Everything I Need To Know About: Solubility & Complex-Ion Equilibria

The Solubility Product Constant - K_{sp} - the equilibrium constant for the solubility equilibrium of a slightly-soluble (nearly insoluble) ionic compound

Example: $PbI_{2(s)} \rightleftharpoons Pb^{+2}_{(aq)} + 2I^-_{(aq)}$

$K_{sp} = [Pb^{+2}][I^-]^2$ * only the products are included in K_{sp} because equilibrium expressions exclude pure liquids & solids and the reactants is a solid.

The same rules for equilibrium ICE tables apply to solubility problems

· When a solution contains two of the same cations ~~as~~ from two different salts, the solid salt becomes less soluble

$\boxed{CaC_2O_{4(s)} + CaCl_{2(aq)}}$ concentration of Ca^{+2} in $CaCl_2$ goes to $CaC_2O_4 \rightarrow Ca^{+2} + C_2O_4^{-2}$ in this equation

When solving ICE Table problems for common ions, the cation concentration (instead of being 0 initially) is the concentration of the common ion.

Will Precipitation occur?

$Q_c = \frac{\text{products}}{\text{reactants}}$

technically, since reactants are solids, they = 1 and $Q_c = [\text{product}][\text{product}]$ same for K_c

If $Q_c < K_c \rightarrow$ forward direction, no precipitate

If $Q_c > K_c \rightarrow$ reverse direction, precipitate

If $Q_c = K_c \rightarrow$ equilibrium, no precipitate

if Q_c is smaller than K_c, more solid than solution, forward direction

if Q_c is larger than K_c, more solution than solid, precipitate

Fractional Precipitation - separating 2 or more ions from a solution by adding a reactant that precipitates first one ion then the next by manipulating K_{sp}.

Example: K_2CrO_4 is added to $.1M\ Ba^{+2}$ & $.1M\ Sr^{+2}$

$[Ba^{+2}][CrO_4^{-2}] = K_{sp}$ for $BaCrO_4$

then

$[Sr^{+2}][CrO_4^{-2}] = K_{sp}$ for $SrCrO_4$

the smaller concentration value precipitates first

% of ~~each~~ one ion remaining when the other the 2nd one begins to precipitate:

$\underset{X}{\overset{Ba^{+2}}{[\text{Original ion}]}}\ \underset{\#}{\overset{CrO_4 \text{ when } Sr^{+2} \text{ begins to precipitate}}{[\text{Anion when 2nd begins to precipitate}]}} = \underset{\#}{K_{sp} \text{ for } BaCrO_4}$

$\frac{X}{\text{original concentration}}$ = % remaining when 2nd cation begins to precipitate