UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2012**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

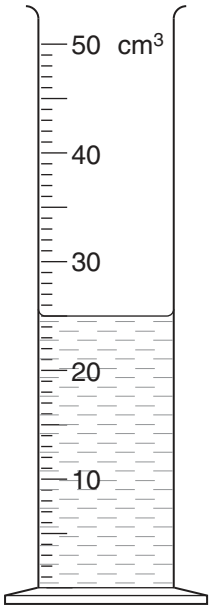
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
The number of marks is given in brackets [ ] at the end of each question or part question.
At the end of the examination, fasten all your work securely together.

For Examiner's Use

This document consists of **18** printed pages and **2** blank pages.

1 **(a)** A student pours aqueous silver nitrate into a measuring cylinder.



What is the volume of aqueous silver nitrate in the measuring cylinder?

..... cm^3 [1]

(b) The student transfers the aqueous silver nitrate into a beaker containing excess aqueous potassium iodide. A precipitate of silver iodide is formed.
What colour is silver iodide?

..... [1]

(c) The student separates the silver iodide precipitate from the solution.
Name the separation process.

..... [1]

(d) The student dries and weighs the silver iodide.

mass of silver iodide = 4.70 g

Calculate the number of moles of silver iodide in this mass.
[A_r: Ag, 108; I, 127]

..... moles [1]

(e) The concentration of aqueous potassium iodide used is 1.00 mol/dm^3. It reacts with aqueous silver nitrate according to the following equation.

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$$AgNO_3 + KI \rightarrow AgI + KNO_3$$

Using your answer from **(d)**, deduce the number of moles of silver nitrate used in the reaction.

..... moles [1]

(f) Using your answers to **(a)** and **(e)** calculate the concentration of the aqueous silver nitrate.

..... mol/dm^3 [1]

[Total: 6]

2 A student is given some copper powder.

(a) The student heats the copper in air to form copper(II) oxide.

Give the formula and colour of copper(II) oxide.

formula .....

colour ..... [2]

(b) The student adds dilute sulfuric acid to the copper(II) oxide. A reaction takes place. Construct the equation for the reaction.

..... [1]

(c) Name the coloured compound present in the aqueous solution formed and give its colour.

name .....

colour ..... [1]

(d) Half of the solution from **(b)** is poured into a beaker. Some powdered zinc is added to this solution and left for a while.
Describe what is seen.

.....

.....

.....

..... [3]

(e) A metal is added to the other half of the solution from **(b)**. No reaction is observed.

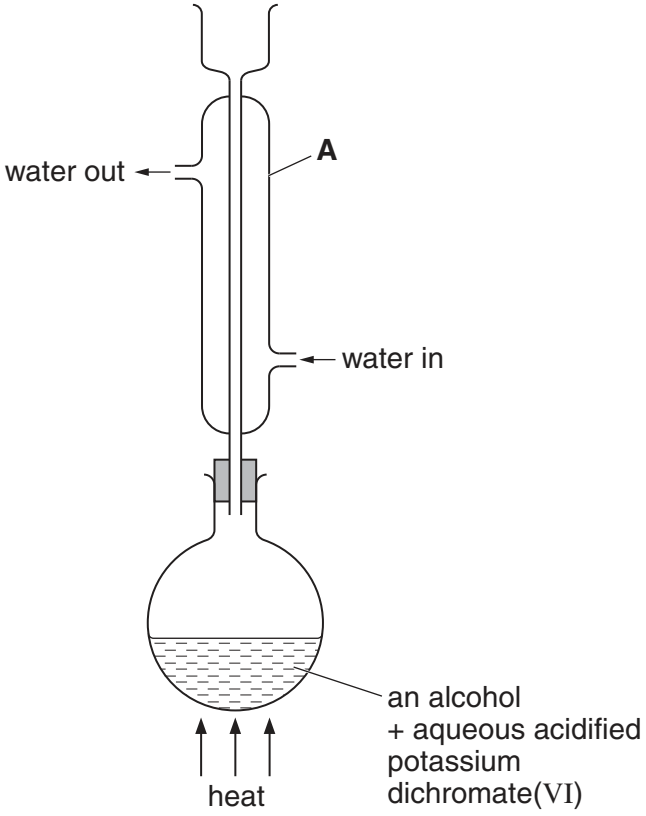
Suggest the name of this metal.

