Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2728823154

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **October/November 2014**

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.

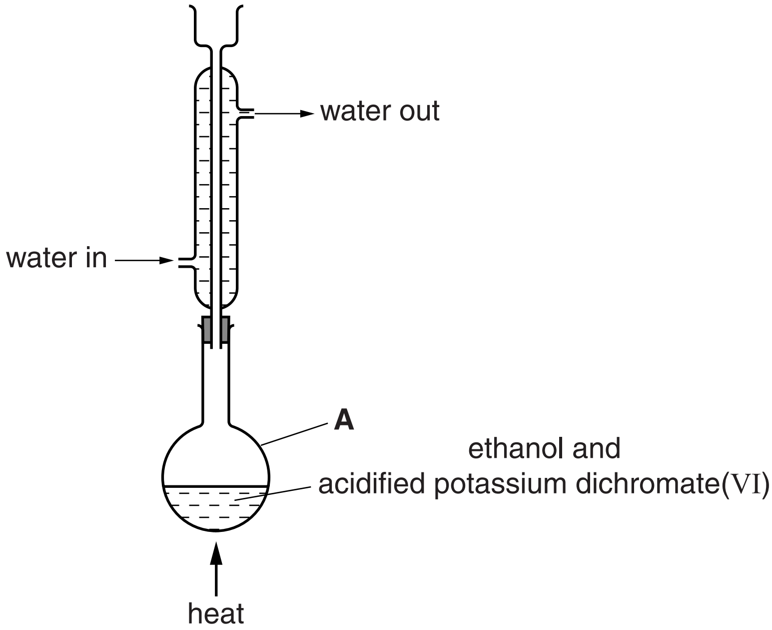
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

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 **15** printed pages and **1** blank page.

DC (CW/SW) 72254/5

1 A student heats a mixture of ethanol and acidified potassium dichromate(VI) using the apparatus shown below.



(a) Name apparatus **A**.

....[1]

(b) Name the organic product of the reaction.

....[1]

(c) What is the colour of the mixture in the flask

- before heating, ...
- after heating? .... [1]

[Total: 3]

2 When excess zinc is added to dilute sulfuric acid a gas is evolved.

(a) Construct an equation for this reaction.

....[1]

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

gas ....

test and observation ....[2]

(c) The volume of gas evolved at regular time intervals is shown in the table below. This is **experiment 1**.

The experiment is repeated using the same amounts of zinc and dilute sulfuric acid but also adding a few drops of aqueous copper(II) sulfate. This is **experiment 2**.

time /s	**experiment 1** volume of gas evolved /cm^3	**experiment 2** volume of gas evolved /cm^3
30	25	40
60	40	55
90	55	65
120	65	
150	65	

Complete the table by filling in the last two volumes of gas for **experiment 2**. [1]

(d) Draw a labelled diagram of the apparatus that the student could use to carry out the reaction, collect the gas and measure its volume.

[3]

(e) The last two volumes of gas in **experiment 1** are the same, indicating that the reaction has stopped.

Why has the reaction stopped?

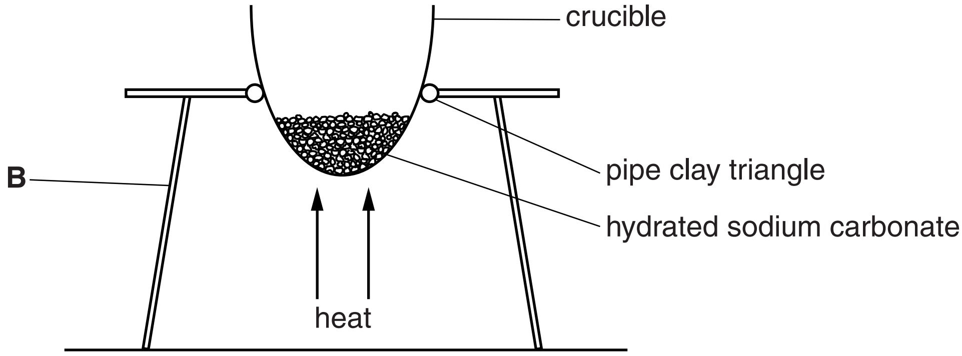
....[1]

(f) Suggest the function of the copper(II) sulfate in **experiment 2**.

