Centre Number	Candidate Number

Candidate Name _____

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

Joint Examination for the School Certificate and General Certificate of Education Ordinary Level

CHEMISTRY 5070/4

PAPER 4 Alternative to Practical

OCTOBER/NOVEMBER SESSION 2001 1 hour

Candidates answer on the question paper.
No additional materials required.

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
All essential working must be shown.

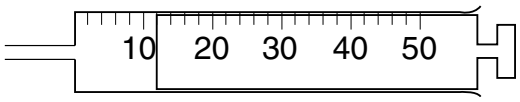
INFORMATION FOR CANDIDATES

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 the products formed.

FOR EXAMINER'S USE

This question paper consists of 14 printed pages and 2 blank pages.

1 Name the apparatus shown below.



.....[1]

2 A student was given some hydrated copper(II) sulphate crystals, $CuSO_4.\mathbf{x}H_2O$. They were placed in a previously weighed test-tube which was then reweighed.

(a) What colour are hydrated copper(II) sulphate crystals?

.....[1]

Mass of test-tube + hydrated copper(II) sulphate crystals = 9.25 g
Mass of test-tube = 5.40 g

(b) Calculate the mass of hydrated copper(II) sulphate used in the experiment.

.....[1]

The crystals were gently heated until they became anhydrous, ie no more water vapour was given off. The crystals changed colour and became powdery.

(c) What colour was the copper(II) sulphate after heating?

.....[1]

Mass of test-tube + copper(II) sulphate after heating = 7.90 g

(d) (i) Calculate the mass of copper(II) sulphate which remained after heating.

.....

(ii) Calculate the mass of water lost from the crystals.

.....
[2]

(e) Calculate

(i) the relative formula mass of anhydrous copper(II) sulphate,
(A_r: Cu, 64; S, 32; O, 16)

.....

(ii) the relative molecular mass of water.

.....

[2]

(f) Using your answers to **(d)** and **(e)**, calculate

(i) how many moles of anhydrous copper(II) sulphate remained after heating,

.....

(ii) how many moles of water were lost on heating.

.....

[2]

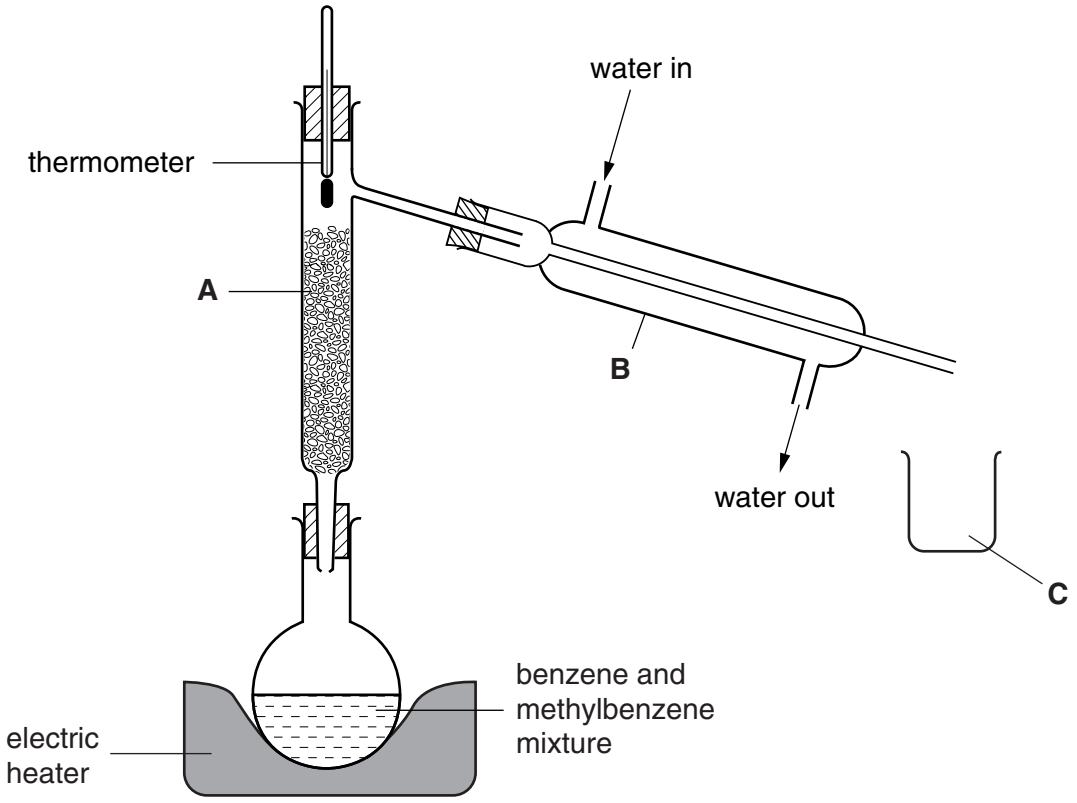
(g) The value of **x** in the formula $CuSO_4.xH_2O$ can be found as follows.

