Rate(speed) of Reaction

Question Paper 5

Level	IGCSE
Subject	Chemistry
Exam Board	CIE
Topic	Chemical Reactions
Sub-Topic	Rate (speed) of Reactions
Paper Type	Alternative to Practical
Booklet	Question Paper 5

Time Allowed: **53 minutes**

Score: **/44**

Percentage: **/100**

1 **Is manganese(IV) oxide a catalyst?**

A catalyst is a substance that speeds up a chemical reaction and remains unchanged.

Hydrogen peroxide, H_2O_2 breaks down to form oxygen. This reaction is very slow without a catalyst. Describe an experiment to show that manganese(IV) oxide is a catalyst for this reaction.

You are provided with the following items.

Hydrogen peroxide solution

Manganese(IV) oxide

Measuring cylinder

Balance

Beaker

Filtration apparatus

Splints/Bunsen burner

Distilled water

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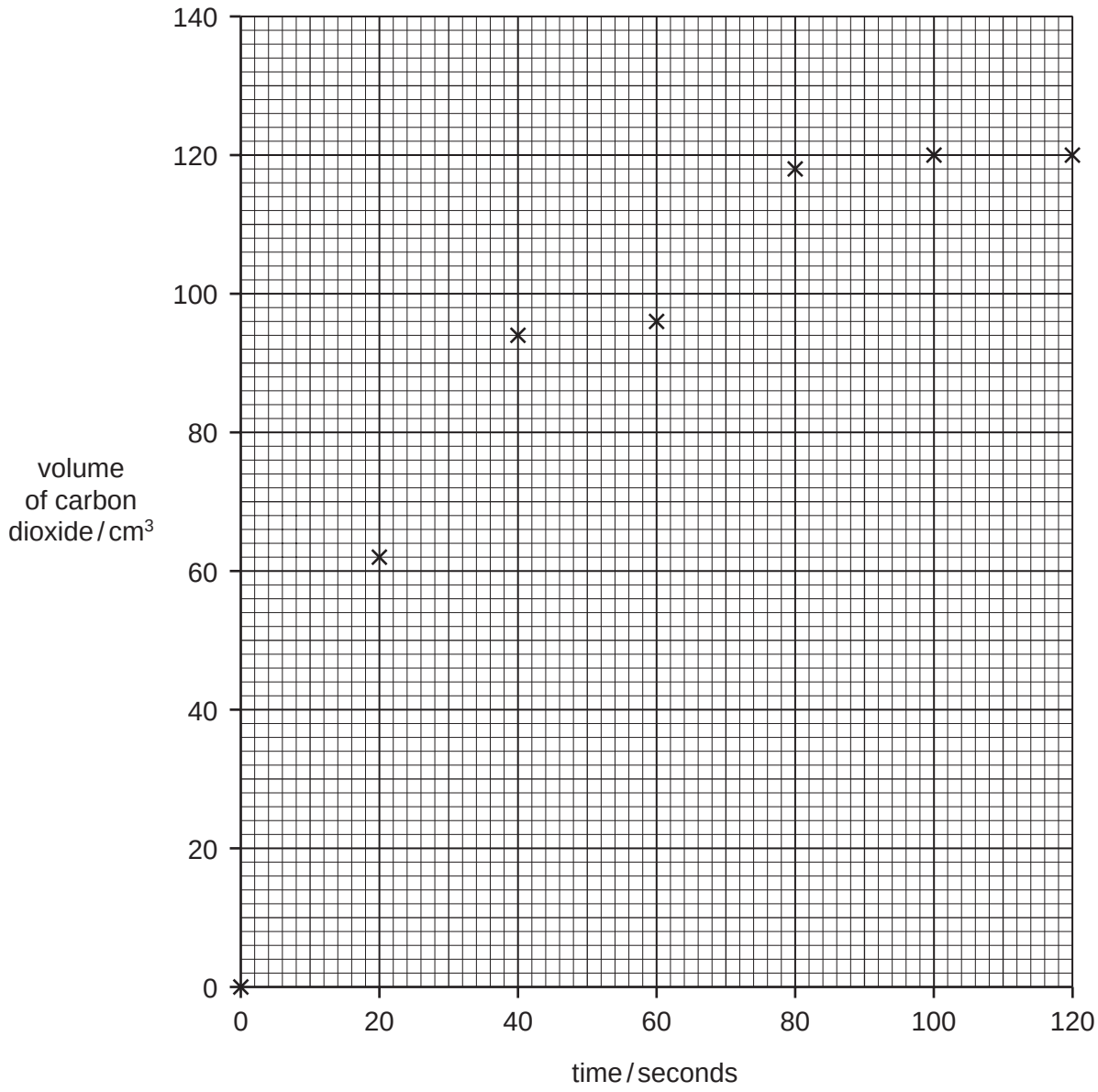
..... [6]

2 The addition of calcium carbonate to excess dilute nitric acid produces carbon dioxide. The volume of carbon dioxide given off at 20 second intervals was recorded and plotted on the grid.



