

Rate(speed) of Reaction

Question Paper 4

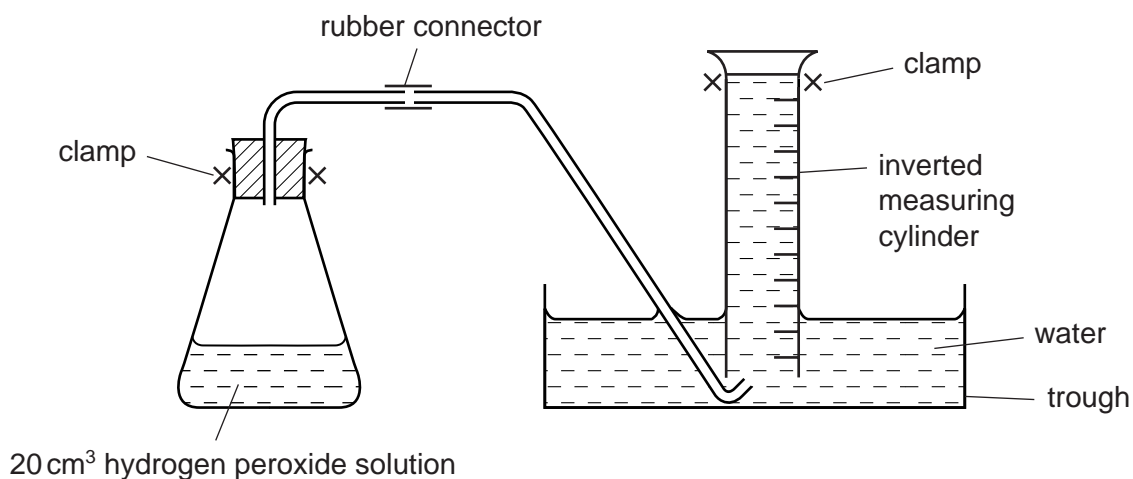
Level	IGCSE
Subject	Chemistry
Exam Board	CIE
Topic	Chemical Reactions
Sub-Topic	Rate (speed) of Reactions
Paper Type	Alternative to Practical
Booklet	Question Paper 4

Time Allowed: 63 minutes

Score: /52

Percentage: /100

- 1 A student investigates the speed of reaction when aqueous hydrogen peroxide breaks down using a catalyst, manganese(IV) oxide. The catalyst remains unchanged at the end of the reaction. The apparatus was set up as shown in the diagram.



Experiment 1

By using a measuring cylinder, 20 cm³ of hydrogen peroxide solution was poured into a conical flask. One spatula measure of manganese(IV) oxide was added to the flask, the bung was quickly put in the flask and the timer started.

The volume of gas collected in the measuring cylinder at 10 seconds, 20 seconds and 30 seconds was measured.

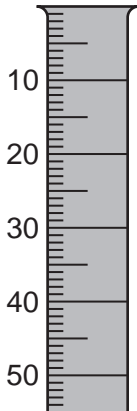
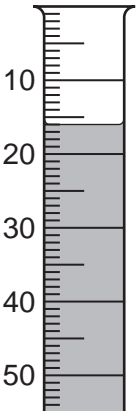
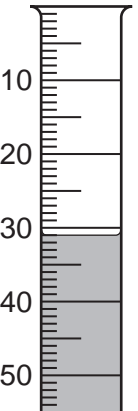
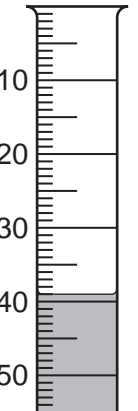
The results are shown in the table below.

time/s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder/cm ³	0	19	39	51

Experiment 2

By using a measuring cylinder 15 cm³ of hydrogen peroxide was poured into the conical flask. The instructions were repeated exactly as given for Experiment 1, but 5 cm³ of distilled water was also added to the flask.

