UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

8552782419

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 2012**

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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
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.

For Examiner's Use

This document consists of **16** printed pages.

DC (SJF/SW)) 42237/3

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International Examinations

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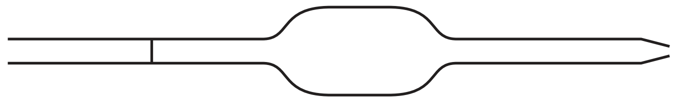
For Examiner's Use

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



.... [1]

(b) **(i)** What safety item should be used with this apparatus?

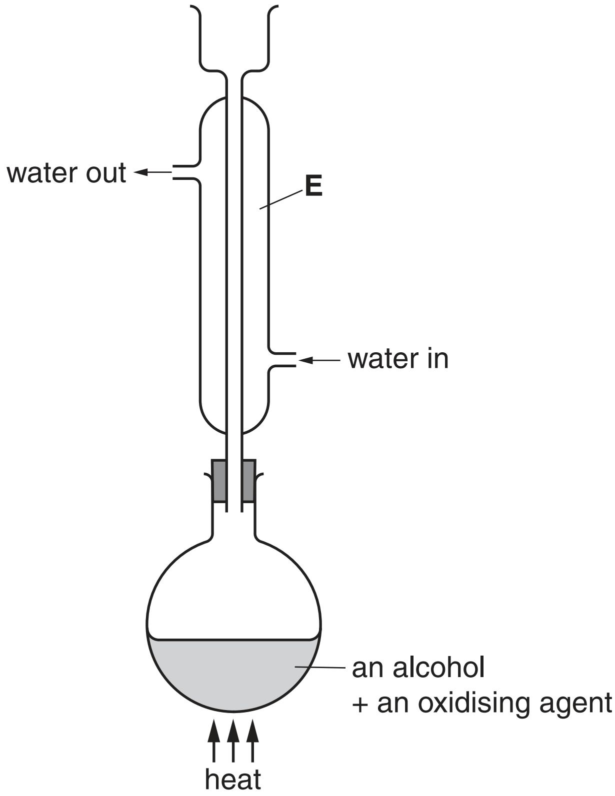
.... [1]

(ii) Why is the safety item used?

.... [1]

[Total: 3]

2 A student uses the apparatus shown below to prepare ethanoic acid, CH_3CO_2H.



(a) **(i)** Name the apparatus **E**.

.... [1]

(ii) Why is it used in this preparation?

....

.... [1]

(b) A small volume of an alcohol is placed in the flask together with an oxidising agent. The mixture is warmed and a colour change observed in the flask.

(i) Name and give the formula of the alcohol which is used to produce ethanoic acid.

name ....

formula .... [1]

(ii) Suggest a suitable oxidising agent and state the colour change which is seen.

oxidising agent ....

the colour changes from ………………………… to ………………………… [2]

(iii) What piece of apparatus should the student use to heat the mixture? Explain your choice.

....

....

.... [2]

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(c) A student compares some of the properties of ethanoic acid with those of sulfuric acid.

A few drops of universal indicator are added to $2\,cm^3$ of $1.0\,mol/dm^3$ solutions of each acid.

(i) What are the final colours of the indicator in

ethanoic acid, ...

sulfuric acid? .... [2]

(ii) A piece of magnesium ribbon is added to $2\,cm^3$ of each acid.

State what is seen and compare and explain the speeds of the two reactions.

....

....

....

.... [2]

(d) A mixture of ethanol and ethanoic acid is warmed with a few drops of concentrated sulfuric acid.

Name and give the structure of the organic product which is formed and state the homologous series of compounds of which it is a member.

name ....

structure ....

series .... [3]

[Total: 14]

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3 A student adds 50 cm^3 of 1.50 mol / dm^3 barium nitrate to 100 cm^3 of 1.00 mol / dm^3 sodium sulfate.

Barium sulfate is produced.

(a) **(i)** Describe the appearance of barium sulfate in the resulting mixture.

.... [1]

(ii) How does the student produce a pure sample of barium sulfate from the original mixture?

....

