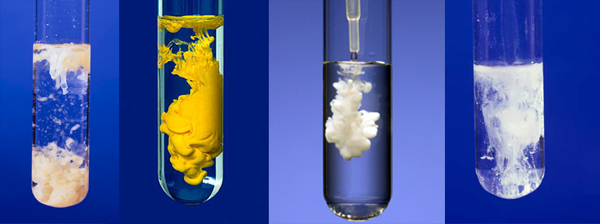
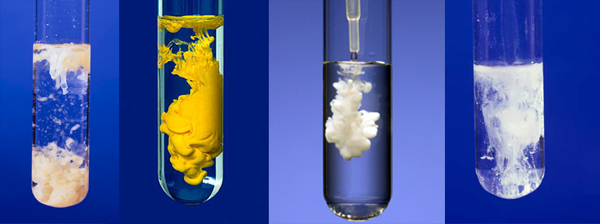
**KSP**

**Question of the Day:** Why is it of any practical importance to look at how well ionic solids that don’t dissolve well in water attempting to redissolve in solution?

Questions to answer during lecture!

1. By definition, an ionic solid has total charge, and because water has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it has the ability to pull apart ionic compounds in solution.
2. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tell us which ionic compounds dissolve well in water, and which ones do not.
3. Even though PbI2 is listed as a substance that does not dissolve in water on the solubility rules, a small amount – less than one out of every \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ PbI2 molecules – does redissolve into solution.
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ does not dissolve well in water, so it is used in X-Ray procedures, because it coats the inside of your esophagus, stomach and intestines!
5. A small amount of a solid that can redissolve might be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in tap water used for washing and drinking, such as the solids PbCl2 and PbF2.
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is an equilibrium constant that measures the amount of an ionic solid that dissolves compared to the amount of an ionic solid that remains as a precipitate.
7. Answer the following questions as you follow the lecture!

Write the chemical equation for the solid PbI2 attempting to redissolve in solution:

Now, write an equilibrium constant expression (Ksp) for the above reaction:

The bottom of any Ksp will be written as a “1”, because solids and liquids do not change in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in solution, only in amount.

Set up an ICE for PbI2 dissolving in water:

Given that the Ksp for PbI2 is 1.4 x 10-8, calculate the molar solubility for PbI2 below:

Cadmium sulfide is an important semiconductor used in the manufacture of photosensors. The Ksp for cadmium sulfide is equal to 8.0 x 10-27. Calculate the concentration of sulfide ion that could dissolve into a .050M solution of sodium sulfide and solid cadmium sulfide at 250C. Compare this to the normal molar solubility of sulfide ion, which is 8.9 x 10-14 M.

Write the chemical equation for the solid CdS attempting to redissolve in solution:

Second, set up an ICE for CdS dissolving in solution:

Third, given the Ksp for CdS above, calculate the concentration of sulfide ion that could dissolve into a .050M solution of sodium sulfide and solid cadmium sulfide at 250C:

Will La(OH)3 precipitate out of solution if the pH of a .0150M solution of La(NO3)3 is adjusted to 9.0? The Ksp for La(OH)3at 250C is 1 x 10-19. La(OH)3 is used in solid form in movie lighting and projection.

First, write the chemical equation for the solid La(OH)3 attempting to redissolve in solution:

Second, because we aren’t sure if a precipitate will form, set up and solve for Q:

Finally, is Q > Ksp, is Q < Ksp, or is Q = Ksp? What does this tell you?

A solution contains 1.0 x 10-2 M Ag+1 and 2.0 x 10-2M Pb+2. When Cl-1 is added, both AgCl and PbCl2 can precipitate. What concentration is necessary to begin precipitating each salt? Which salt precipitates first? The Ksp for AgCl = 1.8 x 10-10, and the Ksp for PbCl2 = 1.7 x 10-5.

First, write the reaction for AgCl attempting to redissolve in solution:

Second, solve for the amount of Cl-1 that must be present to precipitate AgCl:

Third, write the reaction for PbCl2 attempting to redissolve in solution:

Second, solve for the amount of Cl-1 that must be present to precipitate PbCl2:

Which is a smaller amount? The Cl-1 required to precipitate AgCl, or the Cl-1 required to precipitate PbCl2? Which will precipitate first?

1. Consider the following reaction:

Zn(IO3)2 (s) Zn+2 (aq) + 2 IO3-1(aq) + heat

Will the mass of Zn(IO3)2 (s) increase or decrease in response to the following stress? Use the reaction quotient, Q, where reasonable.

A) solid, soluble KIO3 is added.

**GUIDED PRACTICE PROBLEMS!**





1. Iron (III) hydroxide is used to remove deadly arsenic from drinking water. Calculate the equilibrium concentrations of each ion in solution. The Ksp for iron (III) hydroxide is 4 x 10-38.
2. Strontium phosphate is used in the manufacture of fluorescent lights. What is the solubility of each ion in solution at equilibrium? The Ksp for strontium phosphate is 1 x 10-31.
3. The Ksp for copper (II) carbonate is 2.50 x 10-10 at 250C. Calculate the molar solubility of each ion at 250C.
4. The solubility product constant of calcium sulfate is 2.40 x 10-5 at 250C. Calculate the molar solubility of calcium sulfate in a .00800 M solution of CaCl2 at 250C.
5. A solution of Na2SO4 is added dropwise to a solution that is
6. × 10−2 *M* in Ba+2 and 1.0 × 10−2 *M* in Sr+2. The solubility product constants are

as follows:

1. Which cation will precipitate first?
2. What concentration of SO4-2 is necessary to begin precipitation? Neglect volume changes!
3. At what concentration of SO4-2 will the second cation begin to precipitate?
4. Suppose that a 10.0-mL sample of a solution is to be tested for Cl-1 by the addition of 1 drop (or 0.200 mL) of 0.150 M Pb(NO3)2. What is the minimum number of grams of Cl-1 that must be present for PbCl2 (s) to form? The Ksp for PbCl2 (s) = 1.70 x 10-5.
5. A 1.00 liter solution saturated with lead (II) iodide at 250C contains 0.540 grams of PbI2 dissolved. Calculate the Ksp for PbI2 at 250C.
6. Will Co(OH)2 precipitate out of solution if the pH of a 0.020 M solution of Co(NO3)2 is adjusted to 8.5? The Ksp for Co(OH)2 is 1.3 x 10-15.
7. 20.0 mL of a 0.010 M AgNO3 solution is added to 10.0 mL of a 0.0150 M solution of NaIO3. Will a precipitate form? The Ksp for AgIO3 is 3.1 x 10-8.