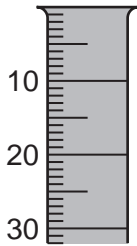
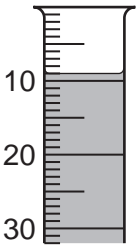
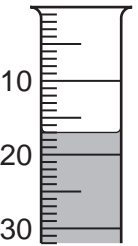
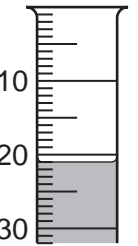
Use the diagrams to record your results in the table below.

time/s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm ³				

[2]

Experiment 3

Experiment 1 was repeated using 10 cm³ of hydrogen peroxide and 10 cm³ of distilled water. Record your results in the table.

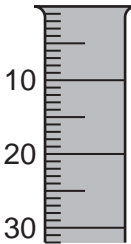
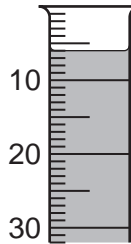
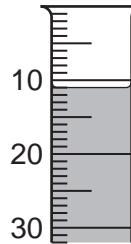
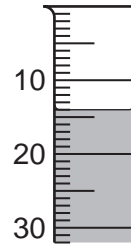
time/s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm ³				

[2]

Experiment 4

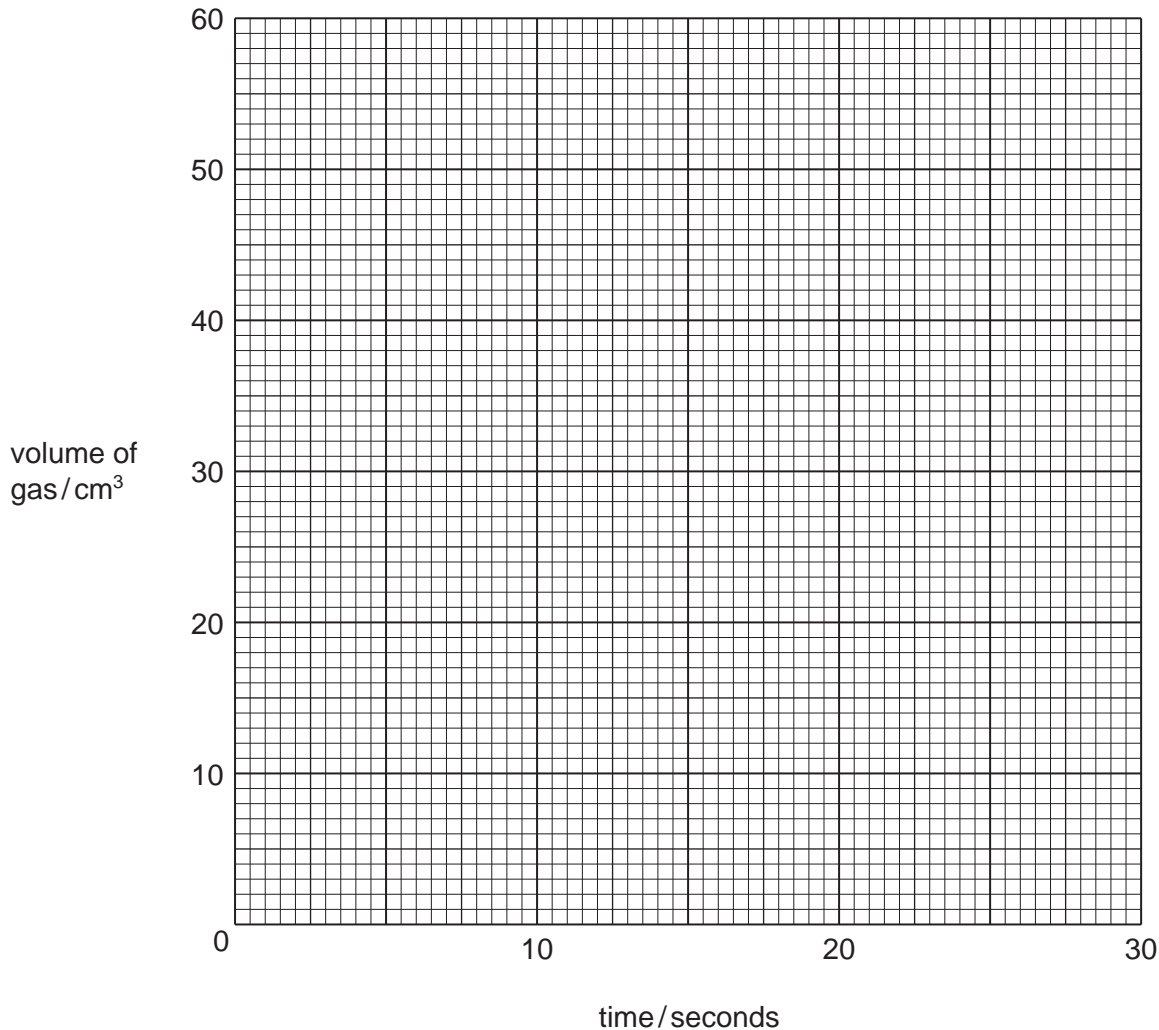
Experiment 1 was repeated using 5 cm^3 of hydrogen peroxide and 15 cm^3 of distilled water.

