Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

8967183008

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2015**

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.
Electronic calculators may be used.
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.

This document consists of **13** printed pages and **3** blank pages.

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CAMBRIDGE
International Examinations

1 **(a)** **(i)** Describe the appearance of zinc.

.....[1]

(ii) Zinc oxide can be made from zinc by heating in air.

Construct the equation for this reaction.

.....[1]

(iii) Which compound may be used to convert zinc oxide into zinc nitrate?

.....[1]

(b) When zinc nitrate is heated in a fume cupboard the following reaction takes place.

$$2Zn(NO_3)_2(s) \longrightarrow 2ZnO(s) + 4NO_2(g) + O_2(g)$$

(i) Suggest why the heating is done in a fume cupboard.

.....[1]

(ii) Calculate the number of moles of zinc nitrate in 3.78 g of zinc nitrate.
[A_r: Zn, 65; N, 14; O, 16]

..... moles [1]

(iii) Using the equation for the reaction and your answer to **(b)(ii)** calculate the volume of each gas produced when 3.78 g of zinc nitrate is heated.
[1 mole of a gas occupies a volume of 24 000 cm^3 at room temperature and pressure.]

volume of NO_2 ..... cm^3

volume of O_2 .....cm^3 [2]

[Total: 7]

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2 **(a)** The general formula of a carboxylic acid is

$$C_nH_{2n+1}COOH$$

G is a carboxylic acid and has a relative formula mass of 88.

Deduce the value of **n** in the formula and hence name compound **G**.

n = ... name of **G** ..... [3]

(b) When magnesium reacts with **G**, a gas is formed.

Name the gas and give a test and observation to identify this gas.

name .....

test and observation .....

.....[2]

(c) Ethyl ethanoate has the same molecular formula as **G**.

(i) To which homologous series does ethyl ethanoate belong?

..... [1]

(ii) Give the structure of ethyl ethanoate.

.....[1]

(iii) Name the two compounds which, under suitable conditions, react to form ethyl ethanoate.

.....[2]

(iv) Compound **H** belongs to the same homologous series as ethyl ethanoate.
H has the same molecular formula as ethyl ethanoate.

Suggest the name and the structure of **H**.

name .....

structure ..... [2]

[Total: 11]

In questions **3** to **7** inclusive, place a tick (✓) in the box against the correct answer.

3 With which piece of apparatus should a safety bulb be used?

(a) beaker ☐

(b) burette ☐

(c) measuring cylinder ☐

(d) pipette ☐

[Total: 1]

4 Concentrated aqueous sodium chloride is electrolysed using carbon electrodes.

Which of the following is correct?

	product at the positive electrode	product at the negative electrode	
(a)	oxygen	sodium	☐
(b)	chlorine	hydrogen	☐
(c)	oxygen	hydrogen	☐
(d)	chlorine	sodium	☐

[Total: 1]

5 Metal **A** displaces metal **B** from a solution of its ions. Metal **B** displaces metal **C** from a solution of its ions.

What could **A**, **B** and **C** be?

	A	**B**	**C**	
(a)	iron	silver	magnesium	☐
(b)	magnesium	iron	silver	☐
(c)	magnesium	silver	iron	☐
(d)	silver	iron	magnesium	☐

[Total: 1]

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6 A student adds solid zinc powder to a beaker containing aqueous copper(II) sulfate.

Which of the following observations are correct?

1 The colour of the solution fades.

2 A red-brown deposit is formed at the base of the beaker.

3 Bubbles of a gas are rapidly evolved.

(a) 1 only ☐

(b) 1 and 2 only ☐

(c) 2 and 3 only ☐

(d) 1, 2 and 3 ☐

[Total: 1]

7 A student is asked to make 250 cm^3 of 0.20 mol/dm^3 sodium hydroxide.
[A_r: Na, 23; O, 16; H, 1]

What is the mass of sodium hydroxide required?

(a) 1.0 g ☐

(b) 2.0 g ☐

(c) 4.0 g ☐

(d) 8.0 g ☐

[Total: 1]

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8 Ammonium sulfate is a nitrogenous fertiliser.
Nitrogen in the fertiliser promotes the growth of plants.

A student is given an aqueous solution of ammonium sulfate, **R**, and is asked to determine its concentration.

Using a pipette, 25.0 cm^3 of **R** is placed in a beaker and 50.0 cm^3 of 2.00 mol/dm^3 sodium hydroxide, an excess, is added.

The following reaction takes place.

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

The mixture is heated until all the ammonia has evolved.

