UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY

Paper 4 Alternative to Practical

5070/04
May/June 2005

1 hour

Candidates answer on the Question Paper.
No Additional Materials are required.

Candidate Name	

Centre Number							Candidate Number				

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
You should use names, not symbols, when describing all reacting chemicals and products formed.
You may use a calculator.

DO NOT WRITE IN THE BARCODE.

DO NOT WRITE IN THE GREY AREAS BETWEEN THE PAGES.

For Examiner's Use

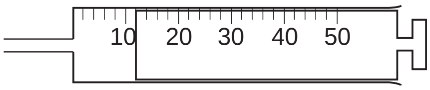
This document consists of **16** printed pages and **4** blank pages.

SPA (KN) S92055/3.1

UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

1 **(a)** Name the apparatus shown below.



....

(b) What is the volume of the gas in the apparatus?

....cm^3 [2]

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2 A student added 150 cm^3 of 0.080 mol/dm^3 barium chloride to 100 cm^3 of 0.15 mol/dm^3 magnesium sulphate.
A precipitate of barium sulphate was produced.

(a) Describe the colour of the precipitate.

....[1]

(b) How could the precipitate be removed from the mixture?

....[1]

(c) Calculate the number of moles of barium chloride and magnesium sulphate used in the experiment.

(i) barium chloride

....moles

(ii) magnesium sulphate

....moles
[2]

(d) Using your answers to part **(c)**,

(i) deduce the number of moles of barium sulphate produced.

....moles

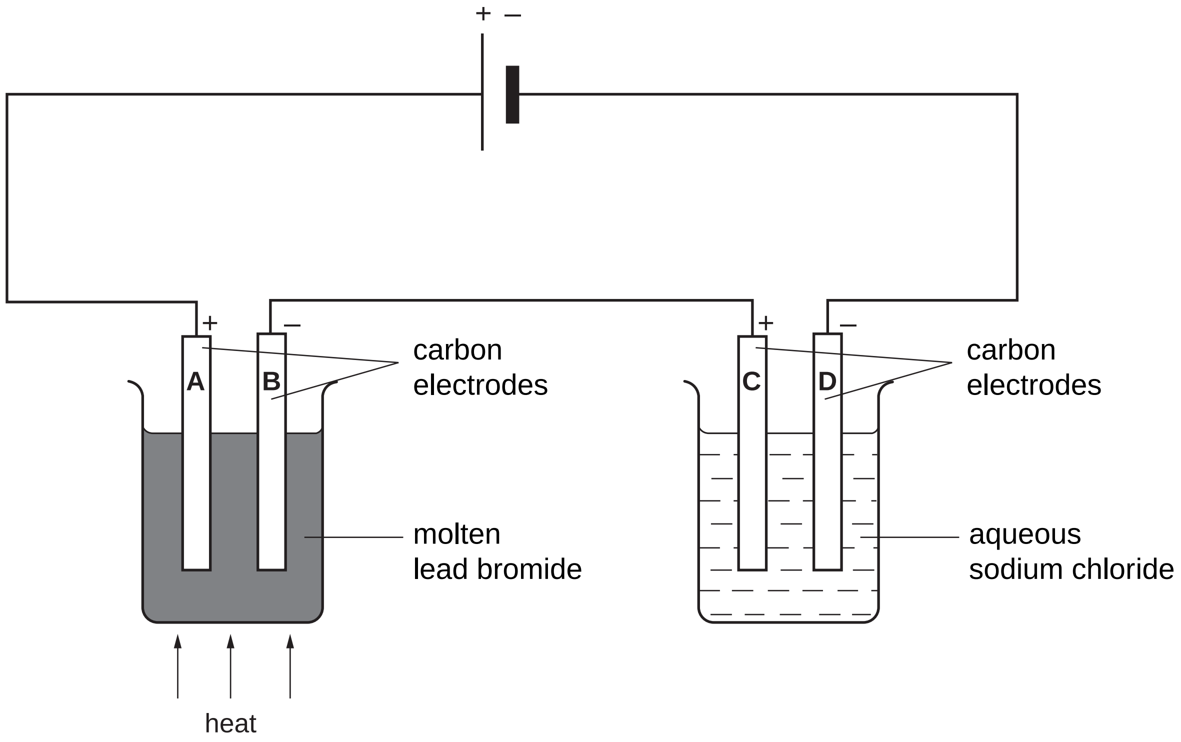
(ii) Give the formula of barium sulphate.

