ions.	[2]
(c) **(i)** To the second 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)**.		**L** may contain Cr^{3+} or Fe^{2+} ions. **L** contains Cr^{3+} ions.	[3]
(d)		**L** contains Cl^{-} ions.	[3]

[Total: 9]

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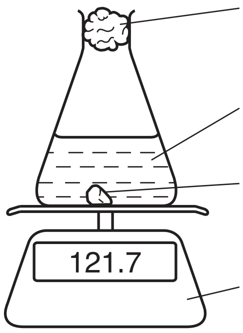
6 Aqueous hydrogen peroxide decomposes at room temperature in the presence of a catalyst to form water and oxygen.

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

A student investigates the rate of decomposition of hydrogen peroxide by carrying out the reaction as shown in the diagram and making the necessary measurements.



(a) Aqueous hydrogen peroxide is an irritant to eyes and skin.

Suggest two safety precautions that the student should take to minimise the risk from using aqueous hydrogen peroxide.

1 ....

2 ....
[2]

(b) Give one reason for using the loosely fitting cotton wool plug.

.... [1]

(c) Which two measurements should the student make in order to follow the rate of reaction in this experiment?

1 ....

2 ....
[2]

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(d) Another student carries out an investigation of the decomposition of hydrogen peroxide using a different method. The results are shown in the table.

time / s	total volume of oxygen / cm^3
0	0
20	19
40	30
60	38
80	44
100	48
120	50
140	50

(i) Draw a diagram of the apparatus that the student uses to achieve the results in the table. Label the apparatus that is used to collect and measure the volume of oxygen gas.

[3]

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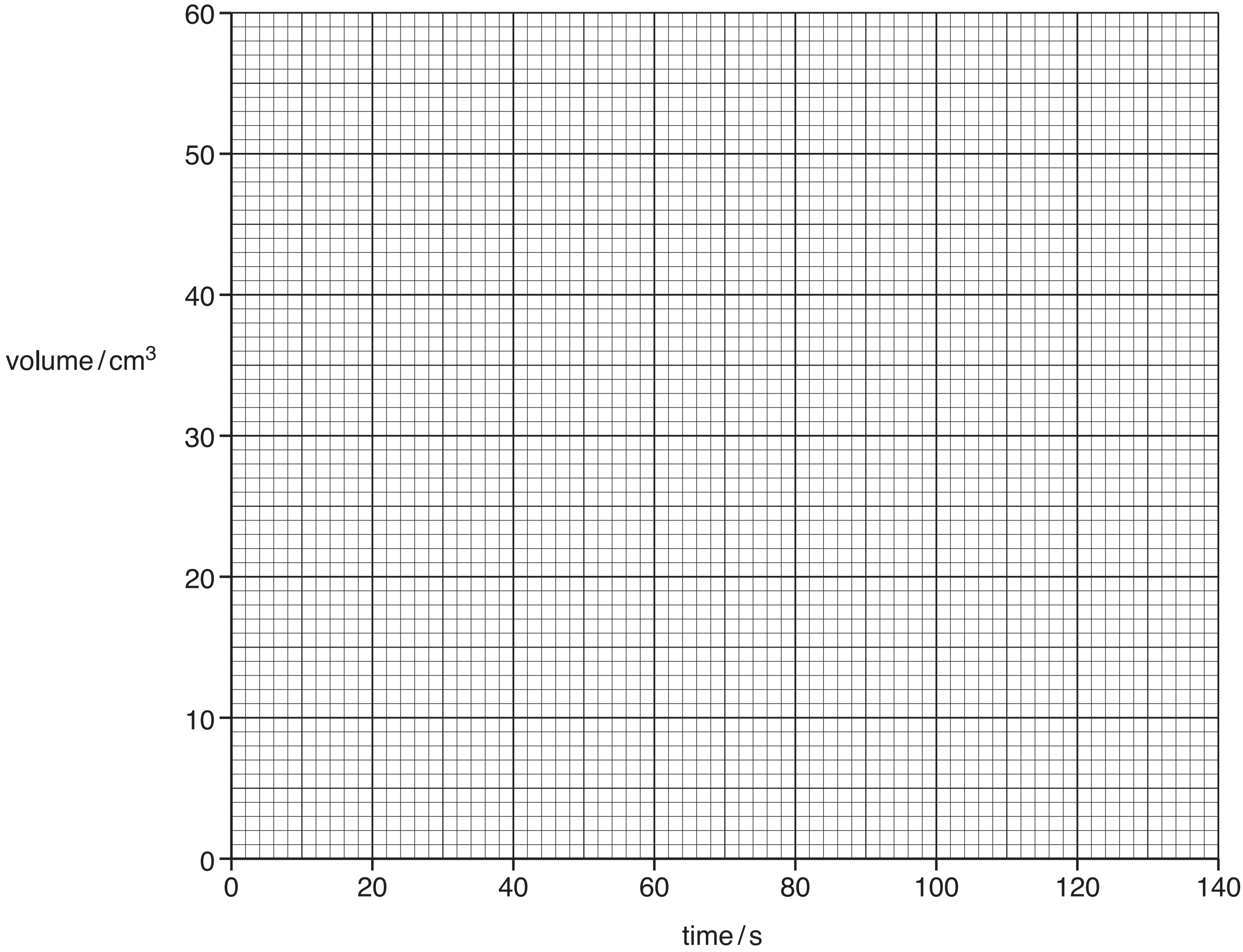
(ii) Plot a graph on the grid using the results in the table. Draw a smooth curve through the points.



[2]

(e) **(i)** Use the **graph** to determine the volume of oxygen produced

in the first 50 seconds, ... cm^3

in the second 50 seconds. .... cm^3 [2]

(ii) Use your answers to **(e)(i)** to determine the average volume of oxygen given off in each second during

the first 50 seconds, ... cm^3/s

the second 50 seconds. .... cm^3/s [2]

(iii) Use your knowledge of rates of reaction to explain why there is a difference in the two answers to **(e)(ii)**.

....

.... [1]

[Total: 15]

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