AP FRQ's Solubility Equilibrium

1. (1998) Solve the following problem related to the solubility equilibria of some metal hydroxides in aqueous solution.

(a) The solubility of $Cu(OH)_2(s)$ is 1.72×10^{-6} gram per 100. milliliters of solution at 25°C.

(i) Write the balanced chemical equation for the dissociation of $Cu(OH)_2(s)$ in aqueous solution.

(ii) Calculate the solubility (in moles per liter) of $Cu(OH)_2$ at 25°C.

(iii) Calculate the value of the solubility-product constant, K_{sp}, for $Cu(OH)_2$ at 25°C.

(b) The value of the solubility-product constant, K_{sp}, for $Zn(OH)_2$ is 7.7×10^{-17} at 25°C.

(i) Calculate the solubility (in moles per liter) of $Zn(OH)_2$ at 25°C in a solution with a pH of 9.35.

(ii) At 25°C, 50.0 milliliters of 0.100-molar $Zn(OH)_2$ is mixed with 50.0 milliliters of 0.300-molar NaOH. Calculate the molar concentration of $Zn^{2+}(aq)$ in the resulting solution once equilibrium has been established. Assume that volumes are additive.

2. (1990) The solubility of iron(II) hydroxide, $Fe(OH)_2$, is 1.43×10^{-3} gram per liter at 25°C.

a. Write the balanced equation for the solubility equilibrium.

b. Write the expression for the solubility product constant, Ksp, and calculate its value.

c. Calculate the pH of a saturated solution of $Fe(OH)_2$ at 25 °C.

d. A 50.0 mL sample of a $3.00*10^{-3}$ molar $FeSO_4$ is added to 50.0 mL of a $4.00 * 10^{-6}$ molar NaOH. Does a precipitate of $Fe(OH)_2$ form? Show calculations to support your answer.

3. (1985) The solubility product constant for strontium sulfate, $SrSO_4$, is 7.6×10^{-7}. The solubility product constant for strontium fluoride, SrF_2, is 7.9×10^{-10}.

a. What is the molar solubility of $SrSO_4$ in pure water?

b. What is the molar solubility of SrF_2 in pure water?

c. An aqueous solution of $Sr(NO_3)_2$ is slowly added to 1.0 liter of a well stirred solution containing 0.0200mol F^- and 0.100 mol SO_4^{-2}. (You may assume the adding of $Sr(NO_3)_2$ does not materially affect the total volume of the solution).

1. Which salt precipitates first? Explain

2. What is the concentration of the Sr^{+2} in the solution when the first precipitate begins to form?

d. As more $Sr(NO_3)_2$ is added to the mixture a second precipitate begins to form. At that stage, what percent of the anion from the first precipitate remains in solution?