....

(iii) Calculate the mass of barium sulphate produced.
(A_r : Ba, 137; S, 32; O, 16)

....g
[4]

3 A student electrolysed lead bromide and aqueous sodium chloride in the apparatus shown below.



Each of the electrodes is labelled with a letter.

(a) Why was it necessary for lead bromide to be molten?

....[1]

(b) **(i)** What was produced at electrode **A**?

....

(ii) What was the appearance of this product?

....

(iii) What was produced at electrode **B**?

....

(iv) Where did this product collect?

....

[4]

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(c) Gases were produced at electrodes **C** and **D**. In each case name the gas and give a test to confirm its presence.

(i) the gas produced at **C** ....

test for this gas ....

(ii) gas produced at **D** ....

test for this gas .... [4]

(d) What change should be made so that sodium is produced at one of the electrodes?

....[1]

For questions **4** to **8** inclusive, place a tick in the box against the best answer.

4 A student did a series of experiments in which a halogen was displaced from a salt by the addition of another halogen.

Which result was **not** correct?

	halogen	salt	halogen produced	
(a)	Br	KC*l*	C*l*	☐
(b)	Br	KI	I	☐
(c)	C*l*	KBr	Br	☐
(d)	C*l*	KI	I	☐

[1]

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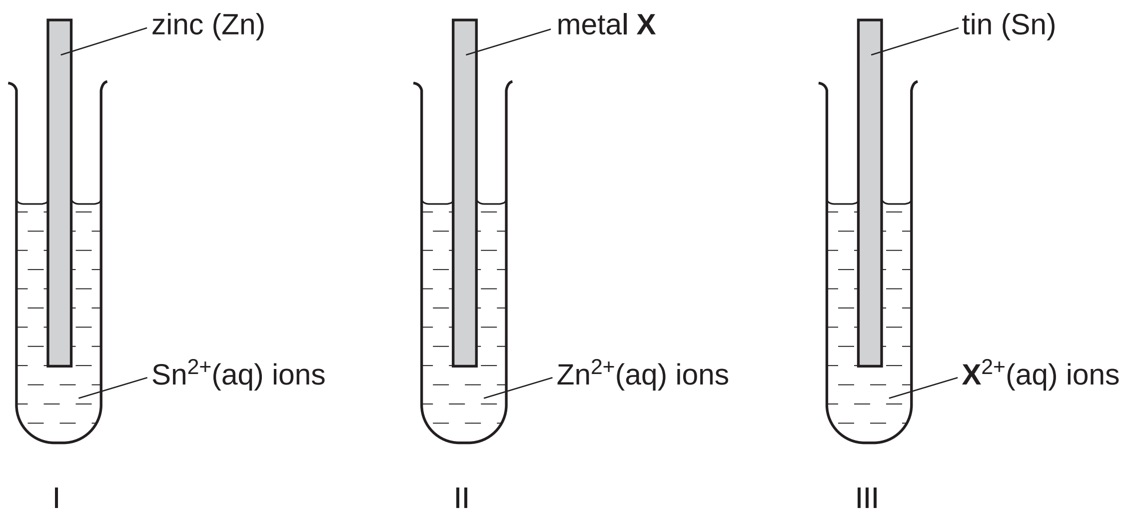
5 Three test tubes each contained an aqueous solution into which a piece of metal was dipped.

Metal **X** is an unknown metal.



After several minutes reactions were taking place in tubes I and II but not in III.

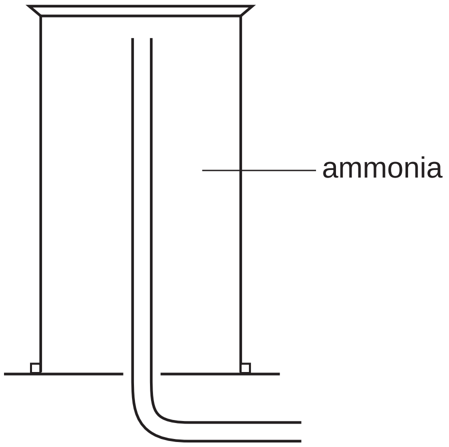
What did this indicate about the relative reactivities of these metals.

