UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1331047203

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2011**

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

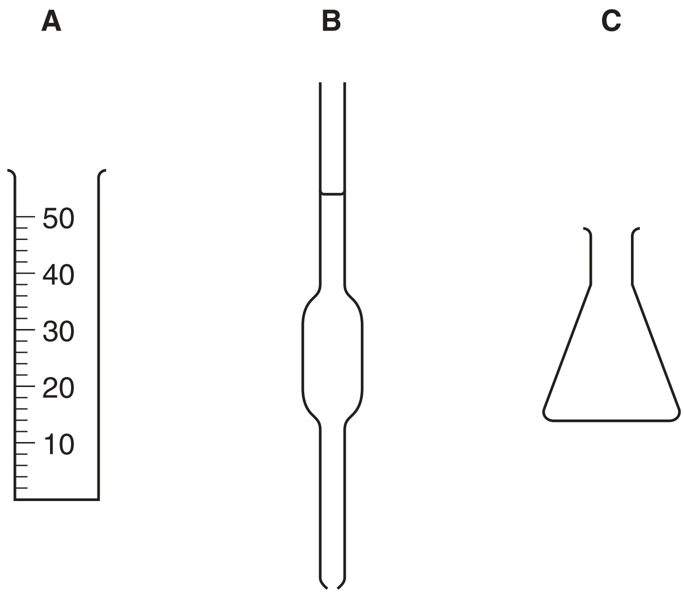
This document consists of **17** printed pages and **3** blank pages.

DC (NF/DJ) 27261/3

UNIVERSITY *of* CAMBRIDGE International Examinations

[Turn over

1



(a) Which of the above apparatus **A**, **B** or **C,** is used for measuring out a fixed volume of liquid for a titration experiment?

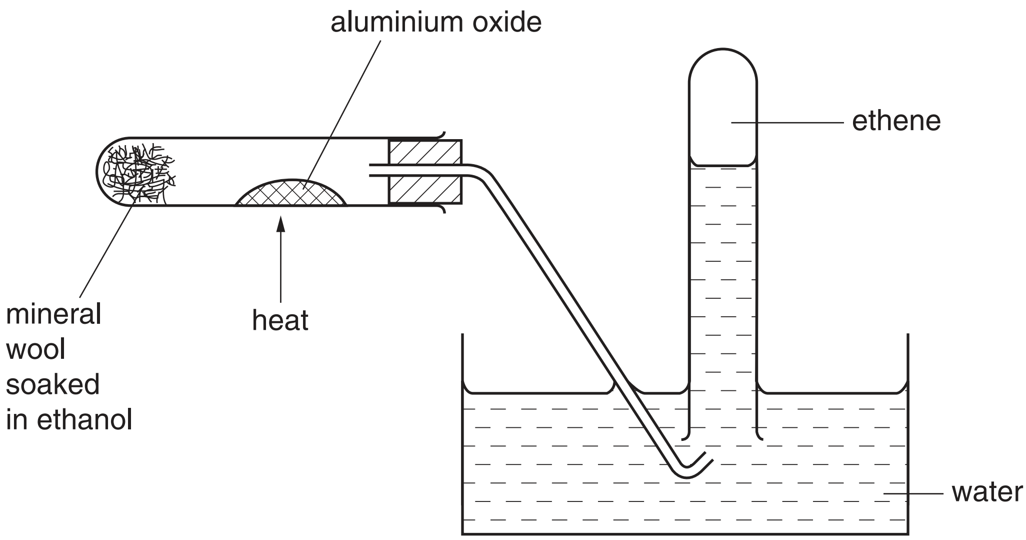
.... [1]

(b) Name this apparatus.

.... [1]

[Total: 2]

2 Ethene is an alkene.
It is made from ethanol in the apparatus shown below.



(a) **(i)** The gas is collected over water.
What does this show about the solubility of ethene in water?

.... [1]

(ii) Suggest the purpose of the aluminium oxide.

.... [1]

(iii) Draw the structure of ethene.

[1]

(b) The apparatus is altered to pass the ethene into aqueous bromine.

What is the colour of aqueous bromine

(i) before ethene is bubbled through it,

.... [1]

(ii) after ethene is bubbled through it?

.... [1]

(iii) What type of reaction occurs between bromine and ethene?

.... [1]

(c) The structure of a different alkene is shown below.