(a) How can the student confirm that all the ammonia has evolved?

.....

.....[1]

(b) After cooling, the remaining mixture is transferred to a volumetric flask and made up to 250 cm^3 with distilled water. This is solution **T**.

25.0 cm^3 of **T** 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.

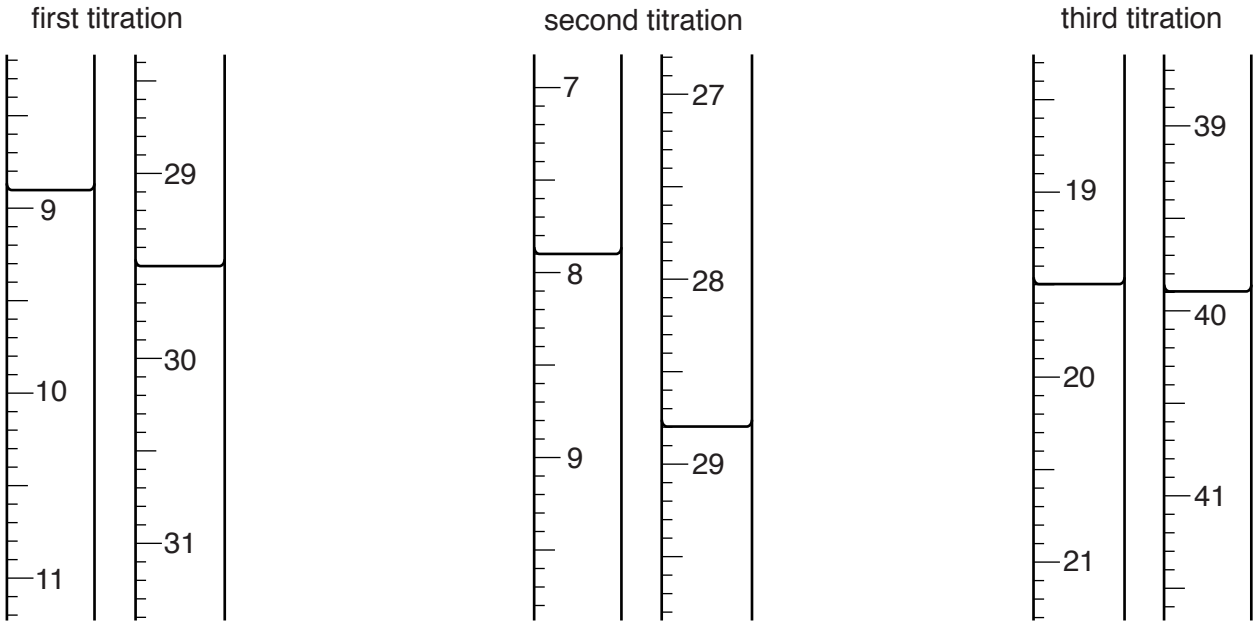
0.100 mol/dm^3 hydrochloric acid is added to **T** until the end-point is reached.

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

What is the colour of the solution in the conical flask

- before hydrochloric acid is added, ...
- at the end-point? ..... [1]

(c) 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 the diagrams to complete the following table.

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

Summary

Tick (✓) the best titration results.

Using these results, the average volume of hydrochloric acid 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]

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(e) **(i)** Using the equation

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

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

..... moles [1]

(ii) Calculate the number of moles of sodium hydroxide in 250 cm^3 of **T**.

..... moles [1]

(f) Calculate the number of moles of sodium hydroxide in 50 cm^3 of 2.00 mol/dm^3 sodium hydroxide.

..... moles [1]

(g) By subtracting your answer to **(e)(ii)** from your answer to **(f)** calculate the number of moles of sodium hydroxide which reacts with 25.0 cm^3 of **R**.

..... moles [1]

(h) When 1 mole of sodium hydroxide reacts with ammonium sulfate, 17 g of ammonia are produced.

Calculate

(i) the mass of ammonia produced from the original 25.0 cm^3 sample of **R**,

.....g [1]

(ii) the mass of ammonia produced from 1 dm^3 of **R**.

.....g [1]

(i) The formula of ammonium sulfate is $(NH_4)_2SO_4$.

Using your answer to **(h)(ii)** calculate the concentration of ammonium sulfate in **R**.
[A_r: N, 14; H, 1]

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

[Total: 15]

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[Turn over

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

Complete the table by giving the observations in tests **(a)**, **(b)** and **(c)** and suggest both the test and observation that lead to the conclusion in test **(d)**.