Record your results in the table.

time/s	0	10	20	30
measuring cylinder diagram				
volume of gas in measuring cylinder / cm^3				

[2]

(a) Plot your results on the grid for each Experiment. Draw 4 graphs and label each clearly with the number of the Experiment.



[5]

(b) (i) Which Experiment has the fastest rate of reaction?

..... [1]

(ii) Explain, in terms of particles, why this Experiment has the fastest rate.

.....
.....
..... [2]

(c) (i) State two sources of error in the Experiments.

1
.....
2
..... [2]

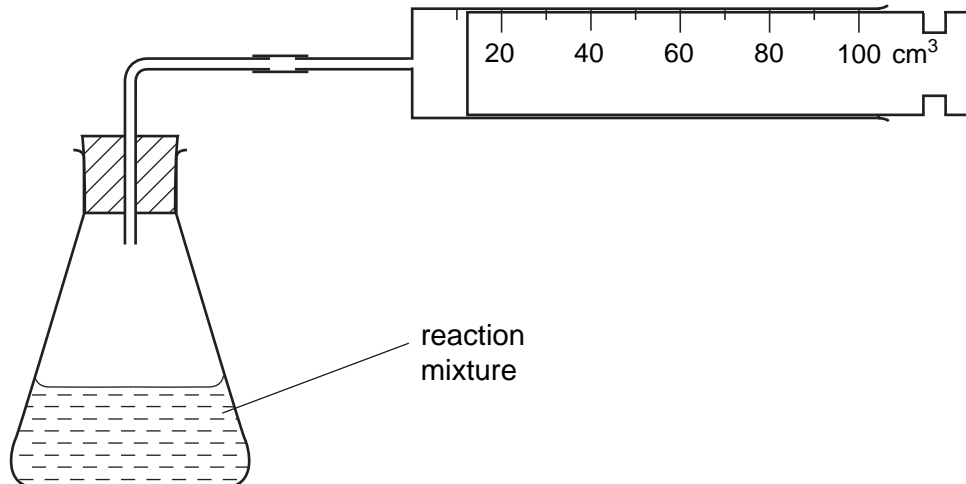
(ii) Suggest two improvements to reduce the sources of error in the Experiments.

1
.....
2
..... [2]

(d) State a practical method you could use to prove that manganese(IV) oxide was a catalyst in Experiment 1.