..... [1]

[Total: 8]

3 A student prepares propanoic acid by oxidising an alcohol with acidified potassium dichromate(VI) in the apparatus shown below.

For Examiner's Use



(a) (i) Name and give the formula of the alcohol used to prepare propanoic acid.

alcohol .....

formula ..... [2]

(ii) Name apparatus **A** and suggest why it is used in this preparation.

name .....

use .....

..... [2]

(iii) Explain which is the better choice to heat the flask; an electric heater or a Bunsen burner.

.....

.....

..... [1]

(b) When all the alcohol has been oxidised the student uses the apparatus shown below to produce a pure sample of propanoic acid (boiling point, 140 °C).

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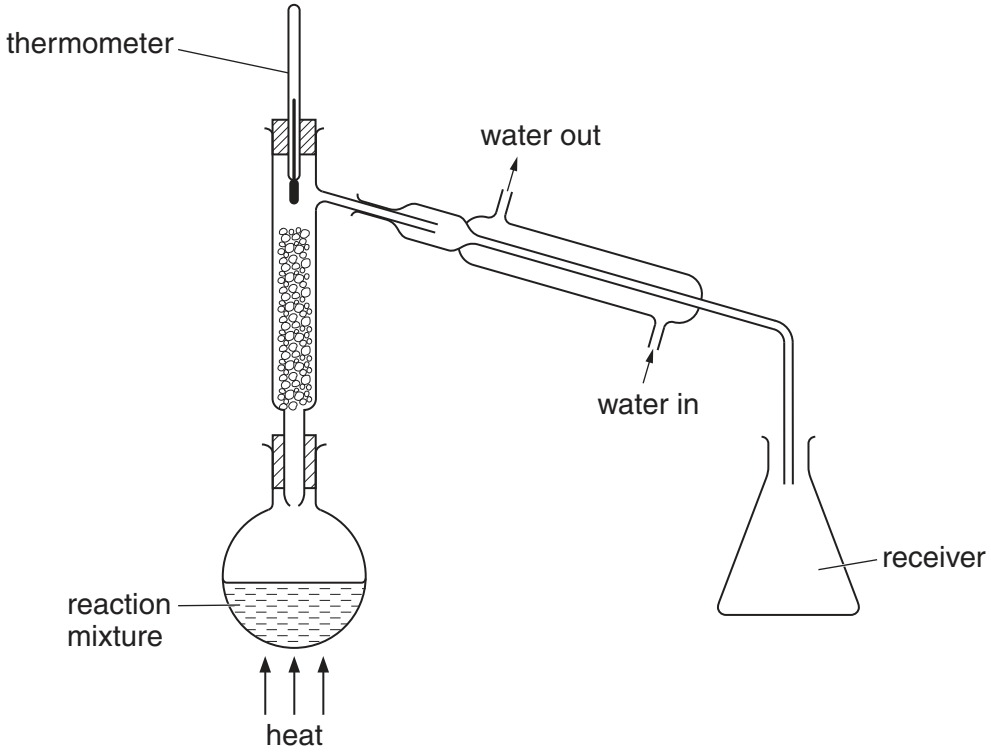

(i) Water will initially distil over into the receiver flask.
What is the reading on the thermometer when the water is distilling over?

..... °C [1]

(ii) How does the student know when propanoic acid begins to distil over?

..... [1]

(iii) Why should the top of the receiver flask remain open?

..... [1]

[Total: 8]

In questions **4** to **7** inclusive, place a tick (✓) in the box against the correct answer.

