UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CHEMISTRY **5070/04**

Paper 4 Alternative to Practical **October/November 2007**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

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

Answer **all** questions.
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 **20** printed pages.

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1 **(a)** Which of the apparatus shown below is used for accurately measuring out a fixed volume of liquid for a titration experiment? (circle the correct answer) [1]
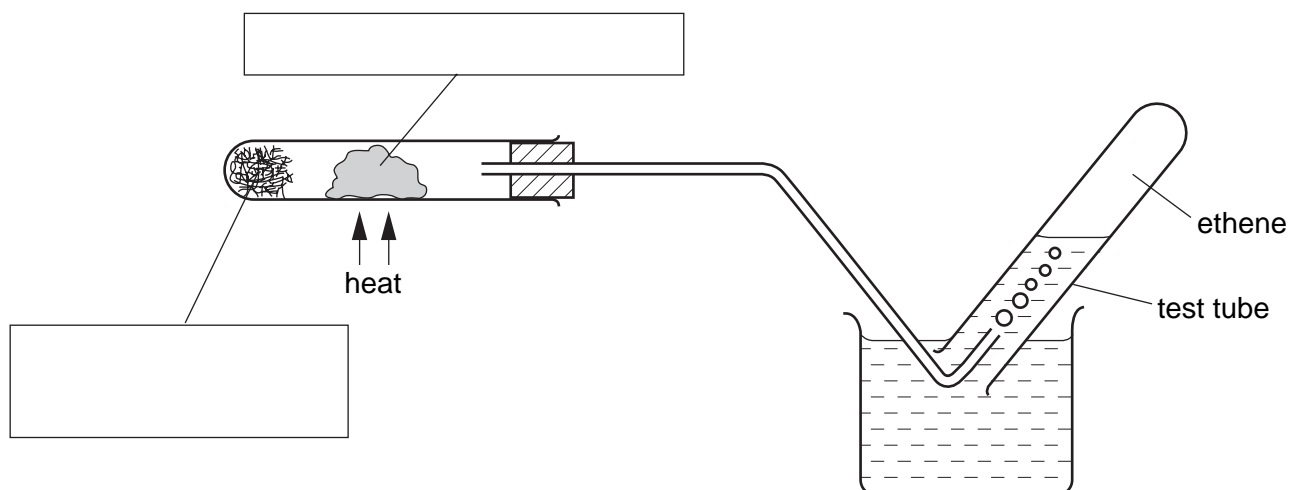
A	B	C
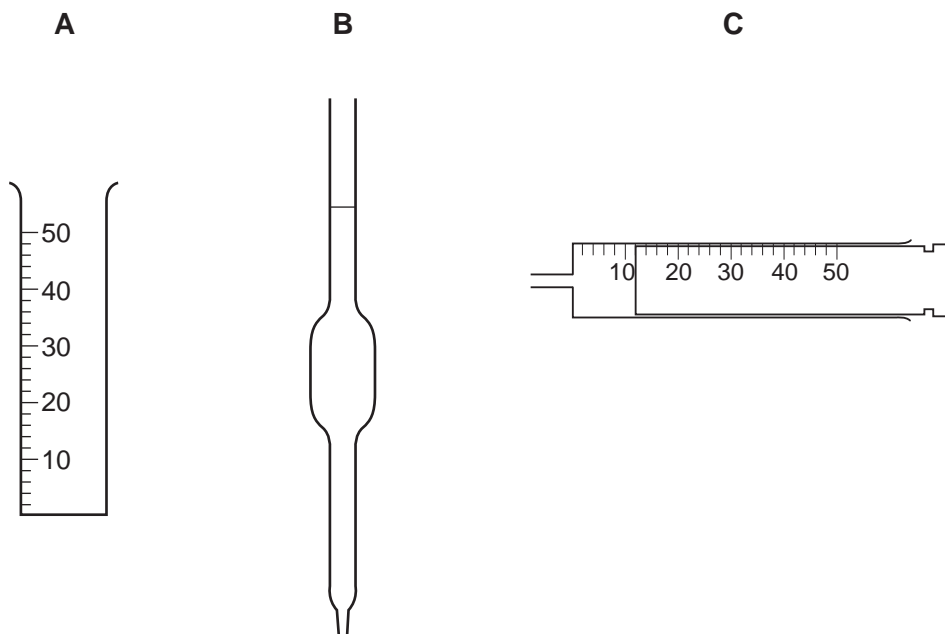
(b) Name the piece of apparatus you selected in **(a)**.

