Take-Home Assignment #5

Please turn in neatly worked solutions for the following problems. Answers are due by 4:00 PM on Wednesday, September 19th.

The intention of these problems is to provide additional experience in solving equilibrium problems by focusing on verifying assumptions and activity effects. Thermodynamic equilibrium constants (i.e. for $\mu = 0$) for all reactions may be found in the Appendices to the textbook.

1. In class we examined a more rigorous solution for the solubility of AgCl in distilled water. In our original approach to the problem we only included the K_{sp} expression. Based on the result of that calculation explain why the following species can be safely ignored: $AgCl_2^-$, $AgCl_3^{2-}$, and $AgCl_4^{3-}$. After providing a written explanation, show by suitable calculations that this reasoning is correct. Note that the actual solubility of AgCl must include the contribution from AgCl*(aq)*. What is the actual solubility of AgCl in distilled water?

2. Suppose you were not able to discount the importance of AgX_2^- when calculating the solubility of AgX in distilled water, where X is a singly charged anion. Show how you would carry out the calculation in this situation by (a) writing an equation that can be solved for the $[Ag^+]$ and writing an equation for the solubility of AgX that is a function of $[Ag^+]$. In your solution, assume the following reactions:

$$AgX(s) \leftrightarrow Ag^+ + X^- \quad K_{sp}$$

$$Ag^+ + X^- \leftrightarrow AgX(aq) \quad K_1$$

$$AgX(a) + X^- \leftrightarrow AgX_2^- \quad K_2$$

3. Calculate the ionic strength of the following solutions that contain the same molar concentration of chloride ion: 0.30 M NaCl, 0.15 M $CaCl_2$, and 0.10 M $AlCl_3$.

4. Calculate the concentration solubility product (K_{sp}^c) for $Zn_2[Fe(CN)_6]$ in a solution of 0.010 M $Mg(NO_3)_2$.

5. Calculate the solubility of $Zn_2[Fe(CN)_6]$ in 0.010 M $Mg(NO_3)_2$ and compare to its solubility in distilled water (see problem 1 of take-home assignment 4).