Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4578280915

CHEMISTRY **5070/42**

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.

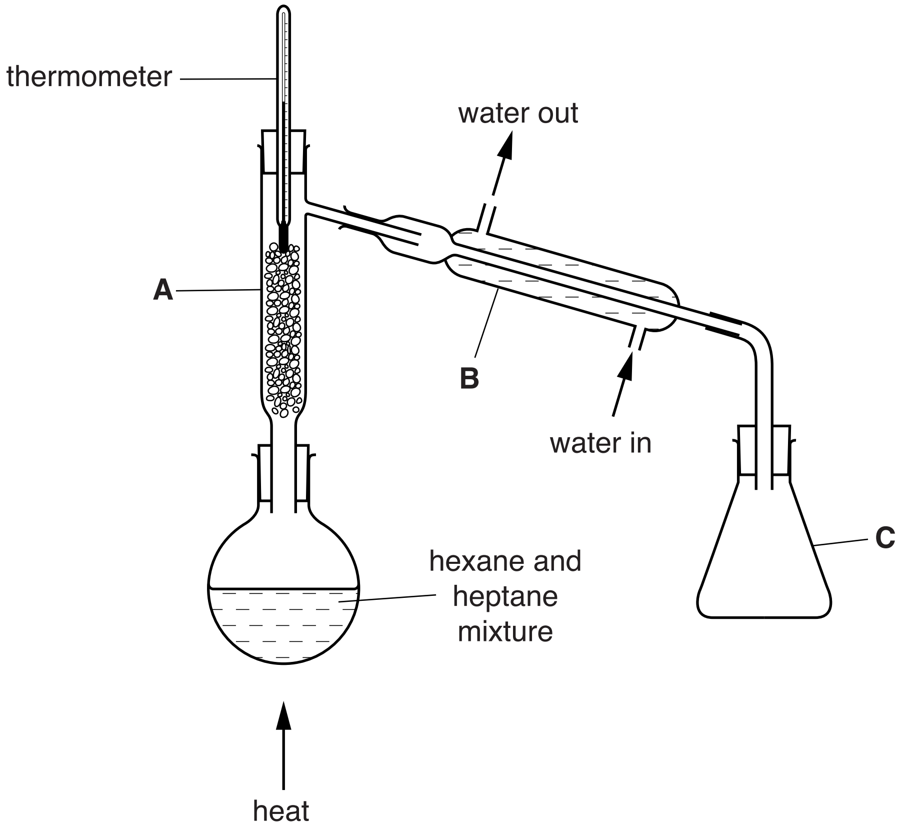
This document consists of **14** printed pages and **2** blank pages.

DC (RW/SW) 107622/3

CAMBRIDGE International Examinations

[Turn over

1 A student separates hexane, C_6H_{14}, (b.p. 69°C) and heptane, C_7H_{16}, (b.p. 98°C) using the apparatus shown.



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

1. ....

2. ....
[2]

The errors were then corrected and the separation started.

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

.... [1]

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

....[1]

(iii) Name apparatus **B**.

.... [1]

(iv) What is the purpose of apparatus **B**?

....[1]

(c) **(i)** What is the reading on the thermometer when the first few drops of liquid appear in **C**?

.... [1]

(ii) Name this liquid.

.... [1]

(d) Suggest which method should be used to heat the mixture and explain your choice.

method ....

explanation ....

.... [2]

[Total: 10]

2 **(a)** Give a test and observation to identify the presence of the nitrate ion, $NO_3^-(aq)$.

test ....

....

observation ....

....[4]

(b) Describe briefly how pure crystals of potassium nitrate may be made from aqueous potassium nitrate.

....

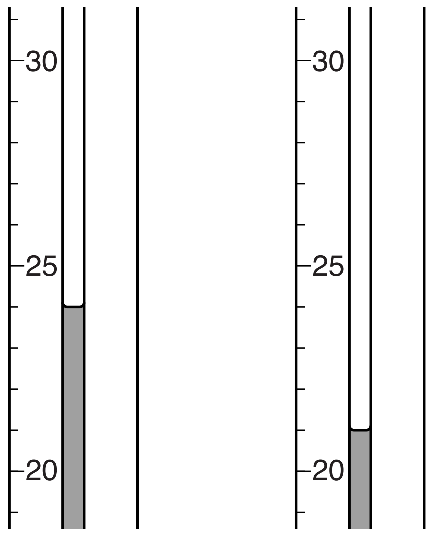
....

....

....

....[3]

(c) A few grams of potassium nitrate are added to water.
A thermometer is used to measure the temperature of the liquid before and after the addition of potassium nitrate.
The diagrams below show parts of the thermometer stem giving the two temperatures.



temperature before addition   temperature after addition

(i) Complete the table and calculate the temperature change.

temperature after potassium nitrate is added / °C	
temperature before potassium nitrate is added / °C	
change in temperature / °C	

[2]

(ii) What type of process does this temperature change indicate?

