# Rate of Reaction between Magnesium and Hydrochloric Acid

A reaction was performed in which 0.35 g of magnesium ribbon was placed in 30.0 mL of 1.0 mol·L^{-1} HCl (aq). A second experiment was performed using the same mass of magnesium ribbon but 30.0 mL of 2.0 mol·L^{-1} HCl. In both cases the acid was initially at room temperature, (20 C). The hydrogen gas produced moved a piston in a syringe. Attached to the syringe piston was a pen, which recorded the volume of hydrogen gas produced versus time on a moving piece of graph paper. A sketch of some sample results is shown below.

Reactionof magnesium with hydrochloric acid

Volumeof H2 Gas

Time

—— 1.0 mol/L HCl   —— 2.0 mol/L HCl
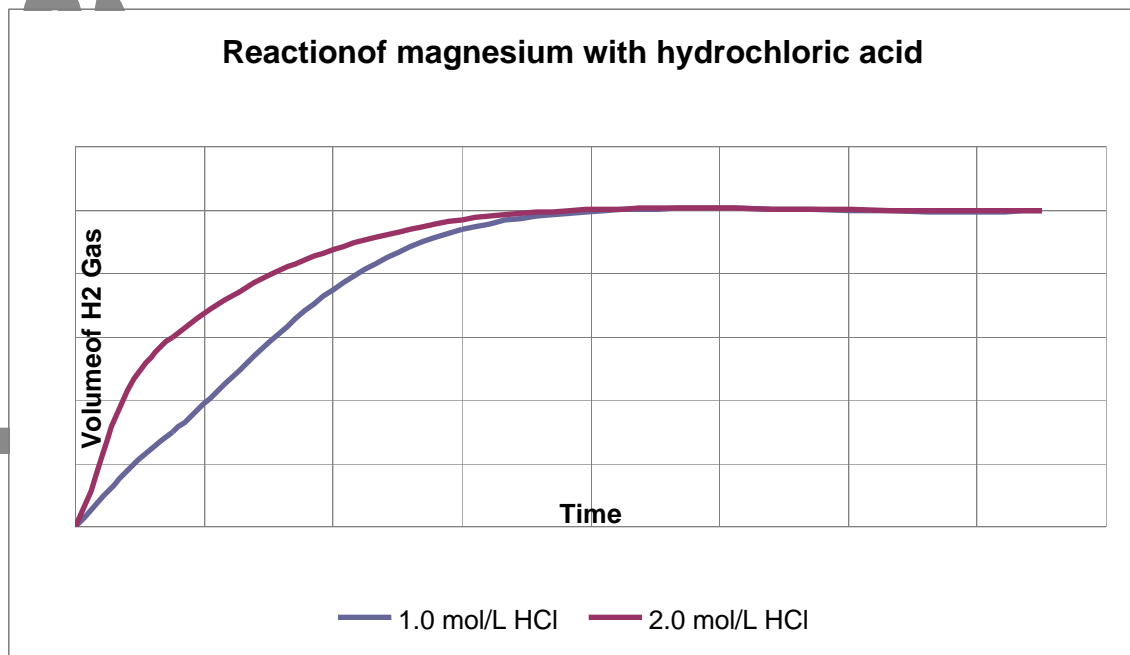
1. Write a balanced molecular equation for the reaction between hydrochloric acid and magnesium metal.

2. Determine which reactant is the limiting reagent and which is the excess, in each experiment.

3. Determine the volume of hydrogen gas that will be produced at 20 C and 100.2 kPa.

4. State how the rate of formation of hydrogen gas changes with time. Explain your answer in terms of collision theory.

5. Consider the graph for Mg and 1.0 mol·L^{-1} HCl. The rising portion of the curve is not really a straight line, but rather a gentle curve. What does this tell you about the rate of reaction? Why does the rate of reaction behave this way?

6. The rising portion of the curve produced using 2.0 mol·L^{-1} HCl looks different than the rising portion of the 1.0 mol·L^{-1} HCl curve. Why?

7. The latter part of both curves levels out to a horizontal line. Explain why the volume eventually remains constant.

8. (i) State how the rate of formation of hydrogen would change if the temperature were increased from 20 C to 40 C.

   (ii) State **two** reasons for the change described in (8)(i) and explain which of the two is the more important reason in causing the change.

9. State and explain how the rate of formation of hydrogen would change if the same amount of magnesium ribbon were used as a fine powder instead of as ribbon.

10. Suggest two ways that may be suitable to measure the rate of this reaction, and explain why they are suitable, (other than the method suggested above).