.... [1]

[Total: 2]

2 A student made ethene gas using the apparatus shown below.

heat

ethene

test tube

(a) Insert in the boxes the names of the substances used in the experiment. [2]

(b) What does this method of collection suggest about the solubility of ethene in water?

....[1]

(c) Why must the delivery tube be removed from the water before the apparatus is allowed to cool?

....[1]

(d) Give a test to confirm the presence of a double bond in ethene.

test ....

observation ....[2]

[Total: 6]

3   The diagram below shows the results of an experiment to identify the components of mixtures **X** and **Y**. Each mixture is known to contain one or more of the single substances **L**, **M**, **N** and **P** and no other substance.
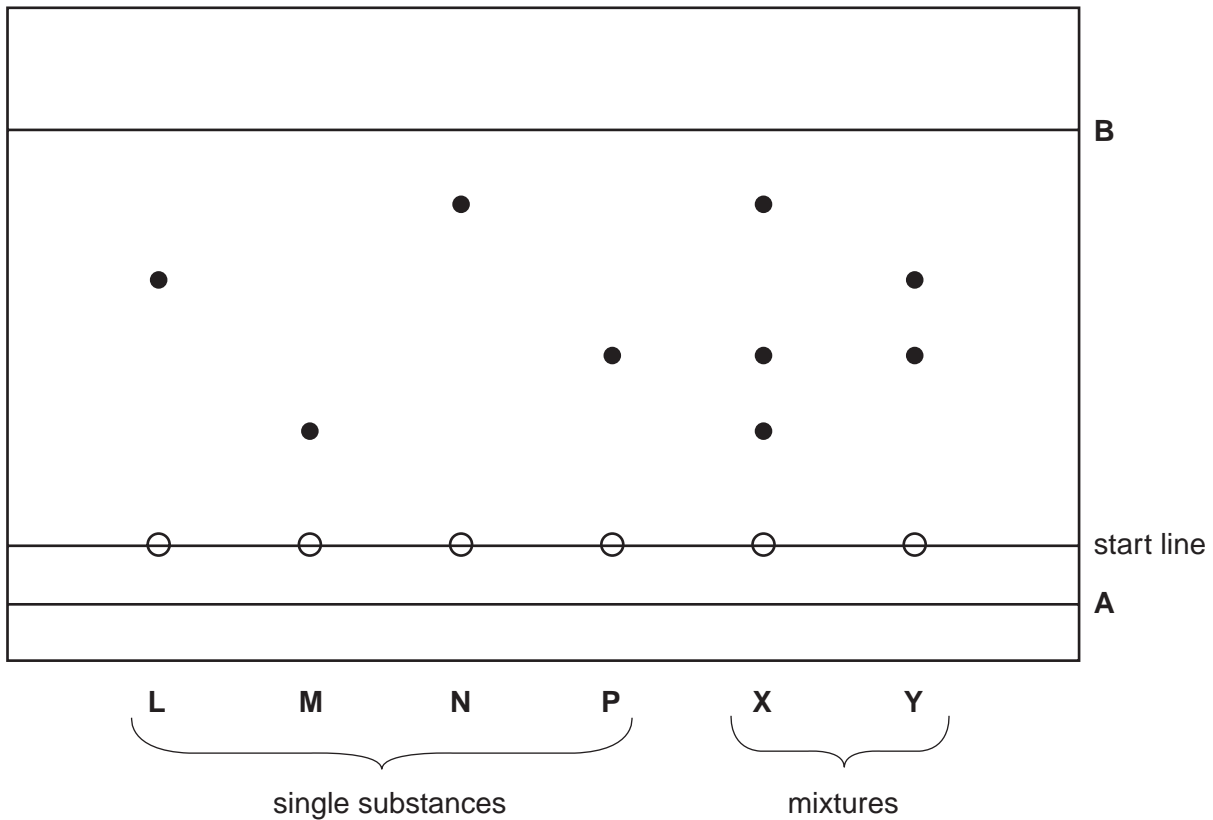
(a) What is the name given to this experiment?

