Homework, Week 9

1. A solution of 50 mL of 2.0 x 10^{-3} M propanoic acid (CH_3CH_2COOH, K_a = 1.34 x 10^{-5}) is prepared.

    a) Draw the molecule and identify the most acidic hydrogen atom.

    b) What is the pH of this solution?

    c) This solution is titrated with 3.0 x 10^{-3} M NaOH. How many mL of the NaOH solution is needed to reach the equivalence point?

    d) What is the pH of the solution at the equivalence point?

2. A solution of 1.0 L of water containing 0.001 moles of Na_2HPO_4 is prepared.

    a) Write the mass balance expression for the phosphate and sodium in this solution.

    b) Write the charge balance expression for this solution.

    c) What is the pH of this solution?

3. What is the pH of a 2 x 10^{-8} M solution of HNO_3?

4. A buffer is prepared at pH 10.0 using NaHS and Na_2S. 50.0 mL of this solution is titrated using 3.00 x 10^{-3} M NaOH and the equivalence point is reached after 8.60 mL. What is the concentration of S^{2-} in the original buffer? (H_2S: pK_{a1} = 7.02, pK_{a2} = 13.9.)

5. Use the data from problem 4 to sketch the total fraction of the solution of H_2S, HS^- and S^{2-} as a function of solution pH. Your y-axis can be a unitless fraction from 0-1.

6. Lake Travis has a pH of approximately 8.2. The bed of Lake Travis is formed of limestone (i.e. calcium carbonate, $CaCO_3$), which forms the primary acid/base system is this lake.

    a) Does Lake Travis have a stable buffer system? Why or why not?

    b) What is the ratio of the two deprotonated forms of carbonic acid at this pH?

    c) Limestone is only minimally soluble in water, but dissolves in acid. What is the source of the acid that dissolves Lake Travis limestone? (The answer is not "pollution." Pristine water from Barton Springs, which also percolates through limestone, has a similar pH.)