Chemical Kinetics

1. Kinetics- area of chemistry that concerns reaction rates
2. Steric factor- reaction will occur if orientation of both product and reactant are correct
    a. If product and reactant don't strike each other correctly, reaction won't occur
3. Factors that determine reaction speed:
    a. Temperature, pressure, and concentration
4. Change in concentration per unit time- Δ conc.
5. Rate of a reaction:
    a. (Concentration at time 2-concentration at time 1)/(time 2- time 1)
    b. Rate decreases over time as concentration of reactants goes down
    c. Rate= K[A]^n
        i. K- rate constant, n-rate order, [A]-concentration of A
    d. Rate of products increases is proportionate to the rate at which the reactants decrease
        i. n=0; rate=K
        ii. n=1; rate proportional to A concentration
        iii. n=2; rate proportional to A^2
6. Rate of reaction for multiple products:
    a. $aA+bB \Rightarrow cC+dD$
    b. $rate=-1/a(\Delta[A]/\Delta t)=-1/b(\Delta[B]/\Delta t)=1/c(\Delta[C]/\Delta t)=-1/d(\Delta[D]/\Delta t)$
    c. Rate of change of the reactants is negative because their concentration is decreasing
7. Differential rate law: rate of a reaction depends on the concentration of reactants
    a. $aA+bB \Rightarrow cC+dD$
    b. rate= K[A]^m[B]^n
    c. overall reaction order= m+n
8. Integrated rate law: relates concentration of reactants and time
    a. Only one reactant
    b. Integrating (with calculus) the first order differential rate law, we get
    c. $Ln([A_t]/[A_0])=-Kt$
        i. $[A_t]$-concentration at time=t, $[A_0]$-initial concentration at time=0
    d. Integrating (with calculus) the second order differential rate law, we get
    e. $1/[A_t]=Kt+1/[A_0]$
    f. Integrating (with calculus) the zero order differential rate law, we get
    g. $[A_t]=-Kt+[A_0]$
9. Rate law is determined from experiments
    a. Concentrations must be measured to obtain the rate law and calculate the rate order

b. Method of Initial Rates- instead of measuring the concentrations over a long period of time, many experiments are done with different initial concentrations to obtain the rate law
c. We measure rate in a number of different ways

10. Half-Life
    a. Time required for the concentration of a reactant to reduce to half its original value
        i. First order half-life
            1. $T_{1/2}=0.693/K$
        ii. Second order half-life
            1. $T_{1/2}=1/(K[A_0])$
        iii. Zero order half-life
            1. $T_{1/2}=[A_0]/(2K)$
        iv. <u>Only zero and second order half life equations depend on initial concentration</u>