(a) Draw a smooth line graph on the grid. [1]

(b) Circle the result which appears to be incorrect? Why have you selected this result?

.....

.....

..... [2]

(c) Why does the reaction slow down?

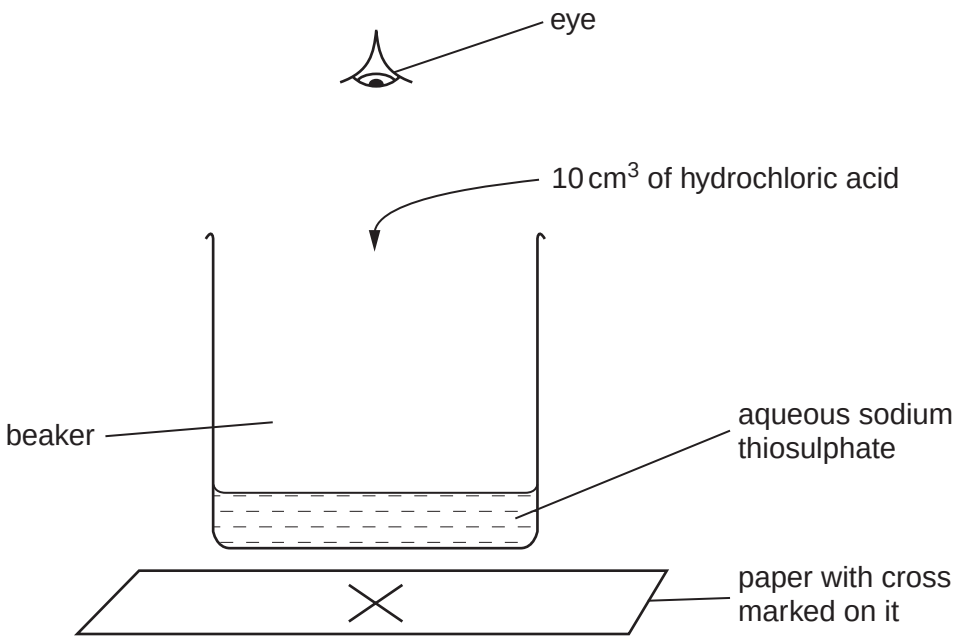
..... [1]

3 A student carried out an experiment to investigate the speed of the reaction between sodium thiosulphate and dilute hydrochloric acid.

$$Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + S + H_2O + SO_2$$

Experiment 1

By using a measuring cylinder, 50 cm^3 of sodium thiosulphate solution was poured into a 100 cm^3 beaker. The beaker was placed on a cross drawn on a piece of paper. 10 cm^3 of hydrochloric acid was added to the beaker and the timer started.



The time was taken until the cross could not be seen. The time was recorded in the table.

Experiments 2, 3, 4 and 5

Experiment 1 was repeated using different volumes of sodium thiosulphate as shown in the table. All experiments were carried out at 25 ÁC.

Table of results

Experiment	volume of sodium thiosulphate/cm^3	volume of water/cm^3	time for cross to disappear/s
1	50	0	5
2	40	10	60
3	30	20	80
4	20	30	130
5	10	40	255

(a) Why does the cross on the paper disappear?

.....

.....[2]

(b) Why was the total volume of solution kept constant?

.....

.....[1]

