



EFFECT OF CONCENTRATION ON RATE 1

Aim

Magnesium reacts with hydrochloric acid: $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$

You are going to see how changing the concentration of the acid affects the rate of the reaction. You will measure the volume of hydrogen gas formed in the first 20 seconds and use this to find the mean rate of the reaction in the first 20 seconds in cm^3/s .

Hypothesis

Predict how changing the concentration of hydrochloric acid will affect the rate of reaction. Explain your hypothesis.

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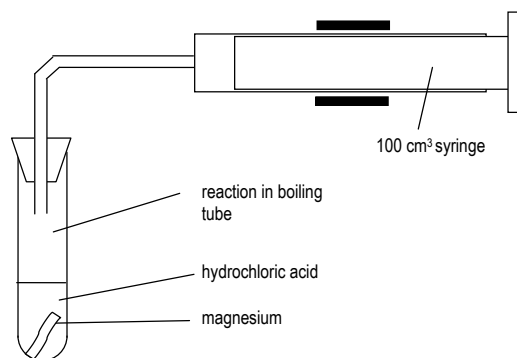
Safety



- Hydrochloric acid is an irritant.
- Hydrogen and magnesium are flammable. There should be no naked flames in the laboratory.

Method

- 1) Prepare 20 cm^3 of 0.4 mol/dm^3 hydrochloric acid by mixing 4 cm^3 of 2.0 mol/dm^3 hydrochloric acid with 16 cm^3 of water in a boiling tube using measuring cylinders. Place the boiling tube in a rack.
- 2) Set up a syringe using a stand and clamp.
- 3) Cut a 3 cm length of magnesium ribbon and rub it down with emery / sandpaper.
- 4) Add the magnesium ribbon to the hydrochloric acid, attaching the delivery tube straight away and starting the timer.
- 5) Record the volume of gas formed in 20 seconds.
- 6) Repeat the experiment with the other concentrations of acid, using a new piece of magnesium each time.