....[1]

[Total: 9]

3 A student heats a sample of hydrated sodium carbonate, $Na_2CO_3.\mathbf{x}H_2O$, in a crucible until all the water of crystallisation is removed. The purpose of the experiment is to determine the value of **x** in the formula $Na_2CO_3.\mathbf{x}H_2O$.



(a) Name the apparatus **B**.

....[1]

(b) How can the student be sure that all the water of crystallisation has been removed?

....[1]

(c) After heating 0.715 g of the hydrated salt, $Na_2CO_3.\mathbf{x}H_2O$, 0.265 g of the anhydrous salt, Na_2CO_3, remained.

(i) Calculate the mass of water of crystallisation removed.

.... g [1]

(ii) Calculate the relative formula mass of sodium carbonate, Na_2CO_3.
[A_r: Na, 23; C, 12; O, 16]

....

Calculate the relative formula mass of water, H_2O.
[A_r: H, 1; O, 16]

....
[1]

(iii) Calculate the number of moles of Na_2CO_3 in 0.265 g.

.... moles of Na_2CO_3

Calculate the number of moles of H_2O in your answer to **(c)(i)**.

.... moles of H_2O
[1]

(d) Using your answers to **(c)(iii)**, calculate the value of **x** in the formula Na_2CO_3.**x**H_2O.

x = ...[1]

[Total: 6]

In questions **4** to **8** inclusive, place a tick (✓) in the box against the correct answer.

4 Which of the following will produce copper(II) sulfate?

(a) a neutralisation reaction using sulfuric acid and an alkali

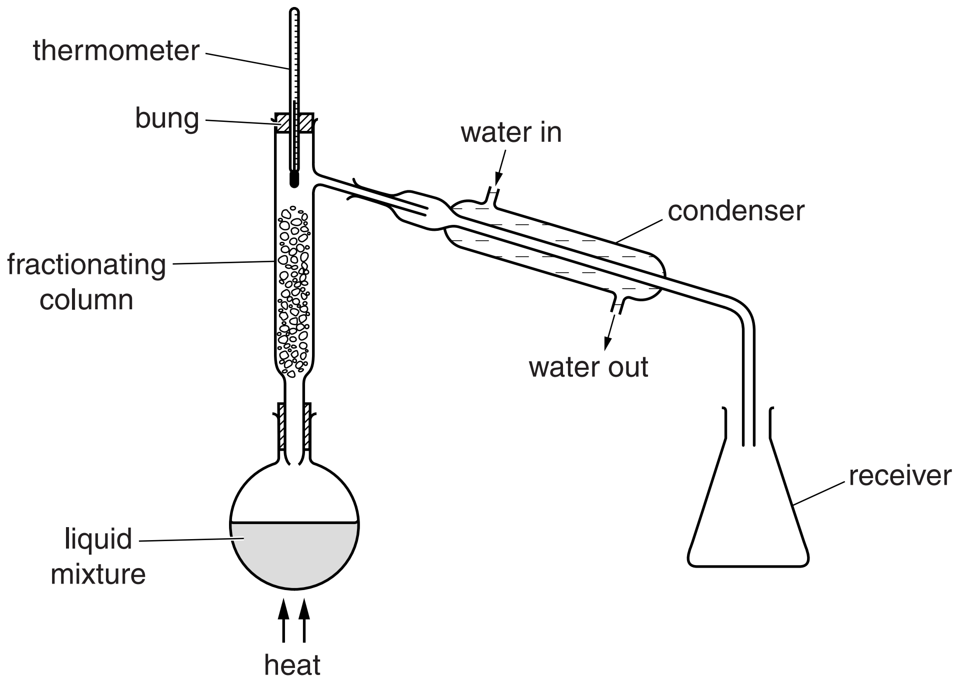
(b) adding copper to dilute sulfuric acid

(c) a precipitation reaction using aqueous copper(II) chloride and dilute sulfuric acid

(d) adding copper(II) oxide to dilute sulfuric acid

[Total: 1]

5 A student sets up the apparatus for fractional distillation as shown below.



What error is the student making in setting up the apparatus?