.....
.....
..... [2]

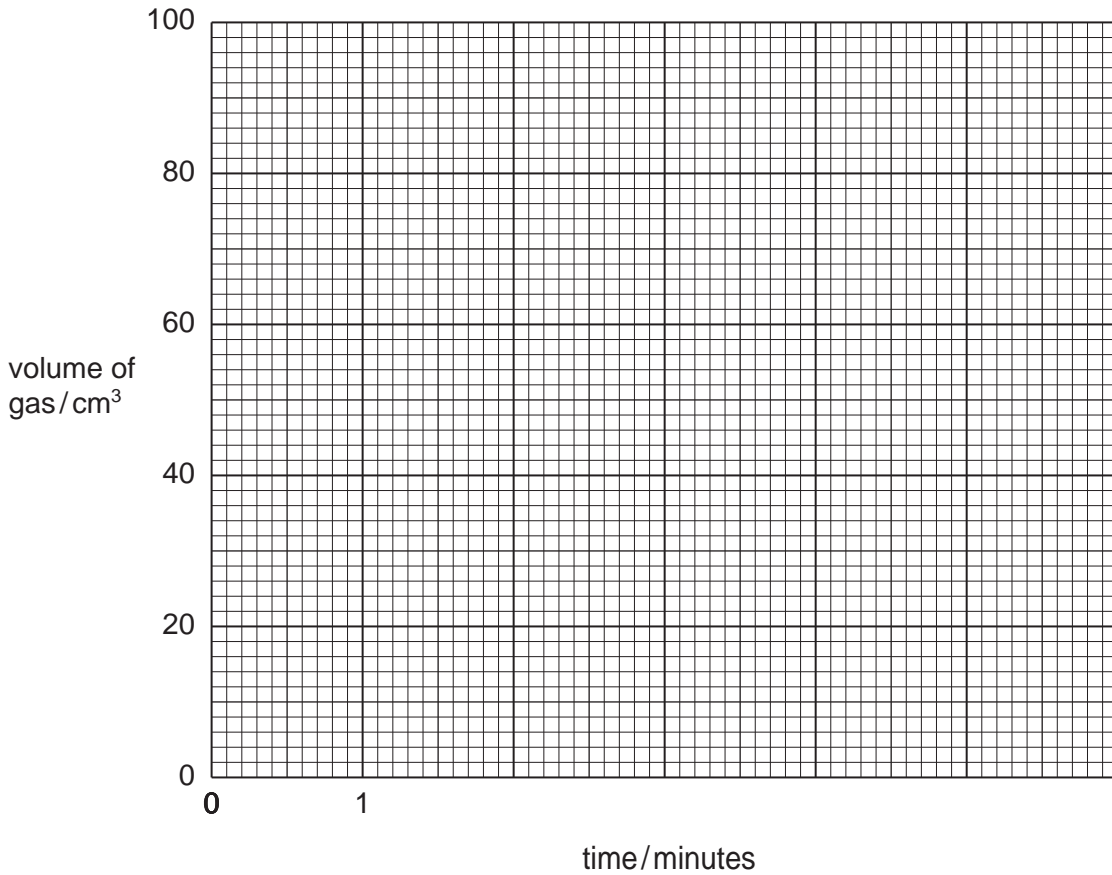
- 2 An investigation into the reaction of calcium with water was carried out using the apparatus below. The temperature of the water increased during the experiment.



The volume of hydrogen collected at one minute intervals was measured. Use the diagrams to record the volumes in the table.

time / minutes	syringe diagram	volume of gas / cm ³
0		
1		
2		
3		
4		
5		
6		

(a) Plot the results on the grid. Join **all** of the results with a smooth curve.



[3]

(b) What type of chemical reaction occurs when calcium reacts with cold water?

..... [1]

(c) (i) Use the graph to describe how the speed of this reaction changes during the six minutes.

.....
..... [2]

(ii) Explain possible reasons for the changes in (c)(i).

.....
.....
..... [2]

- 3 An aqueous solution of hydrogen peroxide decomposes very slowly to form oxygen. The speed of decomposition can be increased by using a catalyst. Two possible catalysts are the solids copper(II) oxide and chromium(III) oxide.

