Answers to Review #8: Solubility Equilibria

1. Know the meanings of, and be able to apply, the following terms:

(molar) solubility spectator ion precipitate trial Ksp

2. Look up the K_{sp} values for these silver salts:
AgCl; **1.77 x 10^{-10}** $AgBrO_3$: **5.38 x 10^{-5}** $AgNO_3$: **very large (soluble)** Ag_2CO_3: **8.46 x 10^{-12}**

a) Arrange these salts from highest to lowest solubility: **$AgNO_3$ > $AgBrO_3$ > AgCl > Ag_2CO_3**

b) Arrange these salts from the poorest to best electrolyte: **Ag_2CO_3 < AgCl < $AgBrO_3$ < $AgNO_3$**

3. Calculate the molar solubility of AgI. How many grams of AgI will dissolve in 2.50 L of distilled water? (9.23×10^{-9} M, 5.42×10^{-6} g in 2.50 L)

4. Repeat question #3 for $Ba(IO_3)_2$. (0.00100 M, 1.22 g in 2.50 L)

5. Calculate the Ksp for strontium fluoride, given that its molar solubility is 1.02×10^{-3} mol/L. (Ksp = 4.24×10^{-9})

6. Calculate the Ksp for silver iodate if its maximum solubility is 0.0498 g/L at 25°C. (Ksp = 3.10×10^{-8})

7. When each of the following pairs of solutions are mixed, a precipitate forms. Write full balanced equations and net ionic equations for each reaction. You should be able to predict the precipitates that will form using the basic solubility rules that you have MEMORIZED:

a) $AgNO_3$ (aq) + NaOH (aq) ↔ AgOH (s) + $NaNO_3$ (aq)

net ionic equation: Ag^+ (aq) + OH^- (aq) ↔ AgOH (s)

b) HCl (aq) + $Pb(CH_3COO)_2$ (aq) ↔ HCH_3COO (aq) + $PbCl_2$ (s)

net ionic equation: Pb^{+2} (aq) + 2 Cl^- (aq) ↔ $PbCl_2$ (s)

c) $Cu(NO_3)_2$ (aq) + K_2S (aq) ↔ CuS (s) + 2 KNO_3 (aq)

net ionic equation: Cu^{+2} (aq) + S^{2-} (aq) ↔ CuS (s)

d) $(NH_4)_2CO_3$ (aq) + $CaBr_2$ (aq) ↔ 2 NH_4Br (aq) + $Ca\,CO_3$ (s)

net ionic equation: Ca^{+2} (aq) + CO_3^{2-} (aq) ↔ $Ca\,CO_3$ (s)

8. Determine whether a precipitate will form when the following solutions are mixed:

a) 100.0 mL of 0.100 M magnesium chlorate with 10.0 mL of 0.20 M sodium hydroxide

The possible precipitate is $Mg(OH)_2$ which has Ksp = 5.61×10^{-12} . Qsp = 3.0×10^{-5} . Since Qsp > Ksp, a precipitate will form.

b) 25.0 mL of 0.00020 M silver nitrate and 55.0 mL of 0.00020 M calcium chloride solution

The possible precipitate is AgCl which has Ksp = 1.77×10^{-10} . Remember, the [Cl-] = 2 x [$CaCl_2$]. Qsp = 1.7×10^{-8} . Since Qsp > Ksp, a precipitate will form.

9. A solution of $Pb(NO_3)_2$ is slowly added to solution that contains a mixture of 0.10 M OH^{1-} (aq), 0.10 M Br^{1-} (aq), and 0.10 M I^{1-} (aq) ions. Which species will precipitate first: $Pb(OH)_2$, $PbBr_2$ or PbI_2 ?

- the species with the smallest Ksp will ppte first, so $Pb(OH)_2$ with Ksp 1.43×10^{-20} will ppte first, followed by PbI_2 with Ksp 9.8×10^{-9} and then $PbBr_2$ with Ksp 6.60×10^{-6} will ppte last.