Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

0134775130

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **October/November 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.

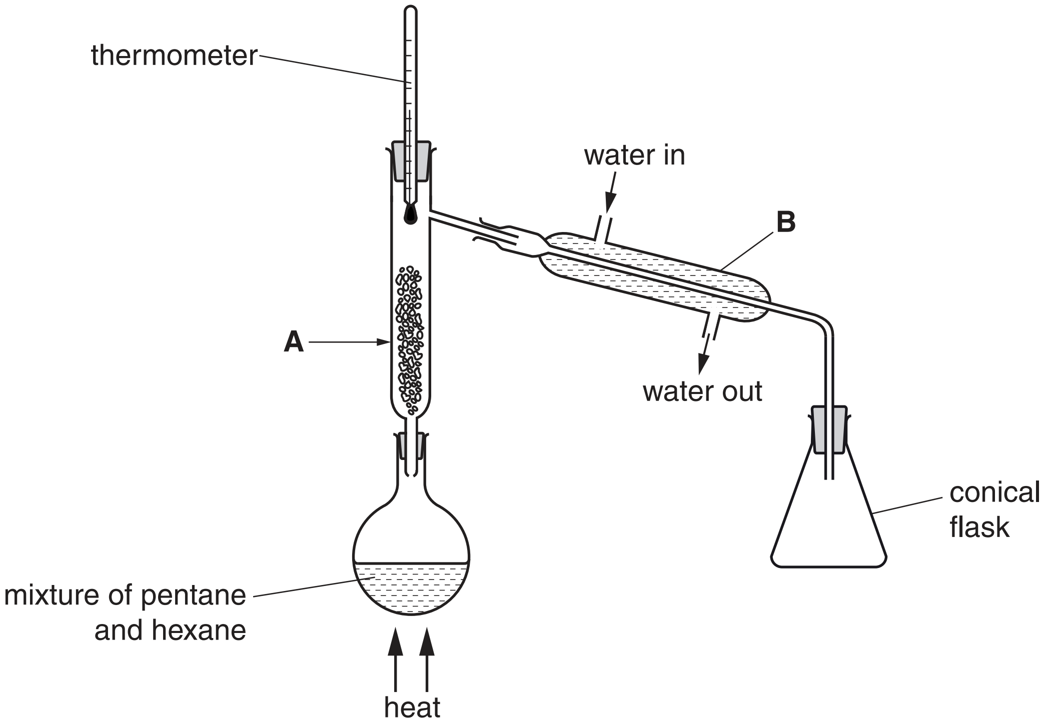
This document consists of **14** printed pages and **2** blank pages.

DC (NF/FD) 107611/4

CAMBRIDGE International Examinations

[Turn over

1 A student separates a mixture of pentane and hexane using the apparatus shown. Pentane collects in the conical flask.



(a) **(i)** Name apparatus **A**.

.... [1]

(ii) What is the purpose of apparatus **A**?

.... [1]

(iii) Name apparatus **B**.

.... [1]

(b) Identify **two** errors in the student's apparatus.

1. ....

2. ....
[2]

The errors are corrected before the separation is started.

(c) Name the process used to separate the mixture of liquids.

.... [1]

(d) **(i)** State why a Bunsen burner should not be used to heat the mixture of pentane and hexane.

.... [1]

(ii) What should be used instead of a Bunsen burner?

.... [1]

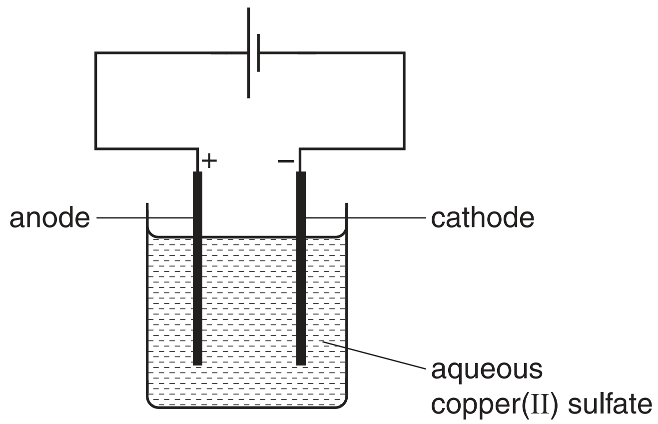
(e) Suggest why pentane collects in the conical flask before hexane.

....

.... [2]

[Total: 10]

2 A student investigates the electrolysis of aqueous copper(II) sulfate using the apparatus shown.



A solid is produced at the cathode. A gas is produced at the anode.

