Chem 116 Student Notes November 4, 2008 (EC)

Lecture 16 (Chapter 15) and start of 17 (Chapter 16): Equilibrium Calculations

Changes in Equilibrium Constants

1) If reaction is multiplied by a number
    (i) exponent of equilibrium constant is placed to the same number
2) If the equilibrium constants of the reaction mechanisms (small steps that add up to the overall reaction) are multiplied
    (i) the product of the K's will equal the equilibrium constant of the overall summed reaction

4 Ways of Disturbing an Equilibrium

1. change product/reactant concentration
    a. K_c in the end (after equilibrium reestablishes) will be the same as before the disturbance because it's still at the same temperature
        i. $\frac{(1.710)}{(0.1000)^2} = \frac{(2.154)}{(0.1123)^2} = 171$ in both cases
    b. increase reactant concentration will make the reaction go toward the right when equilibrium is reestablished (products)
        i. this was clicker question c)
    c. increase product concentration will make the reaction go toward the left when equilibrium is reestablished (reactants)
2. change the volume of a gaseous equilibrium (changing the pressure)
    a. decreasing volume (increasing the pressure) will make the reaction go toward the side that decreases the net #of molecules
    b. increasing volume (decreasing the pressure) will make the reaction go toward the side that increases the net #of molecules
        i. this was clicker question b)
3. change the total pressure of a gaseous equilibrium by adding an inert gas
    a. "inert" means does not react
    b. does not affect the concentrations of the chemicals in the equilibrium reaction
    c. does not affect the partial pressures of each gas
        i. therefore the overall reaction stays the same, and the amounts of each chemical in the reaction stay the same (equilibrium stays where it is, it does not shift right or left)
4. change temperature of reaction
    a. if it is an endothermic reaction (ΔH=positive)
        i. can pretend like heat is considered a reactant
            1. increase temperature means adding heat to the reactant side → reaction goes more to the right (products) to use up some of that heat
                a. this was clicker question d)

2. decrease temperature means taking away heat from the reactant side ← reaction goes more to the left (reactants) to replace some of the heat that got taken away
    a. this was clicker question a)

b. if it is an exothermic reaction (ΔH=negative)
    i. can pretend like heat is considered a product
        1. increase temperature ← reaction goes more to the left (reactants)
        2. decrease temperature → reaction goes more to the right (products)

Acids and Bases

Arrhenius acid-base model:

Acid Base Ionic Salt Water

$[H^+ + \text{Anion}] + [OH^- + \text{Cation}] \leftrightarrows [\text{Anion} + \text{Cation}] + [H^+ + OH^-]$