For Examiner's Use

$$CH_3\ CH = CH\ CH_3$$

(i) Name this alkene.

.... [1]

(ii) Draw the structure of an isomer of this alkene.

[1]

[Total: 8]

For Examiner's Use

3 **(a)** A student measures the boiling point of rain water and sea water.
Which has the higher boiling point?
Explain your answer.

....

.... [1]

(b) Suggest the formula of a salt which is present in sea water.

.... [1]

(c) **(i)** Sea water may be converted into pure water in a laboratory by distillation.
Draw a sketch of the distillation apparatus.

[3]

(ii) Distillation can be used on a large scale to produce drinkable water.
Name another large scale process by which sea water can be converted into drinking water.

.... [1]

(d) Water from natural sources may contain undissolved solids. Name the process by which these solids can be removed.

.... [1]

(e) Bacteria, which are also present in water from natural sources, may be removed by passing a gas through the water.
Name and give a test for this gas.

name ....

test ....

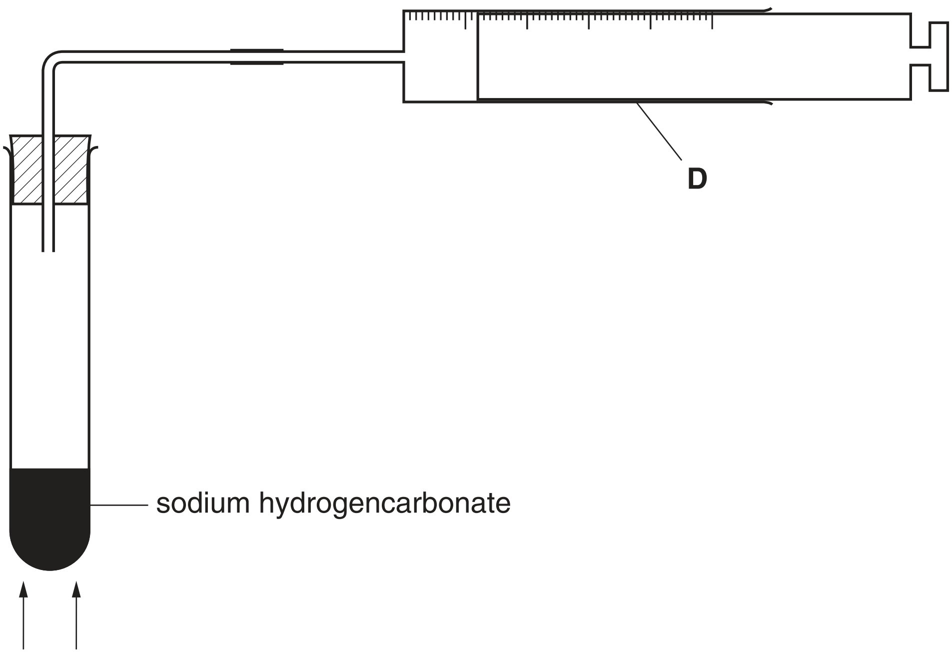
observation .... [2]

[Total: 9]

For Examiner's Use

4 A student heats solid sodium hydrogencarbonate in the apparatus shown below. The carbon dioxide gas produced is collected in apparatus **D**.

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$



(a) Name apparatus **D**.

.... [1]

(b) Give a test for carbon dioxide.

test ....

observation .... [1]

(c) On heating the sample of sodium hydrogencarbonate, 120 cm^3 of carbon dioxide is evolved. The gas is measured at room temperature and pressure.

(i) Calculate the number of moles of carbon dioxide evolved.
[1 mole of a gas occupies 24 dm^3 at room temperature and pressure.]

.... moles [1]

(ii) Using your answer to **(c)(i)** and the equation for the reaction, deduce the number of moles of sodium hydrogencarbonate decomposed.

.... moles [1]

(iii) Using your answer to **(c)(ii)**, calculate the mass of sodium hydrogencarbonate decomposed.
[A_r: H,1; C,12; O,16; Na, 23]

For Examiner's Use

.... g [1]

[Total: 5]

In questions **5** to **9** inclusive, place a tick (✓) in the box against the best answer.

For Examiner's Use

5 Which of the following changes can occur when the first named substance reacts with acidified potassium dichromate(VI)?