....[1]

(b) What do the lines **A** and **B** represent on the diagram?

A ....

B ....[1]

(c) A student who did the same experiment used an ink pen to draw the start line instead of a pencil. How would this student's results have been different from the results shown in the diagram above? Explain your answer.

....

....[2]

(d) Use the diagram to deduce which of the substances **L**, **M**, **N** or **P** are present in

mixture **X**, ...

mixture **Y**. ....[1]

(e) (i) What do you understand by the term R_f value?

....

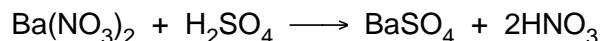...[1]

(ii) Which of the substances **L**, **M**, **N** or **P** has a R_f value of 0.45? Show how you obtained your answer.

substance ....[1]

[Total: 7]

4 A student was asked to make a sample of barium sulphate, $BaSO_4$. She added $100\,cm^3$ of $0.20\,mol/dm^3$ sulphuric acid to $60\,cm^3$ of $0.25\,mol/dm^3$ barium nitrate.
The equation for the reaction is

$$Ba(NO_3)_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HNO_3$$

(a) Describe the appearance of barium sulphate in the resulting mixture.

....[1]

(b) Calculate

(i) the number of moles of sulphuric acid used in the experiment,

.... moles [1]

(ii) the number of moles of barium nitrate used in the experiment.

.... moles [1]

(c) Using your answers to **(b)(i)** and **(ii)** calculate the maximum mass of barium sulphate that could be produced in the reaction.
[A_r: Ba, 137; S, 32; O, 16]

.... g [1]

The barium sulphate was removed from the solution by filtration. It was dried and weighed.

(d) The mass of barium sulphate obtained was $3.35\,g$. Calculate the percentage yield of barium sulphate.

.... % [1]

Another student, doing the same experiment and using the same quantities of barium nitrate and sulphuric acid, obtained 3.60 g of product.

**(e)** Suggest a reason for this increased mass of product.

....[1]

(f) Suggest a different barium salt that could have been used instead of barium nitrate to produce barium sulphate.

....[1]

[Total: 7]

For questions 5 to 9 inclusive, place a tick in the box against the best answer.

5 A student used the apparatus shown below to separate ethanol and water by fractional distillation.

thermometer

water out

condenser

water in

liquid

receiver

heat
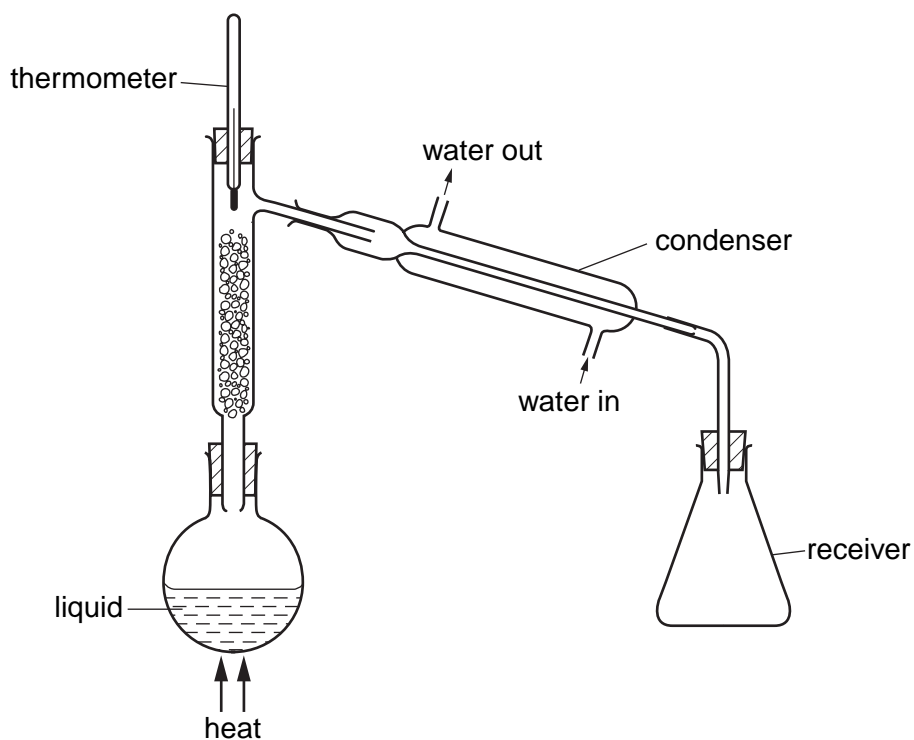
What error has the student made in setting up the apparatus?

