

**Chemistry 3****Set of exercises-2****Part 2: Precipitation-Complexation-redox reactions****Exercise 1**

I) Calculate the solubility products of the following salts knowing their solubilities at 25°C:

$\text{AgCl}$ ,  $S=1.3 \times 10^{-5} \text{ mol/l}$ ;  $\text{Ag}_3\text{PO}_4$ ,  $S=1.63 \times 10^{-5} \text{ mol/l}$ ;  $\text{Ca}_3(\text{PO}_4)_2$ ,  $S=2.5 \times 10^{-3} \text{ g/l}$ ,  $M=310 \text{ g/mol}$ ;  
 $\text{MgF}_2$ ,  $S=8.7 \times 10^{-3} \text{ g/l}$ ,  $M=62.3 \text{ g/mol}$ .

II) Calculate the solubility per (g/l) of the following salts knowing their solubility products at 25°C:

$\text{Ag}_2\text{CO}_3$ ,  $K_s=6.2 \times 10^{-2}$ ,  $M=276 \text{ g/mol}$ ;  $\text{MgCO}_3$ ,  $K_s=2.6 \times 10^{-5}$ ,  $M=84.3 \text{ g/mol}$ ;  
 $\text{Pb}_3(\text{PO}_4)_2$ ,  $K_s=1.5 \times 10^{-32}$ ,  $M=811.6 \text{ g/mol}$ ;  $\text{Bi}_2\text{S}_3$ ,  $K_s=9.85 \times 10^{-73}$ ,  $M=514 \text{ g/mol}$

**Exercise 2**

1- The solubility of silver cyanide ( $\text{AgCN}$ ) in water is  $1.7 \times 10^{-6} \text{ g}$  for 100 ml

-Calculate the necessary mass to prepare a saturated solution with 700 ml volume.

-Calculate the solubility product of this salt

2- A mass of 15 g of potassium cyanide ( $\text{KCN}$ ) is added to this solution. Calculate the corresponding solubility. Conclude.

**Data:** Ag, 108; K=39; C=12; N= 14 g/mol.

**Exercise 3 (homework)**

The solubility product of lead sulfate is  $1.8 \times 10^{-8}$ . Calculate its solubility in: a) Pure water, b) A solution of lead nitrate ( $\text{Pb}(\text{NO}_3)_2$ ) at 0.1 M . c) A solution of  $\text{Na}_2\text{SO}_4$  at  $10^{-3} \text{ M}$ . Conclude.

**Exercise 4**

Calculate the starting pH of precipitation and the pH of complete precipitation for :

a)  $\text{Cu}(\text{OH})_2$  initial  $[\text{Cu}^{2+}]_0=0.010 \text{ M}$  and  $K_{sp}(\text{Cu}(\text{OH})_2) \approx 2.2 \times 10^{-20}$

b)  $\text{Fe}(\text{OH})_3$  knowing that initial  $[\text{Fe}^{3+}]_0=1.0 \times 10^{-3} \text{ M}$  and  $K_{sp}(\text{Fe}(\text{OH})_3) \approx 2.6 \times 10^{-39}$

**Exercise 5 (homework)**

An aqueous solution contains the following ions :  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$  and  $\text{Ni}^{2+}$ , each at the concentration of  $10^{-3} \text{ mol/l}$ . The solubility products of these salts are :

$K_{sp}(\text{Mg}(\text{OH})_2) = 10^{-11}$ ,  $K_{sp}(\text{Ca}(\text{OH})_2) = 10^{-7}$ ,  $K_{sp}(\text{Ni}(\text{OH})_2) = 10^{-17}$

a)  $\text{NaOH}$  is added progressively (dropwise) to this solution. Give the order of the apparition of precipitates of each of the hydroxides.

b) Calculate the pH of precipitation of each of these ions