....

.... [3]

(b) The equation for the reaction is

$$Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$$

(i) Calculate the number of moles of barium nitrate present in 50 cm^3 of 1.50 mol / dm^3 solution.

.... moles [1]

(ii) Calculate the number of moles of sodium sulfate in 100 cm^3 of 1.00 mol / dm^3 solution.

.... moles [1]

(iii) Deduce the number of moles of barium sulfate produced.

.... moles [1]

(iv) Calculate the mass of barium sulfate produced.
[A_r: O,16; S, 32; Ba,137]

.... g [2]

[Total: 9]

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

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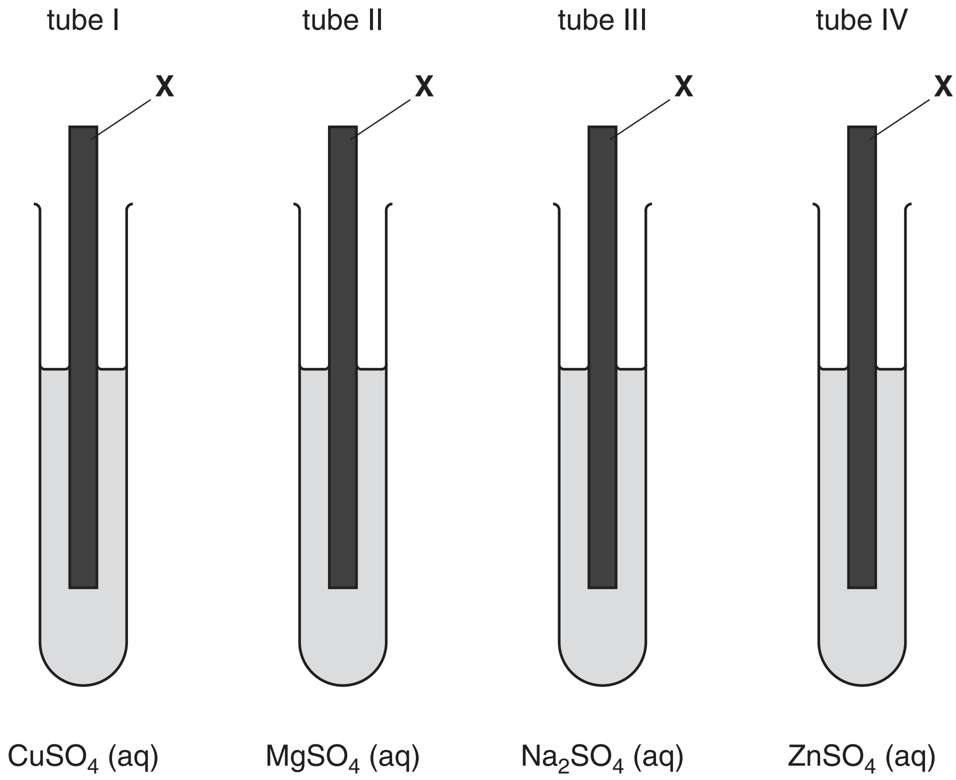
4 Separate strips of a metal **X** are placed in test-tubes containing aqueous solutions of salts as shown in the diagrams.



A deposit is formed on metal **X** in only two of the test-tubes.

In which two test-tubes is a metal deposit formed?

(a) I and II ☐

(b) I and IV ☐

(c) II and III ☐

(d) II and IV ☐ [1]

[Total: 1]

5 Pieces of calcium are added to a test-tube containing water coloured green by Universal indicator.

A gas is given off and the indicator changes colour.

The gas is tested.

Which pair of observations is correct?

