Exam 5, Part III **Name** _____
CHEM 222 **Spring 2011**
30 Points
Due in class, April 13, 2011

You may complete the following individually, or with one (1) partner. You may use your textbook and notes, but may not receive assistance from your classmates or anyone other than Dr. Lamp. *This signed sheet must accompany the completed assignment*. By signing below, you certify that you completed the problems in accordance with these rules. No credit will be given to unsigned papers.

Signature_____ Date_____

To complete this portion of the exam, prepare a *generic* spreadsheet program that will allow you to calculate a curve for the titration of a weak diprotic acid with a strong base. The spreadsheet should allow you to enter data such as pK_a's for each dissociation, and concentration and volume of analyte and titrant used. Section 10-10 introduces one approach to this challenge. The spreadsheet should output two plots: (1) a plot of the fraction of dissociation of the acid as a function of pH (see Figure 9-4 as an example), and (2) a plot of the titration curve, using at least 100 points. To demonstrate the utility of your spreadsheet, perform the calculation with each of the following systems:

1. The titration of 50.00 mL 0.200 M of the newly discovered *acidic acid* with 0.100 M NaOH. For acidic acid, $pK_{a1} = 2.84$ and $pK_{a2} = 6.02$.
2. The titration of your unknown acid from the K_a experiment. Use your experimental conditions and your best guess for the identity of your acid. If your unknown was triprotic, you only need to consider the first two K_a's. If your acid was monoprotic, use a value of 14 for pK_{a2}.

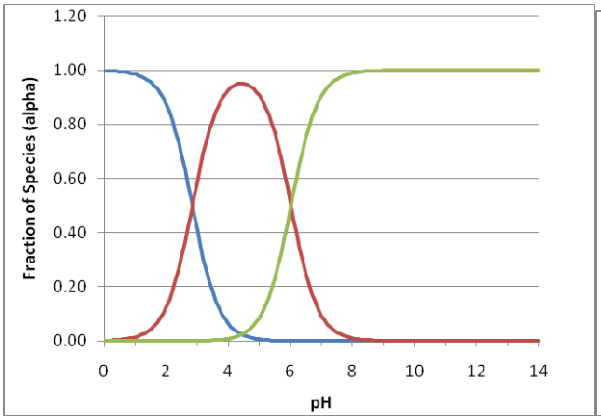
Requirements: Submit both a hardcopy of your spreadsheet output (plots), as well as an electronic copy of the spreadsheet file itself. The file must be uploaded to the "Exam 5 Part III" assignment on our Blackboard course page.

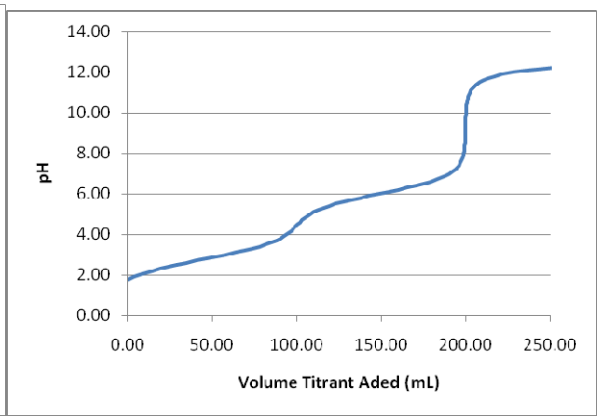
Grading Criteria: As I grade your spreadsheets, I will be comparing your results to those of a simulation that I have prepared (25 points). I will also input data for a third titration and examine the flexibility of your approach (5 points).

Bonus (5 points): Plot your experimental data from your K_a experiment on the same axes as the theoretical curve and provide a brief discussion of the similarities and differences in the data and whether the simulation supports your identification of the unknown acid.

Below are the plots I would have expected to see as I graded your assignments and input a new dataset.

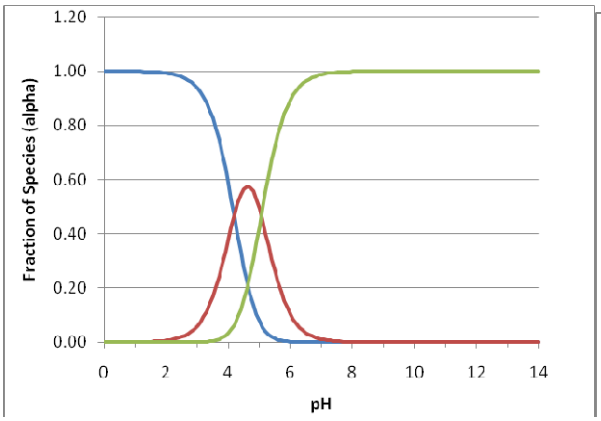
The titration of 50.00 mL 0.200 M of the newly discovered *acidic acid* with 0.100 M NaOH. For acidic acid, pK_{a1} = 2.84 and pK_{a2} = 6.02.

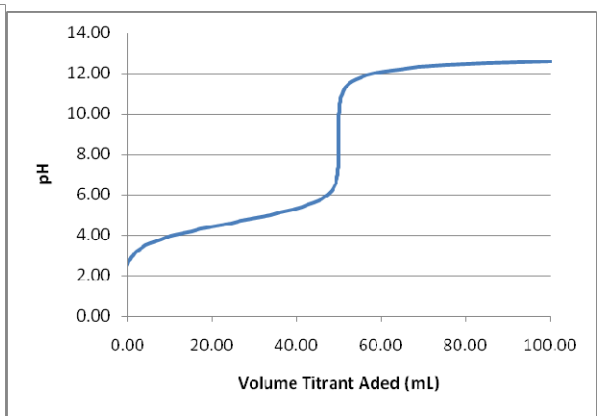




The alpha for HA^- should reach a maximum of 0.95 at pH~4.4. In the titration curve, there should be equivalence points at 100 and 200 mL and the pH should be ~2.84 at 50 mL and ~6.02 at 150 mL.

The titration of 25.00 mL 0.100 M glutaric acid with pK_{a1} = 4.19 and pK_{a2} = 5.06 with 0.100 M NaOH





The alpha for HA^- should reach a maximum of 0.58 at pH ~4.6. In the titration curve, there should be an equivalence point at 50 mL and the pH should be ~4.6 at ~25 mL.