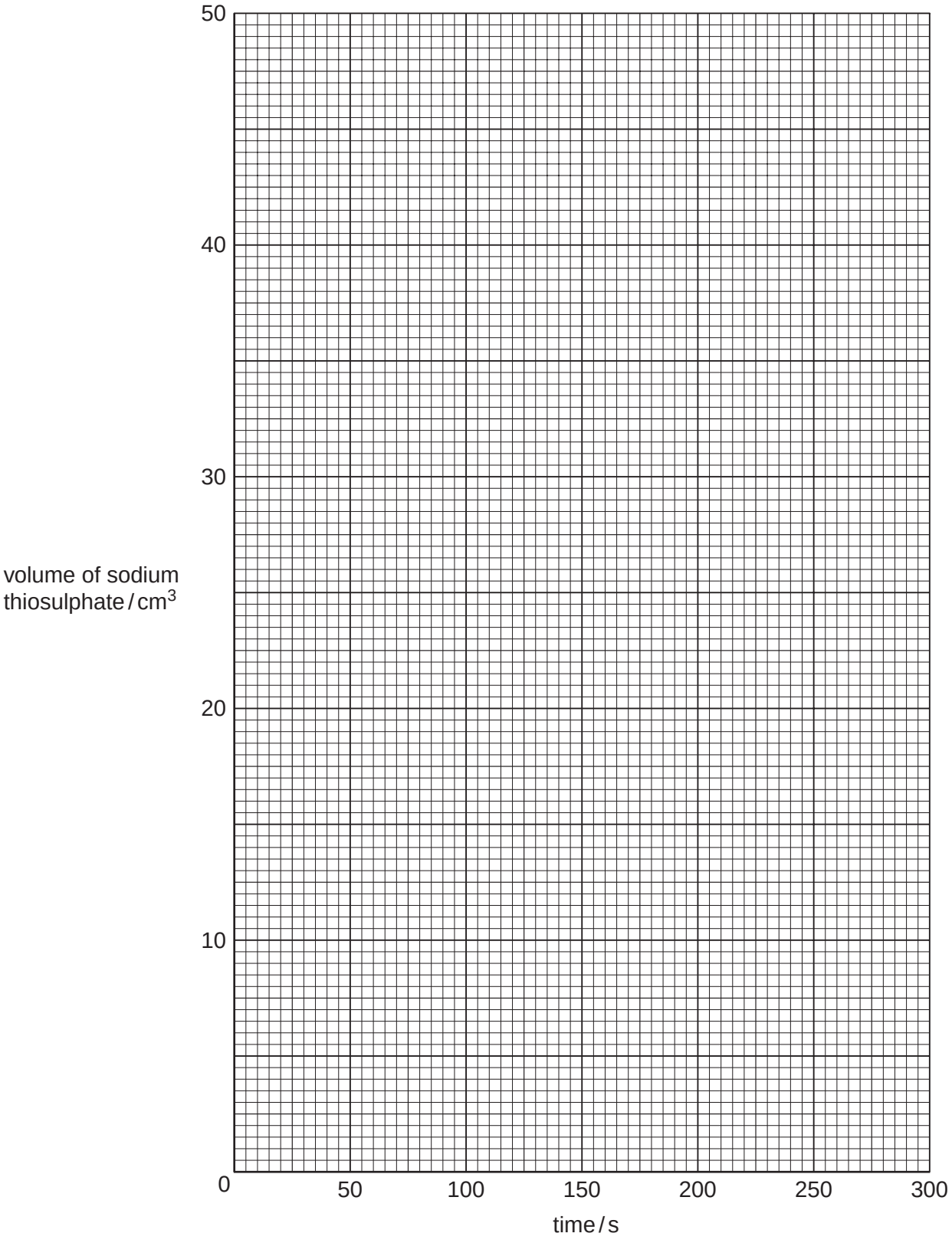
(c) In which order should the water, hydrochloric acid and sodium thiosulphate solution be added to the beaker?

first .....

second .....

last .....[1]

(d) **(i)** Plot the results on the grid below. Draw a smooth line graph and label it 25 ÁC. [5]



(ii) Sketch on the grid the graph you would expect if the experiments were repeated at 50 ÁC. Label this graph. [2]

(e) The experiments were repeated using a 250 cm^3 beaker instead of a 100 cm^3 beaker. Suggest how the results would differ. Explain your answer.