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4 How many of the following salts are insoluble in water?

barium sulfate
calcium carbonate
potassium nitrate
sodium chloride

(a) 1 ☐

(b) 2 ☐

(c) 3 ☐

(d) 4 ☐

[1]

5 $C_{14}H_{30}$ is a long chain hydrocarbon and is a member of the alkane homologous series. When heated strongly in the presence of a catalyst ethene is one of the products.

This reaction is an example of

(a) combustion ☐

(b) cracking ☐

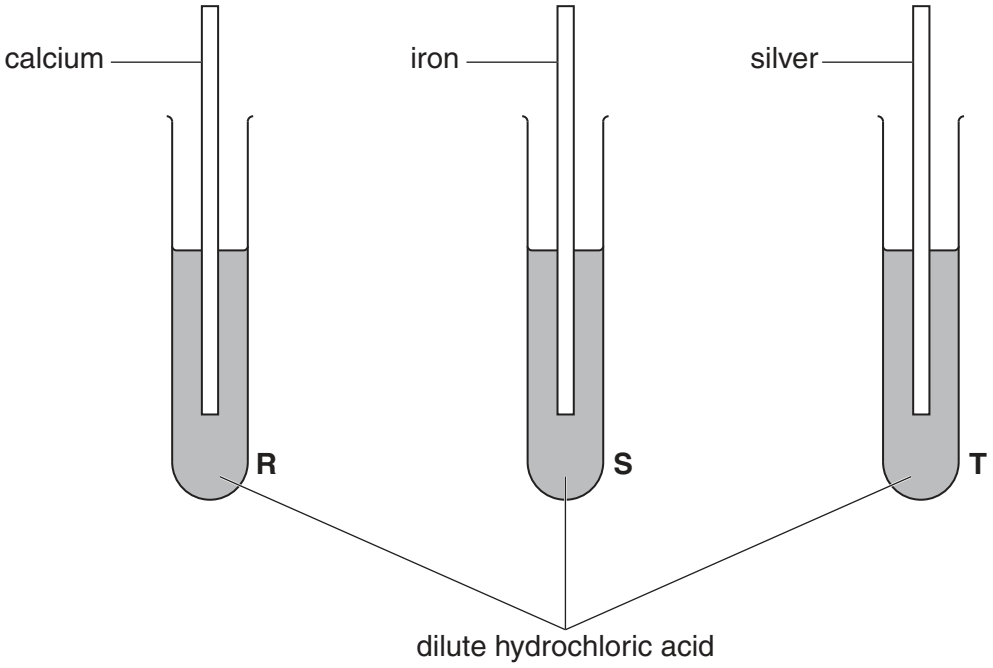
(c) polymerisation ☐

(d) saturation ☐

[1]

6 A student places each of three metals in tubes containing dilute hydrochloric acid.

For Examiner's Use



In which tubes is hydrogen produced?

(a) **R** and **S** only, ☐

(b) **R** and **T** only, ☐

(c) **S** and **T** only, ☐

(d) **R** and **S** and **T**. ☐

[1]

7 A student measures the speed of a reaction between a given mass of zinc and an excess of hydrochloric acid by recording the volume of hydrogen produced.
The results are shown on the graph.