(a) The thermometer is in the wrong position.

(b) There should not be a bung in the top of the fractionating column.

(c) Water enters and leaves the condenser in the wrong place.

(d) There should be a bung in the top of the receiver.

[Total: 1]

6 Aqueous copper(II) sulfate is electrolysed using carbon electrodes. Which of the following results is correct?

	product at positive electrode	product at negative electrode	electrolyte	
(a)	oxygen	copper	stays the same colour	☐
(b)	oxygen	copper	turns lighter blue	☐
(c)	copper	oxygen	turns lighter blue	☐
(d)	oxygen	hydrogen	turns lighter blue	☐

[Total: 1]

7 A compound contains 0.92 g of sodium, 1.42 g of chlorine and 2.56 g of oxygen.
[A_r: Na, 23; C*l*, 35.5; O, 16]

Its empirical formula is

(a) $NaClO$ ☐

(b) $NaClO_2$ ☐

(c) $NaClO_3$ ☐

(d) $NaClO_4$ ☐

[Total: 1]

8 Metals *W*, *X*, *Y* and *Z* are placed separately in aqueous solutions of their ions.

metal	W^{2+}(aq)	X^{2+}(aq)	Y^{2+}(aq)	Z^{2+}(aq)
W	no reaction	*X* displaced	*Y* displaced	no reaction
X	no reaction	no reaction	no reaction	no reaction
Y	no reaction	*X* displaced	no reaction	no reaction
Z	*W* displaced	*X* displaced	*Y* displaced	no reaction

What is the correct order of reactivity of the metals, starting with the most reactive?

(a) *W Y X Z* ☐

(b) *Y W Z X* ☐

(c) *Z W Y X* ☐

(d) *X Z W Y* ☐

[Total: 1]

9 A student is asked to determine the percentage by mass of iron(II) ions, Fe^{2+}, in some tablets.

The student grinds two tablets into a powder.

The powdered tablets are added to a previously weighed container, which is then reweighed.

mass of container + tablets	=	16.07 g
mass of container	=	11.03 g

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

.... g [1]

(b) The powder is dissolved in excess dilute sulfuric acid and the solution made up to 250.0 cm^3 with distilled water. This is solution **H**.

In which apparatus should solution **H** be made up to 250.0 cm^3?

....[1]

(c) A 25.0 cm^3 sample of **H** is measured into a conical flask.

Name the apparatus used to transfer this volume of **H**.

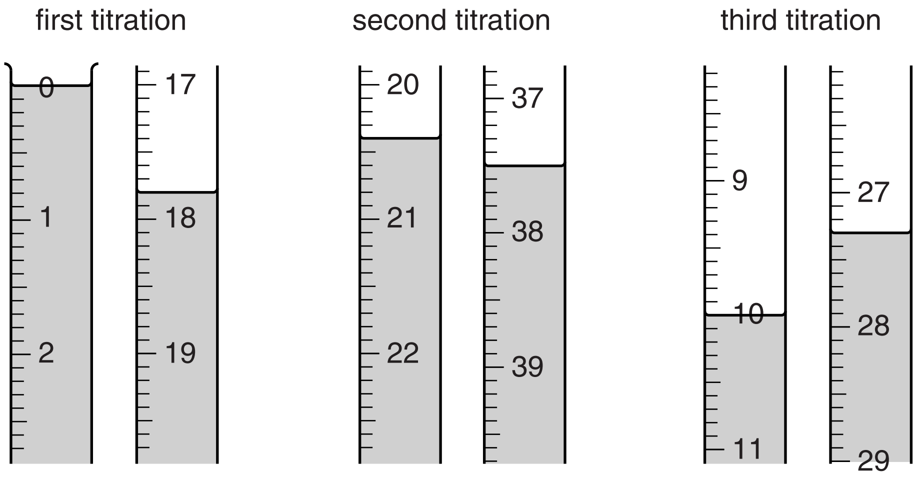
....[1]

(d) Solution **G**, 0.0200 mol / dm^3 potassium manganate(VII), which is purple, is put into a burette and run into the conical flask containing **H**.