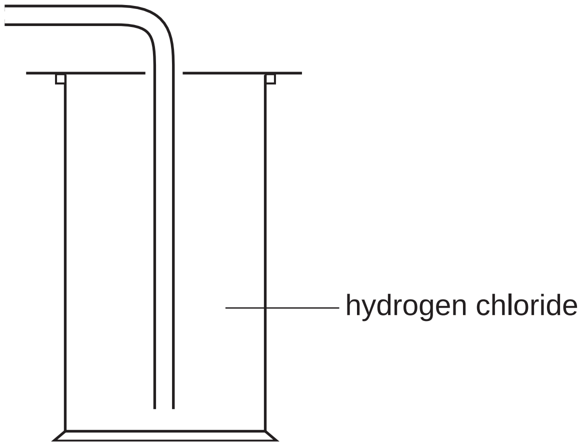
	most reactive ⟵	⟶ least reactive		
(a)	Sn	Zn	**X**	☐
(b)	Sn	**X**	Zn	☐
(c)	**X**	Zn	Sn	☐
(d)	Zn	Sn	**X**	☐

[1]

6 Ammonia and hydrogen chloride cannot be collected by the displacement of water. They are collected by the methods shown below.

What deductions can be made about the properties of the two gases?





	ammonia		hydrogen chloride		
	density	solubility in water	density	solubility in water	
(a)	more dense than air	insoluble	less dense than air	insoluble	☐
(b)	less dense than air	soluble	more dense than air	soluble	☐
(c)	more dense than air	insoluble	less dense than air	soluble	☐
(d)	less dense than air	soluble	more dense than air	insoluble	☐

[1]

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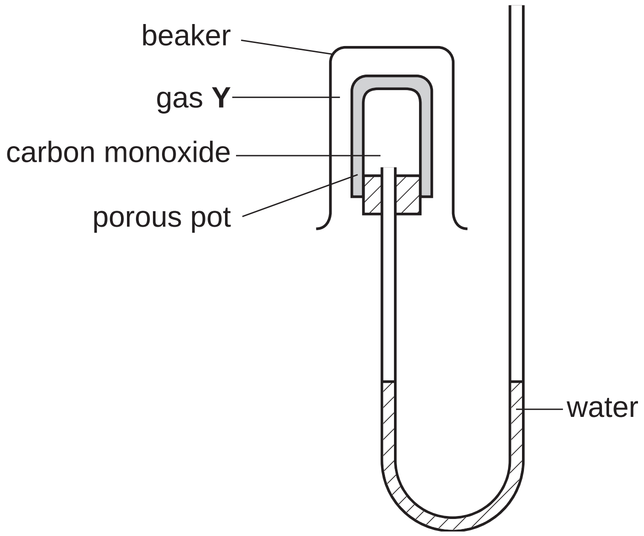
7 A student did some tests on ethanoic acid. Which result was incorrect?

	test	result	
(a)	add sodium carbonate	effervescence	☐
(b)	litmus paper	turned red	☐
(c)	warm with ethanol together with two drops of concentrated sulphuric acid	a sweet smelling liquid	☐
(d)	warm with acidified potassium dichromate(VI)	solution turns green	☐

[1]

8 A beaker of an unknown gas **Y** was inverted over a porous pot containing carbon monoxide as shown. The apparatus was left for a while but the water level did not change.



The gas **Y** could have been

(a) ammonia, ☐

(b) carbon dioxide, ☐

(c) chlorine, ☐

(d) nitrogen. ☐

[A_r: N, 14; H, 1; C, 12; O, 16; C*l*, 35.5.] [1]

9 Hydrated sodium carbonate has the formula $Na_2CO_3.xH_2O$ where x is a whole number.

A student determined the value of x in the formula by titrating an aqueous solution of sodium carbonate with 0.080 mol/dm^3 hydrochloric acid (solution **F**)

A sample of $Na_2CO_3.xH_2O$ was placed in a previously weighed container, which was then reweighed.