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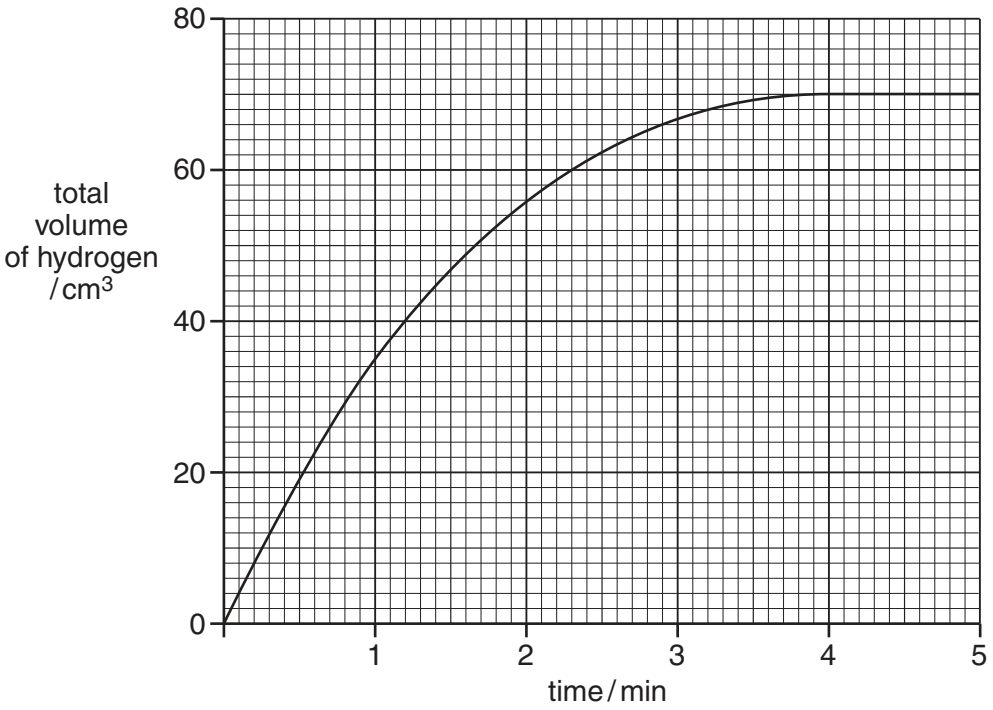

How long does it take for half of the zinc to react?

(a) 1.0 min ☐

(b) 1.5 min ☐

(c) 2.0 min ☐

(d) 2.5 min ☐

[1]

8 A student is given a sample of an organic acid, **G**, and asked to

- determine its relative molecular mass
- suggest its formula.

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(a) A sample of the acid is placed in a previously weighed container and reweighed.

mass of container + **G**	=	8.55 g
mass of container	=	6.94 g

Calculate the mass of **G** used in the experiment.

..... g [1]

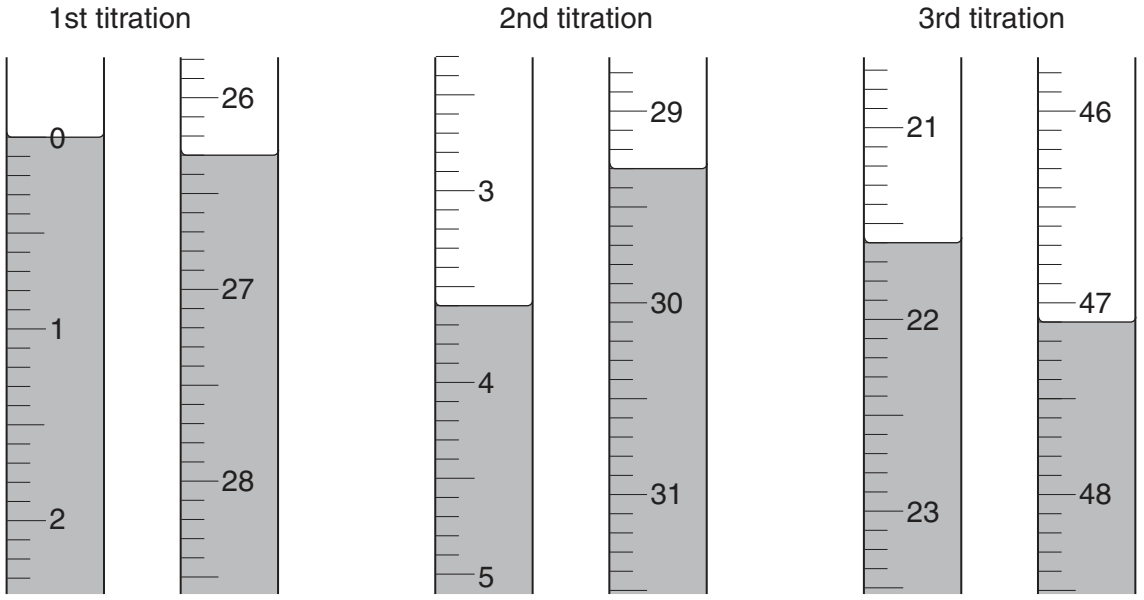
(b) The student transfers the sample to a beaker and adds 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide, an excess. The contents of the beaker are allowed to react and then transferred to a volumetric flask. The solution is made up to 250 cm^3 with distilled water. This is solution **H**.
25.0 cm^3 of **H** is transferred into a conical flask.
A few drops of phenolphthalein indicator are added to the conical flask.
0.100 mol/dm^3 hydrochloric acid is put into a burette and added to the solution in the conical flask until an end-point is reached.
Phenolphthalein is colourless in acidic solution and pink in alkaline solution.

