Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

3949648719

CHEMISTRY **5070/42**

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.

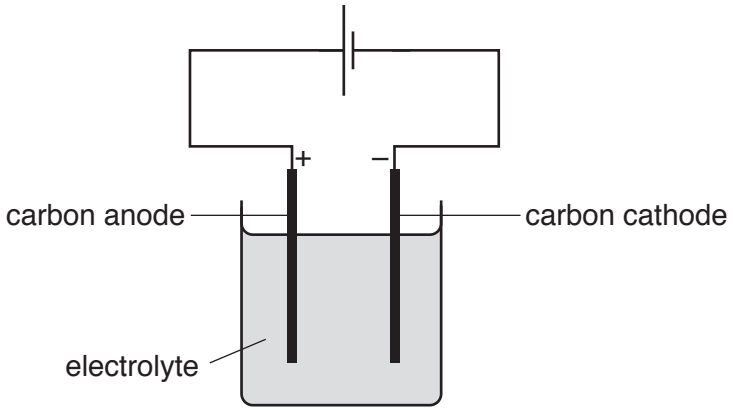
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

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1 A student carries out experiments using two different electrolytes in the apparatus shown.



(a) Complete the table.

electrolyte	name of product at the anode	observations at the anode	name of product at the cathode	observations at the cathode
concentrated aqueous sodium chloride				bubbles of colourless gas
	oxygen		copper	

[6]

(b) Give a test and observation to identify oxygen gas.

..... [1]

[Total: 7]

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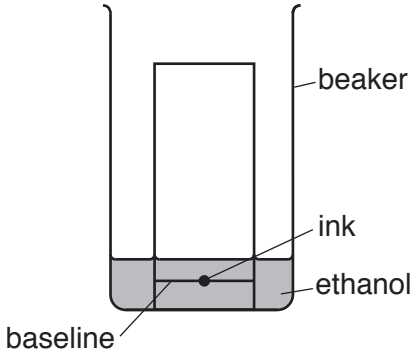
2 **(a)** Ethanol is a reducing agent. It can be oxidised by heating ethanol with acidified aqueous potassium manganate(VII).

State the colour change of the potassium manganate(VII) during the experiment.

from ..... to ..... [1]

(b) Ethanol evaporates easily at room temperature. It can be used as a solvent to separate the dyes in ink.

A student uses the apparatus shown to carry out the separation. There are errors in the diagram.



(i) Name the process used to separate the dyes in ink.

..... [1]

(ii) State two errors in the diagram.

1 .....

2 .....

[2]

(c) Ethanol is a flammable liquid.

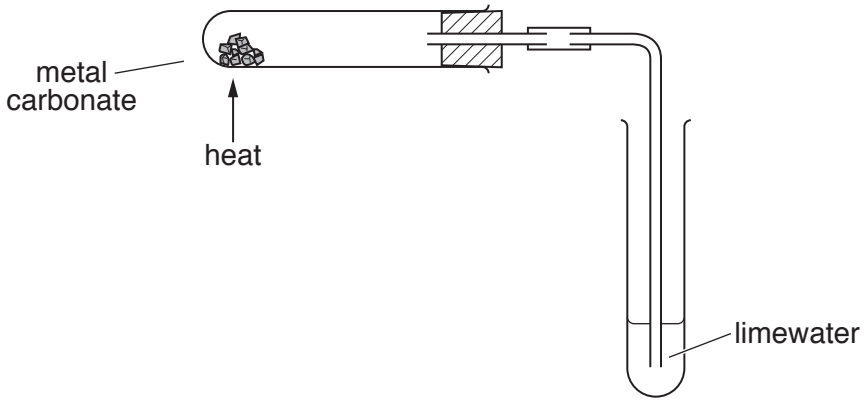
Suggest one safety measure that the student should take to minimise the risk of using ethanol.

..... [1]

[Total: 5]

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3 A student investigates the rate of decomposition of four metal carbonates. When metal carbonates are heated, they decompose and a gas is given off. A student suggests that the ease with which different carbonates decompose can be determined by measuring the time taken for a sample of limewater to turn milky, using the following apparatus.



