PLI 39
Tuesday July 26, 2016

Chapter 17 (Solubility) and Chapter 18 (Entropy)

1. What mass of ZnS (Ksp = 2.5×10^{-22}) will dissolve in 300.0 mL of 0.050 M $Zn(NO_3)_2$? Ignore the basic properties of S^{2-}

2. If you add sodium sulfate to a solution containing these metal cations, each with a concentration of 0.13 M, what will be the concentration of the first ion that precipitates (Ba^{2+} or Sr^{2+}) when the second, more soluble salt begins to precipitate? (K_{sp} for $BaSO_4$ is 1.1×10^{-10}, K_{sp} for $SrSO_4$ is 3.4×10^{-7})?

3. The Ca^{2+} ion in hard water can be precipitated as $CaCO_3$ by adding soda ash, Na_2CO_3. If the calcium ion concentration in hard water originally is 0.017 M and if the Na_2CO_3 is added until the carbonate ion concentration is 0.048 M, what percentage of the calcium ions had been left in the water? (You may neglect carbonate ion hydrolysis.) $K_{sp} = 3.4 \times 10^{-9}$

Note: Question #4 is beyond the scope of Summer Chemistry 104 for 2023.

4. In principle, the ions Ba^{2+} and Ca^{2+} can be separated by the difference in solubility of their fluorides, BaF_2 and CaF_2. If you have a solution that is 0.17 M in both Ba^{2+} and Ca^{2+}, CaF_2 will begin to precipitate first as fluoride ion is added slowly to the solution. What concentration of fluoride ion will precipitate the Ca^{2+} ion without precipitating BaF_2? What concentration of Ca^{2+} remains in solution when BaF_2 just begins to precipitate? ($K_{sp}(BaF_2) = 1.7 \times 10^{-6}$ and $K_{sp}(CaF_2) = 3.9 \times 10^{-11}$)

5. For which of the following reactions is $\Delta S° > 0$? (Do not use any math)

a. $2NO(g) + 2H_2(g) \leftrightarrow N_2(g) + 2H_2O(l)$

b. $2NH_3(g) + 3N_2O(g) \leftrightarrow 4N_2(g) + 3H_2O(g)$

c. $NH_4I(s) \leftrightarrow NH_3(g) + HI(g)$

d. $2H_2O(g) + 2Cl_2(g) \leftrightarrow 4HCl(g) + O_2(g)$

e. $C_2H_4(g) + H_2O(g) \leftrightarrow CH_3CH_2OH(g)$

6. Using standard absolute entropies at 298K, calculate the entropy change for the **system** when **1.94** moles of **N_2(g)** react at standard conditions.

$$N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$$

7. Repeat the above calculations for 2.28 moles of liquid H_2O:

$$2H_2O(l) \leftrightarrow 2H_2(g) + O_2(g)$$