AP CHEMISTRY

TOPIC 12: SOLUTIONS, PART A, EXAMPLES

Day 134:

- Solubility Equilibria
- Common Ion Effect

Example: Silver sulfate dissociates in water according to the equation shown below.

$$Ag_2SO_4\,(s) \rightleftharpoons 2\,Ag^{+1}\,(aq) + SO_4^{-2}\,(aq) \quad K_{sp} = 1.2 \times 10^{-5} \text{ at } 25^0C$$

a) Write the equilibrium expression:

$$K_{sp} = \left[Ag^{+1}\right]^2\left[SO_4^{-2}\right]$$

b) Calculate the concentration, in mol L^{-1} of Ag^{+1} (aq) in a saturated solution of Ag_2SO_4 at 25^0C.

	Ag_2SO_4	$\rightleftharpoons$	$2\,Ag^{+1}$	+	SO_4^{-2}
I	-		0		0
C	-		$+2x$		$+x$
E	-		$2x$		x

$$K_{sp} = \left[Ag^{+1}\right]^2\left[SO_4^{-2}\right] = 1.2\times10^{-5}$$

$$1.2\times10^{-5} = (2x)^2(x) = 4x^3 \quad ; \quad \frac{1.2\times10^{-5}}{4} = x^3 = 3.0\times10^{-6}$$

$$x = \sqrt[3]{3.0\times10^{-6}} = 0.0144 = \left[SO_4^{-2}\right] \; ; \; \left[Ag^{+1}\right] = 2x = (2)(0.0144) = 0.0288$$

c) Calculate the maximum mass, in grams, of Ag_2SO_4 that can dissolve in 100 mL of water at 25^0C.

$$\frac{100\ mL}{}\times\frac{1\ L}{1000\ mL}\times\frac{0.0144\ mol\ SO_4^{-2}}{L}\times\frac{1\ mol\ Ag_2SO_4}{1\ mol\ SO_4^{-2}}\times\frac{311.8\ g}{1\ mol\ Ag_2SO_4} = 0.449\ g\ Ag_2SO_4$$

OR

$$\frac{100\ mL}{}\times\frac{1\ L}{1000\ mL}\times\frac{0.0288\ mol\ Ag^{+1}}{L}\times\frac{1\ mol\ Ag_2SO_4}{2\ mol\ Ag^{+1}}\times\frac{311.8\ g}{1\ mol\ Ag_2SO_4} = 0.449\ g\ Ag_2SO_4$$

Now for the big concept, if you added more solid silver sulfate to the saturated solution (at equilibrium) what would you EXPECT to witness? Describe this below (it is okay to draw a picture):

ANSWER:

Adding solid silver sulfate to a solution at equilibrium WILL NOT CAUSE A SHIFT !!! The solution is already saturated and adding additional solids (that already has an existing precipitate at the bottom of the container) will not cause a shift to form more cations and more anions. The solution is SATURATED !!! The added solid will simply sink to the bottom of the container and DO NOTHING (that our eyes can observe).