K_{SP} and Molar Solubility Problems Worksheet

1. Use the chemical AgCl to describe solubility, molar solubility and solubility product

2. Write balanced equations and solubility product expressions for the following compounds
   a. CuBr
   b. ZnC_2O_4
   c. Ag_2CrO_4
   d. Hg_2Cl_2
   e. $AuCl_3$
   f. $Mn_3(PO_4)_3$

3. Silver Chloride has a larger K_{sp} than silver carbonate (K_{sp} = $1.6x10^{-10}$ and $8.1x10^{-12}$ respectively). Does this mean that AgCl also has a larger molar solubility than Ag_2CO_3? Explain.

4. Calculate the concentration of ions in the following saturated solutions
   a. $[I^-]$ in AgI solutions with $[Ag^+] = 9.1x10^{-9}$
   b. $[Al^{3+}]$ in $Al(OH)_3$ solution with $[OH^-] = 2.9 x10^{-9}$

5. From the solubility data given, calculate the solubility product for the following compounds:
   a. SrF_2 $7.3x10^{-2}$ g/L
   b. Ag_3PO_4 $6.7x10^{-3}$ g/L

6. The molar solubility of $MnCO_3$ is $4.2x10^{-6}$ M. What is K_{sp} for this compound?

7. If 20.0 mL of 0.10 M $Ba(NO_3)_2$ are added to 50.0 mL of 0.10 M Na_2CO_3, will $BaCO_3$ precipitate? Supply explanation / calculations to support answer.

8. A volume of 75 mL of 0.060 M NaF is mixed with 25 mL of 0.15 M $Sr(NO_3)_2$. Calculate the concentrations in the final solution of NO_3^-, Na^+, Sr^{2+}, and F^-. (K_{sp} for SrF_2 = $20.x10^{-10}$)

9. Calculate the K_{sp} for each of the salts whose solubility is listed below.
    a. $CaSO_4 = 5.0 \times 10^{-3}$ mol/L
    b. $MgF_2 = 2.7 \times 10^{-3}$ mol/L
    c. $AgC_2H_3O_2 = 1.02$ g/100 mL
    d. $SrF_2 = 12.2$ mg/100 mL

10. Calculate
    a. the solubility in moles/L of each of three salts and
    b. the concentration of the cations in mg/mL in each of the saturated solutions.
        i. AgCN $K_{sp} = 2.0 \times 10^{-12}$
        ii. $BaSO_4$ $K_{sp} = 1.5 \times 10^{-9}$
        iii. FeS $K_{sp} = 3.7 \times 10^{-19}$
        iv. $Mg(OH)_2$ $K_{sp} = 9.0 \times 10^{-12}$
        v. Ag_2S $K_{sp} = 1.6 \times 10^{-49}$
        vi. CaF_2 $K_{sp} = 4.9 \times 10^{-11}$

11. Consider these slightly soluble salts:
    a. PbS $K_{sp} = 8.4 \times 10^{-28}$
    b. $PbSO_4$ $K_{sp} = 1.8 \times 10^{-8}$
    c. $Pb(IO_3)_2$ $K_{sp} = 2.6 \times 10^{-13}$
        i. Which is the most soluble?
        ii. Calculate the solubility in moles/L for $PbSO_4$.
        iii. How many grams of $PbSO_4$ dissolve in 1 L of solution?
        iv. How can you decrease the concentration of $Pb^{2+}(aq)$ in a saturated solution of $PbSO_4$ solution?
        v. What is the concentration in moles/L of PbS in a saturated solution of the salt?

12. For each of these substances, calculate the milligrams of metallic ion that can remain at equilibrium in a solution having a $[OH^-] = 1.0 \times 10^{-4}$ mol/L.
    a. $Cu(OH)_2$ $K_{sp} = 1.6 \times 10^{-9}$
    b. $Fe(OH)_3$ $K_{sp} = 6.0 \times 10^{-38}$
    c. $Mg(OH)_2$ $K_{sp} = 6.0 \times 10^{-12}$