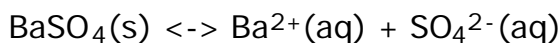


## Chem12 Solubility Product : Notes-90

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.

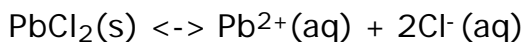
For example, if we dissolve barium sulfate in water, we have the equilibrium (assuming a saturated solution),



$$K_{sp} = [\text{Ba}^{2+}][\text{SO}_4^{2-}] = 1.10 \times 10^{-10} \text{ (at } 25^\circ\text{C)}$$

Since  $K_{sp}$  is a constant, we can find the concentrations of the two species. These are  $1.05 \times 10^{-5}$  M. The solubility of the salt is also  $1.05 \times 10^{-5}$  M.

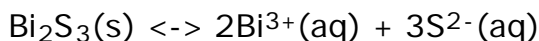
For the following equilibrium, find the equilibrium expression and the solubility.



$$K_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2 = 1.2 \times 10^{-5}$$

The solubility can be found. Let  $x$  be the  $\text{Pb}^{2+}$  ion concentration. The  $\text{Cl}^-$  ion concentration is  $2x$ . Solve the equation,  $[x][2x]^2 = 1.2 \times 10^{-5}$ . The solubility of  $\text{PbCl}_2$ ,  $(x) = 0.014$  M. (at 25 degrees Celsius)

For the following equilibrium, find the equilibrium expression.



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

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.