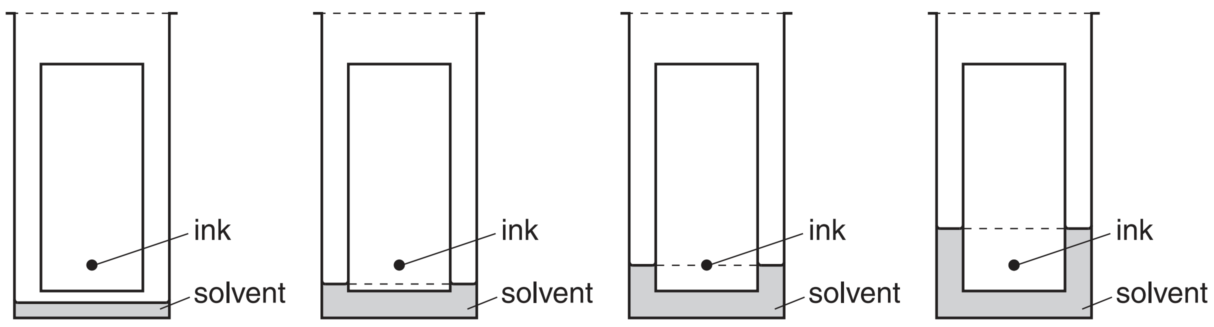
	final colour of solution	test on gas	
(a)	purple	relights a glowing splint	☐
(b)	red	pops in a flame	☐
(c)	purple	pops in a flame	☐
(d)	red	relights a glowing splint	☐

[1]

[Total: 1]

6 Chromatography can be used to separate the dyes present in black ink.

Which diagram shows the correct arrangement at the beginning of the experiment?



(a) ☐ **(b)** ☐ **(c)** ☐ **(d)** ☐

[1]

[Total: 1]

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7 The organic compound **T** contains 85.7% carbon and 14.3% hydrogen.

What is its empirical formula?
[A_r : H,1; C,12]

(a) CH ☐

(b) CH_2 ☐

(c) CH_3 ☐

(d) CH_4 ☐ [1]

[Total: 1]

8 A student does three experiments in which three different solutions of hydrochloric acid are added to equal masses of calcium carbonate.

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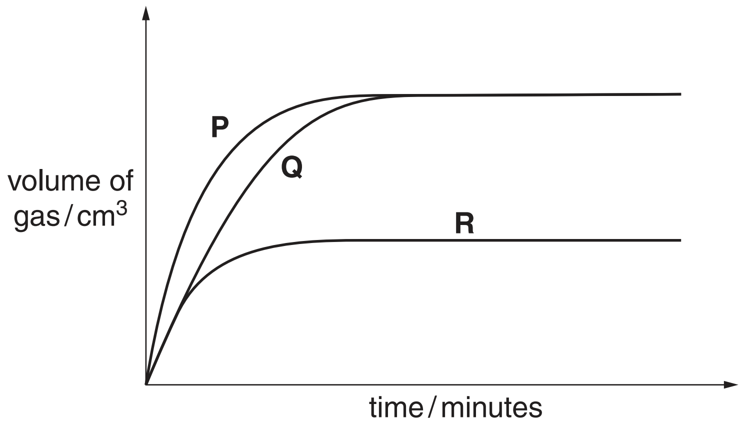
The calcium carbonate is in excess.

The gas produced is collected in a syringe and the volume is recorded at one minute intervals.

The temperature of the acid is the same in each experiment.

The results are used to plot the graphs shown below.



The three solutions are

(I) 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid,

(II) 25.0 cm^3 of 2.0 mol / dm^3 hydrochloric acid,

(III) 50.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid.

Which curve corresponds to which solution?

	(I)	(II)	(III)	
(a)	P	Q	R	☐
(b)	R	Q	P	☐
(c)	Q	R	P	☐
(d)	R	P	Q	☐

[1]

[Total: 1]

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9 A student is given a sample of a metal hydroxide, **M**OH, and asked to determine the relative atomic mass of **M** by titrating an aqueous solution of **M**OH with 0.095 mol/dm^3 sulfuric acid, solution **S**.

(a) A sample of **M**OH is placed in a previously weighed container, which is then reweighed.

mass of container + **M**OH	=	11.58 g
mass of container	=	8.89 g

Calculate the mass of **M**OH used in the experiment.