$$\mathbf{x} = \frac{\text{answer to } \mathbf{(f)(ii)}}{\text{answer to } \mathbf{(f)(i)}}$$

Calculate the value of **x**. Hence write the formula of hydrated copper(II) sulphate crystals.

The formula is .....[2]

3 A student separated benzene (b.p. 80 °C) and methylbenzene (b.p. 111 °C) by using the apparatus shown below.



(a) What error has the student made in setting up the apparatus?

.....[1]

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

.....

(ii) Why is it used?

.....
[2]

(c) (i) Name the apparatus **B**.

.....

(ii) Why is it used?

.....[2]

(d) Why was an electric heater rather than a flame used to heat the mixture?

.....[1]

(e) (i) What was the reading on the thermometer when the first few drops of distillate appeared in **C**?

.....

(ii) What was this distillate?

.....

(iii) How did the student know when all of the first fraction had distilled over?

.....[3]

In questions 4 to 8, place a tick in the box against the best answer.

4 A student added aqueous sodium hydroxide to a salt **X**. On warming, a gas was evolved which turned litmus blue.

Which ion was present in **X**?

(a) Cl^- ☐

(b) H^+ ☐

(c) NH_4^+ ☐

(d) NO_3^- ☐

[1]

5 When aqueous ethanoic acid was added to ethanol, a sweet smelling liquid was produced.

What type of reaction occurred?

(a) esterification ☐

(b) hydrolysis ☐

(c) oxidation ☐

(d) reduction ☐

[1]

6 Water containing a little dilute sulphuric acid was electrolysed, using carbon electrodes.

If 20 cm^3 of oxygen were produced, what was the volume of hydrogen produced?