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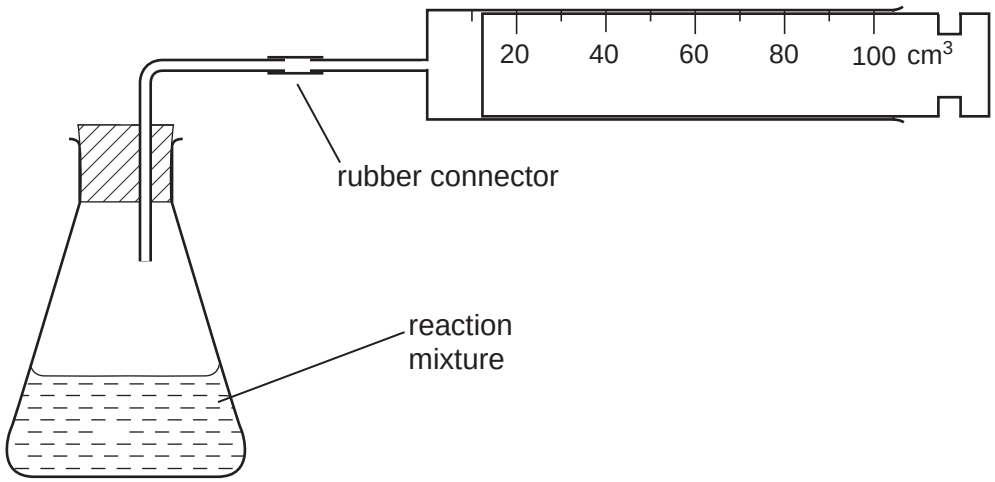
.....[2]

4 An experiment was carried out using the apparatus below.



By using a measuring cylinder, 20 cm^3 of hydrogen peroxide was placed in the flask and 0.8 g of the catalyst, manganese(IV) oxide was added. The bung was replaced and the gas collected was measured at 1 minute intervals. The results were plotted on the grid (opposite).

(a) **(i)** Draw a smooth line graph on the grid. [1]

(ii) Which result appears to be inaccurate? Why have you chosen this result?

.....

.....[2]

(b) What mass of manganese(IV) oxide would remain at the end of the experiment?

.....[1]

(c) What would be the effect of using a rubber connector with a hole in it?

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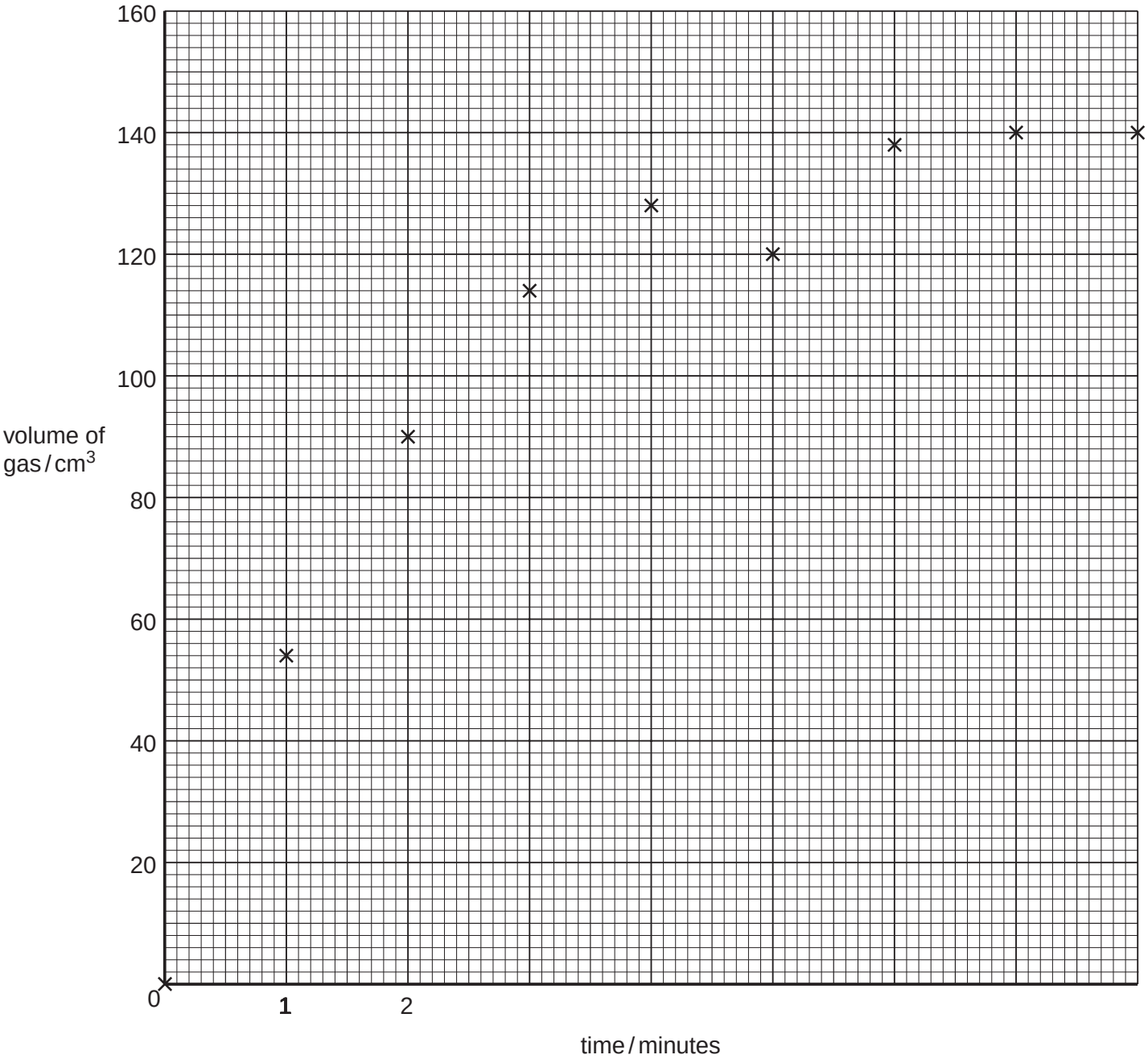
.....[2]

