$M_pX_q(s) \rightleftharpoons pM^{m+}(aq) + qX^{n-}(aq)$ $Ksp=[M^{m+}]^p[X^{n-}]^q$

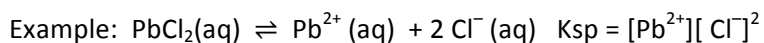Example: $PbCl_2(aq) \rightleftharpoons Pb^{2+}(aq) + 2 Cl^-(aq)$ $Ksp = [Pb^{2+}][Cl^-]^2$

15.1 By the end of this section, you will be able to:

- Write chemical equations and equilibrium expressions representing solubility equilibria
- Carry out equilibrium computations involving solubility, equilibrium expressions, and solute concentrations

15.2 By the end of this section, you will be able to:

- Explain the Lewis model of acid-base chemistry
- Write equations for the formation of adducts and complex ions
- Perform equilibrium calculations involving formation constants

Write ionic equations for dissociation. Write the Equilibrium constant equation for the solubility product. Do the Math!

Define molar solubility.

1. What is the molar solubility of a saturated solution of $CaCO_3(s)$?

2. What is the molar solubility of a saturated solution of $CaCO_3$ (s) in a .15 M solution of Na_2CO_3 (aq)? Did the solubility change? If yes, why? This is the common ion effect!

3. Is $CaCO_3$ more soluble in a solution of pH = 3 or pH = 10. Why?

4. Many of the pigments used by artists in oil-based paints are sparingly soluble in water. For example, the solubility of the artist's pigment chrome yellow, $PbCrO_4$, is 4.6×10^{-6} g/L. Determine the solubility product equilibrium constant for $PbCrO_4$.

If the molar solubility of iron (II) hydroxide is 2.3×10^{-6}, what is Ksp for iron (II) hydroxide?

Precipitation!!! $CaCO_3(s) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$ $K_{sp} = 8.7 \times 10^{-9}$

5. Will a solution of 25.0 mL of 0.100 M $CaCl_2$ mixed with 100. mL of 0.0100 M Na_2CO_3 form a precipitate? (Calculate Q!!)
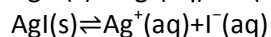
You can selectively precipitate… smaller K ppts first!

6. Precipitation of Silver Halides: A solution contains 0.0010 mol of KI and 0.10 mol of KCl per liter. $AgNO_3$ is gradually added to this solution. Which forms first, solid AgI or solid AgCl?

The two equilibria involved are:
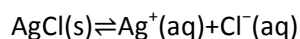
$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$ $Ksp = 1.6 \times 10^{-10}$
$AgI(s) \rightleftharpoons Ag^+(aq) + I^-(aq)$ $Ksp = 1.5 \times 10^{-16}$

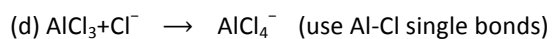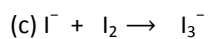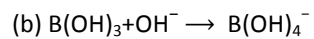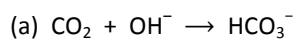7. Lewis Acids and Bases:
Define Lewis Acid

Define Lewis Base

Define Coordinate Covalent Bond

Define ligand

8. Write the Lewis structures of the reactants and product of each of the following equations, and identify the Lewis acid and the Lewis base in each:

(a) $CO_2 + OH^- \longrightarrow HCO_3^-$

(b) $B(OH)_3 + OH^- \longrightarrow B(OH)_4^-$

(c) $I^- + I_2 \longrightarrow I_3^-$

(d) $AlCl_3 + Cl^- \longrightarrow AlCl_4^-$ (use Al-Cl single bonds)

(e) $HCl(g) + PH_3(g) \longrightarrow$

(f) $H_3O^+ + CH_3^- \longrightarrow$
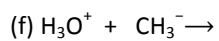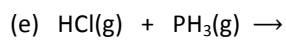
9. Using the dissociation constant, $K_d = 7.8 \times 10^{-18}$, calculate the equilibrium concentrations of Cd^{2+} and CN^- in a 0.250 M solution of $Cd(CN)_4{}^{2-}$.