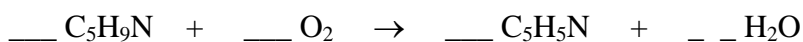


1 (10 points in total). When the following reaction consumes 23.4 moles of oxygen, how many moles of C_5H_5N are produced? What would the concentration of the C_5H_5N be if it were dissolved in 2.000 cubic meters of water?

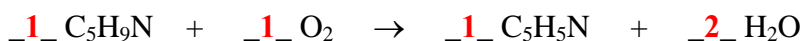


$$n_{O_2} = 23.4 \text{ moles}$$

$$V = 2.000 \text{ m}^3$$

$$n_{C_5H_5N} = ??? \text{ and } [C_5H_5N] = ???$$

[Note: There are only 3 Significant Figures for this data]



$$n_{C_5H_5N} = 1 \times n_{O_2}$$

$$n_{C_5H_5N} = 1 \times 23.4 \text{ moles}$$

$$\underline{n_{C_5H_5N} = 23.4 \text{ moles}}$$

$$V = 2.0 \text{ m}^3 \times 1,000 \text{ l/m}^3 = 2,000 \text{ L}$$

$$[C_5H_5N] = n_{C_5H_5N} / V$$

$$[C_5H_5N] = 23.4 \text{ moles} / 2,000 \text{ L}$$

$$\underline{[C_5H_5N] = 1.17 \times 10^{-2} \text{ m/L (or 0.0117 m/L)}}$$

[Note: Only 3 Significant Figures are allowed for this answer]

2 (10 points in total for 2a + 2b). For each of the following compounds, write out the equation defining the solubility product for each of these solids in an appropriate solvent.

2a (5 points for this part). Li_2S



$$\underline{K_{sp} = [\text{Li}^+]^2 [\text{S}^{2-}]}$$

2b (5 points for this part). $\text{Ca}_3(\text{PO}_4)_2$



$$\underline{K_{sp} = [\text{Ca}^{+2}]^3 [\text{PO}_4^{-3}]^2}$$

3 (10 points in total). For the following system, calculate the pH of the solution. If 2.40 Kg of HI are dissolved in 210 L of water, what is the pH?

$$W_{\text{HI}} = 2.40 \text{ Kg}$$

$$V = 210 \text{ L}$$

$$\text{pH} = ???$$

[Note: There are only 3 Significant Figure for this data.]

$$W_{\text{HI}} = 2.40 \text{ Kg} \times 1,000 \text{ g/Kg} = 2,400 \text{ g}$$



$$MW_{\text{HI}} = (1 \times 1.008) + (1 \times 126.90) = 127.908 \text{ g/mole}$$

$$n_{\text{HI}} = W_{\text{HI}} / MW_{\text{HI}}$$

$$n_{\text{HI}} = 2,400 \text{ g} / 127.908 \text{ g/mole} = 18.7634 \text{ moles}$$

The number of moles of H^+ in Solution = The number of moles of HI dissolved

$$\underline{\underline{n_{\text{H}^+ \text{ in solution}} = n_{\text{HI} \text{ dissolved}}}}$$

$$n_{\text{H}^+} = 18.7634 \text{ moles}$$

$$[\text{H}^+] = n_{\text{H}^+} / V$$

$$[\text{H}^+] = 18.7634 \text{ moles} / 210 \text{ L}$$

$$[\text{H}^+] = 0.0893499 \text{ m/L}$$

$$\text{pH} \equiv -\log[\text{H}^+]$$

$$\text{pH} = -\log(0.0893499)$$

$$\text{pH} = 1.0489058$$

$$\underline{\underline{\text{pH} = 1.05}}$$

[Note: There are only 3 Significant Figures allowed for this answer.]