Analytical Chemistry
Problem Set 9
Due Friday, May 1, 2009 (at 4:00 p.m.)
Total Number of Points = 26

1. (6 points) Harris 10-28. Do the calculations at pH 10.00 only. Be sure to provide some (brief) justification for your answers.

2. (3 points) Harris 23-7 and 23-8

3. (10 points) Butanoic acid (C_3H_7COOH) shows the following phase equilibrium behavior:

$$C_3H_7COOH(benzene) \rightleftharpoons C_3H_7COOH(aq) \qquad K = 0.33_3$$

Find the equilibrium concentration of analyte in each phase when 25 mL of 0.10 M C_3H_7COOH in benzene is extracted by 100. mL of water (a) at pH 4.00 and (b) at pH 10.00. Briefly explain the trend in the concentrations. Warning: Do not use Harris' equation 23-7. Harris always assumes that "phase 2" is the organic phase. I prefer to define "phase 2" as the phase into which the analyte is being extracted.

4. (4 points) The weak base B ($K_b = 1.0 \times 10^{-5}$) really prefers the organic solvent toluene to water:

$$B(toulene) \rightleftharpoons B(aq) \qquad K = 0.020$$

(a) Using the form of the distribution coefficient we derived in class, calculate *D* at pH 8.00.
(b) Based on the equation for *D*, it is obvious that *D* will be lower at pH 10 than at pH 8. Explain this mathematical prediction qualitatively.

5. (3 points) Harris 23-21. Assume that the solvent is the mobile phase.

You should also know how to do Harris 23-27, but you do not need to turn in a solution for this problem.