The results of the investigation are shown in the table.

metal carbonate	time taken for limewater to turn milky / s
calcium carbonate	600
copper(II) carbonate	220
iron(II) carbonate	340
zinc carbonate	380

(a) Name the gas that turns limewater milky.

..... [1]

(b) **(i)** To ensure that the investigation is a fair test, the amount of heat supplied must be constant in each experiment. Suggest how this could be done.

.....

..... [1]

(ii) Suggest two other ways of achieving a fair test in this investigation.

.....

.....

..... [2]

(c) Which of the four metal carbonates decomposes the fastest?

..... [1]

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(d) Another student suggests that a source of inaccuracy in this investigation is that it is a matter of opinion as to when the limewater has turned milky. Suggest how the investigation could be improved to achieve more accurate results.

.....

..... [2]

[Total: 7]

4 A student is given an impure sample of calcium hydroxide, $Ca(OH)_2$. The student attempts to determine the percentage, by mass, of calcium hydroxide in the sample.

(a) The sample is placed in a previously weighed beaker, which is then reweighed.

mass of beaker + sample = 51.23 g

mass of beaker = 49.86 g

Calculate the mass of the sample used in the experiment.

..... g [1]

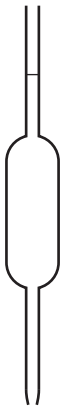
(b) 25.0 cm^3 of 2.00 mol / dm^3 hydrochloric acid, HCl, (an excess) is added to the beaker using apparatus **A**. The contents of the beaker are stirred.

Calcium hydroxide reacts with hydrochloric acid.

$$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$$

The impurities dissolve but do not react with hydrochloric acid.

(i) Name apparatus **A**.



A

..... [1]

(ii) What is the safety item that should be used with apparatus **A**?

..... [1]

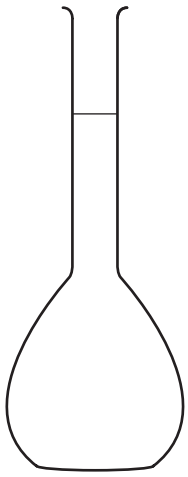
(iii) Why is the safety item used?

..... [1]

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(c) The contents of the beaker are then transferred to apparatus **B**.

The student washes the beaker out twice with distilled water and transfers the washings to apparatus **B**. The student then makes up the solution to the 250 cm^3 mark with distilled water. This is solution **C**.



B

(i) Name apparatus **B**.

..... [1]

(ii) Why does the student wash out the beaker with distilled water and transfer the washings to apparatus **B**?

.....

..... [1]

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

0.100 mol/dm^3 sodium hydroxide 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 calcium hydroxide. The equation for the reaction is shown.

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

(i) Why does the student decide to use apparatus **A** and **not** a measuring cylinder to transfer 25.0 cm^3 of **C** into the conical flask?

..... [1]

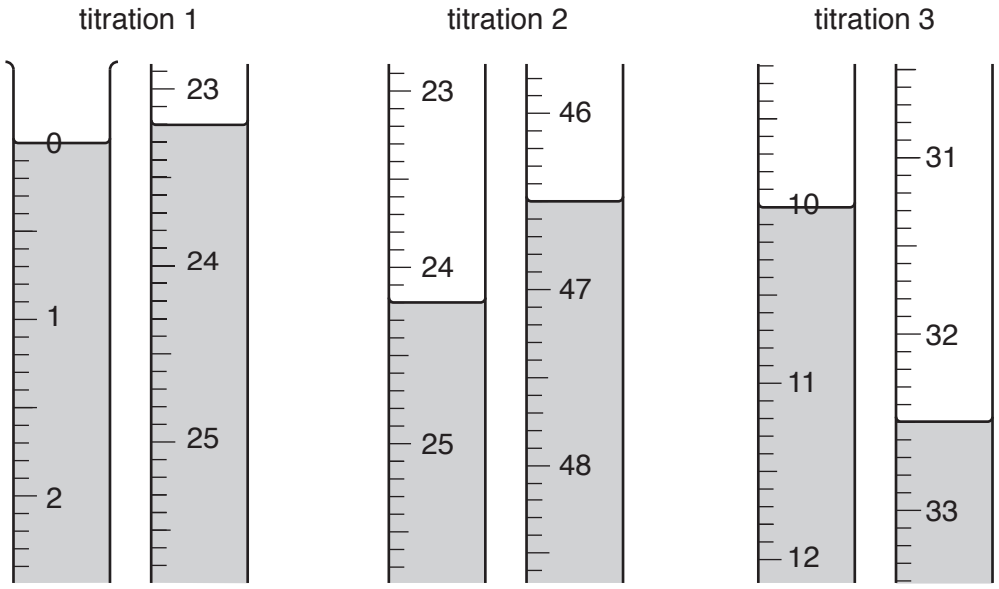
(ii) What is the colour change of the methyl orange indicator at the end-point?