What is the colour of the solution in the conical flask when **G** is just in excess?

....[1]

(e) Three titrations are done. The diagrams below 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 0.0200 mol / dm^3 potassium manganate(VII) / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of 0.0200 mol / dm^3 potassium manganate(VII) is

.... cm^3. [4]

(f) Calculate the number of moles of potassium manganate(VII) in the average volume of **G** used in **(e)**.

.... moles [1]

(g) **One** mole of potassium manganate(VII) reacts with **five** moles of iron(II) ions, Fe^{2+}.

Deduce the number of moles of Fe^{2+} in 25.0 cm^3 of **H**.

.... moles [1]

(h) Deduce the number of moles of Fe^{2+} in 250 cm^3 of **H**.

.... moles [1]

(i) Calculate the mass of Fe^{2+} in 250 cm^3 of **H**.
[A_r: Fe, 56]

.... g [1]

(j) Using your answers to **(a)** and **(i)** calculate the percentage by mass of Fe^{2+} in the tablets.

.... % [1]

[Total: 13]

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

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)**.

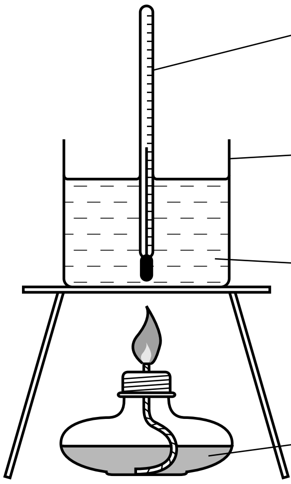
test	observations	conclusions
(a) **L** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A colourless solution is formed.	
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen.		**L** may contain Al^{3+}, Ca^{2+} or Zn^{2+} ions.
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		**L** may contain Al^{3+} or Zn^{2+} ions.
(c) **(i)** To the second part, aqueous ammonia is added until a change is seen.		**L** may contain Al^{3+} or Zn^{2+} ions.
(ii) An excess of aqueous ammonia is added to the mixture from **(i)**.		**L** contains Zn^{2+} ions.
(d)		**L** contains NO_3^- ions.

Conclusion

The formula of **L** is ....

[Total: 10]

11 When alcohols burn they give out heat. A student uses the apparatus below to investigate the amount of heat produced when ethanol is burnt.



Some ethanol is put into the burner which is then weighed.

The temperature of the water is recorded.

The burner is lit and allowed to burn for several minutes.

The flame is extinguished and the final temperature of the water is recorded.

The burner is reweighed.

(a) Use the information given to complete the following.

(i)	initial mass of burner + ethanol	=	80.24 g	
	final mass of burner + ethanol	=	79.99 g	
	mass of ethanol burnt	=	.... g	[1]
(ii)	final temperature of water	=	25.2 °C	
	initial temperature of water	=	15.6 °C	
	rise in temperature	=	.... °C	[1]

(b) (i) Calculate the relative formula mass of ethanol, C_2H_5OH.
[A_r: C, 12; H, 1; O, 16]

relative formula mass = ...[1]

(ii) Using your answers to **(a)(i)** and **(b)(i)**, calculate the number of moles of ethanol burnt.

.... moles [1]

(iii) Using the equation below and your answers to **(a)(ii)** and **(b)(ii)**, calculate ΔH, the heat produced when one mole of ethanol is burnt.

$$\Delta H = \frac{-0.84 \times \text{rise in temperature}}{\text{number of moles of ethanol burnt}} \text{ kJ/mol}$$

Give your answer to the nearest whole number.

.... kJ/mol [1]

(c) What general name is given to a reaction having a negative value of ΔH?

