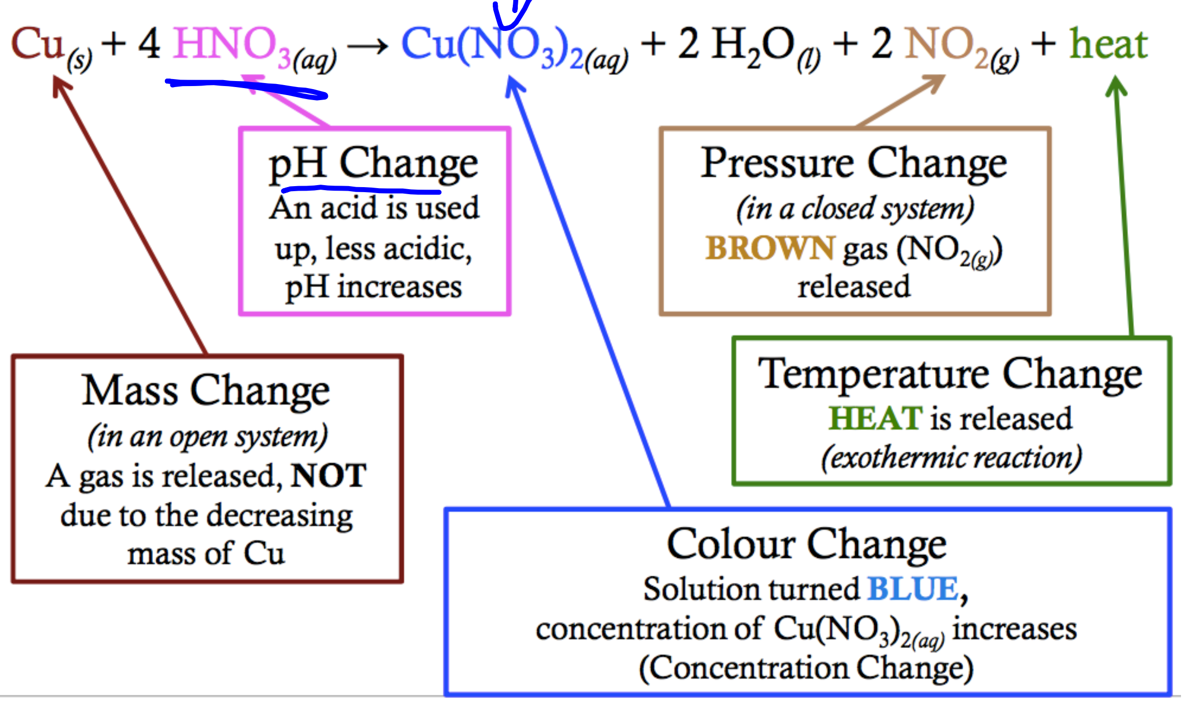
Reaction Kinetics

= study of the rate of reactions and the factors which affect the rates

- **reaction rate** = speed at which a reaction occurs
- measures how a property changes per unit time

$$\text{reaction rate} = \frac{\Delta \text{ amount}}{\Delta t}$$



1. What is the rate of a reaction if 23.5 g of magnesium is used up after 6.0 minutes?

$$\frac{\Delta amt}{\Delta t} = \frac{\Delta m}{\Delta t} = \frac{23.5\,g}{6.0\,min} = 3.9\,\frac{g}{min}$$

2. The rate of a reaction is 0.034 g of Mg per second. Calculate the number of moles of Mg used up in 6.0 minutes.

$$\frac{mol}{6.0\,min} = \left(\frac{0.034\,g}{s}\right)\left(\frac{mol}{24.3\,g}\right)\left(\frac{60\,sec}{min}\right) \times 6.0$$

$$= \frac{0.50\,mol}{6.0\,min}$$

3. An experiment is done to determine the rate of the following reaction:

$$2Al(s) + 6HCl(aq) \rightarrow 3H_2(g) + 2AlCl_3(aq)$$

It is found that the rate of production of $H_2(g)$ is 0.060 g/s. Calculate the mass of aluminum reacted in 3.0 minutes.

$$MAl: \frac{g\,Al}{s} \rightarrow \frac{g}{min} = \left(\frac{0.060\,g\,H_2}{s}\right)\left(\frac{H_2\,mol}{2.0\,g}\right)\left(\frac{2\,mol\,Al}{3\,mol\,H_2}\right)\left(\frac{27.0\,g\,Al}{mol}\right)\left(\frac{60\,s}{min}\right) \times 3$$

x3

$$= \frac{97\,g\,Al}{3\,min}$$

Consider the following reaction:

$$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$$

The following data is collected:

open beaker

$\frac{\Delta amt}{\Delta t}$

Time (min)	Mass of Beaker and Contents (grams)
0.0	256.3
2.0	255.7
4.0	255.1
6.0	254.5

Δt 6.0 min; Δmass 1.8 g

1. What is the rate of production of $H_{2(g)}$ in mol/s?

$$\frac{mol}{s} = \left[\frac{\Delta m}{\Delta t}\right] = \left(\frac{1.8\,g}{6.0\,min}\right)\left(\frac{mol}{2.0\,g}\right)\left(\frac{min}{60\,sec}\right) =$$

$$= 0.0025\ \frac{mol\ H_2}{s}$$

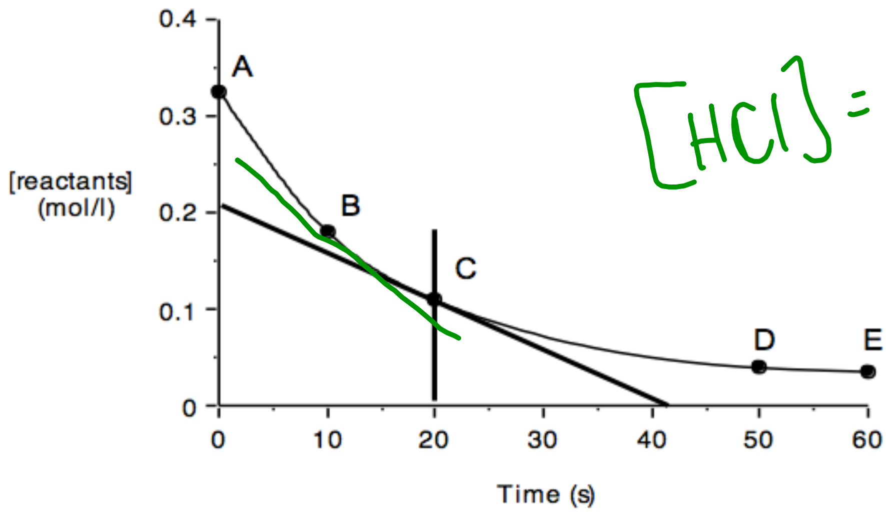
$$2.5\times10^{-3}\ \frac{mol\ H_2}{s}$$

2. What is the rate of $Al_{(s)}$ consumption in g/s for the same interval?

$$\frac{g\ Al}{s} = \left(\frac{2.5\times10^{-3}\ mol\ H_2}{s}\right)\left(\frac{2\ mol\ Al}{3\ mol\ H_2}\right)\left(\frac{27.0\,g\ Al}{mol}\right)$$

$$= 4.5\times10^{-2}\ \frac{g}{s}$$

Rates of reaction do not typically remain constant for the entire duration of a reaction.



- initially rates are fast because [reactants] are high
- rates decrease as reaction proceeds since [reactants] decrease
- The exact rate at any particular time can be obtained by determining the **slope** of a line that is tangent to the concentration–time curve at that point