(a) From what material is the anode made?

.... [1]

(b) Describe the appearance of the solid produced at the cathode.

.... [1]

(c) Name the gas produced at the anode. Give a test and observation to identify this gas.

name of gas ....

test and observation ....
[2]

[Total: 4]

In questions **3** to **5** inclusive, place a tick (✓) in the box against the correct answer.

3 A student finds that a compound contains 4.8 g of carbon, 0.8 g of hydrogen and 6.4 g of oxygen.

[A_r: C, 12; H, 1; O, 16]

What is the empirical formula of the compound?

(a) CH_2O ☐

(b) C_2H_2O ☐

(c) C_2HO_2 ☐

(d) $C_4H_8O_4$ ☐

[Total: 1]

4 Aqueous solutions of which of the following pairs of compounds will **not** react together to form a precipitate?

(a) silver nitrate and ammonium iodide ☐

(b) silver nitrate and barium chloride ☐

(c) sodium hydroxide and copper(II) sulfate ☐

(d) sodium hydroxide and ammonium chloride ☐

[Total: 1]

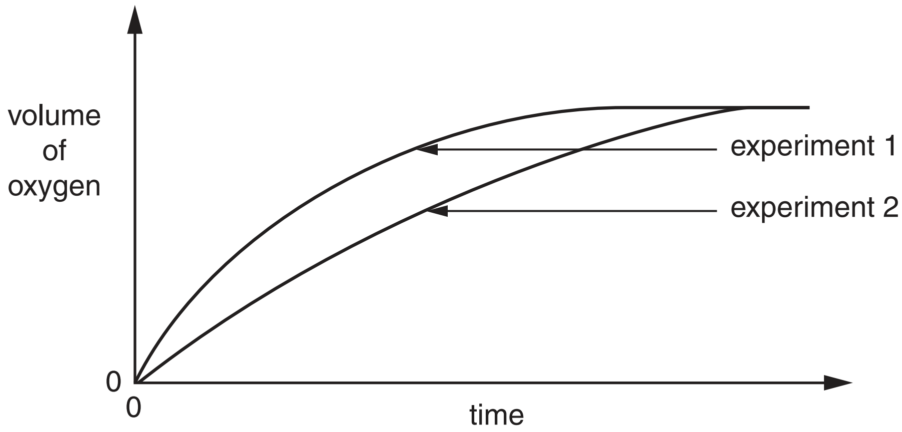
5 A student adds the catalyst manganese(IV) oxide to aqueous hydrogen peroxide. The hydrogen peroxide decomposes.

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

The student measures the volume of oxygen given off at regular time intervals. This is experiment 1.

The student repeats the experiment using **one** different condition. This is experiment 2.

Graphs for both experiments 1 and 2 are shown.



What is the different condition used in experiment 2?

(a) A greater mass of the manganese(IV) oxide was added. ☐

(b) A lower temperature was used. ☐

(c) A greater volume of aqueous hydrogen peroxide was used. ☐

(d) A higher concentration of aqueous hydrogen peroxide was used. ☐

[Total: 1]

6 Copper(II) oxide and carbon are both black solids. Copper(II) oxide reacts with dilute sulfuric acid forming aqueous copper(II) sulfate. Carbon does not react with dilute sulfuric acid.

Describe how you would obtain a pure, dry sample of carbon from a mixture of powdered copper(II) oxide and powdered carbon.

You are provided with

- all the apparatus normally found in a laboratory,
- the mixture of powdered copper(II) oxide and powdered carbon,
- dilute sulfuric acid,
- distilled water.

No other chemicals are available.

You should give experimental details and the observations occurring at each stage of the procedure.

....

....

....

....

....

....

[Total: 5]

7 Limestone is impure calcium carbonate. A student does an experiment to determine the percentage by mass of calcium carbonate in a sample of limestone. The sample of limestone is placed in a previously weighed container and reweighed.

mass of container + limestone	=	10.22 g
mass of empty container	=	5.72 g

(a) Calculate the mass of limestone used in the experiment.

.... g [1]

The student transfers the sample of limestone into a beaker and adds 50.0 cm^3 of 2.00 mol / dm^3 hydrochloric acid, an excess. The calcium carbonate reacts with the hydrochloric acid.

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

The student transfers the contents of the beaker into another container and the volume is made up to 250 cm^3 with distilled water. This is solution **T**.

(b) Name the container in which solution **T** should be made.

