Chem12 Solubility Product : Notes-90

When we dissolve an ionic substance in water to form a saturated solution, we have an equilibrium situation. The equilibrium constant, K_{eq}, for this type of equilibrium is K_{sp} , the **solubility product constant**.

For example , if we dissolve barium sulfate in water, we have the equilibrium (assuming a saturated solution),

$$BaSO_4(s) <-> Ba^{2+}(aq) + SO_4^{2-}(aq)$$

$$K_{sp} = [Ba^{2+}][SO_4^{2-}] = 1.10x10^{-10} \text{ (at 25°C)}$$

Since K_{sp} is a constant, we can find the concentrations of the two species. These are $1.05x10^{-5}$ M. The solubility of the salt is also $1.05x10^{-5}$ M.

For the following equilibrium, find the equilibrium expression and the solubility.

$$PbCl_2(s) <-> Pb^{2+}(aq) + 2Cl^-(aq)$$

$$K_{sp} = [Pb^{2+}][Cl^-]^2 = 1.2x10^{-5}$$

The solubility can be found. Let x be the Pb^{2+} ion concentration. The Cl^- ion concentration is 2x. Solve the equation, $[x][2x]^2 = 1.2x10^{-5}$. The solubility of $PbCl_2$, (x) = 0.014 M. (at 25 degrees Celsius)

For the following equilibrium, find the equilibrium expression.

$$Bi_2S_3(s) <-> 2Bi^{3+}(aq) + 3S^{2-}(aq)$$

$$K_{sp} = [Bi^{3+}]^2[S^{2-}]^3$$

Note: The rules for finding the equilibrium expression, can be seen from the above examples. The coefficients of the ions in the equilibrium equation, become the exponents for the ion concentrations in the equilibrium expression.