Mass of container + $Na_2CO_3.xH_2O$	=	5.71g
Mass of container	=	3.73g

(a) Calculate the mass of $Na_2CO_3.xH_2O$.

..................................g [1]

The sample of $Na_2CO_3.xH_2O$ was dissolved in distilled water and made up to a 250 cm^3 solution. This was solution **G**.

25.0 cm^3 of **G** was transferred to a conical flask.

(b) Which piece of apparatus is most suitable for this purpose?

....[1]

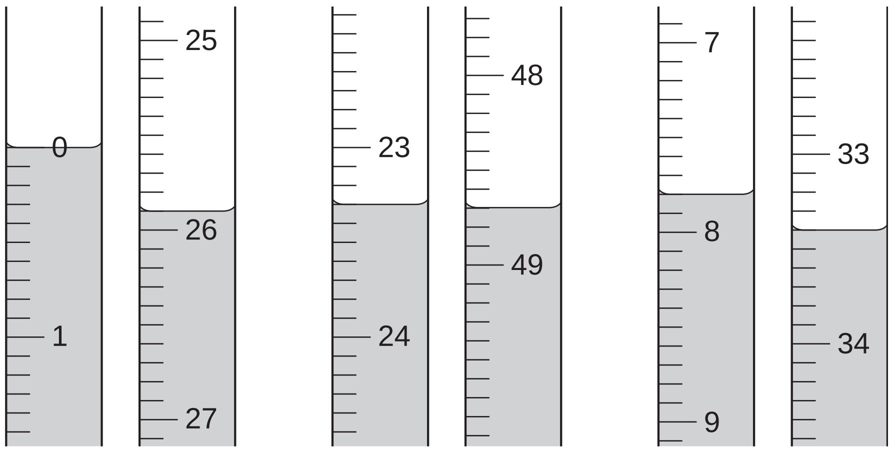
Two drops of methyl orange indicator were added to **G**.
Solution **F** was run in from a burette until an end point was reached.

(c) What was the colour change at the end point?

The colour changed from ....to ....at the end point. [1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels before and after each titration.

first titration second titration third titration



(d) Use the diagrams to complete the following table.

titration	first	second	third
final reading/cm^3			
initial reading/cm^3			
volume of solution **F**/cm^3			
best titration results (✔)			

Summary

Tick (✔) the best titration results. Using these results, the average volume of **F** was

.... cm^3. [4]

(e) Calculate the number of moles of hydrochloric acid in the average volume calculated in **(d)**.

....moles [1]

Sodium carbonate reacts with hydrochloric acid according to the following equation.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$$

(f) Calculate the number of moles of sodium carbonate which reacts with the number of moles of hydrochloric acid calculated in **(e)**.

....moles [1]

(g) Calculate the number of moles of sodium carbonate in 250 cm^3 of solution **G**.

....moles [1]

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

....[1]

(i) Using your answers to **(g)** and **(h)**, calculate the mass of sodium carbonate, Na_2CO_3, in 250 cm^3 of solution **G**.

....g [1]

(j) By subtracting your answer in **(i)** from your answer in **(a)**, calculate the mass of water in the original sample of hydrated sodium carbonate.

....g [1]

(k) Using your answers in **(i)** and **(j)** in the following formula, calculate the value of x in $Na_2CO_3.xH_2O$.

$$x = \frac{106 \times \text{answer } \textbf{(j)}}{18 \times \text{answer } \textbf{(i)}}$$

.... [1]

10 The following table shows the tests a student did on substance **L** and the conclusions made from the observations. Complete the table by describing these observations and suggest the test and observation that led to the conclusion in test **4**.

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test	observation	conclusion
1 **L** was dissolved in water and the solution divided into three parts for tests **2**, **3** and **4**.		**L** is a compound of a transition metal
2 **(a)** To the first part, aqueous sodium hydroxide was added until a change was seen. **(b)** An excess of aqueous sodium hydroxide was added to the mixture from **(a)**.		**L** may contain Fe^{3+} ions.
3 **(a)** To the second part, aqueous ammonia was added until a change was seen. **(b)** An excess of aqueous ammonia was added to the mixture from **(a)**.		The presence of Fe^{3+} ions is confirmed.
4		**L** contains NO_3^- ions.