(a) 10 cm^3 ☐

(b) 20 cm^3 ☐

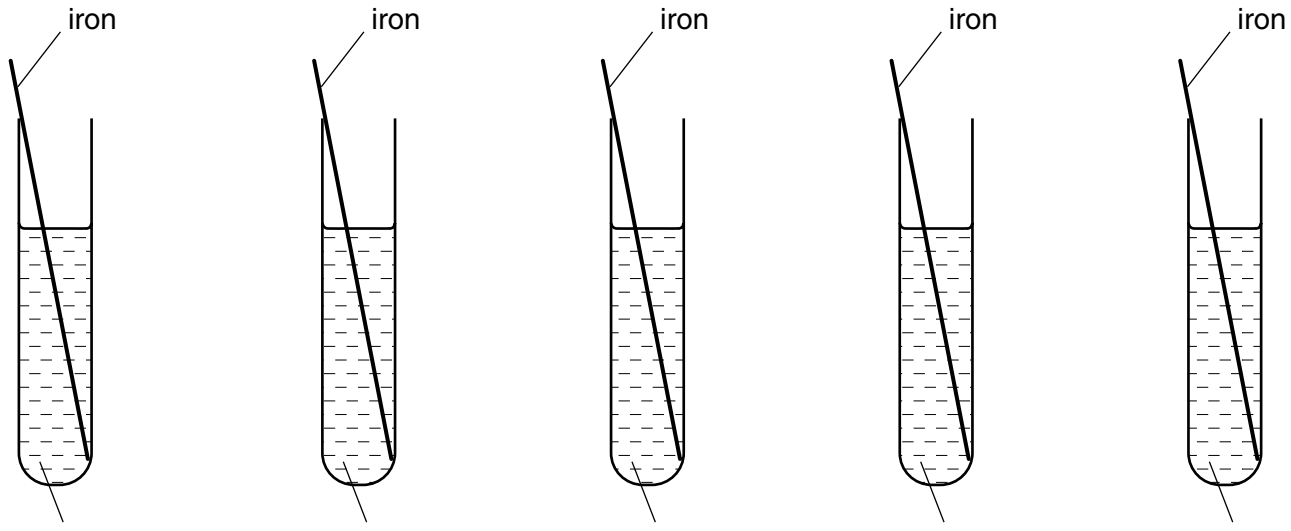
(c) 30 cm^3 ☐

(d) 40 cm^3 ☐

[1]

7 Strips of iron were placed in separate solutions of several metal nitrates.

In which tube was a deposit formed on the surface of the iron?



(a) ☐ **(b)** ☐ **(c)** ☐ **(d)** ☐ **(e)** ☐

[1]

8 Which of the following is **not** a reaction of ethene?

(a) ethene decolourises aqueous bromine from orange to colourless ☐

(b) ethene reacts with ethanoic acid to form an ester ☐

(c) ethene burns to carbon dioxide and water ☐

(d) ethene polymerises into a material which is used to make plastic bags. ☐

[1]

[Turn over

9 A student determined the percentage of iron in iron wire by titration with 0.020 mol/dm^3 potassium manganate(VII), $KMnO_4$, which is purple.

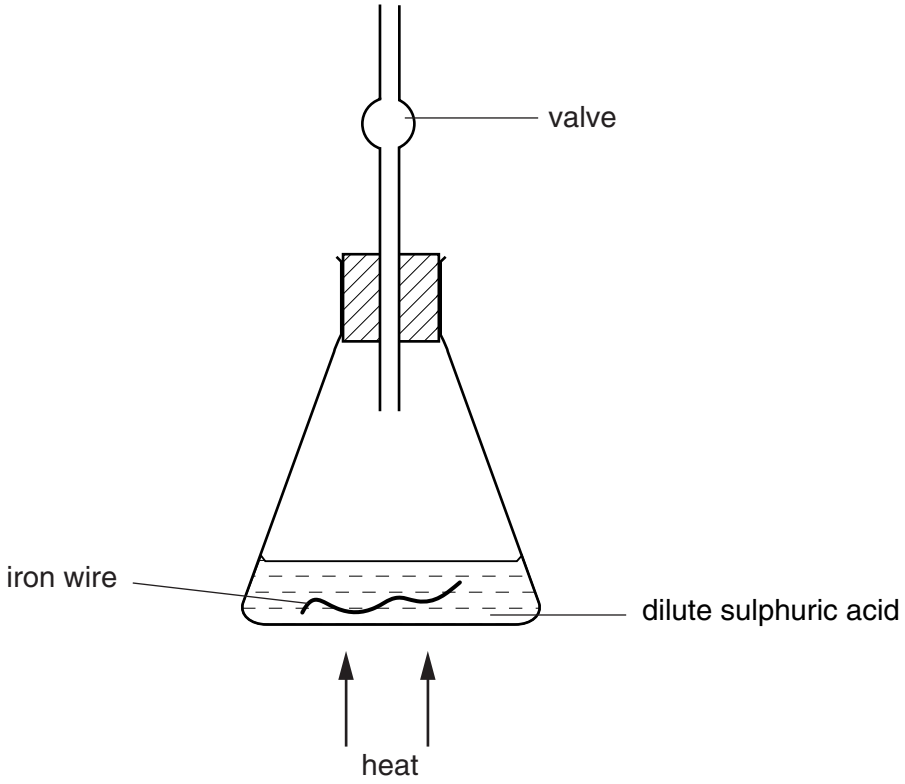
(a) A piece of iron wire was added to a previously weighed container which was then reweighed.

Mass of container + iron wire = 7.39 g
Mass of container = 5.74 g

Calculate the mass of iron wire used in the experiment.

