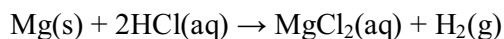

Chemistry Internal Assessment

How does increasing the concentration of hydrochloric acid in a chemical reaction with magnesium affect the rate of reaction?

When magnesium is added to hydrochloric acid, they react together to give magnesium chloride and hydrogen gas as products. The equation for this reaction is:



Research question: How does increasing the concentration of hydrochloric acid in a chemical reaction with magnesium affect the rate of reaction?

Equipment

Table 1: Equipment list and uncertainties	
Equipment	Uncertainty/error
5 x 2cm strips of magnesium ribbon	±1 mm
1, 2, 3, 4 and 5 mol dm ⁻¹ hydrochloric acid solution	
Sand paper	
Conical flask (100cm ³)	±0.5cm ³
2 x Measuring cylinders (100cm ³)	±0.5cm ³
Clamp stand with boss and clamp	
Trough	
Water	
Single-holed rubber bung and delivery tube	
Stopwatch	±0.1s
Scissors	
Ruler	±0.5mm
Pen/pencil	
Paper	

Variables

Table 2: Identifying independent and dependent variables	
Dependent variable	Independent variables
The volume of hydrogen gas produced in 30 second intervals	The concentration of the hydrochloric acid <1 mol dm ⁻³ <2 mol dm ⁻³ <3 mol dm ⁻³ <4 mol dm ⁻³ <5 mol dm ⁻³

Table 3: Identifying control variables, controlling methods and why it requires controlling

Control variables	How will it be controlled?	Why does it need to be controlled?
Experimenter	This will be controlled by using the same experimenters for measuring out the hydrochloric acid solution and reading the volume of the hydrogen gas produced.	This requires controlling as using different experimenters for a certain task may result in human error, and thus alter the accuracy of the results.
Temperature of room	The experiment will be conducted in a room where there is a thermostat, which can be set to a constant temperature.	The temperature of the room needs to be controlled because if it is not constant, it would affect the chemical reaction, and therefore alter the results of the experiment.
Temperature of hydrochloric acid	All the hydrochloric acid solutions will be stored in the same place as each other prior to conducting the experiment.	If the temperature is not constant throughout the experiment, this would affect the chemical reaction and change the results.
Amount of magnesium ribbon	A ruler will be used to measure 2cm strips of magnesium ribbon. The magnesium ribbon will also be measured and cut by the same experimenter.	The amount of magnesium ribbon used in the chemical reaction will be a major factor in the outcome of the experiment. If different amounts were used, this would be an extraneous variable, affecting the accuracy of the results.
Volume of hydrochloric acid	A measuring cylinder will be used to measure out 50cm ³ of hydrochloric acid. Also, the same person will measure out the hydrochloric acid solution throughout the experiment.	If different volumes of hydrochloric acid were used during the experiment, this would affect the rate of reaction, meaning the results will not be as accurate.
Pressure	The entire experiment will be conducted under the same conditions (e.g. same temperature using a thermostat, same room)	An inconstant pressure will add an extraneous variable. Again, altering the results of the experiment.

Method

Preparation

1. Using a ruler and scissors, five strips of 2cm magnesium ribbon were measured and cut out.
2. The pieces of magnesium ribbon were then rubbed with sand paper to remove any layers of oxidation present.
3. The trough was then half-filled with water.
4. The measuring cylinder was then filled with the water in the trough, making sure there were no air bubbles visible inside. (see Figure 1 below)
5. The measuring cylinder was then held upside down in the trough with the clamp stand.

- The delivery tube end of the rubber bung was then placed in the trough of water under the measuring cylinder.

Experiment

- 50cm³ of hydrochloric acid was measured out with the other measuring cylinder and poured into the conical flask.
- A 2cm strip of magnesium ribbon was placed into the conical flask of hydrochloric acid.
- As soon as the magnesium ribbon was placed into the conical flask, the rubber bung was immediately placed on top and the time was recorded on the stopwatch.
- The volume of hydrogen gas collected at the top of the measuring cylinder was recorded at 30 second intervals until no more gas was produced.
- Steps 1 – 4 of the ‘experiment’ procedure were then repeated using 2 mol dm⁻¹, 3 mol dm⁻¹, 4 mol dm⁻¹ and 5 mol dm⁻¹ hydrochloric acid.

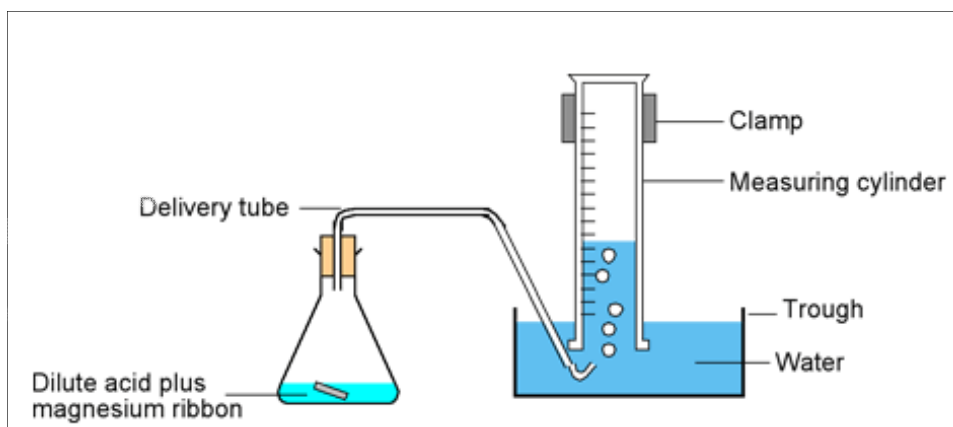


Figure 1. Diagram of experiment set-up (Practical Chemistry)

Results

Table 4: Raw data table*		
Concentration of hydrochloric acid (mol dm ⁻¹)	Time (s) ± 0.1s	Volume of hydrogen gas collected (cm ³) ± 0.5cm ³
1	30	
	60	
	90	
	120	
	150	
	180	

* Use this raw data table for the results of the four other concentrations of hydrochloric acid

Works Cited

Practical Chemistry. 4 March 2008. 24 April 2011

<<http://www.practicalchemistry.org/experiments/the-rate-of-reaction-of-magnesium-with-hydrochloric-acid,100,EX.html>>.