What is the colour of the solution in the conical flask

(i) before the acid 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.



Use the diagrams to complete the following table.

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titration number	1	2	3
final reading/cm^3			
initial reading/cm^3			
volume of 0.100 mol/dm^3 hydrochloric acid used/cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of 0.100 mol/dm^3 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 from **(c)**.

..... moles [1]

(e) Construct the equation for the reaction between hydrochloric acid and sodium hydroxide.

..... [1]

(f) Using your equation and the answer from **(d)**, deduce the number of moles of sodium hydroxide present in 25.0 cm^3 of **H**.

..... moles [1]

(g) Using your answer from **(f)** calculate the number of moles of sodium hydroxide in 250 cm^3 of **H**.

..... moles [1]

[Turn over

(h) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide.

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..... moles [1]

(i) By subtracting your answer in **(g)** from your answer in **(h)**, calculate the number of moles of sodium hydroxide that reacts with the original sample of the organic acid, **G**.

..... moles [1]

(j) **One** mole of **G** reacts with **two** moles of sodium hydroxide. Deduce the number of moles of **G** in the sample.

..... moles [1]

(k) Using your answers from **(a)** and **(j)** calculate the relative molecular mass of the acid **G**.

..... [1]

(l) The acid **G** contains two carboxylic acid groups and has the formula

$$HO_2CC_xH_yCO_2H$$

where **x** and **y** are whole numbers.

Deduce the values of **x** and **y** in the formula.
[A_r: H, 1; C, 12; O, 16]

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x .....

y ..... [2]

[Total: 16]

9 **M** is a compound which contains three ions.
Complete the table by adding the conclusion for **(a)**, the observations for **(b)(i)**, **(ii)** and **(iii)**, and both the test and observation for **(c)**.

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test	observations	conclusions
(a) **M** is dissolved in water and the resulting solution divided into two parts for use in tests **(b)**, **(c)**.	A coloured solution is formed.	
(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)**. **(iii)** This mixture is heated.		**M** contains Fe^{2+} ions. **M** contains Fe^{2+} ions. **M** contains NH_4^+ ions.
(c)		**M** contains SO_4^{2-} ions.

