Problem Set 5
Due before noon on Friday October 6, 2006 to Cupples II Room 208 or 209

Point values are shown in brackets. Show your work. Explain any assumptions that you make. You are encouraged to discuss the course material outside of class and are permitted to work together on problem sets; however, you are expected to turn in your own work.

Notes: unless specifically instructed to do so, you can make calculations in MINEQL that 1) ignore ionic strength corrections to activity and 2) involve turning all solids off.

1. [20] Use MINEQL+ to investigate the system in problem 3b of Problem Set 4.
   a) Prepare a LogC-pH plot for the system in 3b (show the pH range 2-12). Use MINEQL+ to make the calculations and then export your data to an application for preparing the plot.
   b) Use MINEQL+ to solve for the pH of the system. Briefly (2-3 sentences) describe the approach that you followed to solve the problem using MINEQL+.

2. [20] Consider an open system with PCO2 = 10^{-3.43} bar.
   a) Use MINEQL+ to prepare a LogC-pH plot of this system (show the pH range 2-12).
   b) Solve for the pH when 10^{-4} NaHCO3 is added.
   c) Is your answer different if you add 10^{-4} NaOH? Briefly explain (1-2 sentences) why or why not.

3. [20] Use MINEQL+ to examine a system containing [Na3PO4]T = 10^{-4}M and [MES]T = 10^{-3}M. MES (full name) is a weak monoprotic acid with a pKa of 6.15. The MES is added in its acid form (i.e., as HA and not as NaA or some other salt). MES is not in the MINEQL+ database and so you will need to add it to the program.
   a) Prepare a LogC-pH plot for the system (show pH 0-14).
   b) What is the pH of the system at equilibrium?
   c) If the ionic strength is increased to 0.1M through the addition of NaNO3, then what is the pH?
   d) What is the pH of the system without MES at low ionic strength conditions?

4. [20] Consider a system in equilibrium with P_{NH3} = 10^{-6} bar and P_{CO2} = 10^{-3.43} bar.
   a) Make some modifications to the tableaus in MINEQL that permit a fixed partial pressure of NH3. Describe the modifications that you made.
   b) Prepare a LogC-pH plot for the system (show pH 2-12).
   c) What is the pH of the system at equilibrium?

5. [20] Problem 3 in Chapter 5 of Water Chemistry. You may find it helpful to use MINEQL to assist in preparing the LogC-pH plot and the requested table. In addition to preparing a table, present a titration plot showing the pH as a function of the concentration of HCl added.