THE SOLUBILITY PRODUCT CONSTANT (Ksp) OF SILVER ACETATE

In a saturated solution, the ions in solution are in equilibrium with the solid. The rate at which ions are leaving the solid crystal is equal to the rate at which they are returning to the crystal:

$$AgCH_3CHOO(s) \leftrightarrow Ag^{+1}(aq) + CH_3COO^{-1}(aq)$$

The concentrations of the ionic species, Ag^{+1} and CH_3COO^{-1}, when no net change in concentration is taking place, determine the equilibrium solubility. The equilibrium constant expression for this reaction is:

$$Ksp = [Ag^{+1}]\,[CH_3COO^{-1}]$$

If pure silver acetate is dissolved, the acetate ion concentration is the same as the silver ion concentration*. Thus, the solubility product constant can be calculated after experimentally determining the equilibrium concentration of either ion.

In this experiment, you will determine the equilibrium concentration of the silver ion in a saturated solution of silver acetate at room temperature. The reaction between Cu(s) and $Ag^{+1}(aq)$ is the same one which we studied in SCH 3A.

Procedure:

(Day 1)

1. Carefully measure, in a 100 mL graduated cylinder, 100 mL of a saturated silver acetate solution. Pour the solution into a clean, dry 250 mL beaker.
2. Obtain about 30 cm of 16 gauge copper wire. Clean the surface of the wire with some emery cloth or file and wind the wire into a loose coil around a test tube.
3. Find the mass of the copper coil to the nearest 0.01 g and place it into the beaker containing the saturated solution of silver acetate. Allow the system to stand overnight so all the silver ions will have an opportunity to react.

(Day 2)

4. Shake the silver crystals free from the copper wire into the beaker. Wash any adhering crystals into the beaker with a stream of distilled water from a water bottle.. Finally, wash the wire in a stream of water from the tap. When the wire is dry, find its mass.
5. Decant the solution off the silver crystals and rinse them with distilled water. Place the silver into a container designated by your teacher so it can be used again.

* small differences due to hydrolysis of acetate are neglected here

Calculations and Results:

1. Calculate the number of moles of Cu(s) which reacted with the silver ions.

2. Recall the relationship between Cu(s) and Ag^{+1}(aq). How many moles of silver ions were present in the 100 mL sample? What is the concentration of the silver ions in moles per liter?

3. What is the concentrations of the acetate ions present in the solution, expressed in mol/L?

4. Calculate the value of Ksp for silver acetate at room temperature.

5. If 100 mL of 0.02 M silver nitrate and 100 mL of 0.02 M sodium acetate were mixed, would a precipitate of silver acetate be expected to form? Show all of your work.

6. Suppose that some solid sodium acetate was added to the saturated solution of silver acetate. After the sodium acetate is dissolved, what will be the effect of the increased concentration of the acetate ion on the equilibrium: (Le Chatelier)

$$AgCH_3CHOO(s) \leftrightarrow Ag^{+1}(aq) + CH_3COO^{-1}(aq)$$

7. Calculate the concentration of the silver ions if the acetate ion concentration in the solution of question 6 is 1.0 M.