Solubility #4

1. When excess Ag_2CO_3 solid is shaken with 1.00 L of 2.00 M K_2CO_3, it is determined that 6.00×10^{-6} mol Ag_2CO_3 solid dissolves. Calculate the solubility product for silver carbonate.

2. Calculate the K_{sp} for SrF_2 if the solubility is 0.122 g/L.

3. A saturated solution of calcium hydroxide is found to have $[OH^-]$ of 2.09×10^{-2} M. Calculate the K_{sp} for $Ca(OH)_2$.

4. The solubility of Ag_2SO_4 is 0.62 g/L at 6° C. What is the K_{sp} at this temperature?

5. Describe an analytical method which could be used to determine the K_{sp} of a saturated solution of silver sulphate other than drying the solid from a saturated solution.

6. At 20° C the solubility of PbF_2 is 64 mg per 100 mL of solution. Determine the K_{sp} for lead II fluoride. $0.64\ g/L \times \frac{1\ mol}{245.2\ g} = 2.61 \times 10^{-3}\ mol/L$ $[Pb^{2+}] = 2.61 \times 10^{-3}$ M

   $K_{sp} = [Pb^{2+}][F^-]^2 = 7.1 \times 10^{-8}$ $[F^-] = 5.22 \times 10^{-3}$ M

7. The equilibrium in a saturated ZnI_2 solution is given by:

$$ZnI_{2(s)} \longleftrightarrow Zn^{2+}_{(aq)} + 2I^-_{(aq)}$$

Predict the effect on the solubility of ZnI_2 of adding some:

(a) solid NaI. Solubility of ZnI_2 will decrease
(b) solid $Zn(NO_3)_2$ decrease
(c) solid NaOH $Zn(OH)_2$ (s) produced; solubility will increase
(d) concentrated HCl no effect
(e) solid NH_4NO_3 no effect

(#1) $[Ag^+] = \frac{2(6.00 \times 10^{-6}\ mol)}{1.00\ L} = 1.20 \times 10^{-5}$ M $[CO_3^{2-}] = 2.00\ M + 6.00 \times 10^{-6}\ mol/L = 2.00$ M

$K_{sp} = [Ag^+]^2[CO_3^{2-}] = 2.88 \times 10^{-10}$

(#2) $0.122\ g/L \times \frac{1\ mol}{125.6\ g} = 9.71 \times 10^{-4}\ mol/L$ $[Sr^{2+}] = 9.71 \times 10^{-4}$ M

$[F^-] = 2(9.71 \times 10^{-4}\ M) = 1.94 \times 10^{-3}$ M

$K_{sp} = [Sr^{2+}][F^-]^2 = 3.67 \times 10^{-9}$

(#3) $[OH^-] = 2.09 \times 10^{-2}$ M $[Ca^{2+}] = \frac{2.09 \times 10^{-2}\ M}{2} = 1.05 \times 10^{-2}$ M

$K_{sp} = [Ca^{2+}][OH^-]^2 = 4.57 \times 10^{-6}$

(#4) $0.62\ g/L \times \frac{1\ mol}{311.9\ g} = 1.99 \times 10^{-3}\ mol/L$ $[Ag^+] = 2(1.99 \times 10^{-3}\ M) = 3.98 \times 10^{-3}$ M

$[SO_4^{2-}] = 1.99 \times 10^{-3}$ M

$K_{sp} = [Ag^+]^2[SO_4^{2-}] = 3.1 \times 10^{-8}$

(#5) Titrate a known volume of saturated Ag_2SO_4 solution with standardized NaCl to the stoichiometric point as determined by an indicator. The moles of Cl^- added = moles Ag^+ initially present. Then, $K_{sp} = [Ag^+]^2[SO_4^{2-}]$