1 Fatimah investigates the reaction between sodium hydrogencarbonate and dilute hydrochloric acid.

She always adds 0.5 g of sodium hydrogencarbonate to 20 cm^3 of dilute hydrochloric acid.

She measures the time it takes for the reaction mixture to stop bubbling.

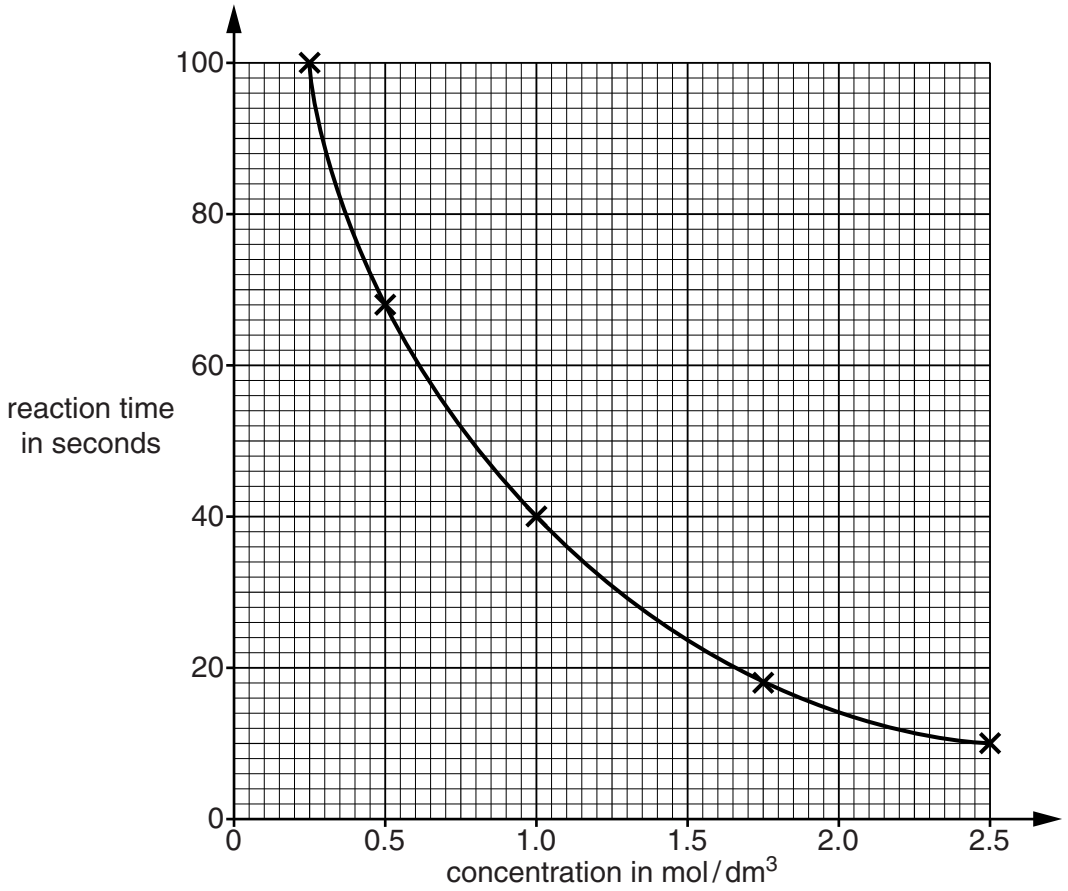
This is called the **reaction time**.

She does five different experiments.

She keeps the temperature the same.

Each experiment uses a **different concentration** of acid.

Look at a graph of her results.



Fatimah concludes that as the concentration of acid increases, the rate of reaction increases.

Explain, with a reason, whether the results support Fatimah's conclusion.

Use the reacting particle model to explain Fatimah's results.



The quality of written communication will be assessed in your answer to this question.

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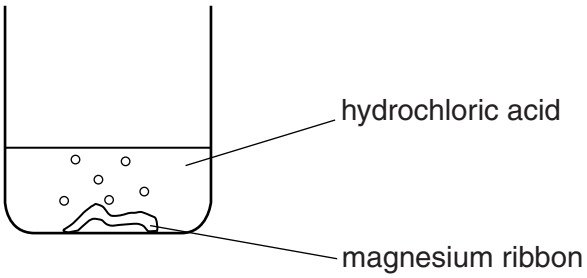
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2 Rachel investigates the reaction between magnesium and hydrochloric acid.

She adds a piece of magnesium ribbon to hydrochloric acid in a beaker.

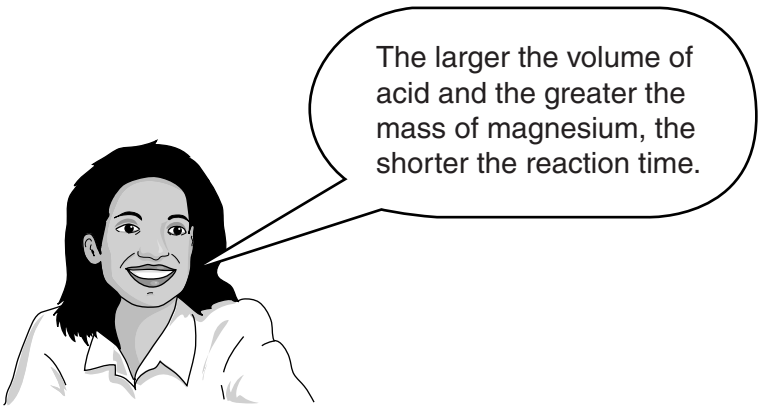


Rachel measures the time it takes for all the magnesium ribbon to react.

This is the reaction time.

She does five different experiments.

Look at Rachel's prediction.



Look at Rachel's results.

Experiment number	Mass of magnesium used in g	Volume of acid used in cm^3	Concentration of acid in mol/dm^3	Reaction time in seconds
1	0.05	25	1.0	30
2	0.10	25	1.0	30
3	0.05	50	1.0	30
4	0.05	50	2.0	15
5	0.10	50	2.0	15

(a) Explain if Rachel's results support her prediction. Use the reacting particle model to explain the difference between the reaction time in experiments **3** and **4**.



The quality of written communication will be assessed in your answer to this question.

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(b) Rachel repeats experiment **1**. This time she uses acid at a **higher** temperature.

Explain, using the reacting particle model, what happens to the rate of reaction.

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[Total: 8]

3 Nitrogen molecules react with oxygen molecules.

Nitrogen monoxide molecules are made.

$$N_2 + O_2 \rightarrow 2NO$$

The reaction is endothermic.

(a) Explain, in terms of bond breaking and bond making, why this reaction is endothermic.

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(b) Nitrogen molecules and oxygen molecules react extremely slowly, even at 200 °C.

The reaction between nitrogen and oxygen becomes faster as both the temperature and the pressure increase.

Explain why, using the reacting particle model.



The quality of written communication will be assessed in your answer to this question.

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[Total: 9]