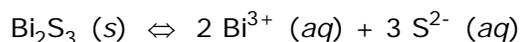


Session #25: Homework Solutions

Problem #1

Bi_2S_3 dissolves in water according to the following reaction:

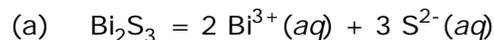


for which the solubility product, K_{sp} , has the value of 1.6×10^{-72} at room temperature.

(a) At room temperature how many moles of Bi_2S_3 will dissolve in 3.091×10^6 liters of water?

(b) How many Bi^{3+} ions will be found in the solution described in part (a)?

Solution



$$\therefore [\text{Bi}^{3+}] = 2 C_s \text{ and } [\text{S}^{2-}] = 3 C_s$$

$$\therefore K_{\text{sp}} = (2 C_s)^2 (3 C_s)^3 = 4 C_s^2 \cdot 27 C_s^3 = 108 C_s^5$$

$$\therefore C_s = \left(\frac{K_{\text{sp}}}{108} \right)^{1/5} = 1.715 \times 10^{-15} \text{ mol/L}$$

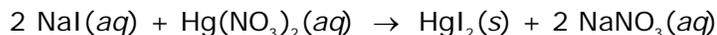
$$\therefore \text{in } 3.091 \times 10^6 \text{ L} \Rightarrow 5.3 \times 10^{-9} \text{ mol Bi}_2\text{S}_3$$

(b) $[\text{Bi}^{3+}] = 2 C_s = 1.06 \times 10^{-8} \text{ mol}$

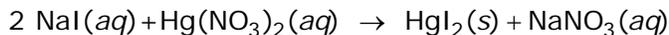
N_{AV} ions/mol $\Rightarrow 6.38 \times 10^{15} \text{ Bi}^{3+}$ ions in the 3.091×10^6 liters of water of part (a)

Problem #2

Calculate the volume of 0.25 M NaI that would be needed to precipitate all the Hg^{2+} ion from 45 mL of a 0.10 M $\text{Hg}(\text{NO}_3)_2$ solution according to the following reaction:



Solution



$$\frac{0.10 \text{ mol Hg}(\text{NO}_3)_2}{1 \text{ L}} \times 0.045 \text{ L} = 4.5 \times 10^{-3} \text{ mol Hg}(\text{NO}_3)_2$$

$$4.5 \times 10^{-3} \text{ mol Hg}(\text{NO}_3)_2 \times \frac{2 \text{ mol NaI}}{1 \text{ mol Hg}(\text{NO}_3)_2} = 9.00 \times 10^{-3} \text{ mol NaI}$$

$$\frac{9.00 \times 10^{-3} \text{ mol NaI}}{0.25 \frac{\text{mol NaI}}{\text{L}}} = 3.6 \times 10^{-2} \text{ L} \times \frac{1000 \text{ ml}}{1 \text{ L}} = 36 \text{ mL NaI}$$

Problem #3

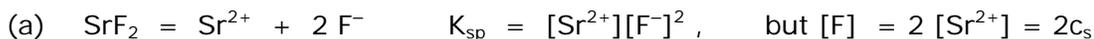
(a) Strontium fluoride, SrF_2 , has a K_{sp} value in water of 2.45×10^{-9} at room temperature.

Calculate the solubility of SrF_2 in water. Express your answer in units of molarity.

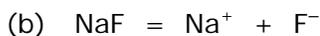
(b) Calculate the solubility of SrF_2 in 0.03 M NaF (*aq*). Express your answer in units of molarity.

Assume that NaF is completely dissociated in water.

Solution



$$\therefore K_{\text{sp}} = c_s (2 c_s)^2 = 4 c_s^3 \quad \therefore c_s = \left(\frac{K_{\text{sp}}}{4} \right)^{1/3} = 8.49 \times 10^{-4} \text{ M}$$



$\therefore [\text{F}^-] = 0.003 \text{ M}$, which dominates the other equilibrium

$$\therefore K_{\text{sp}} = [\text{Sr}^{2+}][\text{F}^{-}]^2 \Rightarrow [\text{Sr}^{2+}] = \frac{K_{\text{sp}}}{[\text{F}^{-}]^2} = \frac{2.45 \times 10^{-9}}{(0.03)^2} = 2.72 \times 10^{-6} \text{ M}$$

$$\therefore [\text{Sr}^{2+}] = c_s = 2.72 \times 10^{-6} \text{ M}$$

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3.091SC Introduction to Solid State Chemistry
Fall 2009

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