(a) ethanoic acid $\longrightarrow$ ethanol ☐

(b) ethanol $\longrightarrow$ ethyl ethanoate ☐

(c) ethyl ethanoate $\longrightarrow$ ethanol ☐

(d) ethanol $\longrightarrow$ ethanoic acid ☐ [1]

6 A sample of air taken from a busy industrial city contains a number of gases. The sample is bubbled through water containing a few drops of litmus solution. The litmus turns red.

Which of these gases causes this change?

(a) ammonia ☐

(b) carbon monoxide ☐

(c) methane ☐

(d) sulfur dioxide ☐ [1]

7 A student does some tests on substance **M**.

M has a high melting point.

Solid **M** does not conduct electricity.

What could substance **M** be?

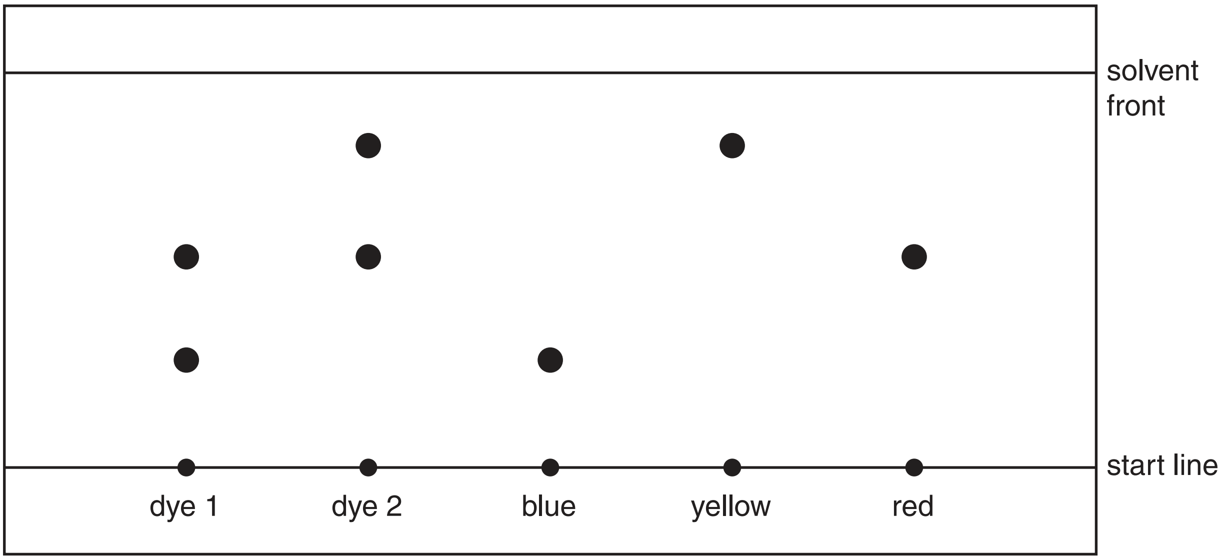
(a) iodine ☐

(b) iron ☐

(c) sodium chloride ☐

(d) sugar ☐ [1]

8 The following diagram is obtained in an experiment to compare two dyes, dye 1 and dye 2.



Which statement is correct?

(a) only one dye contains red ☐

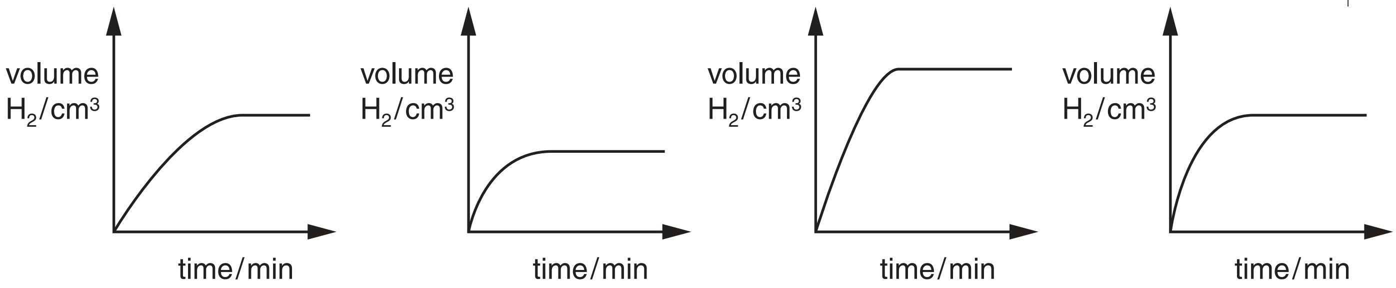
(b) only one dye contains yellow ☐

(c) both dyes contain blue ☐

(d) both dyes contain all three colours ☐ [1]

For Examiner's Use

9 When excess granulated zinc is added to dilute hydrochloric acid, hydrogen gas is produced. The experiment is repeated using excess powdered zinc and the same volume of hydrochloric acid. Which **two** graphs best represent the rates of production of hydrogen gas in the two experiments?