(a) The thermometer is in the wrong position. ☐

(b) The water enters the condenser in the wrong place. ☐

(c) The top of the receiver should be open. ☐

(d) The volume of liquid is too small. ☐

[Total: 1]

6 A student did some tests on a sample of a fertiliser **F**. The results were as follows.

A solution of **F** was warmed with aqueous sodium hydroxide and a gas was evolved that turned damp litmus paper blue.

A solution of **F** was mixed with an acidified solution of barium chloride but no precipitate was produced.

A solution of **F** was mixed with an acidified solution of silver nitrate and a white precipitate was produced.

Which ions does **F** contain?

(a) ammonium and chloride ☐

(b) ammonium and nitrate ☐

(c) potassium and chloride ☐

(d) potassium and sulphate ☐

[Total: 1]

7 Hydrogen peroxide may be catalytically decomposed using manganese(IV) oxide.
The equation for the reaction is

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$
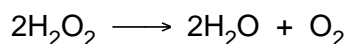
Three experiments were done using different solutions of hydrogen peroxide but keeping the mass of manganese(IV) oxide constant.

The graph shows the results of the three experiments.
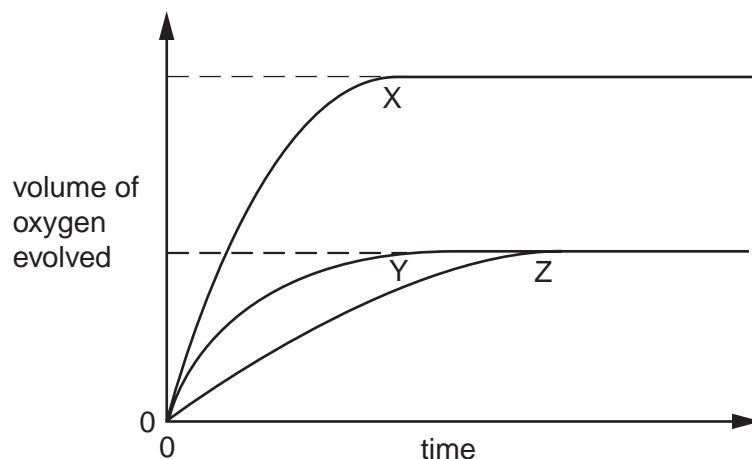
The three solutions were

