EXAM III

Chapter 19 Review — Solubility

1. For a chemical reaction involving slightly soluble salts: such as

$$A_x B_y (s) \rightleftharpoons xA^{y+} + yB^{x-}$$

2. The solubility product constant is given as:

$$K_{sp} = [A^{y+}]^x [B^{x-}]^y$$

3. The solubility can be obtained as follows:

Let S = solubility in $\frac{\text{moles}}{L} = A^{y+} = B^{x-}$

So $S = xS = yS$

Then: $K_{sp} = (xS)^x (yS)^y$ ← [To calculate K_{sp} given 'S']

$$K_{sp} = x^x y^y S^{x+y}$$

$$S = \sqrt[x+y]{\frac{K_{sp}}{x^x y^y}}$$ ← [To calculate 'S' given 'K_{sp}']

Example: the solubility of $Pb_3(AsO_4)_2$ is $S = 3.3 \times 10^{-8}$ Moles/L

Ch 19 Cont.

4. Simultaneous Equilibria

$AB_2 \rightleftharpoons A^{+2} + 2B^-$ $\quad K_{sp_{(AB_2)}} = K_1 = 1.7\times10^{-5}$

$A^{+2} + C^{2-} \rightleftharpoons AC$ $\quad K_2 = \frac{1}{K_{sp_{(AC)}}} = \frac{1}{1.8\times10^{-14}}$

$AB_2 + C^{2-} \rightleftharpoons AC + 2B^-$ $\quad K_{net} = K_1 K_2$

$K_{net} = \frac{1.7\times10^{-5}}{1.8\times10^{-14}} = 9.4\times10^{-9}$

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5. Complex Ions and solubility

$AgCl(s) \rightleftharpoons Ag^+ + Cl^-$ $\quad K_{sp} = 1.8\times10^{-10}$

$Ag^+ + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+$ $\quad K_f = 1.6\times10^{7}$

$AgCl + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+ + Cl^-$

$K_{net} = K_{sp} K_f$

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6. Common Ion problems

eg. what is the solubility of $CaCO_3$ in 0.15 M $CaCl_2$

$CaCO_3(s) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$

		Ca^{2+}	CO_3^{2-}
I	—	$\frac{0.15}{+S}$	0
C	—		S
E	—	$0.15+S$	S

0.15 M Ca^{2+} from $CaCl_2$ is common ion.

$0.15+S$ from $CaCl_2$; S from $CaCO_3$

$K_{sp} = [Ca^{2+}][CO_3^{2-}]$

$= (0.15+S)(S)$

EXAM III Review

Chapter 20 "Entropy & Free Energy"

- Define the second law of thermodynamics
- " Entropy.
- Calculate ENTROPY change

$$\Delta S_{universe} = \Delta S_{system} + \Delta S_{surroundings}$$

$$\Delta S_{system} = \sum S^\circ_{prod} - \sum S^\circ_{reactants}$$

$$\Delta S_{surroundings} = \frac{-\Delta H_{system}}{T} \quad @ \text{ const } P \text{ & } T$$

- Know what the significance of the sign of ΔS (+ or −) for each case.
- Given the signs of ΔH° and ΔS°, know what is product favored.

Understand also when $\Delta H^\circ(-)$ and $\Delta S^\circ(-)$

$\Delta H^\circ(+)$ and $\Delta S^\circ(+)$

Depends on magnitudes of ΔH° and ΔS° and on T.