1 **2** **3** **4**

	granulated zinc	powdered zinc	
(a)	**1**	**3**	☐
(b)	**2**	**3**	☐
(c)	**1**	**4**	☐
(d)	**2**	**4**	☐

[1]

BLANK PAGE

10 Vinegar contains ethanoic acid.
A student determines the concentration of ethanoic acid in a sample of vinegar by titration with 0.200 mol / dm^3 sodium hydroxide.

25.0 cm^3 of vinegar is transferred to a graduated flask and made up to 250 cm^3 with distilled water. This is solution **E**.

(a) 25.0 cm^3 of **E** is transferred to a conical flask and a few drops of bromothymol blue indicator added.

Bromothymol blue has the following colours:

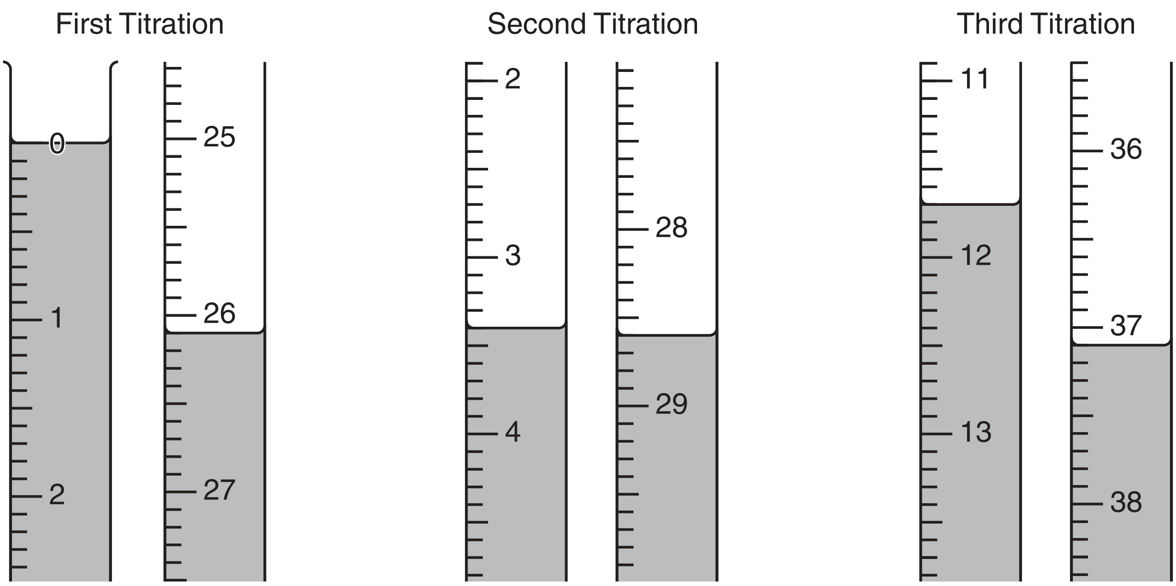
pH 5 yellow,
pH 10 blue.

0.200 mol / dm^3 sodium hydroxide is put into a burette and run into the conical flask containing **E** until the end-point is reached.

What is the colour change of the bromothymol blue at the end-point?

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

(b) 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 results table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of 0.200 mol / dm^3 sodium hydroxide used / cm^3			
best titration results (✓)			

Summary:

Tick (✓) the best titration results.

Using these results, the average volume of 0.200 mol / dm^3 sodium hydroxide required is

.... cm^3. [4]

(c) Calculate the number of moles of sodium hydroxide in the average volume of 0.200 mol / dm^3 sodium hydroxide in **(b)**.

.... moles [1]

(d) Using the equation

$$CH_3CO_2H \; + \; NaOH \; \longrightarrow \; CH_3CO_2Na \; + \; H_2O$$

and your answer to **(c)**, deduce the number of moles of ethanoic acid in 25.0 cm^3 of **E**.