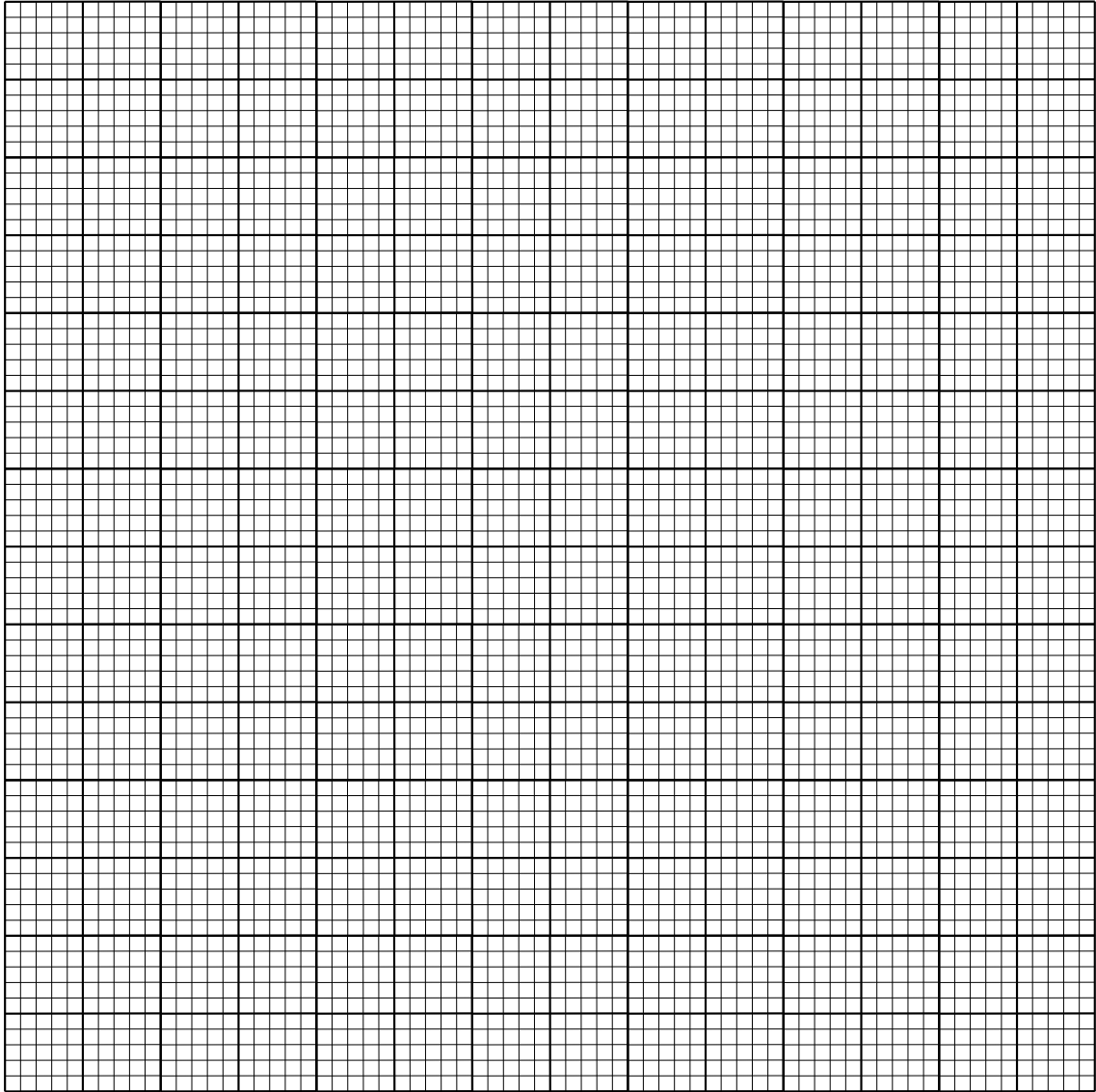


Results

Concentration of HCl (mol/dm^3)	0.4	0.8	1.2	1.6	2.0
Volume of 2.0 mol/dm^3 HCl (cm^3)	4	8	12	16	20
Volume of water (cm^3)	16	12	8	4	0
Volume of gas in 20 seconds (cm^3)					
Mean rate of reaction (cm^3/s)					

Analysis

- 1 Calculate the mean rate of reaction for each experiment in cm^3 of hydrogen formed per second in the first 20 seconds. Fill this in the results table.
- 2 Plot a graph of rate of reaction versus concentration of acid on the grid over the page.



- 3 Identify the independent, dependent and key control variables in this investigation.

Independent =

Dependent =

Control =

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4 Explain why the control variables had to be controlled in this experiment.

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5 Describe what the results tell us how changing the concentration affects the rate of reaction.

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6 Explain why concentration has this effect on the rate of reaction using collision theory.

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7 The rate of reaction should be proportional to the concentration of the acid. Do your results this. Justify your answer.

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8 A student found that when water rather than acid was used in this experiment, i.e. a concentration of acid of 0 mol/dm^3 , the syringe did show a few cm^3 of gas in the syringe. This is called a zero-point error. Explain why this occurs and explain whether this is a systematic or random error.

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9 You calculated a mean rate of reaction in each experiment. Explain why this is called a *mean* rate.

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10 Identify two significant problems with this experiment and suggest ways in which these could be reduced.

Problem 1

Solution

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Problem 2

Solution

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ASSESSMENT GRID	Working towards	Good understanding
makes a sensible prediction		
justifies prediction with sensible science		
follow instructions to obtain reasonable experiment results		
can calculate reaction rates		
can draw a graph well		
can identify independent, dependent and control variables		
can explain why variables must be controlled		
can write a good conclusion		
can explain the results using collision theory		
shows understanding of proportionality		
shows understanding of systematic v random errors		
shows understanding of mean rates		
can identify significant issues with the experiment and ways to improve it		