[Total: 8]

TURN OVER FOR QUESTION 10

10 A student prepares a sample of the salt, sodium sulfate.

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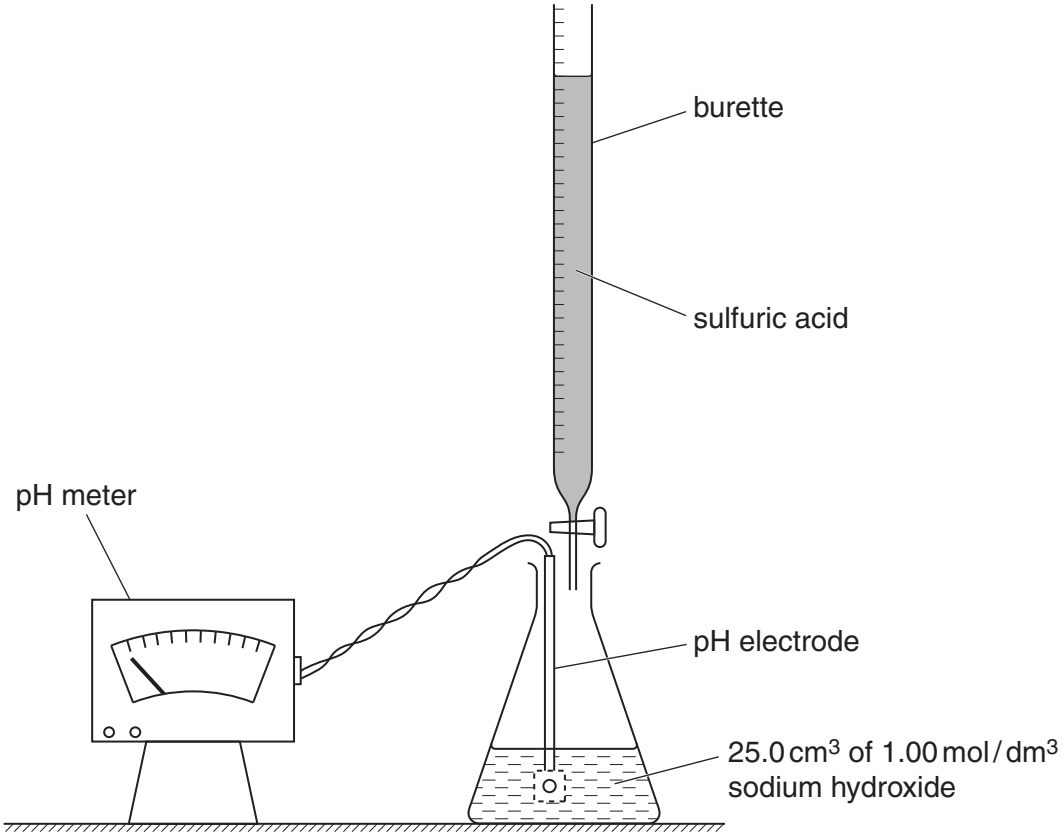
$25.0\,cm^3$ of $1.00\,mol/dm^3$ sodium hydroxide is transferred to a conical flask and sulfuric acid is added from a burette.

After each addition of sulfuric acid, the pH of the solution is recorded. The apparatus and table of results are shown below.



pH value	volume of acid added / cm^3
13.6	5.0
13.4	10.0
12.2	20.0
11.8	22.0
11.2	24.0
10.0	26.0
4.2	28.0
3.0	30.0
1.2	40.0

(a) On the grid plot a graph of pH against the volume of acid added and draw a smooth curve through all of the points.