....[1]

[Total: 10]

3 **(a)** When zinc is heated in air it reacts with oxygen to form an oxide.
A student does an experiment to find the formula of zinc oxide.

Some zinc is placed in a previously weighed crucible and reweighed.

mass of crucible + zinc = 7.04 g
mass of crucible = 5.74 g

(i) Calculate the mass of zinc used in the experiment.

.... g [1]

The crucible containing the zinc is heated and zinc oxide is produced. The crucible with zinc oxide is weighed.

mass of crucible + zinc oxide = 7.36 g

(ii) Calculate the mass of zinc oxide produced.

.... g [1]

(iii) Using your answers to **(i)** and **(ii)**, calculate the mass of oxygen that combines with the zinc.

.... g [1]

(iv) Using your answers to **(i)** and **(iii)**, calculate the formula of zinc oxide. Show all your working.
[A_r : Zn, 65; O, 16]

formula ....[2]

(b) When zinc reacts with dilute hydrochloric acid, a gas is produced.
Name the gas. Give a test and observation to identify the gas.

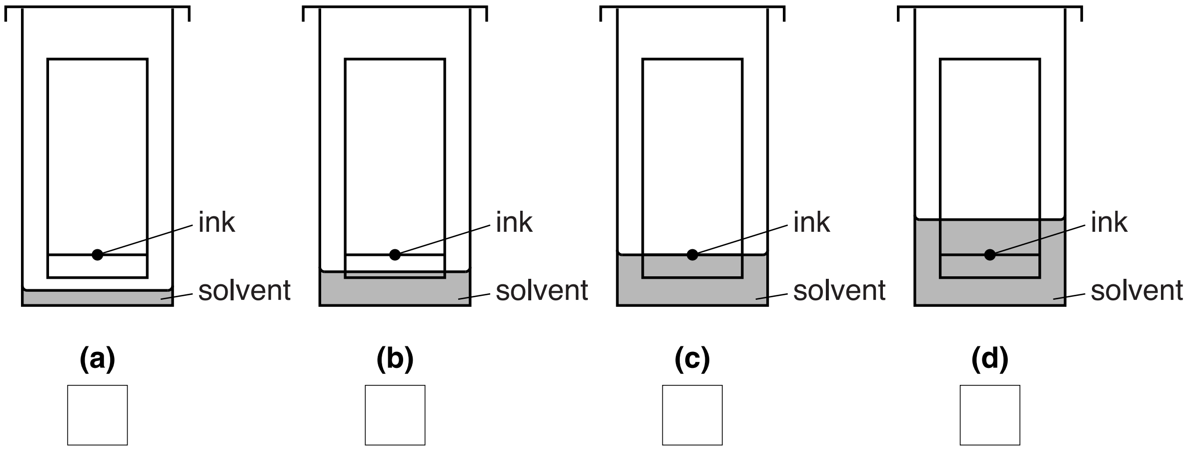
gas ....

test and observation ....
[2]

[Total: 7]

In questions **4** to **6** inclusive, place a tick (✓) in the box against the correct answer.

4 Chromatography can be used to separate the dyes present in black ink.
Which diagram shows the correct arrangement at the beginning of the experiment?



[Total: 1]

5 A student is given a sample of damp soil which is known to be acidic.
Which of the following substances may be used to neutralise the soil?

(a) calcium hydroxide ☐

(b) sodium chloride ☐

(c) potassium sulfate ☐

(d) zinc nitrate ☐

[Total: 1]

6 A small piece of calcium is added to a test-tube containing water coloured green by Universal Indicator.
A gas is given off and the indicator changes colour.
Which pair of observations is correct?

	final colour of indicator	test on gas	
(a)	purple	relights a glowing splint	☐
(b)	red	pops in a flame	☐
(c)	purple	pops in a flame	☐
(d)	red	relights a glowing splint	☐

[Total: 1]

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

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

The student titrates **R**, an aqueous solution containing 8.00 g/dm^3 of the organic acid, with **S**, an aqueous solution containing 0.100 mol/dm^3 of sodium hydroxide.

25.0 cm^3 of **S** is transferred into a conical flask. A few drops of thymolphthalein indicator are added to the conical flask.

Thymolphthalein is colourless in acid solution and blue in alkaline solution.

R is put into a burette and added to the solution in the conical flask until an end-point is reached.

