Ksp Study Guide

Things to remember:

- Slightly soluble salts will dissolve in water to produce ions and establish equilibrium.
- The extent to which a salt dissolves is its solubility. Molar solubility is measured in moles per liter ("x" from an ICE chart).
- Solids and liquids do not appear in equilibrium expressions.
- Ksp values can be used to compare solubilities of two different salts only when the salts have the same Ion:Ion ratio. (e.g. you may compare AgCl and CuI but cannot compare AgCl with PbI_2)
- Saturated solution = equilibrium conditions.
- Calculate Q when determining if a precipitate will form.
- The presence of a common ion in solution decreases the solubility of a salt.
- If two or more precipitates are possible, the salt that is less soluble will precipitate first. Thus, use the Ksp value and expression to determine the concentration of ions necessary to begin precipitation for each salt.
- pH + pOH = 14
- $[OH^-] = 10^{-pOH}$

1. Calculate the $[OH^-]$ in a solution with a pH of 9.

2. The Ksp of Ag_2CrO_4 is 1.1×10^{-12}.
   a. What is the molar solubility of Ag_2CrO_4 in pure water?
   b. What is the molar solubility of Ag_2CrO_4 in 0.223 M Na_2CrO_4 solution?
   c. Explain why the molar solubility of Ag_2CrO_4 in pure water differs from that in Na_2CrO_4 solution.

3. The solubility of MgF_2 is 1.21×10^{-3} mol L^{-1}. What is the Ksp value of MgF_2?

4. The pH of a saturated solution of $Cd(OH)_2$ is 9.333. Calculate the Ksp value of $Cd(OH)_2$.

5. A **saturated** solution is prepared by adding excess $PbI_2(s)$ to distilled water to form 1.0 L of solution at 25°C. The concentration of $Pb^{2+}(aq)$ in the **saturated** solution is found to be 1.3×10^{-3} M.
   a. Write the dissociation equation of $PbI_2(s)$ in water.
   b. Write the equilibrium-constant expression for the equation.
   c. Calculate the molar concentration of $I^-(aq)$ in the solution.
   d. Calculate the value of the equilibrium constant, Ksp.

6. The value of Ksp for the salt $BaCrO_4$ is 1.2×10^{-10}. A 500. mL sample of 8.2×10^{-6} M $Ba(NO_3)_2$ is added to 500. mL of 8.2×10^{-6} M Na_2CrO_4. Does a precipitate form?

7. A solution contains 1.0×10^{-4} M Cu^+ and 2.0×10^{-3} M Pb^{2+}. If a source of I^- is added gradually to this solution, will PbI_2 (Ksp = 1.4×10^{-8}) of CuI (Ksp = 5.3×10^{-12}) precipitate first? Specify the concentration of I^- necessary to begin precipitation of each salt.