(i) $25\,cm^3$ of $2.0\,mol/dm^3$ hydrogen peroxide,

(ii) $50\,cm^3$ of $1.0\,mol/dm^3$ hydrogen peroxide,

(iii) $50\,cm^3$ of $2.0\,mol/dm^3$ hydrogen peroxide.
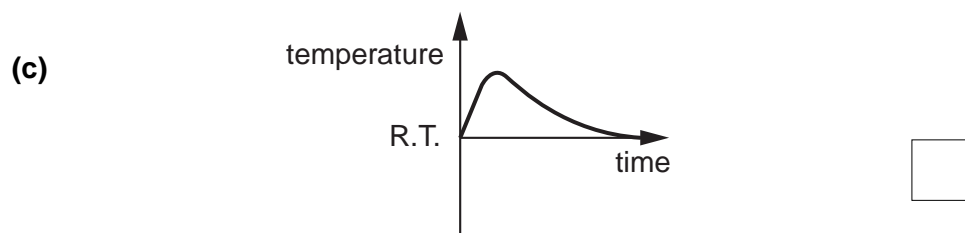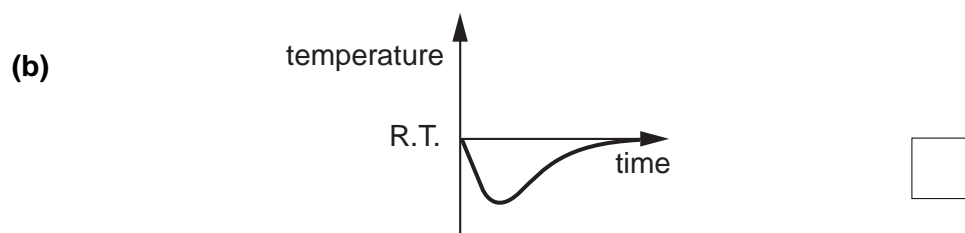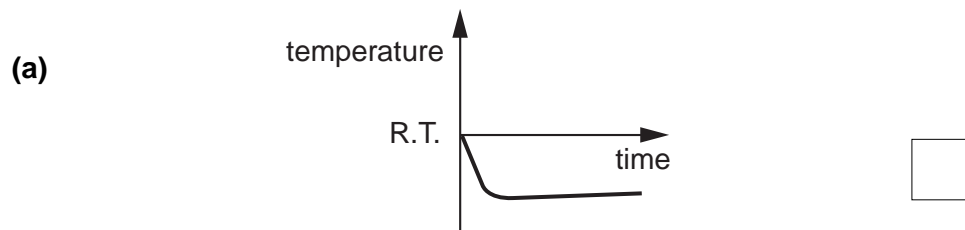
Which curve corresponded to which solution?

	(i)	(ii)	(iii)	
(a)	X	Y	Z	
(b)	Y	X	Z	
(c)	Y	Z	X	
(d)	Z	Y	X	

[Total: 1]

8 The dissolving of potassium iodide in water is an endothermic process.

Which of the graphs below correctly shows the temperature changes that occur when potassium iodide is stirred with water until there is no further change of temperature?
[R.T. = room temperature]

(a)

temperature

R.T.

time

(b)

temperature

R.T.

time

(c)

temperature

R.T.

time

(d)

temperature

R.T.

time

[Total: 1]

 [Turn over
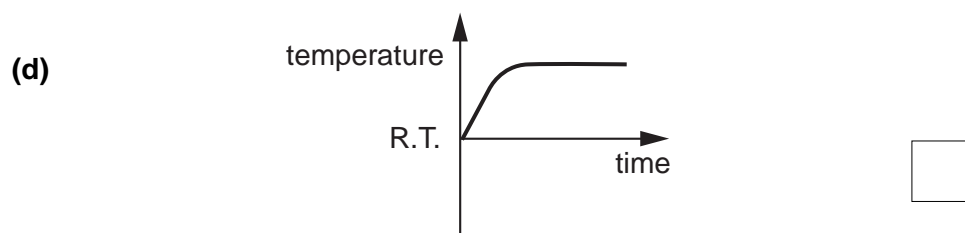
9 A student oxidised propanol using an acidified solution of potassium dichromate(VI). A carboxylic acid was produced. What was the formula of the acid?

    (a) HCOOH

    (b) CH_3COOH

    (c) C_2H_5COOH

    (d) C_3H_7COOH [Total: 1]

10 The following experiment was used to determine the percentage of copper(II) oxide in a mixture **C**, containing copper and copper(II) oxide.

A sample of **C** was added to a previously weighed beaker, which was then reweighed.

mass of beaker + **C**   =   32.65 g
mass of beaker   =   27.80 g

(a) Calculate the mass of **C** used in the experiment.

....g [1]

50.0 cm^3 of 1.00 mol/dm^3 sulphuric acid (an excess) was transferred to the beaker containing the sample of **C**. This mixture was warmed gently while being stirred and then left to stand for a few minutes. The unreacted solid settled at the bottom of the beaker leaving a coloured solution.

Copper(II) oxide reacts with sulphuric acid but copper does not react.

(b) **(i)** What colour was the solution?

....[1]

(ii) How was the unreacted copper removed from the solution?

....[1]

(iii) Write an equation for the reaction between copper(II) oxide and sulphuric acid.

....[1]

The solution which remained after the copper was removed, was transferred to a volumetric flask and made up to 250 cm^3 with distilled water. This was solution **D**.

25.0 cm^3 of **D** was transferred into a conical flask and a few drops of indicator was added. A burette was filled with a solution of 0.100 mol/dm^3 sodium hydroxide. This was run into the conical flask containing **D** and the indicator until the end-point was reached.