Plan an investigation to find out which of these two oxides is the better catalyst for this decomposition.

The space below can be used for a diagram.

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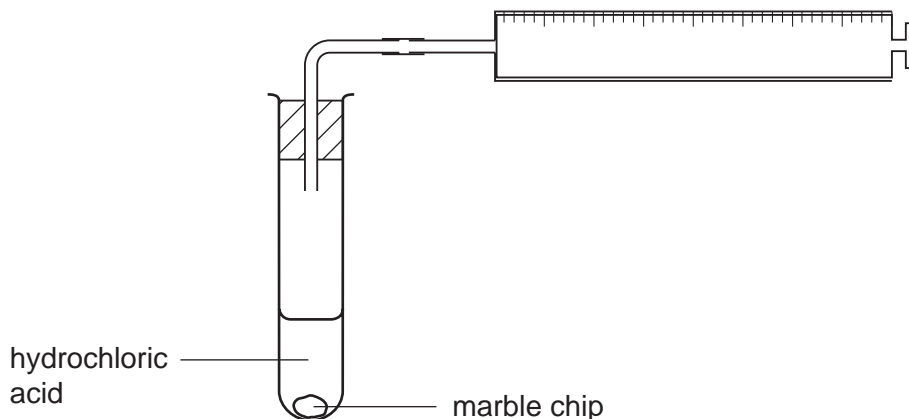
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[6]

- 4 A student investigated the speed of reaction between aqueous hydrochloric acid and marble chips (calcium carbonate).

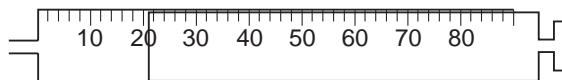
The apparatus below was used.



5 test-tubes were put in a rack. To each test-tube was added 10 cm^3 of different solutions of aqueous hydrochloric acid and a marble chip. The marble chips were the same size.

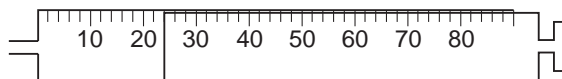
Experiment 1

By using a measuring cylinder 10 cm^3 of the solution **P** of aqueous hydrochloric acid was placed in the first test-tube. A marble chip was added and the volume of gas collected after two minutes was measured. Use the gas syringe diagram to record the volume.



Experiment 2

Experiment 1 was repeated using the solution **Q** of aqueous hydrochloric acid. Use the diagram to record the volume of gas collected in the table.

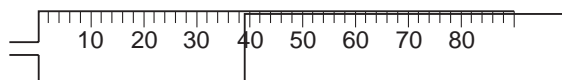


Experiments 3, 4 and 5

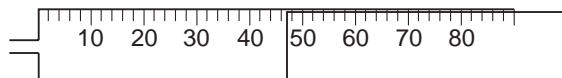
Experiment 1 was repeated using the solutions **R**, **S** and **T** of aqueous hydrochloric acid in the third, fourth and fifth test-tubes.

Use the diagrams to record the volumes in the table.

