

## General Chemistry II

### Chapter 13 Lecture Notes

#### Chemical Kinetics

**Chemical Kinetics** is concerned with reaction rates.

Typical reaction rate units are M/s, the change in concentration of a species per unit time.

There is a huge variation in possible reaction rates.

Increasing reaction rates is the goal of many industrial (and biological) processes.

In a simple reaction,  $A \rightarrow B$ , the number of A molecules or  $[A]$  decreases with time and the number of B molecules or  $[B]$  increases with time.

The reaction rate can be expressed in several useful forms,

$$\text{Rate} = -\Delta[A]/\Delta t \text{ or } \text{rate} = \Delta[B]/\Delta t$$

(Since is it desirable for rate values to be positive, the  $[A]$  equation has a negative sign.)

Species may be monitored by pressure, pH, spectroscopically or otherwise.

#### The Oxidation of Formic Acid by Molecular Bromine.



The reaction may be followed by tracking the loss of bromine color spectroscopically using Beer's Law.

The average rate of the reaction can be calculated by measuring the bromine concentration and the time at two different stages of the reaction. The average rate will typically vary with the time interval and the stage of the reaction chosen. Since the reaction rate will decrease as the reactants are used up, a plot of the reaction rate vs. time will be a curve. The average rate of the reaction is not necessarily equal to the instantaneous rate of the reaction at any given time.

A sketch of  $\text{Br}_2(\text{M})$  vs. time will show steadily decreasing rate.

$$\text{Rate} = -\Delta[\text{Br}_2]/\Delta t$$

Since  $[\text{Br}_2]$  is in mol/L and  $t$  is in seconds, the rate is expressed with units M/s.

The instantaneous rate at a given point of the reaction is more meaningful, since it is constant for a given reaction at a specified temperature and specified reactant concentrations.

To separate the factors influencing the rate of a reaction, one reactant concentration can be held constant by making it so high that it changes little during the reaction.

For the reaction between bromine and formaldehyde, keeping formaldehyde concentration constant, the rate of disappearance of bromine is proportional to  $[\text{Br}_2]$ .

$$\text{Therefore, } \text{rate} \propto [\text{Br}_2] \text{ or } \text{rate} = k[\text{Br}_2] \text{ or } k = \text{rate}/[\text{Br}_2]$$

$k$ , called the rate constant, therefore equals the reaction rate divided by the bromine concentration *at constant temperature and formaldehyde concentration.*

# General Chemistry Ii Chapter Chemical Kinetics Test

**J Spring**



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