Conclusion: the formula for substance **L** is ....[10]

[Turn over

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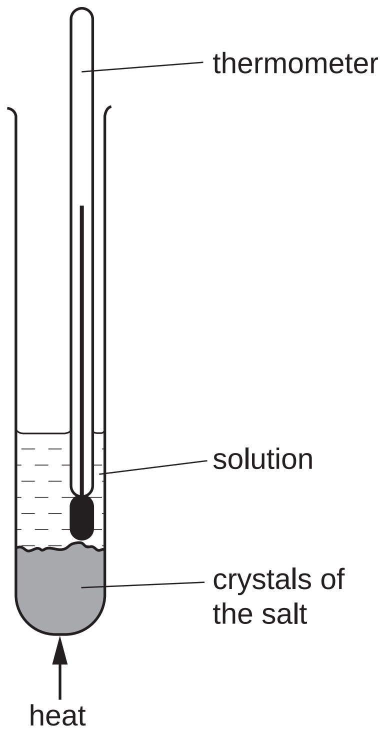
11 A student found the solubility of the salt potassium chlorate(V), in water using the apparatus shown below.



10 g of water was put into a boiling tube. To this 0.5 g of potassium chlorate(V) was added. The tube and its contents were heated until the solid dissolved. The tube was allowed to cool. At the first sign of solid appearing the temperature was taken. The experiment was repeated using 1.0, 2.0, 3.0, and 4.0 g of potassium chlorate(V).

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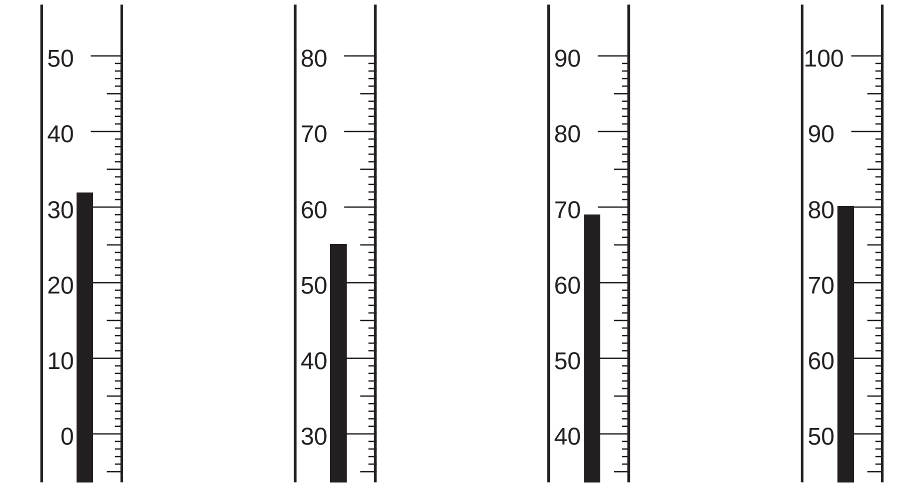
Question 11 continues overleaf.

(a) The thermometer stems below show the temperature at which the solid appeared. Use these values to complete the table below.



mass of potassium chlorate(V) in 10 g of water	0.5 g	1.0 g	2.0 g	3.0 g	4.0 g
temperature / °C at which potassium chlorate(V) appears	10				