11



5 A student investigated the speed of reaction between aqueous potassium bromate and potassium iodide solution.

A burette was filled up to the 0.0 cm^3 mark with aqueous potassium iodide.

To each of 5 test-tubes was added 6 cm^3 of aqueous potassium iodide to be used in the 5 following experiments.

Experiment 1

By using a measuring cylinder 12 cm^3 of aqueous potassium bromate was poured into a small beaker. To this solution was added 4 cm^3 of water, 2 cm^3 of hydrochloric acid, 5 cm^3 of starch solution and 1 cm^3 of sodium thiosulphate solution.

The beaker was placed on a cross drawn on a piece of paper.

From one of the test-tubes 6 cm^3 of aqueous potassium iodide was added to the mixture in the beaker and the timer started. A dark blue colour formed. The timer was stopped when the cross on the paper could not be seen.

Use the stop clock diagram to record the time in the table.

Experiment 2

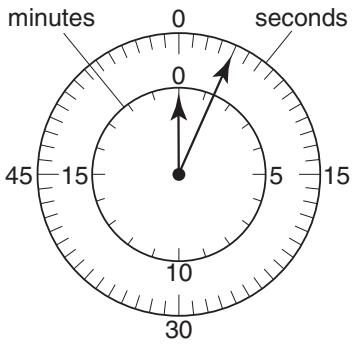
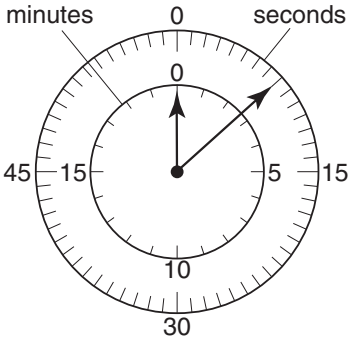
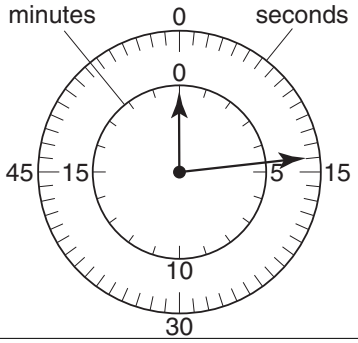
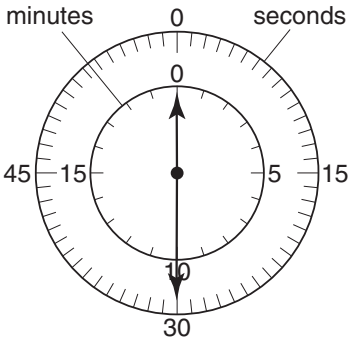
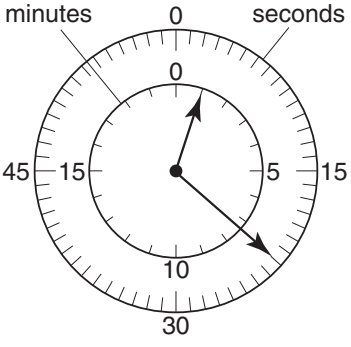
By using a measuring cylinder 10 cm^3 of potassium bromate solution was poured into a beaker. The instructions were repeated exactly as given for Experiment 1, but 6 cm^3 of water was added to the beaker.

Use the diagram to record the time in the table.

