Chem 2 AP Homework #4-5: Acid Base and Redox Titrations
(Take from book, Problems pg. 155 #82, 83, 84, 86, 88, 90, 92, 94, 96)

4.82 Why does an acid-base indicator change color when the pH changes? (What happens to molecule?)

4.83 A student carried out two titrations to standardize a NaOH solution of unknown concentration by titrating the NaOH with KHP (potassium hydrogen phlalate-an acid). She titrated the NaOH with two similar masses of KHP but one time the KHP was dissolved in <u>20.00 mL of distilled water</u> and the other time the KHP was dissolved in <u>40.00 mL of water</u>. Assuming no experimental error, would she obtain the same result for the concentration of the NaOH solution both times?

4.84 Would the volume of a 0.20 *M* NaOH solution needed to titrate 25.0 mL of a 0.10 *M* HNO_2 (a weak acid) solution to its equivalence point be different from the volume of NaOH needed to titrate 25.0 mL of a 0.10 *M* HCl (a strong acid) solution? The data is organized for you below:

NaOH	+	HNO_2 →		or	NaOH	+	HCl →
0.20M		0.10M			0.20M		0.10M
		25 mL					25 mL

4.86 Calculate the concentration (in molarity) of a NaOH solution if 25.0 mL of the solution are needed to neutralize 17.4 mL of a 0.312 *M* HCl solution.

First, complete the molecular eq: HCl(*aq*) + NaOH(*aq*) →

4.88 What volume of a 0.500 *M* HCl solution is needed to neutralize each of the following?

(a) 10.0 mL of a 0.300 *M* NaOH solution

Molecular: HCl(*aq*) + NaOH(*aq*) ⟶

(b) 10.0 mL of a 0.200 *M* $Ba(OH)_2$ solution

Molelcular: HCl(*aq*) + $Ba(OH)_2$(*aq*) ⟶

4.90 Explain why potassium permanganate ($KMnO_4$) and potassium dichromate ($K_2Cr_2O_7$) can serve as internal indicators in redox titrations.

4.92 The SO_2 present in air is mainly responsible for the acid rain phenomenon. Its concentration can be determined by titrating against a standard permanganate solution as follows.

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

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.

4.94 The concentration of a hydrogen peroxide solution can be conveniently determined by titration against a standardized potassium permanganate solution in an acidic medium according to the following equation:

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

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.

4.96 Oxalic acid ($H_2C_2O_4$) is present in many plants and vegetables. 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, what is the percent by mass of $H_2C_2O_4$ in the sample?

$$\text{Net Ionic Eq: } 2MnO_4^- + 6H^+ + 5\ H_2C_2O_4 \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Answers: 86) 0.217 M; 88a) 6.00 mL; 88b) 8.00 mL; 92) 9.45×10^{-3} g SO_2; 94) 0.06020 M; 96) 5.40% $H_2C_2O_2$