Chem 2 AP Homework #4-6: Problems pg. 155-156 #4.90-4.96 (even)

90 **Explain why potassium permanganate ($KMnO_4$) and potassium dichromate ($K_2Cr_2O_7$) can act as internal indicators in redox titrations.**

The MnO_4^- and $Cr_2O_7^{2-}$ ions both change colors when reduced, so their color in the reaction flask acts as an indicator of their presence when they are just in excess.

92 **The concentration of SO_2 in air can be determined by titrating against a standard permanganate solution as follows:**

$$\mathbf{5SO_2 + 2MnO_4^- + 2H_2O \longrightarrow 5SO_4^{2-} + 2Mn^{2+} + 4H^+}$$

Calculate the number of grams of SO_2 in a sample of air if 7.37 mL of 0.00800 M $KMnO_4$ solution are required for the titration.

$$?\ \text{mol KMnO}_4 = 7.37\ \text{mL} \times \frac{0.00800\ \text{mol KMnO}_4}{1000\ \text{mL soln}} = 5.90 \times 10^{-5}\ \text{mol KMnO}_4$$

$$5.90 \times 10^{-5}\ \text{mol KMnO}_4 \times \frac{5\ \text{mol SO}_2}{2\ \text{mol KMnO}_4} \times \frac{64.07\ \text{g SO}_2}{1\ \text{mol SO}_2} = \boxed{\mathbf{9.45 \times 10^{-3}\ g\ SO_2}}$$

94 **The concentration of hydrogen peroxide can be determined by titration against a standardized potassium permanganate solution in acidic medium:**

$$\mathbf{2MnO_4^- + 5H_2O_2 + 6H^+ \longrightarrow 5O_2 + 2Mn^{2+} + 8H_2O}$$

If 36.44 mL of a 0.01652 M $KMnO_4$ solution are required to oxidize 25.00 mL of a H_2O_2 solution, calculate the molarity of the H_2O_2 solution.

$$?\,\text{mol KMnO}_4 = 36.44\ \text{mL} \times \frac{0.01652\ \text{mol KMnO}_4}{1000\ \text{mL soln}} = 6.020 \times 10^{-4}\ \text{mol KMnO}_4$$

$$?\,\text{mol H}_2\text{O}_2 = 6.020 \times 10^{-4}\ \text{mol KMnO}_4 \times \frac{5\ \text{mol H}_2\text{O}_2}{2\ \text{mol KMnO}_4} = 1.505 \times 10^{-3}\ \text{mol H}_2\text{O}_2$$

$$\textbf{Molarity of } \mathbf{H_2O_2} = \frac{1.505 \times 10^{-3}\ \text{mol H}_2\text{O}_2}{0.02500\ L} = \boxed{\mathbf{0.06020}\ \boldsymbol{M}}$$

96 **If 24.0 mL of 0.0100 M $KMnO_4$ solution is needed to titrate 1.00 g of a sample of $H_2C_2O_4$ (oxalic acid) to the equivalence point by the following reaction:**

$$\mathbf{2MnO_4^- + 6H^+ + 5H_2C_2O_4 \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O}$$

what is the percent by mass of $H_2C_2O_4$ in the sample?

$$?\ \text{mol KMnO}_4 = 24.0\ \text{mL} \times \frac{0.0100\ \text{mol KMnO}_4}{1000\ \text{mL soln}} = 2.40 \times 10^{-4}\ \text{mol KMnO}_4$$

$$?\,\text{g H}_2\text{C}_2\text{O}_4 = 2.40 \times 10^{-4}\ \text{mol KMnO}_4 \times \frac{5\ \text{mol H}_2\text{C}_2\text{O}_4}{2\ \text{mol KMnO}_4} \times \frac{90.04\ \text{g H}_2\text{C}_2\text{O}_4}{1\ \text{mol H}_2\text{C}_2\text{O}_4} = 0.0540\ \text{g H}_2\text{C}_2\text{O}_4$$

$$\textbf{mass \%} = \frac{0.0540\ \text{g}}{1.00\ \text{g}} \times 100\% = \boxed{\mathbf{5.40\%\ H_2C_2O_4}}$$