.... g [1]

(b) The student transfers the sample of **M**OH to a beaker, adds about 100 cm^3 of distilled water and stirs the mixture until all the solid has dissolved. The contents of the beaker are then transferred to a volumetric flask.
The solution is made up to 250 cm^3 with distilled water.
This is solution **G**.
25.0 cm^3 of **G** is transferred to a conical flask.
A few drops of methyl orange indicator are added to the conical flask.

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

What is the colour of the solution in the conical flask

(i) before **S** is added, ...

(ii) at the end-point? ....[1]

(c) The student does three titrations. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.

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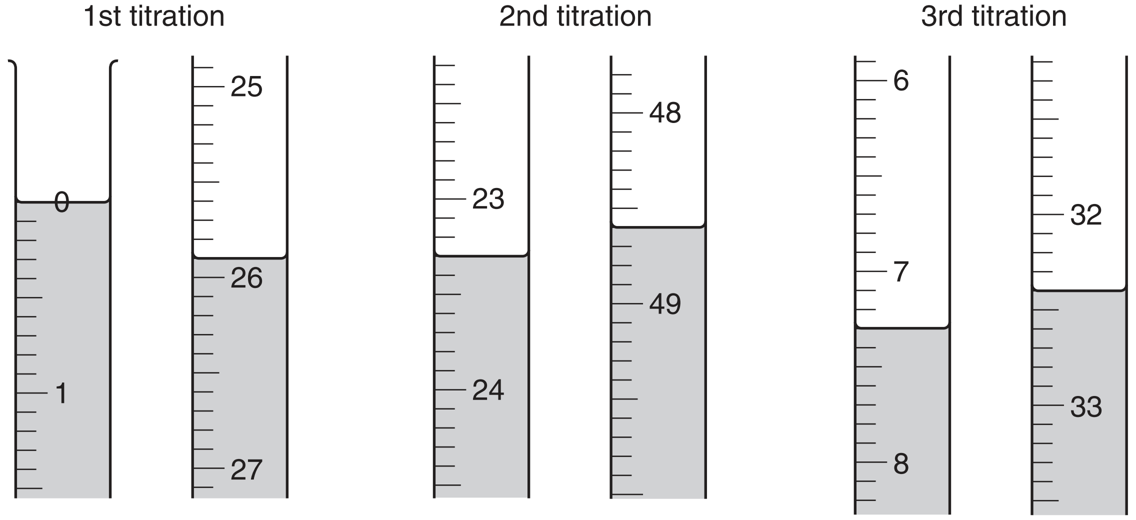

Use the diagrams to complete the following table.

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

Summary

Tick (✓) the best titration results.

Using these results the average volume of **S** is

.... cm^3 [4]

(d) Calculate the number of moles of sulfuric acid in the average volume of 0.095 mol / dm^3 sulfuric acid, **S**, from **(c)**.

.... moles [1]

[Turn over

(e) Using your answer to **(d)** and the equation, calculate the number of moles of **M**OH in 25.0 cm^3 of **G**.

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$$2\mathbf{M}OH + H_2SO_4 \rightarrow \mathbf{M}_2SO_4 + 2H_2O$$

.... moles [1]

(f) Using your answer to **(e)** calculate the number of moles of **M**OH in 250 cm^3 of **G**.

.... moles [1]

(g) Using your answers to **(a)** and **(f)** calculate the mass of one mole of **M**OH.

.... [1]

(h) Using your answer to **(g)** calculate the relative atomic mass of **M**.
[A_r: H,1; O,16]

.... [1]

[Total: 11]

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10 **V** is a compound which contains two ions.

Complete the table by adding the observations for **(a)**, **(b)(i)**, **(b)(ii)** and **(c)**, and the test and observation for **(d)**.

test	observation	conclusion
(a) **V** is dissolved in water and the solution divided into three parts for use in **(b)**, **(c)** and **(d)**.		**V** is probably not a compound of a transition metal.
(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)**.		 **V** may contain Ca^{2+} ions.
(c) To the second part, aqueous ammonia is added until a change is seen.		The presence of Ca^{2+} in **V** is confirmed.
(d)		The presence of Cl^- in **V** is confirmed.