In this experiment the indicator is blue in acid and green in alkali.

(c) What was the colour of the solution in the conical flask

(i) before the sodium hydroxide was added, ...

(ii) at the end-point? ....

[1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.

1st titration   2nd titration   3rd titration
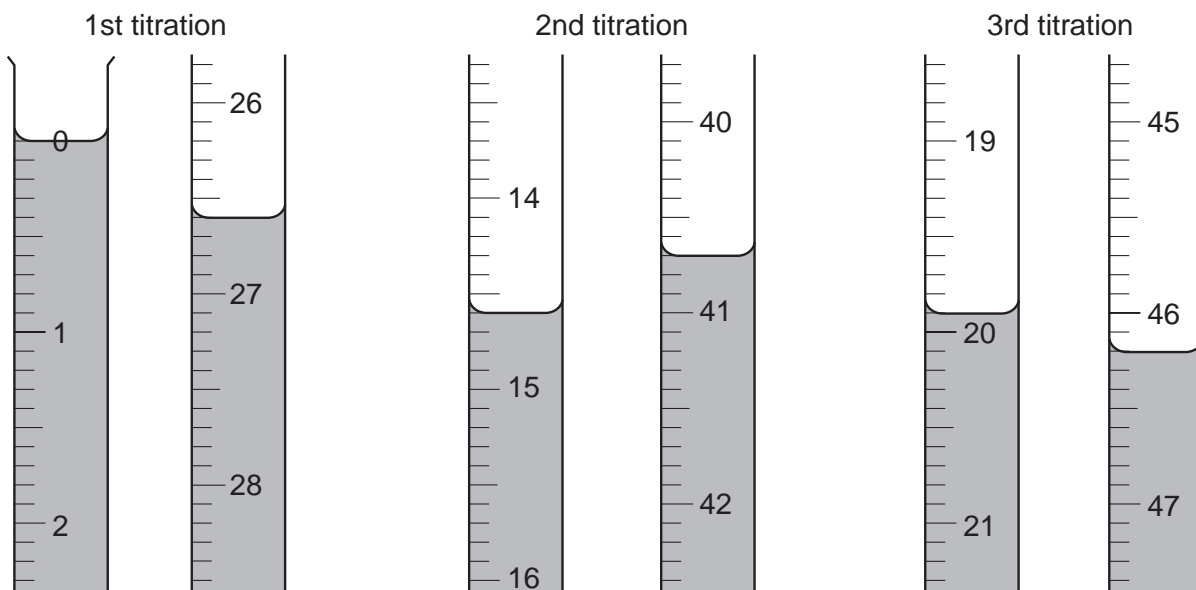
(d) Use the diagrams to complete the following results table.

| titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume of sodium hydroxide used / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results. Using these results, the average volume of $0.100\,mol/dm^3$

sodium hydroxide was .... cm^3.   [4]

(e) Calculate the number of moles of sodium hydroxide in the average volume of $0.100\,mol/dm^3$ sodium hydroxide in **(d)**.

.... moles [1]

Sodium hydroxide reacts with sulphuric acid according to the following equation.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$
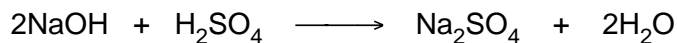
(f) Calculate the number of moles of sulphuric acid which reacted with the sodium hydroxide in **(e)**.

.... moles [1]

(g) Using your answer in **(f)**, calculate the number of moles of sulphuric acid in 250 cm^3 of solution **D**.

.... moles [1]

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

.... moles [1]

(i) By subtracting your answer in **(g)** from your answer in **(h)**, calculate the number of moles of sulphuric acid which reacted with the copper(II) oxide in **C**.

.... moles [1]

(j) Using your equation in **(b)(iii)**, deduce the number of moles of copper(II) oxide in the sample of **C**.

.... moles [1]

                                       [Turn over

(k) Using your answers in **(a)** and **(j)** calculate

    (i) the mass of copper(II) oxide in the sample of **C**,
        [A_r: Cu, 63.5; O, 16]

.... g [1]

    (ii) the percentage of copper(II) oxide in the sample of **C**.