..... g [1]

The iron wire was placed in a conical flask as shown below. Sufficient dilute sulphuric acid was added to react completely with the iron wire. The flask was warmed to convert the iron into iron(II) ions, Fe^{2+}. The valve allows the gas to escape but does not allow air into the flask.



(b) (i) Why was it necessary to prevent air entering the apparatus?

.....

(ii) Name the gas produced during the reaction in **(a)**.

.....

(iii) Give a test for the gas.

.....

.....[3]

When all the iron had reacted, the solution was cooled and made up to 250 cm^3 with dilute sulphuric acid in a graduated flask. This was solution **P**.

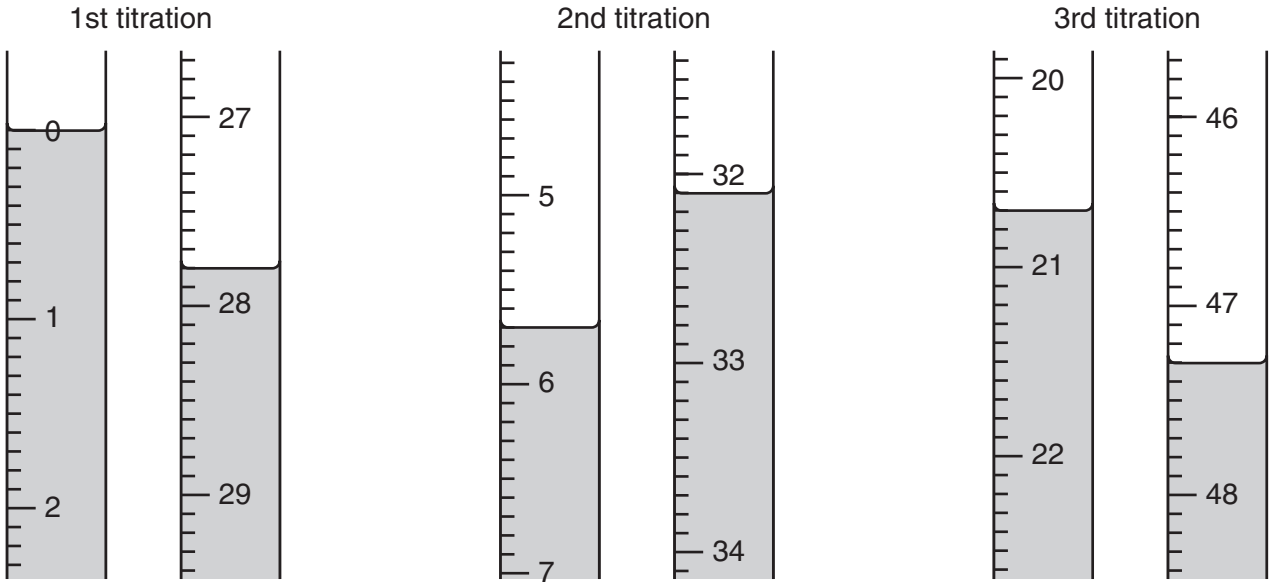
A 25.0 cm^3 sample of this solution was pipetted into a titration flask.

Then, 0.020 mol/dm^3 potassium manganate(VII) was added from a burette.

(c) What colour change showed that the end point had been reached?

The colour changed from ..... to .....[1]

Three titrations were done. Parts of the burette with the liquid levels before and after each titration are shown below.



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

titration number	first	second	third
Final reading/cm^3			
First reading/cm^3			
Volume of 0.020 mol/dm^3 potassium manganate(VII) used			
Best titration results (✓)			

Summary

Tick the best titration results. Using these results, the average volume of 0.020 mol/dm^3 potassium manganate(VII) required was .....cm^3

The volume of **P** used was 25.0 cm^3. [4]

(e) Calculate how many moles were present in the average volume of 0.020 mol/dm^3 $KMnO_4$.

.....[1]

(f) Five moles of Fe^{2+} react with one mole of $KMnO_4$.

Calculate how many moles of Fe^{2+} were present in 25.0 cm^3 of solution **P**.

.....[1]

(g) Calculate how many moles of Fe^{2+} were in 250 cm^3 of solution **P**.

