Reaction Rate:

Mathematically, rate = \frac{\Delta \text{quantity}}{\Delta \text{time}}

What is \( \Delta \)?

What are some examples of a ‘quantity’ that can change in a reaction?

Therefore, what are some valid units for rate?

Suppose we observe the following reaction in the lab. What are some quantities we could measure over a period of time in order to obtain a reaction rate?

\[
\text{Mg}(s) + 2\text{HCl}(aq) \rightarrow \text{MgCl}_2(aq) + \text{H}_2(g) + \Delta \text{E} \text{ (heat)}
\]

Rate can be measured by measuring the consumption of a reactant, or measuring the production of a product, all the while timing the reaction.

Suppose the rate for the reaction under discussion was determined by measuring the mass loss of the reactant Mg\(_{(s)}\) per unit time. Draw a graph to represent this:

Suppose the rate is determined by monitoring the increase in volume of the product H\(_2\) gas. Draw a graph for this:

Remember from math that slope = \frac{\text{rise (y axis)}}{\text{run (x axis)}}

What is the rise (y axis) in each of the graphs we’ve just drawn?

A change in _quantity_ (dep. var.)

What is the run (the x axis) in each?

A change in _time_ (indep. var.)

Therefore, what does the slope of these graphs represent?

\[
\text{reaction rate} = \frac{\text{rise}}{\text{run}} = \frac{\text{change in quantity}}{\text{change in time}}
\]
Therefore, what does the slope of these graphs represent?

\[
\text{rate} = \frac{\text{rise}}{\text{run}} = \frac{\Delta \text{quantities}}{\Delta \text{time}}
\]

What are the units of rate for each of the previous two graphs?

First graph:

Second graph:

Look at the two graphs again. What do you notice about the magnitude of the slope as your reaction proceeds? What does this tell you about reaction rate as a reaction proceeds?

Draw a graph of rate (y axis) vs. time for a reaction:

As reactants get used up, there are less and less collisions between reactant particles, therefore less and less effective collisions, so reaction rate is always decreasing!

**AS A REACTION PROCEEDS, THE RATE IS ALWAYS DECREASING.**

**Assignment 1:**

1) For the reaction: \( \text{NaHCO}_3 \text{(s)} \rightarrow \text{NaCl} \text{(aq)} + \text{H}_2\text{O} \text{(l)} + \text{CO}_2 \text{(g)} \)

Describe three things that you could measure while timing the reaction to calculate a reaction rate. For each, state the quantity being measured and what substance is being measured.

2) For the reaction: \( 2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O} \text{(l)} \)

Describe three things that you could measure while timing the reaction to calculate a reaction rate. For each, state the quantity being measured and what substance is being measured.

3) Hebden page 10, question 17

4) For the reaction: \( 2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O} \text{(l)} \)

Draw a graph for:

a) Mass loss of \( \text{O}_2 \) per unit time as the reaction proceeds
b) volume gain of \( \text{H}_2\text{O} \) per unit time
c) rate per unit time