Unit 5 Day 6 Activity – Solubility Name:_____
CH302 – Spring 2013
Vanden Bout/LaBrake EID:_____

Today we will practice the skill of THINKING LIKE A CHEMIST while considering the concept of solubility. Platinum stars will be on the line.

Consider the following demonstration, and describe macroscopically.

1. A solution of lead II nitrate is mixed with a solution of potassium iodide.

2. Describe the demonstration from a microscopic perspective using words and a picture.

3. Use chemical equations to model the changes.

Be prepared to explain if called upon in class.

THINK ABOUT THIS INSOLUBLE SALTS FROM DIFFERENT PERSPECTIVES!

4. Consider that the Ksp of PbI_2 is 1.4×10^{-8}. Predict the concentration of Pb^{2+} ions in solution in a saturated solution of PbI_2. Predict the concentration of the I^{-1} ions in the saturated solution.

The solubility product is the value of the ion product of the molar concentrations of all the ions in the formula unit at saturation (or equilibrium). Consider adding more iodide ion to this saturated solution of PbI_2 in the form of adding some solid, soluble KI salt to the solution.

5. Will the concentration of I^- in the solution change? Will the concentration of the Pb^{2+} ion change? Why or why not?

You must consider that the solubility product for a given salt is the product of the molar concentrations of the ions raised to the power of the coefficient. If you add more of one ion, then the concentration of that added ion would increase. Because the solubility product value is a constant, if one factor in that expression increases then the other factor will need to decrease in order to keep the product (the value of K_{sp}) constant! This effect is called the **COMMON ION EFFECT**.

6. Assume you add solid PbI_2 to a 0.5 molar aqueous solution of KI. What will be the concentration of Pb^{2+} in the solution? What will be the molar solubility of the salt?

7. What will be the concentration of the I^- anion?

Be prepared to explain your result if called upon.

When we demonstrated the precipitation reactions in class, we mixed together solutions containing high concentrations of the soluble salts to insure we could have a concentration of the insoluble salt product high enough to see a nice precipitate. However, if the concentrations of the ions are low enough, you might not see a precipitate forming! One can predict the formation of a precipitate based on calculating the ION product. The ION product is of the similar form as the K_{sp} expression, except the ION product is the product of the concentrations at any point in time, not just at the equilibrium condition. The ION product is also referred to as the **REACTION QUOTIENT** and for PbI_2 will be expressed as: $Q_{sp} = [Pb^{2+}][I^-]^2$. If the value of Q_{sp} is greater than K, then a precipitate will form. If the value is less that K, then a precipitate will NOT form!

8. Suppose you mix 1 liter each of 0.2 M solutions of $Pb(NO_3)_2(aq)$ and KI(aq). Follow these steps to determine if a precipitate will form! First determine the molar concentrations of the two salts in the mixture.

9. Calculate the value of Q_{sp} for the PbI_2.

10. Determine if the value of Q_{sp} is greater or less than K_{sp}. Predict if a precipitate will form under these conditions.

11. If a precipitate did form, predict the mass of the precipitate that will fall out of solution.

12. Assume that you cannot change the concentration of the I^- ion in this solution. However, you can change the Pb^{2+} ion concentration in your solution. To what concentration would you have to lower the Pb^{2+} ion concentration to prevent the precipitation from occurring?

Be prepared to share your answers with the class if called upon.