.... moles [1]

(e) Calculate the number of moles of ethanoic acid in 250 cm^3 of **E**.

.... moles [1]

(f) **(i)** Deduce the number of moles of ethanoic acid in the original 25.0 cm^3 of vinegar.

.... moles [1]

(ii) Calculate the concentration of ethanoic acid in the vinegar in mol/dm^3.

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

[Total: 10]

11 The following table shows the tests a student does on compound **W** and the conclusions made from the observations.

For Examiner's Use

Complete the table by adding the observations for tests **(a)**, **(b)** and **(c)** and both the test and observation which lead to the conclusion for test **(d).**

test	observations	conclusions
(a) **W** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.		**W** does not contain 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)**.		**W** may contain Al^{3+} or Zn^{2+} ions.
(c) **(i)** To the second part aqueous ammonia is added until a change is seen. **(ii)** An excess of aqueous ammonia is added to the mixture from **(i)**.		The presence of Al^{3+} ions in **W** is confirmed.
(d)		**W** contains NO_3^- ions.

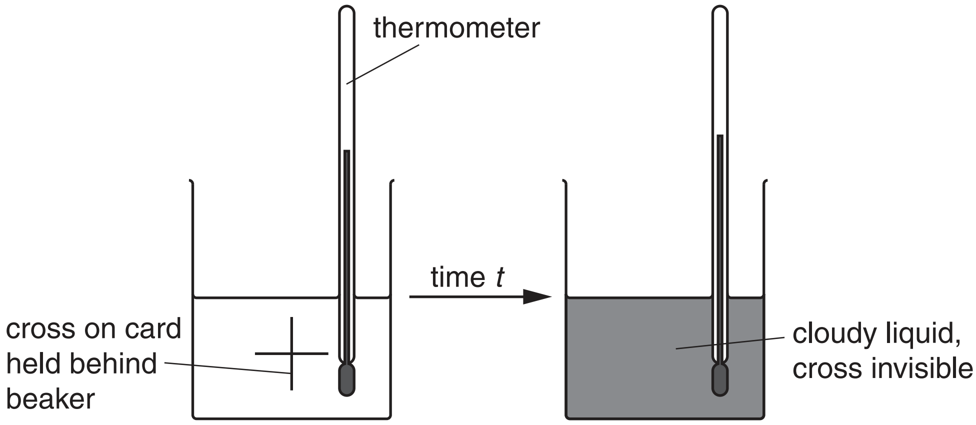
Conclusion:

The formula for **W** is ....

[Total: 10]

BLANK PAGE

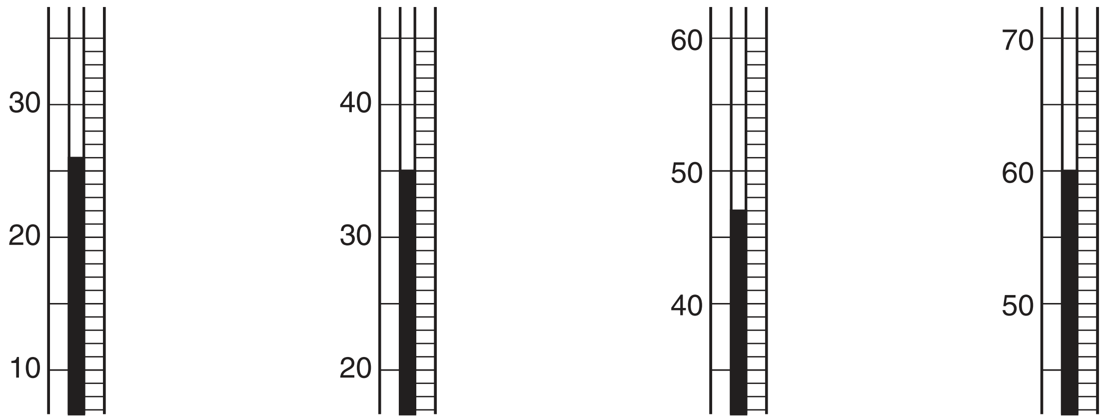
12 The reaction between aqueous sodium thiosulfate and hydrochloric acid produces a precipitate of sulfur which makes the solution go cloudy. The speed of this reaction can be investigated by measuring the length of time it takes for the solution to go cloudy.
A student does two experiments to investigate the effects of both temperature (Experiment **1**) and concentration (Experiment **2**) on the speed of the reaction.