Experiments 3, 4 and 5

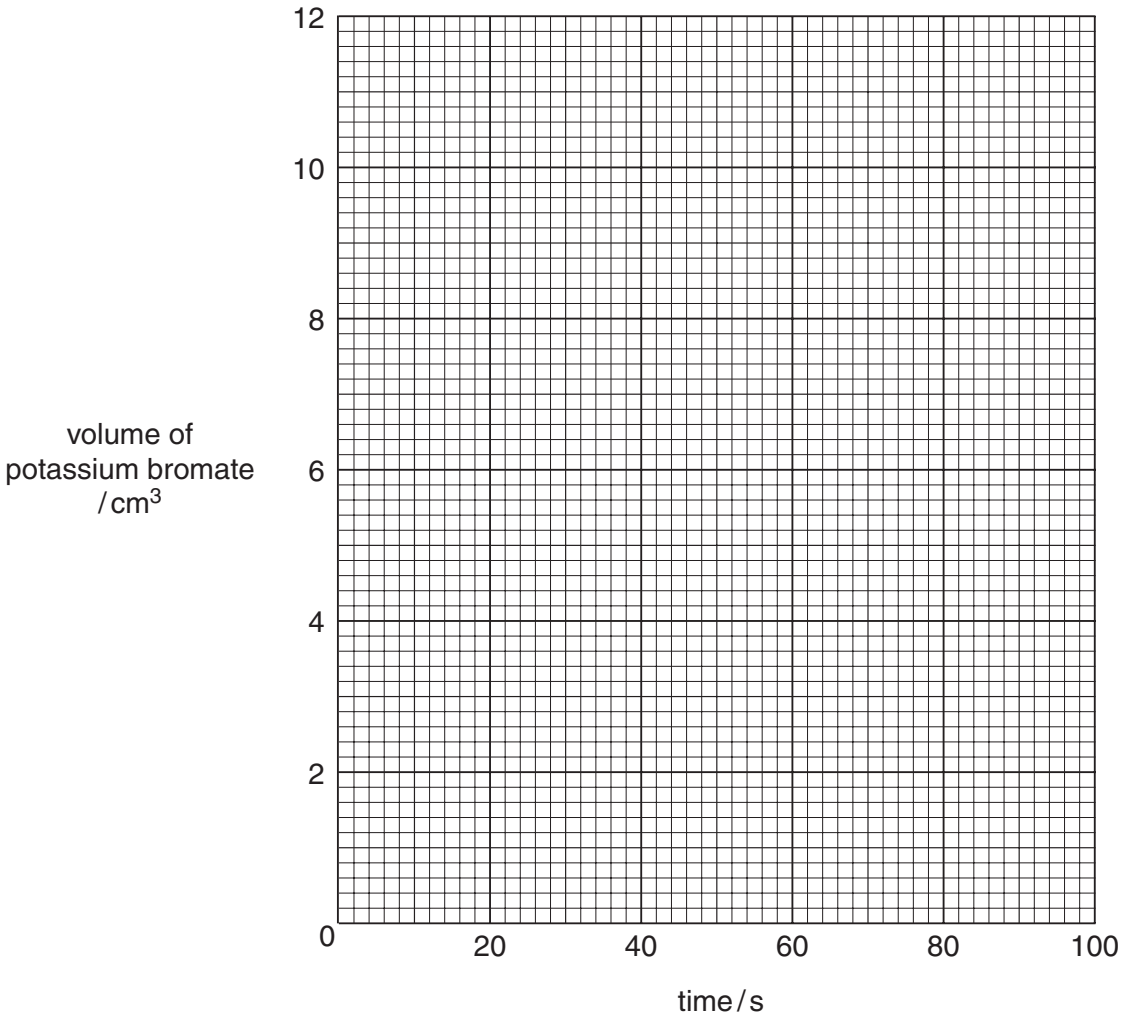
Experiment 1 was repeated using the volumes of aqueous potassium bromate and water specified in the table of results. Record the times in the table.

Table of results

Experiment	volume		clock diagram	time/s
	potassium bromate/cm^3	water/cm^3		
1	12	4		
2	10	6		
3	8	8		
4	6	10		
5	4	12		

[5]

(a) Plot the results on the grid. Draw a smooth line graph.



[4]

(b) From your graph estimate the time of the reaction if Experiment 1 was repeated using 5 cm^3 of potassium bromate and 11 cm^3 of water.

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Show clearly on your graph how you worked out your answers. [3]

(c) **(i)** Which experiment is the quickest?

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(ii) Explain why this experiment is the quickest.

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.....[3]

(d) (i) State **two** possible sources of error in the experiments.

1 .....

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2 .....

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(ii) Suggest **two** improvements to reduce the sources of error in the experiments.

1 .....

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2 .....

.....[4]