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

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(e) The student does three titrations.

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



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]

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

..... moles [1]

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

$$NaOH + HCl \longrightarrow NaCl + H_2O$$

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

..... moles [1]

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

..... moles [1]

(i) Calculate the number of moles of hydrochloric acid in 25.0 cm^3 of 2.00 mol / dm^3 hydrochloric acid.

..... moles [1]

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

..... moles [1]

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

$$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$$

calculate the number of moles of calcium hydroxide in the sample.

..... moles [1]

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(l) Calculate the mass of calcium hydroxide in the sample.

[A_r: Ca, 40; O, 16; H, 1]

..... g [1]

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

.....% [1]

(n) Another student carries out an experiment to determine the percentage, by mass, of calcium hydroxide in a sample. She uses the same technique but instead of using three drops of methyl orange indicator in the titration, she uses 3 cm^3. Methyl orange is a weak acid.

State and explain whether the average titration volume of sodium hydroxide would be smaller, larger or unchanged if 3 cm^3 of methyl orange indicator was used instead of three drops.

.....

.....

..... [2]

[Total: 22]

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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.		**L** may contain Cr^{3+} or Fe^{2+} ions.	
(ii) An excess of aqueous ammonia is added to the mixture from **(i)**.		**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.		**L** may contain Cr^{3+} or Fe^{2+} ions.	
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		**L** contains Cr^{3+} ions.	[3]
(d)		**L** contains SO_4^{2-} ions.	[3]

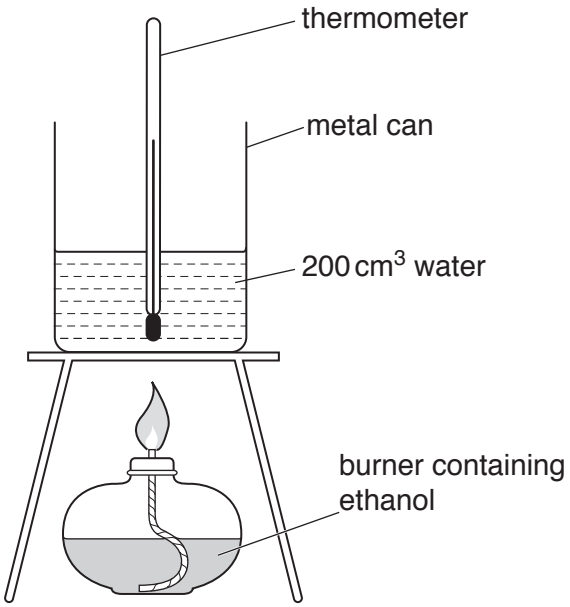
[Total: 9]

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6 When alcohols burn in air they give out heat energy to the surroundings. A student investigates the amount of heat energy produced when alcohols burn.

The student is provided with a burner containing ethanol, a metal can containing 200 cm^3 of water, a thermometer and the other apparatus shown in the diagram.

The student determines the temperature rise of the water in the metal can when a known mass of ethanol undergoes combustion. The student assumes that all the heat energy produced by the burning ethanol is transferred to the water in the metal can.



(a) The student finds that when she uses 0.5 g of ethanol, the temperature of the water increases by 9.9 °C.

(i) What are the measurements the student takes to obtain these two figures?

.....

..... [2]

(ii) A data book states that the temperature increase should have been greater than 9.9 °C.

Suggest two reasons why the temperature of the water did not increase by as much as the data book suggested.

1 .....

2 .....
[2]

(iii) Suggest two ways in which the apparatus can be improved to produce a temperature rise closer to the data book value.

1 .....