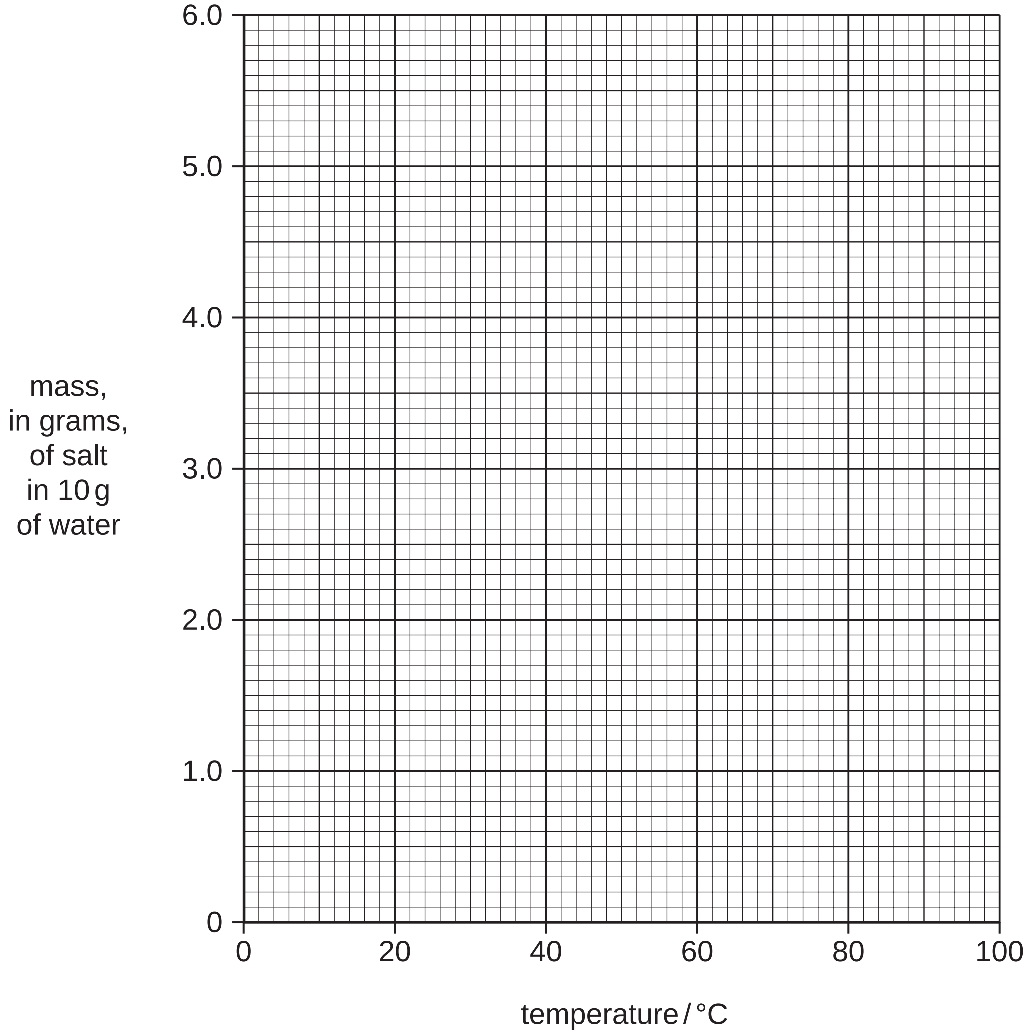
[2]

The experiment was repeated for the salt potassium chloride, the results for which are shown in the table below.

mass of potassium chloride in 10 g of water	3.5	4.0	4.5	5.0
temperature / °C at which potassium chloride appears	10	33	56	80

(b) Plot the results for both potassium chlorate(V) and for potassium chloride on the grid opposite.
Join the points for potassium chlorate(V) with a smooth curved line and those for potassium chloride with a straight line.

Extend each line in both directions, so that at the lower ends each line crosses the vertical axis and at the upper ends the lines cross. Use the resulting lines to answer the following questions.



[4]

(c) What is the mass of each compound that dissolves in 10 g of water at 0 °C?

(i) Potassium chlorate(V) ....g

Potassium chloride ....g

(ii) At what temperature is the solubility of each salt the same?

....°C [3]

(d) The *solubility of a salt* is defined as the maximum mass of salt that will dissolve in 100 g of water at a given temperature.
Calculate the solubility of both potassium chlorate(V) and potassium chloride at the temperature you have given in **(c)(ii)**.

....g [1]

(e) The student was given a boiling-tube containing 3.0 g of potassium chlorate(V) in 10.0 g of water at a temperature of 40 °C
Describe the appearance of the contents of the tube.

....[1]

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