[Total: 7]

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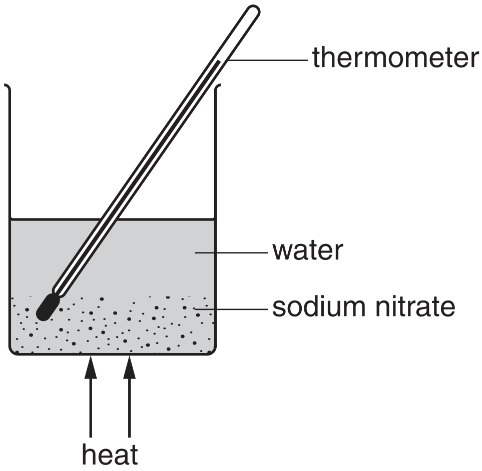
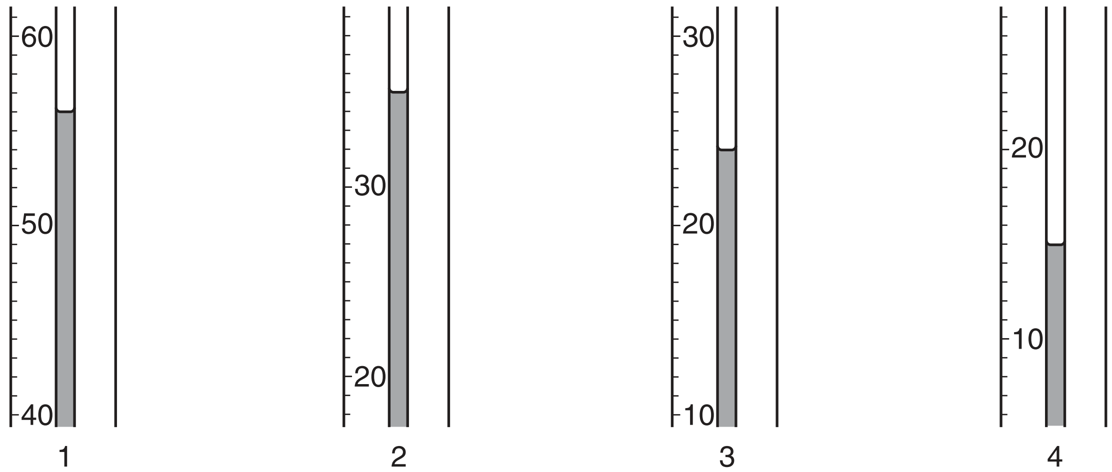
11 A student does four experiments to find how the solubility of sodium nitrate varies with temperature.



10.0 g of sodium nitrate is put into a beaker and 10.0 cm^3 of water is added.
The beaker is heated and the contents stirred until all the solid dissolves.
The beaker is allowed to cool slowly. The temperature at which crystals first appear is noted.

A further 10.0 cm^3 of water is added and the process repeated.
The experiment is repeated for two further 10.0 cm^3 additions of water.

The diagrams below show parts of the thermometer stem indicating the temperature at which crystals appear for total volumes of 10.0, 20.0, 30.0 and 40.0 cm^3.



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The solubility of sodium nitrate at each temperature is calculated by using the formula

$$\text{solubility in g}/100\,\text{cm}^3\text{ water} = \frac{\text{mass of sodium nitrate}}{\text{volume of water}} \times 100$$