.... % [1]

[Total: 17]

11 Substance **V** is a reducing agent. The table below shows the tests a student did on **V**. Complete the conclusion in **(a)** and the observations in tests **(b)** and **(c)**.

In cases where a colour change is involved, both the initial and final colours should be stated.

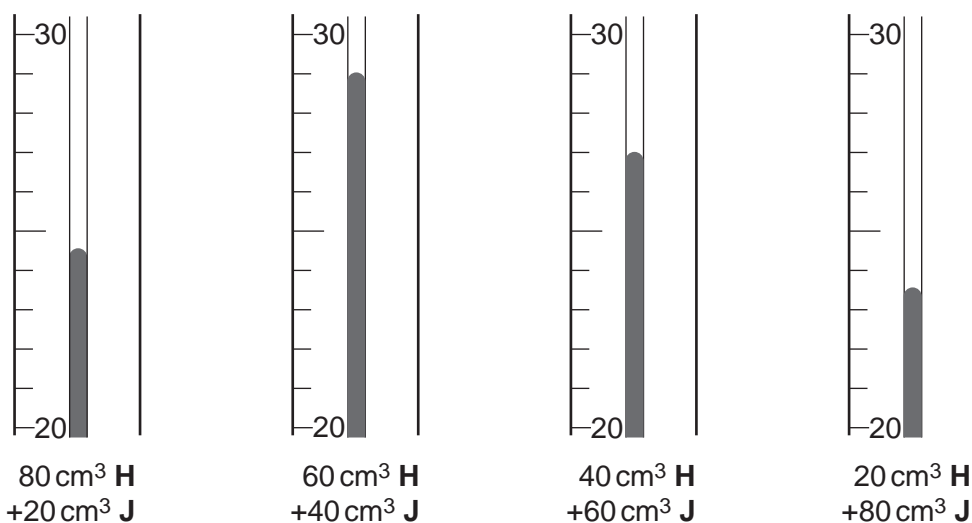|	test	observation	conclusion
(a)	Substance **V** was dissolved in water and the resulting solution divided into two parts for tests **(b)** and **(c)**.	A coloured solution was produced.	
(b)	To the first part a few drops of acidified potassium dichromate(VI) were added.		**V** is a reducing agent.
(c)	To the second part a few drops of acidified potassium manganate(VII) were added.		**V** is confirmed to be a reducing agent.

[Total: 5]

12 The addition of an acid solution to aqueous sodium hydroxide produces a rise in temperature.

A student was provided with solution **H**, sulphuric acid, and solution **J**, $1.00\,\text{mol}/\text{dm}^3$ aqueous sodium hydroxide.

He investigated the temperature changes produced on mixing together different volumes of **H** and **J** while, in each experiment, keeping the total volume of solution constant at $100\,\text{cm}^3$.

The initial temperature of both **H** and **J** was $20\,°C$.

The diagrams below show parts of the thermometer stems for the maximum temperature recorded in each experiment.

| $80\,\text{cm}^3$ **H**	$60\,\text{cm}^3$ **H**	$40\,\text{cm}^3$ **H**	$20\,\text{cm}^3$ **H**
$+20\,\text{cm}^3$ **J**	$+40\,\text{cm}^3$ **J**	$+60\,\text{cm}^3$ **J**	$+80\,\text{cm}^3$ **J**

(a) You are to record these temperatures in the table below and then calculate the rise in temperature for each of the four mixtures.

volume of **H**/cm^3	volume of **J**/cm^3	maximum temperature/$°C$	temperature rise/$°C$
80	20		
60	40		
40	60		
20	80		

[2]

(b) Plot these results on the grid below and join the points with two intersecting straight lines.

