**KSP – Molar Solubility**

**Worksheet**

Organic Chemistry Tutor

1. The molar solubility of NiCO3 is 3.74 x 10-4 mol/L. Calculate the Ksp value for NiCO3.

2. The molar solubility of Ca(OH)2 is 6.875 x 10-3 mol/L. Calculate the Ksp for Ca(OH)2.

3. The solubility of Ca3(PO4)2 is 5.1 x 10-5 g/L. Calculate the Ksp value for Ca3(PO4)­2.

4. The solubility of Ba2+ is 2.667 x 10-8 mol/L in a saturated solution of Ba3(PO4)2. Calculate the Ksp value for Barium Phosphate.

5. The Ksp value for AgBr is 5 x 10-13. Calculate the molar solubility of AgBr.

6. The Ksp value for PbI2 is 1.4 x 10-8. Calculate the molar solubility of PbI2.

7. The Ksp value for Ag3PO4 is 1.8 x 10-18.

(a) Calculate the molar solubility of Ag3­PO4. (b) What is the concentration of Ag+ in a saturated solution of Ag3PO4?

8. The Ksp value for Pb3(PO4)2 is 1 x 10-54. (a) Calculate the molar solubility of Pb3(PO4)­2. (b) What is the concentration of PO43- in a saturated solution of Pb3(PO4)2? (c) Calculate the solubility of Pb3(PO4)2 in g/L.

9. The Ksp value for PbF2 is 4 x 10-8. (a) Calculate the molar solubility of solid PbF2 in a 0.5 M NaF solution. (b) What is the molar solubility of PbF2 in a saturated solution of Lead (II) Fluoride? (c) What effect does the presence of a common ion such as F- have on the molar solubility PbF2?

10. The Ksp value for AgCl is 1.6 x 10-10. Calculate the molar solubility of solid AgCl in a solution of 0.35M MgCl2.

11. The Ksp value of Mg(OH)2 is 8.9 x 10-12.

(a) What is the pH of a saturated solution of Mg(OH)2? (b) Calculate the molar solubility of Mg(OH)2 at a pH of 12.5.

12. A solution is prepared by mixing 200 mL of a 0.10 M Ca(NO3)2 solution with 300 mL of a 0.25 M NaF solution. (a) Will precipitation occur in this solution? (b) Calculate the equilibrium concentrations of Ca2+ and F- in this solution. The Ksp value for CaF2 is 4 x 10-11.

13. A solution contains 1.6 x 10-4 M Mg(NO3)2 and 2.0 x 10-6 M Ca(NO3)2. If F- is added slowly to the solution, will MgF2 or CaF2 precipitate first? (The Ksp values for MgF2 and CaF2 are 6.4 x 10-9 and 4.0 x 10-11)

14. Consider a saturated solution of PbI2. (a) If the concentration of Pb2+ increases, will dissolution or precipitation occur? (b) What effect will the addition of solid PbI2 have on the system? (c) In what direction will the reaction shift if sodium Iodide is added to the solution? (d) Will the concentration of Pb2+ increase or decrease upon the addition of NaI? (e) If the pH of the solution increases, will the solubility of PbI2 increase or decrease?

**PbI2 (s) ↔ Pb2+(aq) + 2 I-(aq)**

15. Consider a saturated solution of CaF2. (a) If the pH of the solution decreases, will the solubility of CaF2 increase or decrease? (b) Will precipitation or dissolution occur? (c) What effect will the addition of Mg(NO3)2 have on the CaF2 system?

16. Consider a saturated solution of AB2. The dissolution of AB2 is an endothermic process. (a) What effect will an increase in temperature have on the solubility of AB2? (b) Will Ksp increase or decrease if the temperature increases?

**AB2 (s) ↔ A2+­(aq) + 2 B-(aq)** ΔH = +100 kJ

17. Which substance has the highest molar solubility? AgCl, AgBr, or AgI? (The Ksp values for AgCl, AgBr, and AgI are 1.6 x 10-10, 5.0 x 10-13, and 1.5 x 10-16 respectively.)

18. Which substance has the highest molar solubility? NiS, PbBr2, or Ag3PO4? (The Ksp values for NiS, PbBr2, and Ag3PO4 are 3.0 x 10-21, 4.6 x 10-6, and 1.8 x 10-18)

**Answers:**

1. 1.4 x 10-7

2. 1.3 x 10-6

3. 1.3 x 10-32

4. 6 x 10-39

5. 7 x 10-7 mol/L

6. 1.5 x 10-3 mol/L

7a. 1.6 x 10-5 mol/L

7b. 4.82 x 10-5 mol/L

8a. 6.21 x 10-12 M

8b. 1.24 x 10-11 M

8c. 5.04 x 10-19 g/L

9a. 1.6 x 10-7 M

9b. 2.2 x 10-3 M

9c. The common ion F- reduces the molar solubility of PbF2.

10. 2.29 x 10-10 mol/L

11a. pH = 10.4

11b. 8.9 x 10-9

12a. Yes. Q > Ksp. The reaction will shift to the left causing precipitation.

12b. [Ca2+] = 8.2 x 10-9 M, [F-] = 0.07 M

13. CaF2 will precipitate first in this solution.

14a. Precipitation

14b. No effect

14c. It will shift to the left causing precipitation.

14d. Pb2+ will decrease in concentration

14e. Dissolution will occur causing the solubility of PbI2 to increase.

15a. The solubility of CaF2 to increase.

15b. Dissolution will occur.

15c. The reaction will shift to the right favoring dissolution causing the solubility of CaF2 to increase.

16a. The solubility will increase.

16b. Ksp will increase.

17. AgCl

18. PbBr2