Problems of Solubility equilibria

1) The solubility product constant of copper(I) sulfide (Cu_2S) is 1.600×10^{-47}. Find out:

a) Molar solubility of Cu_2S in pure water.

b) Molar concentration of Cu^{2+} and S^{2-} in the saturated solution.

2) Find out the volume of aqueous saturated solution of magnesium hydroxide ($Mg(OH)_2$) that contains 2 g of this compound if its solubility product constant is $k_{sp} = 1.200\times10^{-11}$.

3) Calculate the mass of zinc hydroxide ($Zn(OH)_2$) contained in 1000 mL of an aqueous saturated solution of this compound if its solubility product constant is $k_{sp} = 5.850\times10^{-17}$.

4) At 25 °C the molar solubility in pure water of silver sulfide (Ag_2S) is 9.873×10^{-18} mol/L. Determine:

a) Solubility product constant.

b) Molar concentration of Ag^{+} and S^{2-} in the saturated solution.

5) In an aqueous saturated solution of copper(I) sulfide (Cu_2S) the molar concentration of S^{2-} is 1.651×10^{-16} mol/L. Find out:

a) Molar solubility and solubility product constant of Cu_2S in pure water.

b) Molar concentration of Cu^{2+} in the saturated solution.

6) The solubility product constant of magnesium hydroxide ($Mg(OH)_2$) is 1.680×10^{-11}. Find out:

a) Molar solubility of $Mg(OH)_2$ in pure water.

b) Molar concentration of Mg^{2+} in the saturated solution.

c) pH of the saturated solution.

7) A flask contains 1550 mL of an aqueous saturated solution of lead(II) chloride ($PbCl_2$). The mass of solute is 6.741 g. Calculate:

a) Molar solubility of $PbCl_2$ in pure water.

b) Solubility product constant.

8) The solubility product constant of silver chromate (Ag_2CrO_4) is 2.850×10^{-12}. Find out:

a) Molar solubility of Ag_2CrO_4 in pure water.

b) Molar concentration of Ag^{+} and CrO_4^{2-} in the saturated solution.

9) The solubility product constant of manganese(II) hydroxide ($Mn(OH)_2$) is 1.200×10^{-13}. Determine:

a) Molar solubility of $Mn(OH)_2$ in pure water if we ignore initial hydroxide concentration from water.

b) Molar solubility of $Mn(OH)_2$ in an aqueous solution of NaOH where pH = 11.88.

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10) The solubility product constant of silver chloride (AgCl) is 1.190×10^{-10}. Determine:

a) Molar solubility of AgCl in pure water.

b) Molar solubility of AgCl in a 2.97×10^{-3} mol/L solution of sodium chloride (NaCl).

11) At 25 °C the molar solubility in pure water of calcium fluoride (CaF_2) is 2.169×10^{-4} mol/L. Determine:

a) Solubility product constant.

b) Molar solubility of CaF_2 in a 0.0314 mol/L solution of calcium nitrate ($Ca(NO_3)_2$).

12) In a saturated aqueous solution of silver chromate (Ag_2CrO_4) the molar concentration of Ag^+ is 1.560×10^{-4} mol/L. Find out:

a) Molar solubility and solubility product constant of Ag_2CrO_4 in pure water.

b) Molar solubility of Ag_2CrO_4 in a 5.46×10^{-3} mol/L solution of sodium chromate (Na_2CrO_4).

13) The solubility product constant of zinc hydroxide ($Zn(OH)_2$) is 4.950×10^{-17}. Determine:

a) Molar solubility of $Zn(OH)_2$ in pure water if we ignore initial hydroxide concentration from water.

b) Molar solubility of $Zn(OH)_2$ in an aqueous solution of NaOH where pH = 10.53.

Answers:

1) **a)** 1.587×10^{-16} mol/L, **b)** $[Cu^{2+}] = 3.175\times10^{-16}$ mol/L, $[S^{2-}] = 1.587\times10^{-16}$ mol/L.

2) 237.7 L.

3) 0.243 mg.

4) **a)** 3.850×10^{-51}, **b)** $[Ag^+] = 1.975\times10^{-17}$ mol/L, $[S^{2-}] = 9.873\times10^{-18}$ mol/L.

5) **a)** 1.651×10^{-16} mol/L, 1.800×10^{-47}, **b)** $[Cu^{2+}] = 3.302\times10^{-16}$ mol/L.

6) **a)** 1.613×10^{-4} mol/L, **b)** $[Mg^{2+}] = 1.613\times10^{-4}$ mol/L, **c)** 10.51.

7) **a)** 0.01564 mol/L, **b)** 1.530×10^{-5}.

8) **a)** 8.932×10^{-5} mol/L, **b)** $[Ag^+] = 1.786\times10^{-4}$ mol/L, $[CrO_4^{2-}] = 8.932\times10^{-5}$ mol/L.

9) **a)** 3.107×10^{-5} mol/L, **b)** 2.122×10^{-9} mol/L.

10) **a)** 1.091×10^{-5} mol/L, **b)** 4.011×10^{-8} mol/L.

11) **a)** 4.080×10^{-11}, **b)** 1.800×10^{-5} mol/L.

12) **a)** 7.802×10^{-5} mol/L, 1.900×10^{-12}, **b)** 9.318×10^{-6} mol/L.

13) **a)** 2.313×10^{-6} mol/L, **b)** 4.401×10^{-10} mol/L.