.....[1]

(h) Calculate the mass of iron in 250 cm^3 of solution **P**.
(A_r: Fe, 56)

.....[1]

(i) Using your answers to **(a)** and **(h)**, calculate the percentage of iron in the iron wire.

.....[1]

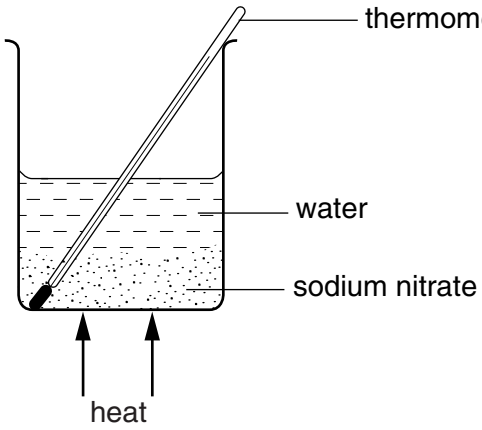
10 The following table shows the tests on substance **W** and the conclusions made from the observations.
Complete the table by describing these observations and suggest the test and observations which led to the conclusion from test 4.

test	observation	conclusion
1 **W** was dissolved in water and the solution divided into three parts for tests 2, 3 and 4.		**W** is not 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)**.		**W** may contain Al^{3+} or Zn^{2+} 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 Zn^{2+} ions is confirmed.
4		**W** contains Cl^- ions.

Conclusion

The formula for substance **W** could be .....[10]

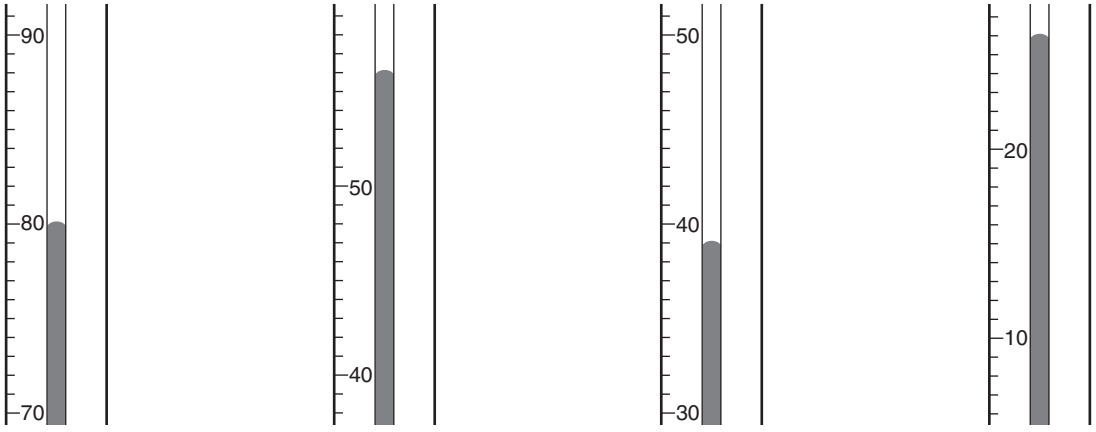
11 A student did four experiments to find how the solubility of sodium nitrate varies with temperature.



A 20.0 g sample of sodium nitrate was put into the beaker and 10.0 cm^3 of water were added. The beaker was heated and the contents stirred until all the solid was dissolved. The beaker was allowed to cool slowly. The temperature at which crystals first appeared was noted.

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

(a) The diagrams below show the thermometer when crystals appeared for total volumes of 10.0, 20.0, 30.0 and 40.0 cm^3.



The solubility of sodium nitrate at each temperature was calculated by using the formula below.

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

(i) Complete the temperature column using the temperatures shown in the diagram.