(a) Experiment **1**

50 cm^3 of aqueous sodium thiosulfate is put into a beaker and 5.0 cm^3 of 2.0 mol/dm^3 hydrochloric acid added.
A stop watch is started and the temperature of the mixture is noted. At the moment the cross becomes invisible, the watch is stopped and the time taken recorded.
The experiment is repeated four more times, keeping the volumes and concentrations of both solutions the same but using different temperatures.

The diagrams below show parts of the thermometer stem for each of the four experiments, indicating the temperature of the mixture / °C.

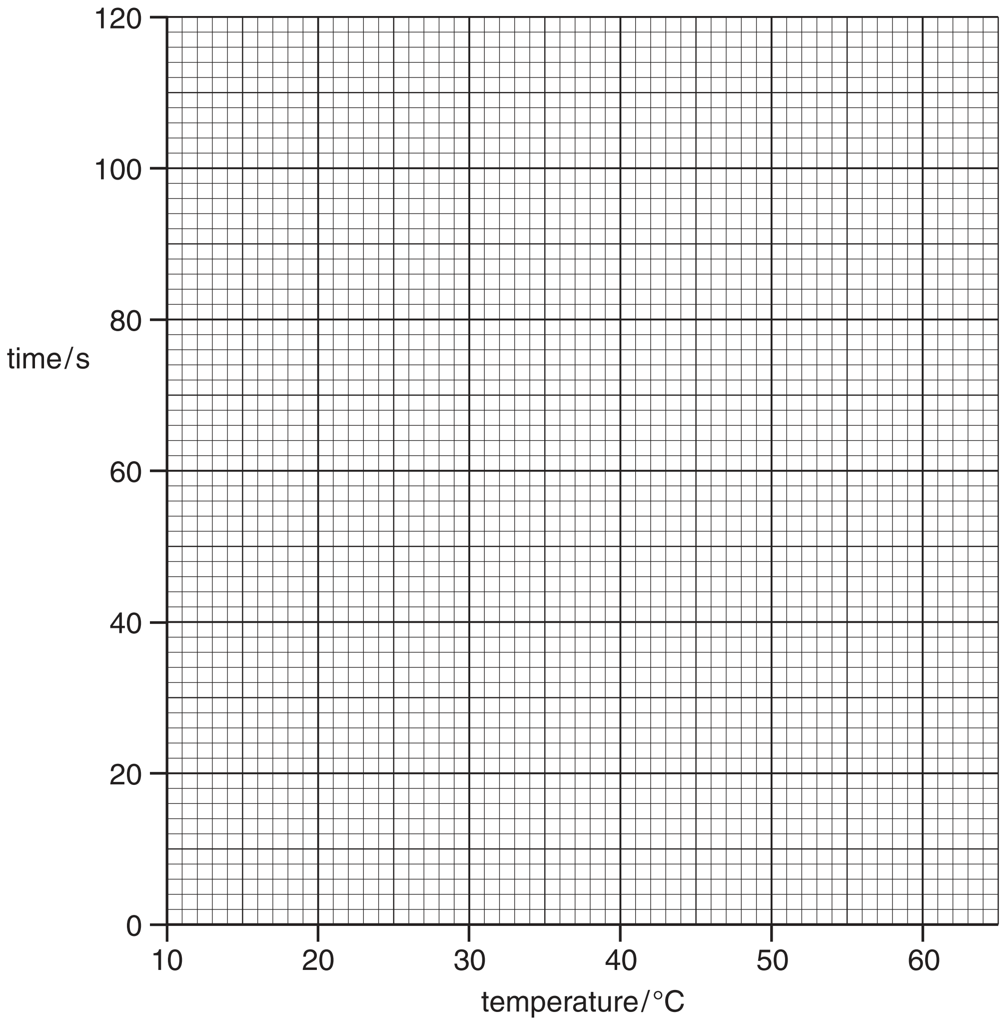


(i) Use these diagrams to complete the table below.

temperature of the mixture / °C	time / sec
20	110
	73
	48
	30
	20

[2]

(ii) Plot the results on the grid below and draw a smooth curve through the points.



[2]

(iii) Use your diagram to determine how long it would take for the cross to become invisible at 30°C.

.... s [1]

(iv) From your graph determine the temperature at which the reaction would be twice as fast as at 20 °C.