.... [1]

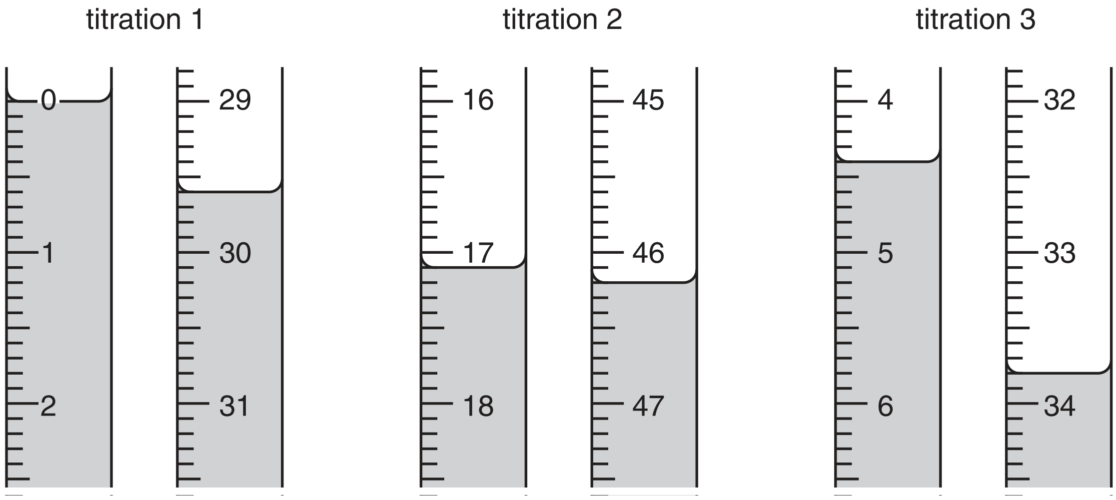
25.0 cm^3 of **T** is transferred to a conical flask and a few drops of methyl orange indicator are added.

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

(c) What is the colour change of the methyl orange at the end-point?

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

(d) Three titrations are done. 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 results 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 / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of 0.100 mol / dm^3 sodium hydroxide 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)**.

.... moles [1]

(f) Using the equation

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

and your answer to **(e)**, deduce the number of moles of hydrochloric acid in 25.0 cm^3 of **T**.

.... moles [1]

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

.... moles [1]

(h) Calculate the number of moles of hydrochloric acid in the original 50.0 cm^3 of 2.00 mol/dm^3 hydrochloric acid.

.... moles [1]

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

.... moles [1]

(j) Using the equation

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

and your answer to **(i)**, calculate the number of moles of calcium carbonate that reacted with the hydrochloric acid.

.... moles [1]

(k) Calculate the relative formula mass of calcium carbonate.

[A_r: Ca, 40; C, 12; O, 16]

.... [1]

(l) Using your answers to **(j)** and **(k)**, calculate the mass of calcium carbonate in the sample of limestone.

.... g [1]

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

....% [1]

[Total: 16]

8 The table shows the tests a student does on compound **L**.

L contains three different ions.

Complete the table by adding the conclusion for **(a)**, the observations for **(b) (i)**, **(ii)** and **(iii)**, the conclusions for **(c)(i)** and **(ii)** and both the test and observation which lead to the conclusion for test **(d)**. Any gases produced should be identified by test, result and name.

test	observations	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 sodium hydroxide is added until a change is seen.		**L** contains Fe^{2+} ions.	
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		**L** contains Fe^{2+} ions.	
(iii) This mixture is then heated.		**L** contains NH_4^+ ions.	[4]
(c) **(i)** To the second part, aqueous ammonia is added until a change is seen.	A green precipitate forms.		
(ii) An excess of aqueous ammonia is added to the mixture from **(i)**.	The precipitate is insoluble in excess.		[1]
(d)		**L** contains SO_4^{2-} ions.	[3]

(e) The green precipitate that forms in test **(c)** turns brown at the surface after a few minutes. Suggest why.

....

.... [2]

[Total: 11]

9 When magnesium powder is added to an excess of hydrochloric acid, the temperature rises.

(a) (i) What type of reaction does the temperature rise indicate?

.... [1]

(ii) In addition to the temperature rise, give **two** observations that can be made as the reaction takes place.

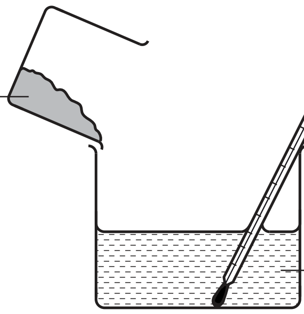
....