Experiment 3



Experiment 4



Experiment 5

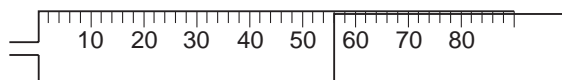
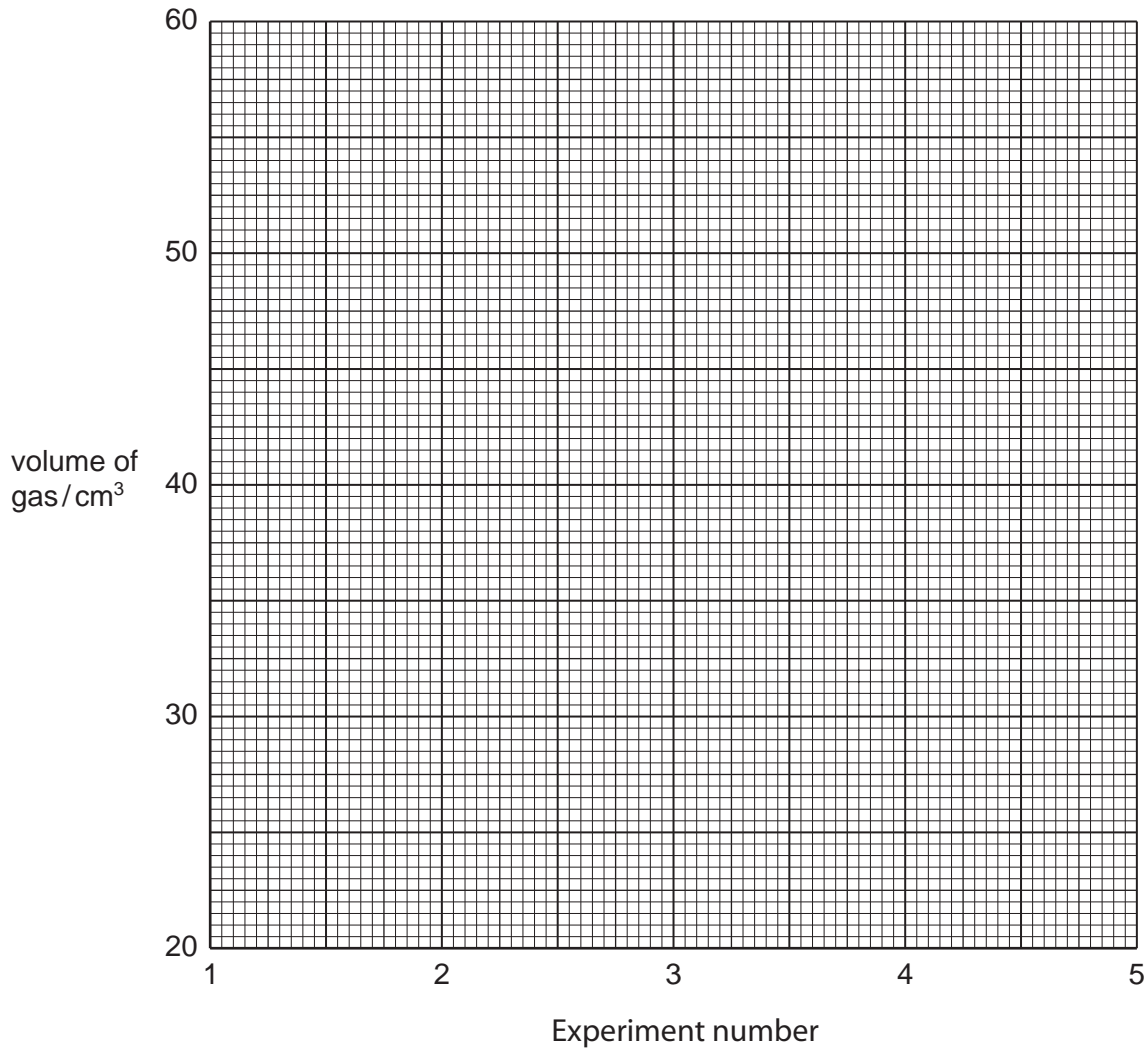


Table of results

Experiment	solution of hydrochloric acid	volume of gas collected / cm ³
1	P	
2	Q	
3	R	
4	S	
5	T	

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



[4]

(b) Which result appears inaccurate? Give a reason for your choice.

Experiment

reason [2]

(c) (i) Which Experiment had the fastest rate of reaction?

..... [1]

(ii) Suggest why this Experiment was the fastest.

.....

.....

..... [2]

(d) How would the student know which of the reactants in the Experiment was in excess?

.....
..... [2]

(e) (i) State **one** possible source of error in the Experiments.

.....
..... [1]

(ii) Suggest **one** improvement to reduce this source of error in the Experiments.

.....
..... [1]