.... °C [1]

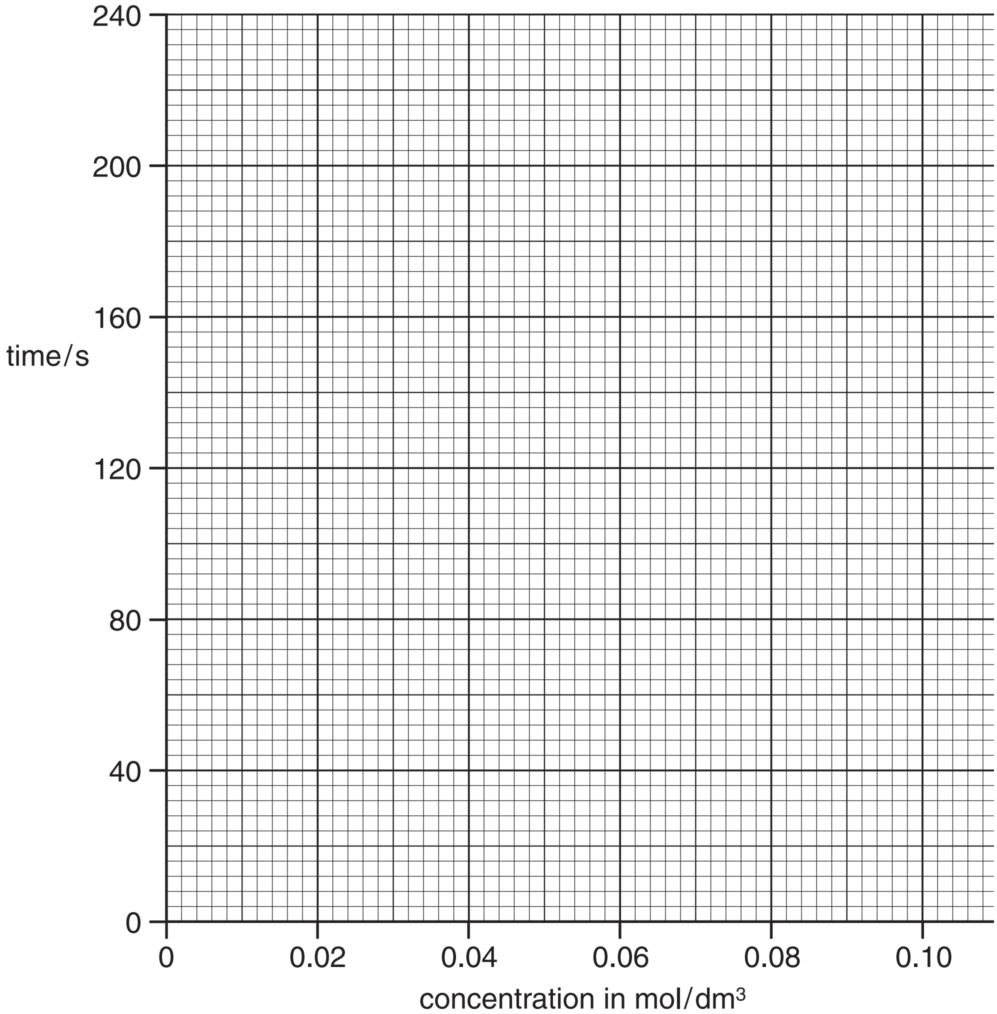
(b) Experiment **2**

5.0 cm^3 of 2.0 mol / dm^3 hydrochloric acid is added to 50 cm^3 of 0.02 mol / dm^3 sodium thiosulfate. The temperature is kept at 30 °C.
The time taken for the cross to become invisible is recorded.
The experiment is repeated four more times, keeping all volumes, concentrations and temperatures the same **except** for the concentration of sodium thiosulfate, which is altered.

concentration of sodium thiosulfate mol / dm^3	time / s
0.02	210
0.04	90
0.06	44
0.08	30
0.10	20

For Examiner's Use

(i) Plot the results on the grid below and draw a smooth curve through the points.



[2]

(ii) Use your graph for Experiment **2** to determine how long it takes for the cross on the card to become invisible when the concentration of sodium thiosulfate is 0.03 mol / dm^3.

.... s [1]

(iii) Use both graphs to determine the concentration of sodium thiosulfate in the first experiment.

.... mol / dm^3 [2]

[Total: 11]

BLANK PAGE