2 .....
[2]

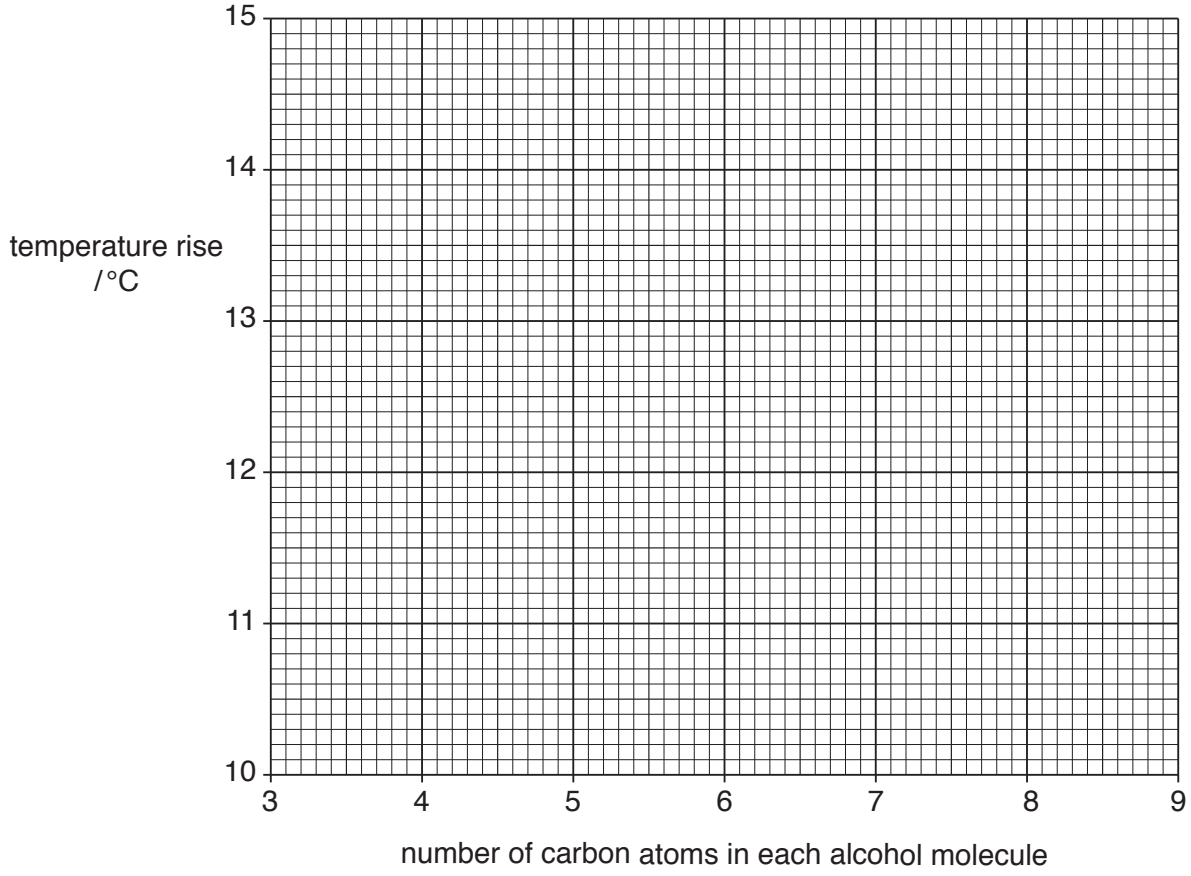
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(b) The student repeats the experiment using several different alcohols. The same amount of alcohol is burnt in each case.

The results obtained are shown in the table.

number of carbon atoms in each alcohol molecule	temperature rise / °C
3	10.5
4	11.1
5	11.6
6	12.5
7	12.8
8	13.4

Plot the results on the grid. Draw a straight line of best fit. Extend your graph to the right hand edge of the grid.



[2]

(c) One of the results is incorrect. Circle this result on your grid and suggest what the correct result should be.

..... °C [1]

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(d) Use your graph to deduce the temperature rise if a compound from the homologous series of alcohols with **nine** carbon atoms in each molecule is used in the experiment.

..... °C [1]

[Total: 10]

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