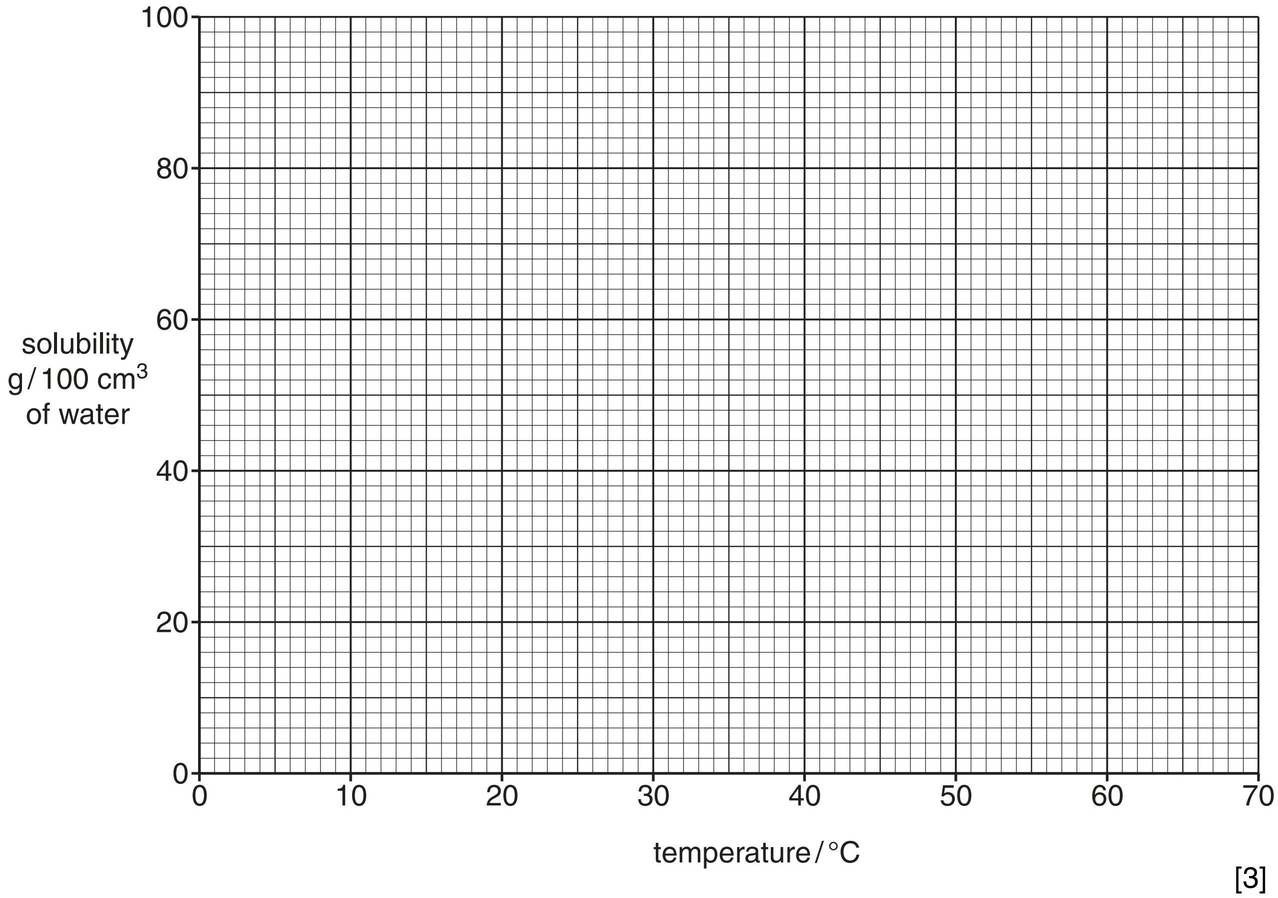
(a) Complete the temperature column of the table using the temperatures shown in the diagram.

Complete the solubility column of the table using the formula shown above.

experiment	total volume of water in solution / cm^3	temperature at which crystals appear / °C	solubility / g /100 cm^3 of water.
1	10.0		100
2	20.0		
3	30.0		33
4	40.0		

[2]

(b) Plot the results on the grid below and draw a smooth curve through the points. Extend the curve to meet the vertical axis.



[3]

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(c) Use the graph to answer the following questions.

What is the solubility of sodium nitrate at

(i) 0 °C,

.............................g / 100 cm^3 water

(ii) 40 °C?

.............................g / 100 cm^3 water
[2]

(d) What is the lowest temperature at which 50 cm^3 of water will dissolve 35 g of sodium nitrate?

.... °C [2]

(e) A hot solution of 150 g of sodium nitrate in 100 cm^3 of water is cooled to 50 °C. What mass of sodium nitrate crystallises out?

.... g [2]

[Total: 11]