.... [2]

(iii) Construct an equation for the reaction between magnesium powder and hydrochloric acid.

.... [1]

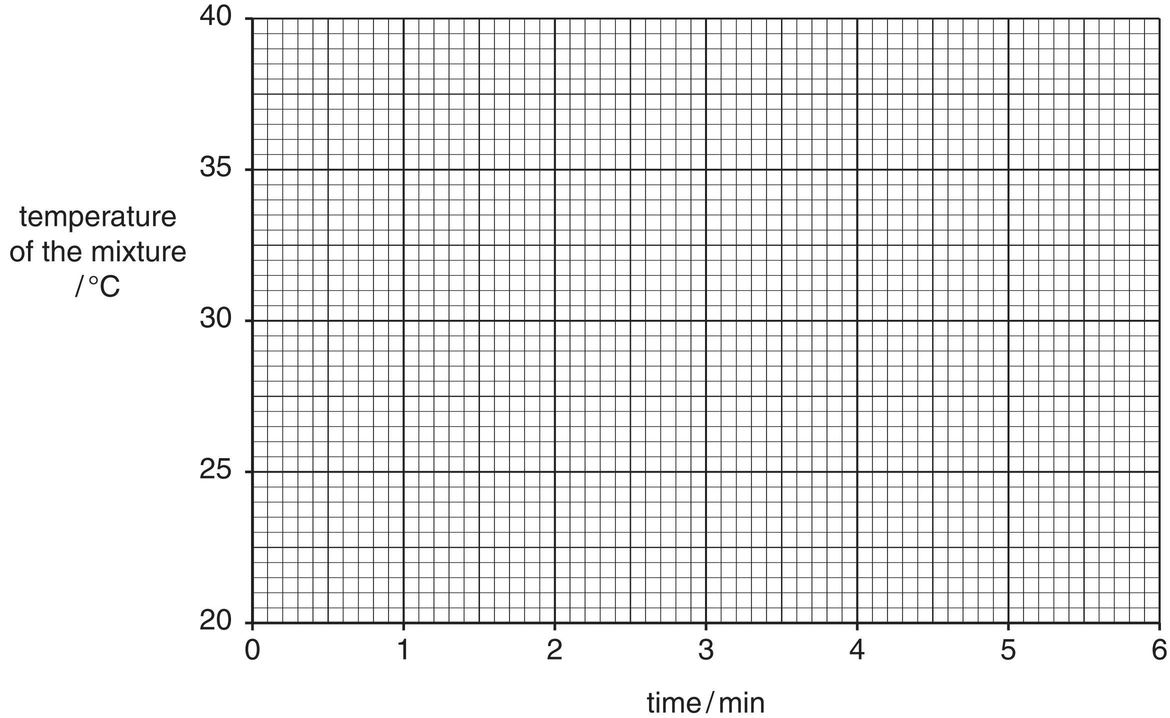
(b) A student does an experiment to determine the amount of heat produced in the reaction. The student transfers $50.0\,cm^3$ of $2.0\,mol/dm^3$ hydrochloric acid to a beaker. The temperature of the solution is 20.0 °C. When 0.20 g of magnesium powder is added to the hydrochloric acid the temperature rises rapidly.



The student records the temperature of the mixture at one minute intervals.

time/min	temperature of the mixture/°C
1.0	37.4
2.0	35.2
3.0	33.1
4.0	31.1
5.0	29.0
6.0	26.9

Plot the results on the grid. Draw a straight line through the points. Extend the line until it intersects the *y*-axis.



[3]

(c) **(i)** Use your graph to determine the temperature at 0 minutes. This gives the maximum temperature of the mixture reached in the reaction.

.... °C [1]

(ii) The initial temperature of the hydrochloric acid was 20.0 °C. Use your answer to **(c)(i)** to calculate the maximum temperature rise.

.... °C [1]

(d) 4.2 joules (J) of heat energy are required to raise the temperature of 1.0 cm^3 of hydrochloric acid by 1 °C.

(i) Calculate the amount of heat energy in joules (J) required to raise the temperature of 50.0 cm^3 of hydrochloric acid by 1 °C.

.... J [1]

(ii) Calculate the amount of heat energy in joules (J) required to raise the temperature of 50.0 cm^3 of hydrochloric acid by the maximum temperature rise calculated in **(c)(ii)**.

.... J [1]

[Total: 11]

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