The Solubility Product Constant

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What is K_{sp}?

Some solid salts and Arrhenius bases (M^+OH^-) are only very slightly soluble in water. For these substances we can define an equilibrium constant known as K_{sp}.

Example $CaF_2\,(s) \hat{U} Ca^{+2}\,(aq) + 2F^-\,(aq)$

$K_{sp} = [Ca^{+2}]\,[F^-]^2$

Three major things can be done with K_{sp}

(1) Given the solubility, calculate the K_{sp}

(2) Given the K_{sp}, calculate the solubility (this includes the possibility of a common ion)

(3) Decide if and when precipitation of the insoluble substance will start when mixing 2 solutions together

(1) Calculate the K_{sp} value for bismuth sulfide (Bi_2S_3), which has a solubility of 1.0×10^{-15} mole/L at 25°C. Answer - $K_{sp} = 1.1 \times 10^{-73}$

(2) The K_{sp} value for $Cu(IO_3)_2$ is 1.4×10^{-7} at 25°C. Calculate its solubility. Answer – 3.3×10^{-3} mole/L

(2) Calculate the solubility of solid CaF_2 ($K_{sp} = 4.0 \times 10^{-11}$) in a 0.025 M NaF solution. Answer – 6.4×10^{-8} mole/L

(3) A solution is prepared by adding 750.0 mL of 4.00×10^{-3} M $Ce(NO_3)_3$ to 300.0 mL of 2.00×10^{-2} M KIO_3. Will $Ce(IO_3)_3$ ($K_{sp} = 1.9 \times 10^{-10}$) precipitate from this solution? Answer - yes