Solubility Product Worksheet
CHEM 212

1. Write a generalized equilibrium solubility product expression (K_{sp}) for the following reaction describing the dissolution of a sparingly soluble salt in water.

$$aA_{(s)} \Leftrightarrow cC_{(aq)} + dD_{(aq)}$$

$K_{sp} = [C]^c [D]^d$

2. Write the reaction and solubility product equilibrium expression for slightly soluble $BaSO_{4\,(s)}$ dissolved in water.

$BaSO_{4(s)} \rightleftharpoons Ba^{2+}_{aq} + SO_4^{2-}{}_{aq}$

$K_{sp} = [Ba^{2+}][SO_4^{2-}]$

If the pK_{sp}= 9.96 for the above reaction, calculate the $[Ba^{2+}]$ at equilibrium. $p = -\log$

$K_{sp} = 1.096 \times 10^{-10} = [Ba^{2+}][SO_4^{2-}] = x^2$

$x = [Ba^{2+}] = 1.47 \times 10^{-5} M = [SO_4^{2-}]$

3. Write the reaction and solubility product equilibrium expression for slightly soluble $Y_2(CO_3)_3$ dissolved in water.

$Y_2(CO_3)_{3(s)} \rightleftharpoons 2Y^{3+} + 3CO_3^{2-}$

$K_{sp} = [Y^{3+}]^2[CO_3^{2-}]^3 =$

If the K_{sp}= 1.03 x10^{-31} for the above reaction, calculate the $[Y^{3+}]$ at equilibrium.

$K_{sp} = [Y^{3+}]^2[CO_3^{2-}]^3 = (2x)^2 \cdot (3x)^3 = 108\,x^5$

$4x^2 \cdot 27x^3$

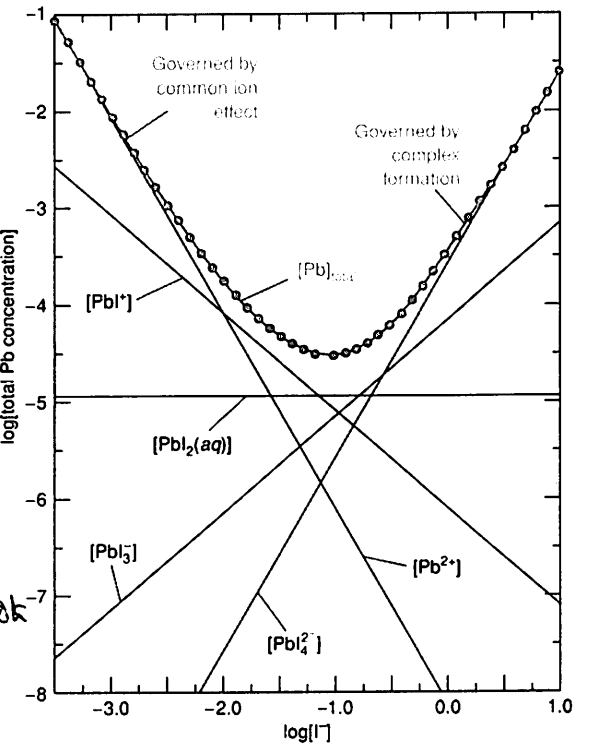
$K_{sp} = 2.488 \times 10^{-7}$

4. Look up the Ksp value for $CaCO_3$, PbI_2 in the back of your textbook (Appendix F, pg AP9).

calcite $CaCO_{3(s)}$ $K_{sp} \Rightarrow$ 8.35 (pKsp) $\quad 4.5 \times 10^{-9}$ (Ksp)

PbI_2 $K_{sp} \Rightarrow$ 12.61 $\quad 2.5 \times 10^{-13}$

5. Consider the diagram shown to the right. Locate the Ksp value. Is it constant? Is what you observe in the diagram consistent with your understanding of Ksp?



Ksp is the dotted line, and not a single value as tabulated in the back of the book. However, the

6. Identify and describe the effect of iodine concentration on aqueous Pb concentration at low I^- concentration. What is this phenomena called?

common ion effect

Solubility of a salt decreases when low concentrations of the constituent ions are present in solution.

7. Identify and describe the effect of iodine concentration on aqueous Pb concentration at high I^- concentration. What is this phenomena called?

complexation

When very high concentrations of constituent ions are in solutions, solubilities increase due to complex formation

8. In problem 2, if there were already 2.4×10^{-3}M SO_4^{2-} in solution, what would be the equilibrium $[Ba^{2+}]$?

$K_{sp} = 1.09 \times 10^{-10} = [Ba^{2+}][SO_4^{2-}] = x \cdot (2.4 \times 10^{-3} + x)$

$0 = x^2 + 2.4 \times 10^{-3} x - 1.09 \times 10^{-10} \Rightarrow x = 4.54 \times 10^{-8}$ M

$[Ba^{2+}] = x = 4.54 \times 10^{-8}$ M