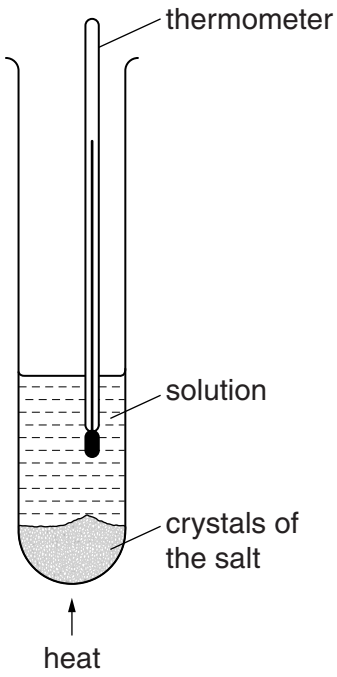
test	observation	conclusion
(a) **M** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.		**M** probably does not contain a transition metal ion.
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen. **(ii)** An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		**M** may contain Al^{3+}, Ca^{2+} or Zn^{2+} ions. **M** may contain Al^{3+} or Zn^{2+} ions.
(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)**.		The presence of Al^{3+} ions in **M** is confirmed.
(d)		**M** contains NO_3^- ions.

[Total: 9]

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10 A student investigates the solubility of two salts, ammonium chloride and potassium nitrate.

He uses the apparatus shown.



10 g of water is placed in a boiling tube and 7.0 g of ammonium chloride is added.

The tube and contents are heated until all the solid dissolves.

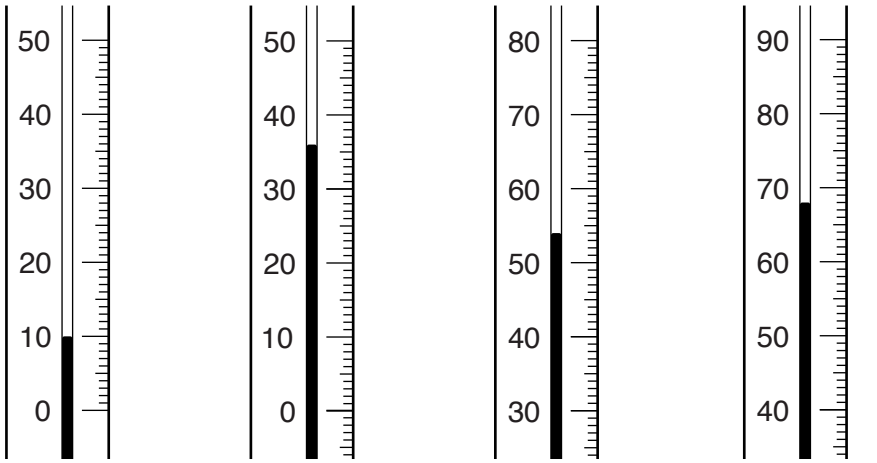
The tube is allowed to cool.

Solid ammonium chloride first appears at 80 °C.

The temperature is noted in the table in **(a)**.

(a) The experiment is repeated using 3.0, 4.0, 5.0 and 6.0 g of ammonium chloride.

The diagrams below show part of the thermometer stem, giving the temperature at which the solid first appears in each test.



Use the thermometer readings to complete the following table.

mass of ammonium chloride in 10 g of water / g	3.0	4.0	5.0	6.0	7.0
temperature at which ammonium chloride first appears / °C					80

[2]

(b) The experiment is repeated using different masses of potassium nitrate, the results for which are shown in the following table.

mass of potassium nitrate in 10 g of water / g	2.0	3.0	4.0	5.0	6.0	7.0
temperature at which potassium nitrate first appears / °C	4	18	29	37	45	50

What problem might the student experience in completing the experiment using 2.0 g of potassium nitrate? Suggest how this problem may be overcome.

.....

.....[2]

