Analytical Chemistry
Problem Set 9—due Wednesday, April 26, 2006 (at 5 p.m.)

Total points for this assignment = 20. Because this assignment is rather short, it will be worth only half of the other problem sets.

1. (3 points) Harris 23-7 and 23-8

2. (10 points) Butanoic acid (C$_3$H$_7$COOH) shows the following phase equilibrium behavior:

\[
\text{C}_3\text{H}_7\text{COOH}(\text{benzene}) \rightleftharpoons \text{C}_3\text{H}_7\text{COOH}(\text{aq}) \quad K = 0.333
\]

Find the equilibrium concentrations of butanoic acid in each phase when 25 mL of 0.10 M C$_3$H$_7$COOH 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.

3. (4 points) The weak base B ($K_b = 1.0 \times 10^{-5}$) really prefers the organic solvent toluene to water:

\[
\text{B}(\text{toluene}) \rightleftharpoons \text{B}(\text{aq}) \quad K = 0.020
\]

(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.

4. (3 points) Harris 23-21

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