**Chapter Summary: Solubility Equilibria**

**Solubility Product** ($K_{sp}$): is a value that indicates how much of the salt is present in the solution at a particular temperature. For example:

\[ A_2B \rightleftharpoons 2A^+ + B^{2-} \]

\[ K_{sp} = [A^+]^2[B^{2-}] \]

Common ion effect: shift of equilibrium when a salt is added.

**Solubility Quotient** ($Q_{ip}$): determines if precipitation will occur (similar to $Q_c$ in equilibrium chapter)

- $Q_{ip} > K_{sp}$ = precipitation occurs
- $Q_{ip} = K_{sp}$ = saturation of solution
- $Q_{ip} < K_{sp}$ = precipitation will not occur

(In general very small value of $K_{sp}$ indicates complete precipitation)

Factors affecting solubility: common ion effect and pH, complex ion formation

**Effect of pH on solubility**: pH of a solution will affect solubility if the conjugate ion (acid or base) is acidic or basic. E.g. Cl$^-$ is very weak conjugate base (CB) and is not considered basic, whereas HCO$_3^-$ is weak CB whose solubility is affected by the pH.

**Complex Ions**: a complex ion is polyatomic anion or cation consisting of central metal ion and is associated with other groups called ligands. Common ligands are anions Cl$^-$ and OH$^-$ and molecules NH$_3$ and H$_2$O.

When ammonium hydroxide is added to a solution of copper (II) ions it forms a complex [Cu(NH$_3$)$_4$]$^{2+}$. In such a solution it is not necessary that all copper ions are ligated. The degree to which an ion will form ligands is calculated by $K_f$ (formation constant) and since this process of ligand formation in reversible, $K_f$ is calculated like the equilibrium constant. If an ion is capable of forming ligands then its solubility will increase.

**Selective/Fractional Precipitation**: can be done by calculating the amount of ion needed for precipitation.

**Qualitative Inorganic Analysis**: separation of a mixture of cations on the basis of their solubility in different conditions (acidic, basic, complex ion formation).