Solubility Problems (no calculator)

You can do all of these problems with or without a calculator. Answers provided were generated without a calculator.

1. A *Mohr Titration* is a procedure for finding out the amount of Cl^- in a solution by titrating it with aqueous $AgNO_3$:

   $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

   Calculate the Ag^+ concentration at the equivalence point, that being the point in the titration where the number of moles of added silver is equal to the moles of Cl^- ion initially present. $pK_{sp}(AgCl) = -\log(K_{sp}(AgCl)) = 9.74$ **[about 1 x 10^{-5} M]**

2. Calculate the molar solubility of the hypothetical compound A_3B_2 (K_{sp} 1.08 x 10^{-23}) in:
   a) Water **[1 x 10^{-5}]**
   b) 0.10 M $A(NO_3)_2$ **[About 5 x 10^{-11}]**

3. The pH of a certain metal hydroxide of formula $M(OH)_3$ is 12.48 at 25°C. What is K_{sp} for the metal hydroxide? **[about 2.7 x 10^{-7}]**

4. A solution has $[Cl^{-1}] = 1.8 \times 10^{-2}$ M and $[Br^{-1}] = 0.010$ M. $AgNO_3$ is slowly added to the solution. What will be the percent of the first ion remaining at the point of maximum separation of Br^- and Cl^{-1}? $K_{sp}(AgBr) = 5 \times 10^{-13}$, and $K_{sp}(AgCl) = 1.8 \times 10^{-10}$ **[0.5% of Br^- remains]**

5. $M(OH)_2(s)$ is dissolved in water to a produce a saturated solution. A 25.00 mL sample of the clear saturated solution required 10.00 mL of 0.1000 *M* HCl for its tritration. What is the K_{sp} of $M(OH)_2$? **(3.2 x 10^{-5})**

6. The K_{sp} of $MX_3(s)$ at 27°C is 1.0 x 10^{-12}. At 52°C it is 1 x 10^{-11}. Calculate $\Delta H°$ for the reaction:

   $M^{3+}(aq) + 3X^-(aq) \rightleftharpoons MX_3(s)$
   (-75 kJ/mol)

7. The solubility product of Ag_2CrO_4 is 1.0 x 10^{-12}.
   a) Can the molar solubility of Ag_2CrO_4 be lowered to 5.0 x 10^{-8} by using CrO_4^{2-} as the common ion? Explain by calculating the $[CrO_4^{2-}]$ that would be required. **(No)**
   b) Can the molar solubility of Ag_2CrO_4 be lowered to 5.0 x 10^{-8} by using Ag^+ as the common ion? Explain by calculating the $[Ag^+]$ that would be required. **(Yes)**