Name:________________

Solubility Product Constant (Ksp) – Supplemental Worksheet KEY

1. What is the solubility, in moles/liter, of AgI if the $K_{sp} = 8.5 \bullet 10^{-12}$?

$$AgI\ (s) \rightarrow Ag^{+}(aq) + I^{-}(aq)$$

$$K_{sp} = [Ag^{+}]^{1}[I^{-}]^{1}$$

We know our $K_{sp} = 8.5 \bullet 10^{-12}$ and we can insert this into our K_{sp} equation.

$$8.5 \bullet 10^{-12} = [Ag^{+}]^{1}[I^{-}]^{1}$$

Since we have a 1:1 ion-ion dissociation of AgI, we can set x to the following then plug into our K_{sp} equation:

$$x = [Ag^{+}] = [I^{-}]$$

$$8.5 \bullet 10^{-12} = x \cdot x$$

$$8.5 \bullet 10^{-12} = x^{2}$$

$$2.93 \bullet 10^{-6} = x$$

$$\mathrm{x} = 2.93 \bullet 10^{-6} \frac{mol}{L} = [Ag^{+}] = [I^{-}]$$

$$S_{AgI} = 2.93 \bullet 10^{-6} \frac{mol}{L}$$

2. If the solubility of Li_2CO_3 is 1.32 g/100 mL, what is its K_{sp} at room temperature?

$$Li_2CO_3\ (s) \rightarrow 2Li^{+}(aq) + CO_3^{2-}$$

$$K_{sp} = [Li^{+}]^{2}[CO_3^{2-}]^{1}$$

$$2Li^{+} = 2x\ ;\ CO_3^{2-} = x$$

$$K_{sp} = (2x)^{2}x = 4x^{3}$$

Next, we need to determine the solubility in terms of mol/L. Since we have been given the solubility in terms of g/mL, we need to convert this.

$$S_{Li2CO3} = \left|\frac{1.32\ g\ Li_2CO_3}{100\ mL}\right|\frac{1\ mol\ Li_2CO_3}{73.891\ g\ Li_2CO_3}\left|\frac{1000\ mL}{1\ L}\right| = 17.84 \frac{mol}{L}\ Li_2CO_3$$

Since we have converted the solubility into mol/L we can insert this into our K_{sp} equation below:

$$K_{sp} = 4(17.84\frac{mol}{L})^3 = 22720.67 = 2.27\times10^4$$

3. What is the solubility, in moles/liter, of $HgBr_2$ if the $K_{sp} = 6.2\bullet10^{-9}$?

$$HgBr_2\ (s) \rightarrow Hg^{2+}(aq) + 2Br^-$$

$$K_{sp} = [Hg^{2+}]^1[Br^-]^2$$

$$2Br^- = 2x\ ;\ Hg^{2+} = x$$

$$K_{sp} = (2x)^2x = 4x^3$$

$$6.2\times10^{-9} = 4x^3$$

In order to find the solubility at this step, we must solve for x!

$$6.2\times10^{-9} = 4x^3$$

$$\frac{6.2\times10^{-9}}{4} = x^3$$

$$\sqrt[3]{\frac{6.2\times10^{-9}}{4}} = x$$

$$x = 0.001157 = 1.157\times10^{-3}\frac{mol}{L}$$

$$S_{HgBr2} = 1.157\times10^{-3}\frac{mol}{L}$$

4. If $Cu_3(AsO_4)_2$ has a $K_{sp} = 8.0\bullet10^{-36}$, then what is the concentration of $[Cu^{2+}]$ in a saturated solution?

$$Cu_3(AsO_4)_2\ (s) \rightarrow 3Cu^{2+}(aq) + 2AsO_4{}^{3-}$$

$$K_{sp} = [Cu^{2+}]^3[AsO_4{}^{3-}]^2$$

$$3Cu^{2+} = 3x\ ;\ 2AsO_4{}^{3-} = 2x$$

$$K_{sp} = [3x]^3[2x]^2 = 27x^3\times4x^2 = 108x^5$$

$$8\times10^{-36} = 108x^5$$

$$\frac{8\times10^{-36}}{108} = x^5$$

$$\sqrt[5]{\frac{8\times10^{-36}}{108}} = 3.75\times10^{-6} = x$$

$$[Cu^{2+}] = [3x]^3 = [3(3.75\times10^{-6})]^3 = 1.04\times10^{-15}\frac{mol}{L}$$

5. How many moles of AgCl will dissolve in 250 mL of water if the $K_{sp} = 1.7 \bullet 10^{-10}$?

First, we must find the solubility of AgCl. We can do so by the following:

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

$$K_{sp} = [Ag^{+}]^1[Cl^{-}]^1$$

We know our $K_{sp} = 8.5 \bullet 10^{-12}$ and we can insert this into our K_{sp} equation.

$$1.7 \bullet 10^{-10} = [Ag^{+}]^1[Cl^{-}]^1$$

Since we have a 1:1 ion-ion dissociation of AgI, we can set x to the following then plug into our K_{sp} equation:

$$x = [Ag^{+}] = [Cl^{-}]$$

$$1.7 \bullet 10^{-10} = x \cdot x$$

$$1.7 \bullet 10^{-10} = x^2$$

$$1.30 \bullet 10^{-5} = x$$

$$\mathrm{x} = 1.30 \bullet 10^{-5} = [Ag^{+}] = [Cl^{-}]$$

$$S_{AgCl} = 1.30 \bullet 10^{-5}\frac{mol}{L}$$

Second, we must find the amount of moles of AgCl in 0.250 L of water.

$$n_{AgCl} = S_{AgCl}\times V_{H2O}$$

$$n_{AgCl} = 1.30 \bullet 10^{-5}\frac{mol}{L}\times 0.250\ \mathrm{L} = 3.25 \cdot 10^{-6}\ moles\ of\ AgCl$$