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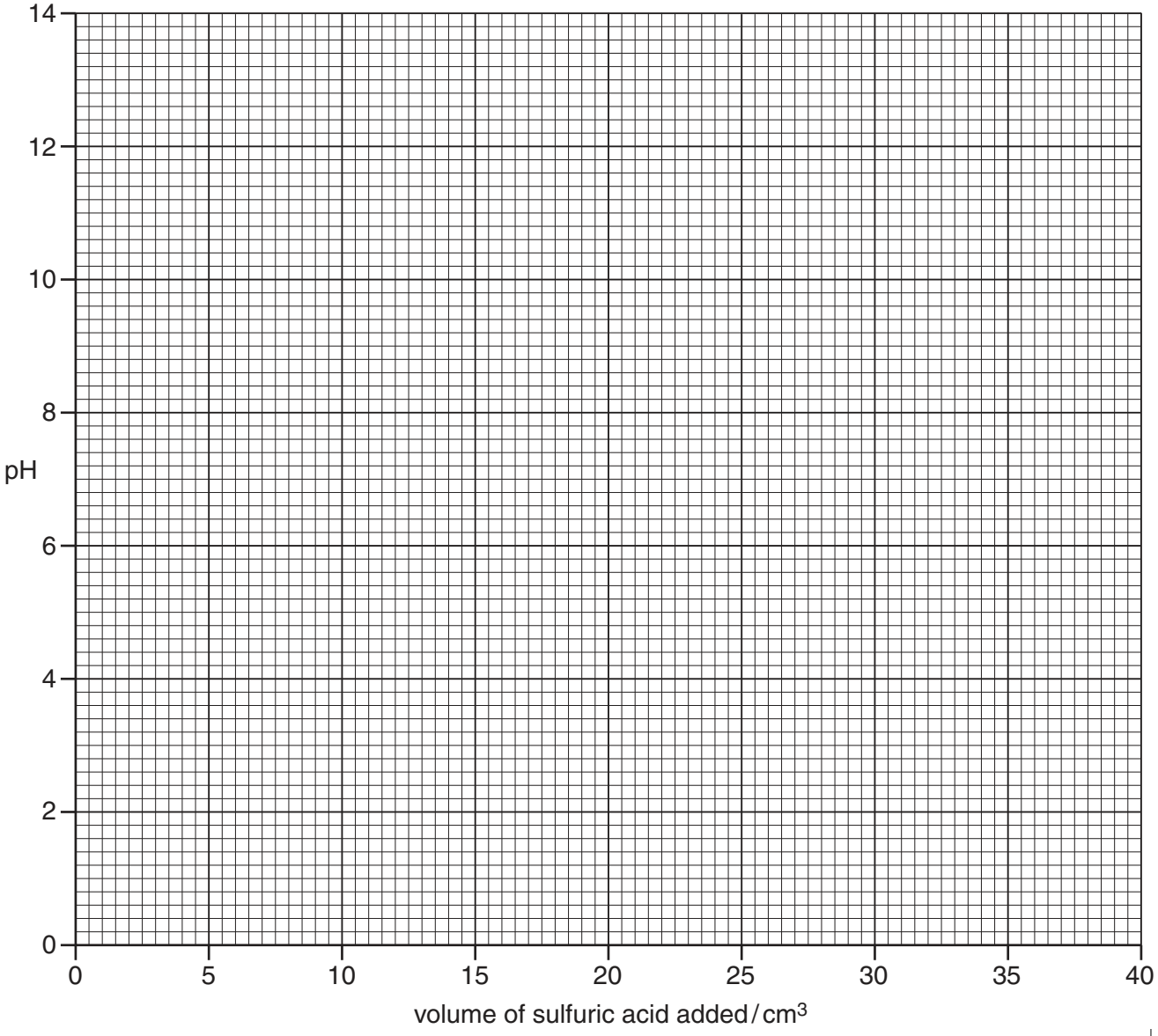

[2]

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

(i) What is the pH of the solution when 15.0 cm^3 of acid is added?

..... [1]

(ii) Suggest the pH of the solution at the end-point.

..... [1]

(iii) Using your answer to **(ii)**, what volume of acid is required to neutralise 25.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide?

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..... cm^3 [1]

(c) (i) Construct the equation for the reaction between sulfuric acid and sodium hydroxide.

..... [1]

(ii) Using the equation and your answer from **(b)(iii)** calculate the concentration of the sulfuric acid used.

..... mol/dm^3 [1]

(d) In a separate experiment the volume of sulfuric acid calculated in **(b)(iii)** is added to 25.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide. The resulting solution is used to produce sodium sulfate crystals.
Describe briefly how the student makes good quality sodium sulfate crystals from this solution.

.....

.....

.....

.....

..... [3]

[Total: 10]

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