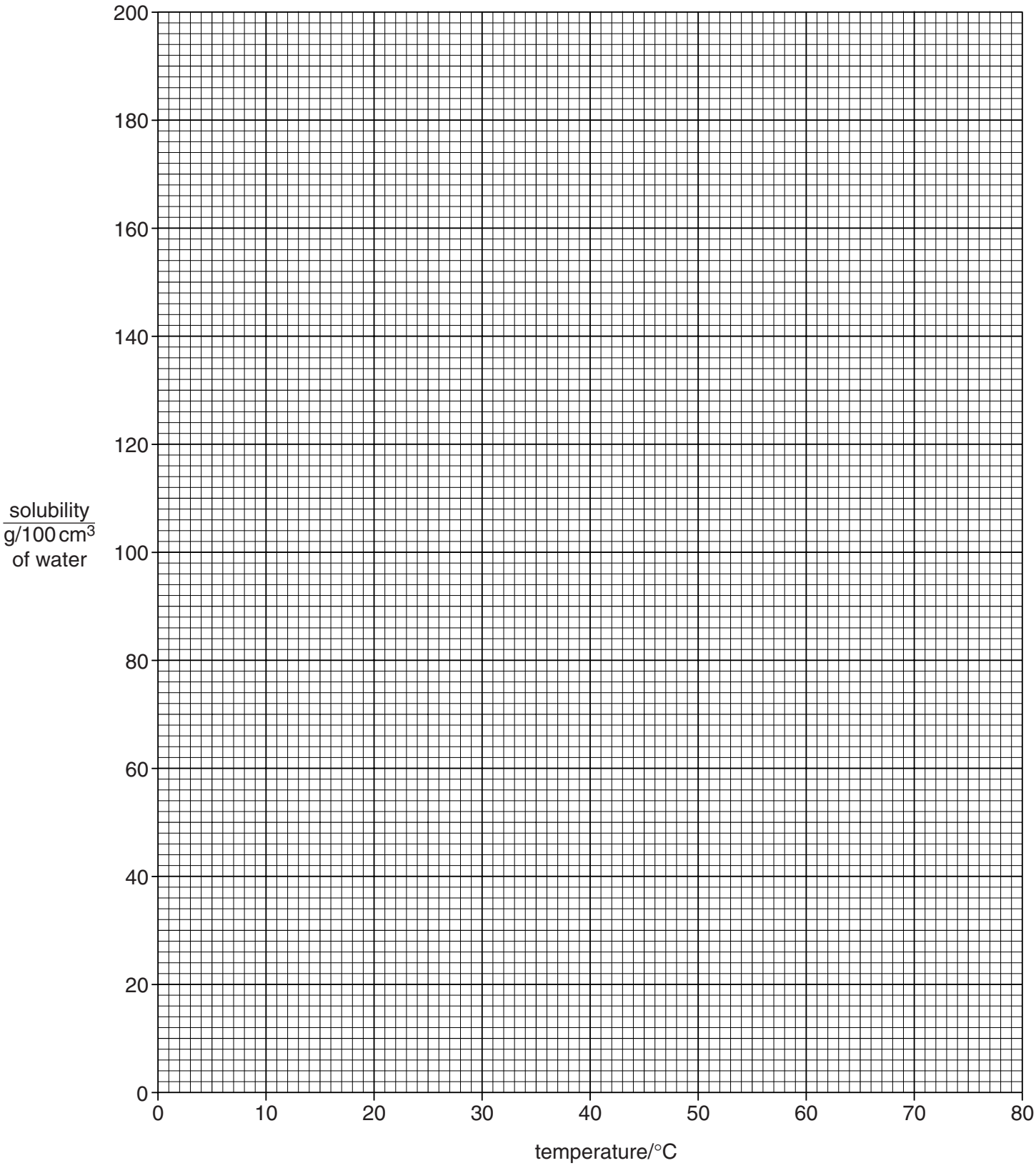
(ii) Complete the solubility column using the formula shown above.

experiment	total volume of water in solution/cm^3	temperature at which crystals appear/°C	solubility / g/100 cm^3 of water
1	10		200
2	20		
3	30		67
4	40		

[3]

For Examiner's Use

(b) Plot the results on the grid below. Connect the points with a smooth curve and extend this curve to meet the vertical axis.



[2]

[Turn over

Use the curve on page 13 to answer the following questions.

(c) What is the solubility of sodium nitrate at

(i) 10 °C,

.....

(ii) 70 °C?

.....
[2]

(d) What is the lowest temperature at which 100 cm^3 of water will dissolve 110 g of sodium nitrate?

.....[1]

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

.....[2]

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