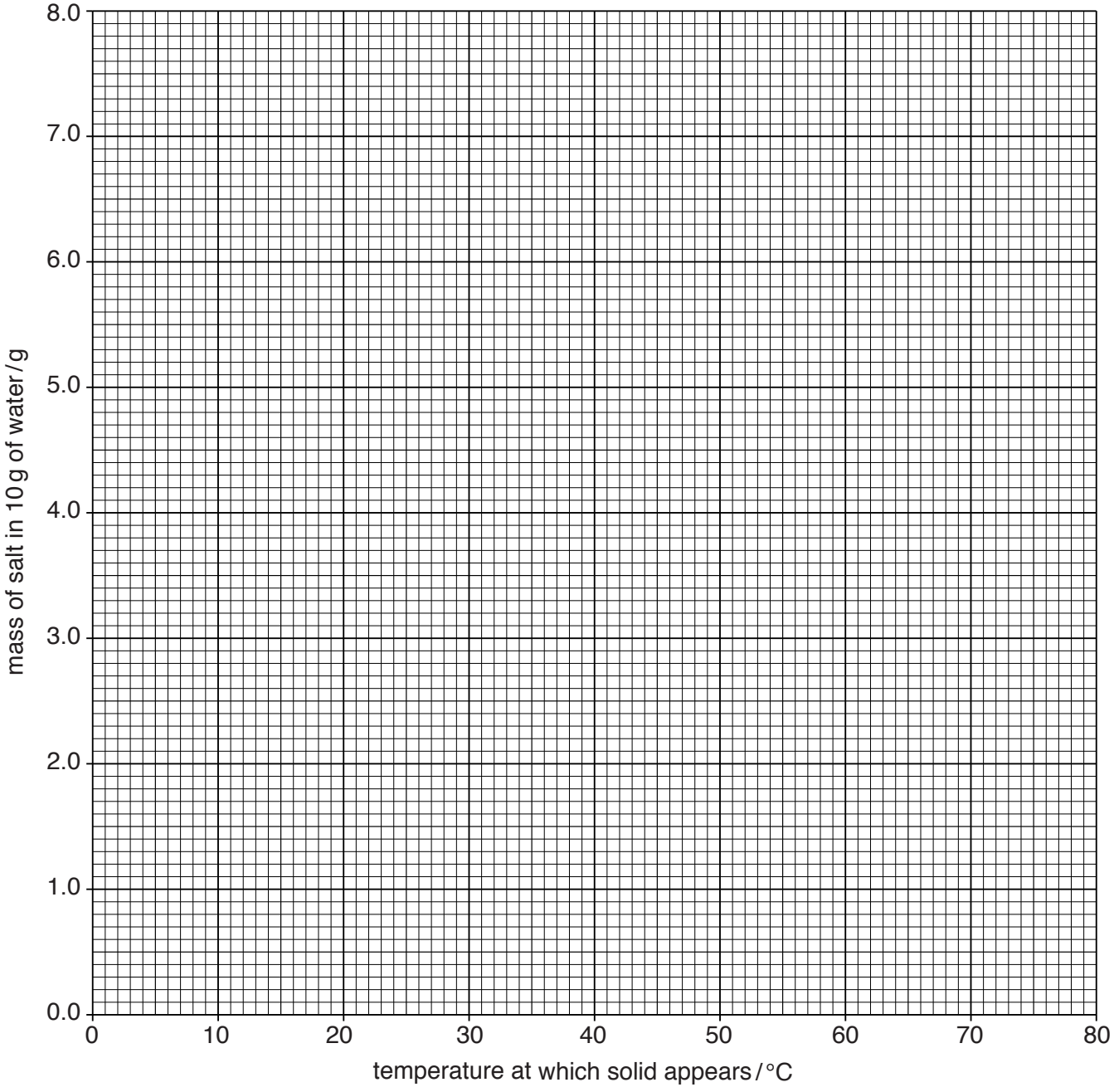
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(c) Plot the results for both ammonium chloride and potassium nitrate on the grid.

Draw a smooth curve through the points for ammonium chloride and label it ammonium chloride.

Draw a smooth curve through the points for potassium nitrate and label it potassium nitrate.

Extend both curves so that each curve crosses the *y*–axis.



[3]

(d) Use your graphs to answer the following questions.
What is the mass of each compound that dissolves in 10 g of water at 0 °C?

(i) ammonium chloride

..... g [1]

(ii) potassium nitrate

..... g [1]

(e) The solubility of a compound is defined as the maximum mass of compound that will dissolve in 100 g of water at a given temperature.

(i) At what temperature is the solubility of each compound the same?

.....°C [1]

(ii) Calculate the solubility of both ammonium chloride and potassium nitrate at the temperature you have given in **(e)(i)**.

.....g / 100 g of water [1]

(f) The student is given two boiling tubes, one containing 5.0 g of ammonium chloride in 10 g of water, the other containing 5.0 g of potassium nitrate in 10 g of water.

Both are stirred and heated to a temperature of 45 °C.

Describe the appearance of the contents of each boiling tube at 45 °C.

ammonium chloride

.....

potassium nitrate

.....
[2]

[Total: 13]

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