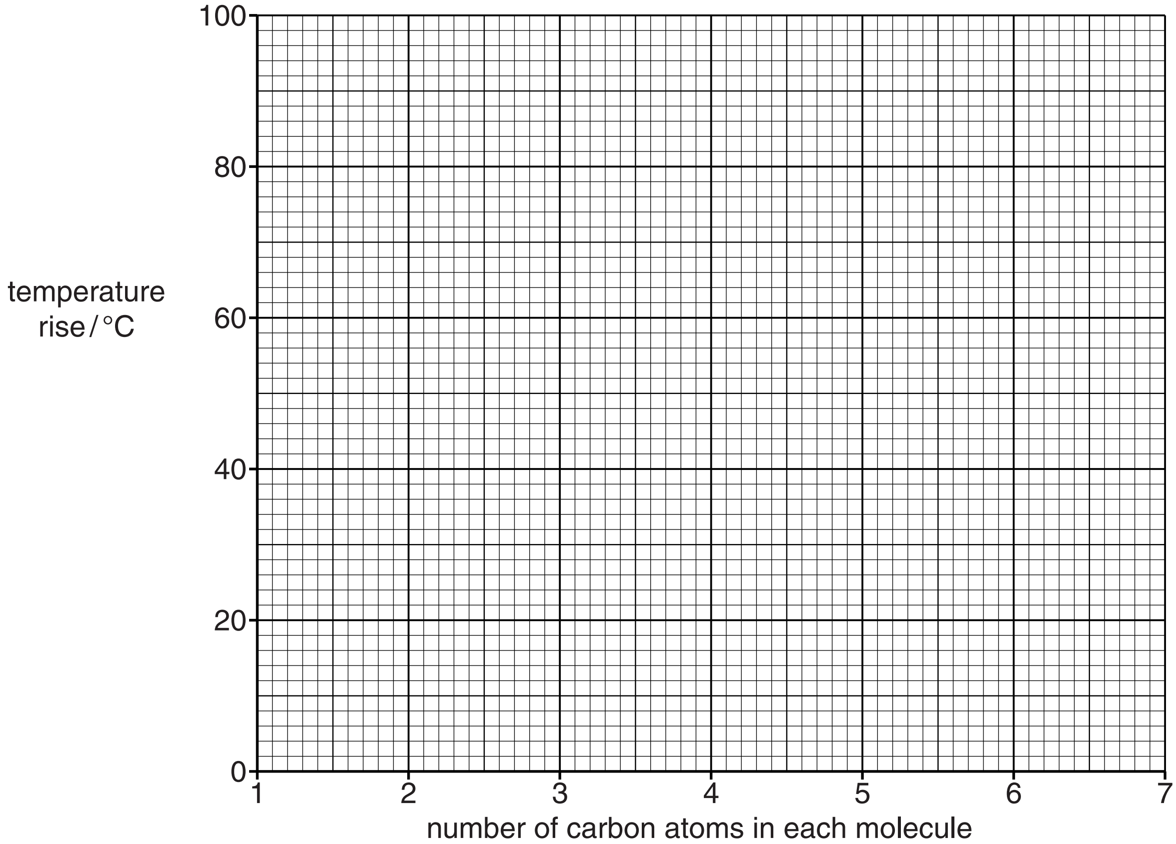
....[1]

(d) The experiment is repeated using several members of a homologous series of organic compounds. The same number of moles of each compound is burnt. The initial and final temperature of the water is measured and the temperature rise calculated.

The following results were obtained.

number of carbon atoms in each molecule	temperature rise / °C
2	20
3	38
4	48
5	62
6	76

Plot the results on the grid. Draw a straight line of best fit through the points.



[2]

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

.... °C [2]

(f) Use your graph to deduce the temperature rise if a compound from the same homologous series with **one** carbon atom is used in the experiment.

.... °C [1]

(g) The student repeats the experiment using a compound from the same homologous series with **seven** carbon atoms.

(i) Use your graph to deduce the temperature rise that the student might expect.

.... °C [1]

(ii) Explain why it is not possible for the student to obtain the temperature rise in **(g)(i)**.

....[1]

(iii) Suggest one change that can be made to the experiment that would make it possible to obtain the temperature rise in **(g)(i)**.

....[1]

[Total: 14]

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