(a) What is the colour in the conical flask

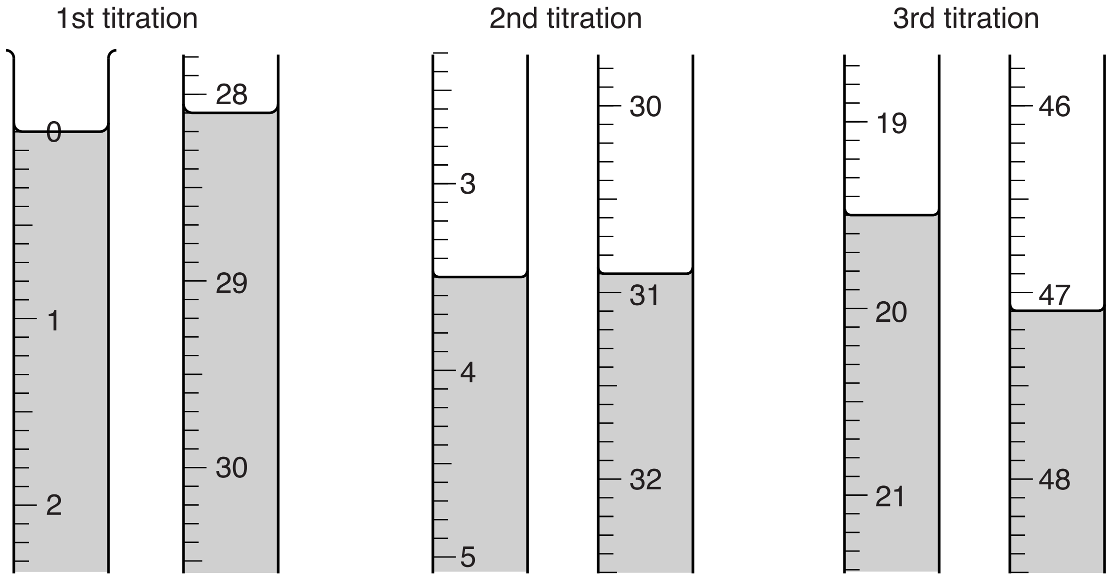
- before **R** is added,

  ....

- at the end-point?

  .... [1]

(b) 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 these diagrams to complete the following table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of **R** used / cm^3			
best titration results (✓)			

Summary
Tick (✓) the best titration results.
Using these results, the average volume of **R** used is .... cm^3. [4]

(c) Calculate the number of moles of sodium hydroxide in 25.0 cm^3 of **S**.

.... moles [1]

(d) Given that 1 mol of acid neutralises 1 mol of sodium hydroxide, use your answer in **(c)** to deduce the number of moles of the organic acid in the average volume of **R**.

.... moles [1]

(e) Calculate the number of moles of the acid in 1.00 dm^3 of **R**.

.... moles [1]

(f) Using your answer to **(e)** and the information that **R** contains 8.00 g / dm^3 of the acid, calculate the relative molecular mass of the acid.

....[1]

(g) The organic acid has the formula

$$C_{\mathbf{n}}H_{2\mathbf{n}+1}CO_2H$$

where **n** is a whole number.

Using your answer to **(f)**, deduce the value of **n** and hence the molecular formula and the name for the organic acid.
[A_r: H, 1; C, 12; O, 16]

n = ...

molecular formula ....

name ....
[4]

[Total: 13]

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

<table>
<tr><th>test</th><th>observations</th><th>conclusions</th><th></th></tr>
<tr><td>(a) M is dissolved in water and the resulting solution is divided into three parts for tests (b), (c) and (d).</td><td></td><td>M is not a compound of a transition metal.</td><td>[1]</td></tr>
<tr><td>(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 (i).</td><td>A white precipitate forms.

The precipitate dissolves.</td><td></td><td>[1]</td></tr>
<tr><td>(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 (i).</td><td>A white precipitate forms.

The precipitate is insoluble.</td><td></td><td>[1]</td></tr>
<tr><td>(d)</td><td></td><td>M contains Cl^- ions.</td><td>[3]</td></tr>
</table>

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

[Total: 7]

Question 9 begins on page 12.

9 The reaction between aqueous barium chloride and dilute sulfuric acid produces a precipitate of barium sulfate.

$$BaCl_2(aq) + H_2SO_4(aq) \rightarrow 2HCl(aq) + BaSO_4(s)$$

(a) State the colour of this precipitate.

.... [1]

A series of experiments are done to find the mass of precipitate formed when different volumes of dilute sulfuric acid are added to a fixed volume of aqueous barium chloride. The precipitate formed is filtered, dried and transferred to a container.

Solution **V** is 1.20 mol / dm^3 barium chloride.
Solution **W** is sulfuric acid of unknown concentration.