temperature
rise / °C

volume of **H** / cm^3
volume of **J** / cm^3

[2]
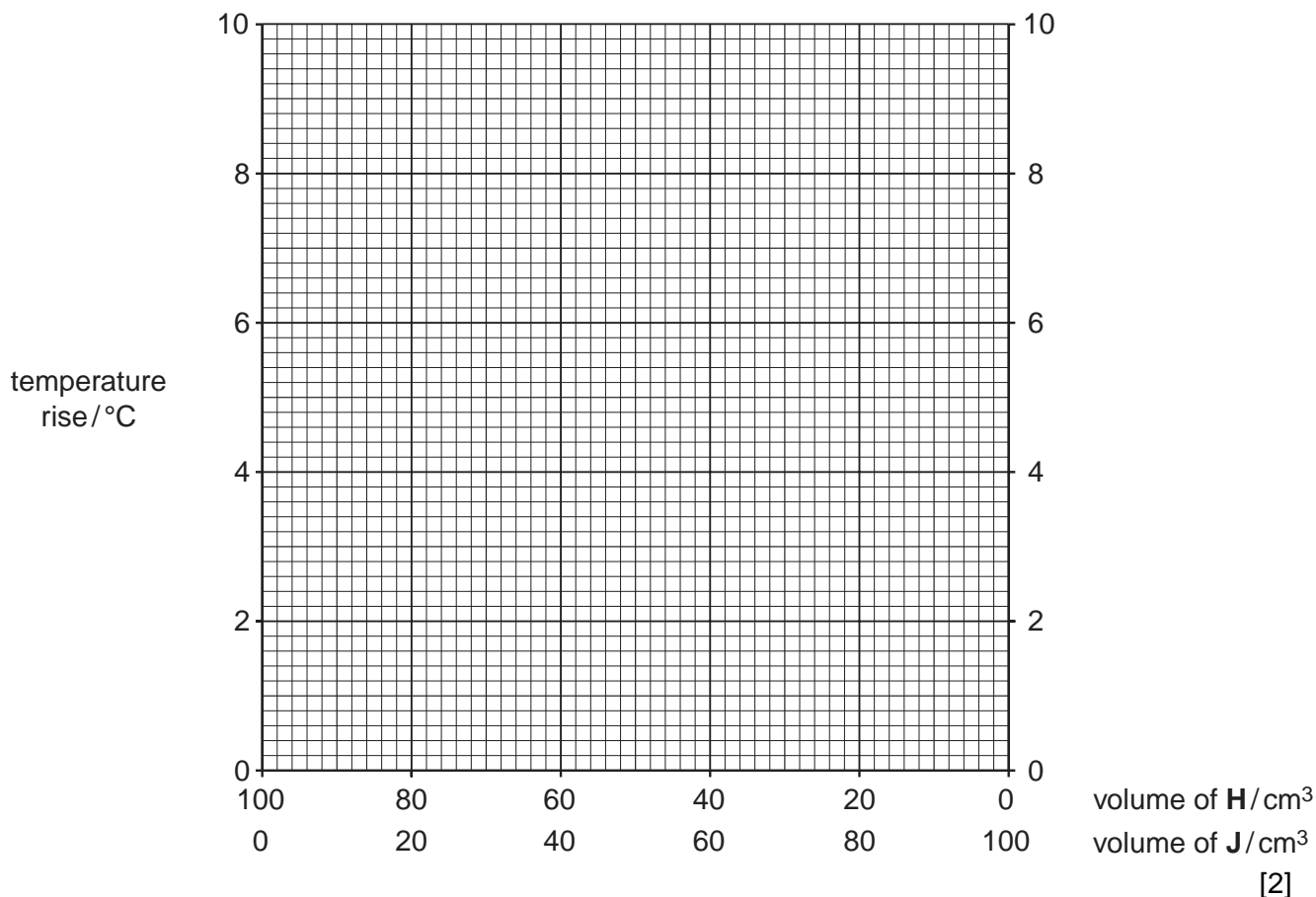
Use your graph to deduce

(c) **(i)** the greatest temperature rise that could occur,

.... °C [1]

(ii) the volumes of **H** and **J** which would produce this temperature rise.

H .... cm^3

J .... cm^3

[1]

(d) Solution **J** was 1.00 mol/dm^3 sodium hydroxide. **H** was sulphuric acid. Using your answers to **(c)(ii)**, calculate the concentration of **H**.

....[3]

(e) The student repeated the experiment. The concentrations of **H** and **J** were half those used in the original experiment.

The total volume and the initial temperature were the same as in the original experiment.

Suggest

(i) the greatest temperature rise that could occur,

....[1]

(ii) the volumes of **H** and **J** that would produce this temperature rise.

....[1]

[Total: 11]