Solubility Equilibrium and Solubility Product Problems

SCH4U 2004 - 2005

Calculating K_{sp} from solubility data

1. The solubility of silver bromide is found to be 8.8×10^{-7} mol/L at 25°C. Calculate the K_{sp} for silver bromide.

2. The solubility of iron (II) hydroxide is 1.4×10^{-3} g/L at 298 K. What is K_{sp}.?

3. The solubility of copper (II) bromide is 2.0×10^{-4} mol/L at 25°C. Calculate the K_{sp} at 25°C.

4. The solubility of strontium sulphate is 5.83×10^{-4} mol/L at 25°C. Calculate the K_{sp} at 25°C.

5. The solubility of magnesium hydroxide is 1.5×10^{-4} mol in 100 mL at 18°C. Calculate K_{sp}.

6. The solubility of silver sulphide is 1.3×10^{-3} mol in 50 mL, at 20°C, what is K_{sp}?

7. The solubility of barium fluoride is 2.2×10^{-2} mol/L at 25°C. Calculate the K_{sp} at 25°C.

8. The solubility of lithium carbonate at 15°C is 1.5 g/100 mL of water. Calculate the K_{sp} of lithium carbonate at 15°C.

Calculating solubility from K_{sp}

1. Calculate the solubility of calcium carbonate in water at 25°C. The K_{sp} of calcium carbonate is 4.8×10^{-5}.

2. What is the solubility of calcium hydroxide, in g/L if the solubility product constant for calcium hydroxide is 4.0×10^{-6}?

3. The K_{sp} for magnesium fluoride is 6.4×10^{-9}. What is the solubility in g/L?

4. The solubility product of copper (II) sulphide, CuS, is 4×10^{-38} at 25°C. Calculate:
   (a) the number of moles of CuS that will dissolve in 1.0 L of solution
   (b) the number of grams of CuS that will dissolve in 1.0 L of solution
   (c) the concentration of the sulphide-ion present

5. What is (a) the solubility of calcium hydroxide, $Ca(OH)_2$, in g/L (b) and the $[OH^{-1}]$, if the solubility product constant for $Ca(OH)_2$ is 4×10^{-6}?

6. The solubility product constant, K_{sp} , of $Ag_2CrO_{4(s)}$ in water is 5.00×10^{-13} at 25 ^{O}C, what is the concentration of Ag^{+1} in a saturated solution of Ag_2CrO_4 at 25 ^{O}C.

7. The K_{sp} of Ag_2CO_3 at 25 ^{O}C is 8.20×10^{-12}. Calculate the mass of silver that may be recovered from a saturated solution of $Ag_2CO_{3(aq)}$ at 25^{O}C.

Will a Precipitate Form? (WAPF)

1. Will a precipitate form if 20.0 mL of 0.010 M $CaCl_2$ are mixed with 20.0 mL of 0.080 M Na_2SO_4(K_{sp} of $CaSO_4 = 2.45 \times 10^{-5}$)

2. Will a precipitate form if 40.0 mL of 8.0×10^{-3} M $Mg(NO_3)_2$ are mixed with 60.0 mL of 1.0×10^{-2} M K_2CO_3 (K_{sp} of $MgCO_3 = 2.6 \times 10^{-5}$)

3. Will a precipitate form if 25 mL of 4×10^{-3} M $AgNO_3$ are mixed with 75 mL of 2.0×10^{-4} M Na_2CrO_4 (K_{sp} of $AgCrO_4 = 9.0 \times 10^{-12}$)

4. A student dissolves 0.166 g of lead nitrate, $Pb(NO_3)_2$, in 1.0 L of 0.01 M solution of sodium sulphate, Na_2SO_4. Will a precipitate form? Identify the precipitate, given K_{sp} $PbSO_4 = 6.3 \times 10^{-7}$.

5. 25.0 mL of a 1×10^{-4} M solution of sodium chloride are mixed with 25.0 mL of a 2×10^{-14} M silver nitrate solution. Will a precipitate form if K_{sp} $AgCl = 1.8 \times 10^{-10}$?

6. 25.0 mL of a 4.0×10^{-6} mol/L solution of NaBr are mixed with 75.0 mL of a 1.0×10^{-2} mol/L $AgNO_3$ solution. Will a precipitate form if $K_{sp} = AgBr = 5.0 \times 10^{-13}$?

7. A student mixes 70.0 mL of a 4.0×10^{-6} mol/L NaBr solution with 30.0 mL of 1.0×10^{-10} mol/L of $CuNO_3$. Will a precipitate form, given K_{sp} $CuBr = 5.9 \times 10^{-9}$?

Common Ion Effect

1. Calculate the solubility of silver chloride in 0.10 M NaCl, K_{sp} $AgCl = 2.0 \times 10^{-10}$.
2. Calculate the solubility of strontium sulphate in a 0.2 M solution of sodium sulphate, K_{sp} $SrSO_4 = 7.2 \times 10^{-9}$ at 25°C.

3. Calculate the solubility of solid CaF_2 (K_{sp} $CaF = 4.0 \times 10^{-11}$ in a 0.025 M NaF solution).

4. A solution contains 1.0×10^{-5} M Na_3PO_4. What is the minimum concentration of $AgNO_3$ that would cause precipitation of solid Ag_3PO_4, K_{sp} $Ag_3PO_4 = 1.8 \times 10^{-18}$.

Solubility Equilibria

1. Which of the following salts will produce the greatest concentration of ions in aqueous solutions?

Ag_2CrO_4	$K_{sp} = 1.9 \times 10^{-12}$	$Mg(OH)_2$	$K_{sp} = 2.0 \times 10^{-13}$
$BaCrO_4$	$K_{sp} = 8.5 \times 10^{-11}$	PbS	$K_{sp} = 7.0 \times 10^{-29}$
$Fe(OH)_3$	$K_{sp} = 6.0 \times 10^{-38}$	Ag_2S	$K_{sp} = 1.3 \times 10^{-3}$

2. A solution is 1×10^{-14} M in NaF, Na_2S and Na_3PO_4. What would be the order of precipitation as a source of Pb^{+2} is added gradually to a solution? The relevant K_{sp} values are K_{sp} $PbF_2 = 4 \times 10^{-8}$, K_{sp} $PbS = 7 \times 10^{-29}$ and K_{sp} $Pb_3(PO_4)_2 = 1 \times 10^{-54}$.

3. A solution is known to contain Hg_2^{+2}, Zn^{+2} and Ca^{+2} ions. If a student wants to separate these three ions by precipitating them one by one from solution, in what order must the three following be added?

a) H_2SO_4, HCl and H_2S b) H_2SO_4, H_2S and HCl
c) H_2S, H_2SO_4 and HCl d) H_2S, HCl and H_2SO_4