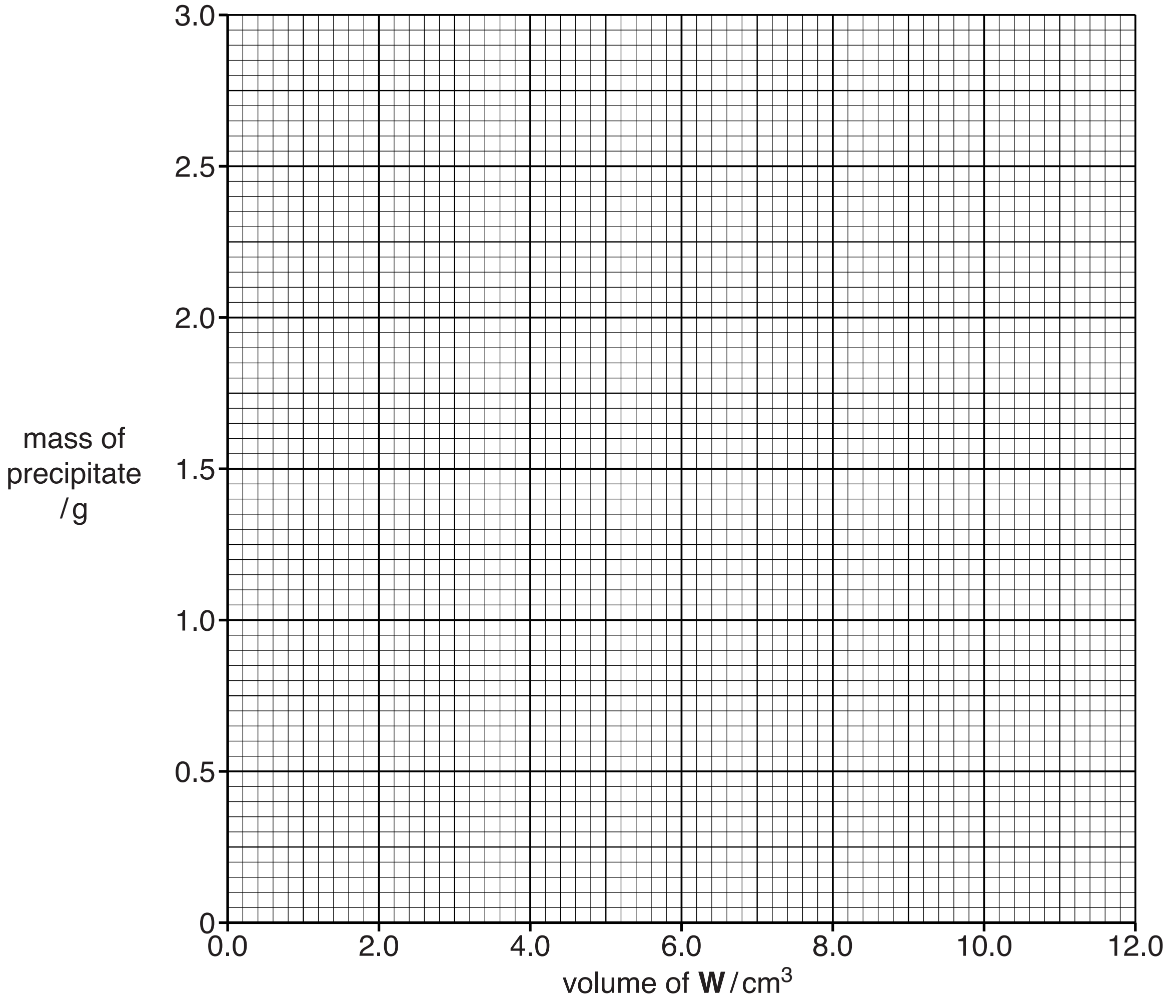
The table below shows the results of these experiments.

(b) Complete the final column by calculating the mass of precipitate formed in each experiment.

volume of **V** / cm^3	volume of **W** / cm^3	mass of empty container / g	mass of container + precipitate / g	mass of precipitate / g
10.0	2.0	2.70	3.35	0.65
10.0	4.0	2.70	4.00	
10.0	6.0	2.70	4.65	
10.0	8.0	2.70	5.30	
10.0	10.0	2.70	5.50	
10.0	12.0	2.70	5.50	

[1]

(c) Plot the mass of precipitate against the volume of **W** on the grid. Draw **two** intersecting straight lines through the points.



[3]

(d) Use the data on your grid to deduce

(i) the volume of **W** that would produce 1.20 g of precipitate,

.... cm^3 [1]

(ii) the maximum mass of precipitate that is produced,

.... g [1]

(iii) the minimum volume of **W** that reacts completely to produce the maximum mass in **(ii)**.

.... cm^3 [1]

(e) Using your answer to **(d)(iii)** and the equation for the reaction, calculate the concentration of the sulfuric acid, **W**, used in the experiment.

$$BaCl_2(aq) + H_2SO_4(aq) \rightarrow 2HCl(aq) + BaSO_4(s)$$

.... mol/dm^3 [2]

[Total: 10]

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