

Chem 201 Guidelines for Test #2, Summer, 2006

The next midterm (Tuesday, Aug 8) will focus mainly on materials covered in the period since the last midterm. Study the lecture notes, the assigned chapter and the assigned homework. Be able to do problems similar to those in the homework or those discussed in class. Be able to interrelate some of the concepts learned. Most of the exam is expected to be problem-solving involving. . .

- Kjeldahl, Mohr, Fajans & Volhard titrations. Know equations from memory. Practice calculations.
- acid-base (weak and strong, etc) equilibria and titration (includes Gran plot)
- Be able to do calculations using various calibration methods / explain their advantages and disadvantages.
- Spectroscopy: UV-vis, as well as atomic flame methods.
- Be familiar with the following expts: soda ash experiments.

For practice, you ought to try the self-quizzes and the problems discussed in lecture, homework problems. These questions are meant to give you an idea of the level of difficulty and types of questions that may be asked. Do not expect an answer key to the questions below.

1. In the fully protonated form, aspartic acid (Asp), is in the form, H_3Asp^+ . The pK_a values for aspartic acid are: 2.0, 3.9, and 10.0.
 - a) What are the different values of pK_{b1} , pK_{b2} , etc?
 - b) What is the isoelectric point for Asp?
 - c) Using the Henderson-Hasselbalch Equation estimate the value of the pH at which 90% of the Asp would be in the fully protonated form.
 - d) What is the pH of a 0.4 M sodium hydrogen aspartate, NaHAsp , solution (How many dissociable protons does it have?).
 - e) What is the pH of a 0.3 M solution of sodium aspartate (Na_2Asp)?

2. The anion of a hypothetical sodium salt, NaA , has a pK_a of 2. What is the ionic strength of a 5.5 M solution of this salt? Write the mass balance and charge balance equations for this solution. What is the pH of this solution? ? Write the mass balance and charge balance equations for a H_3PO_4 solution.

3. Calculate the concentration of 4-Methyl aniline ($\text{pK}_a = 5$) if 45.0 mLs of this analyte requires 25.0 mLs of 0.15M NaOH (i.e. the titrant). Determine its pH at a) $V_{\text{NaOH}} = V_e$? b) at $V_{\text{NaOH}} = .25 V_e$? c) at $V_{\text{NaOH}} = 1.25V_e$? OK. Now practice the same types of calculations for a diprotic weak acid when the $V_{\text{NaOH}} = 0, .25V_e, V_e, 1.25V_e, 2V_e, 2.25V_e$. (n.b. "0.25 V_e " means 0.25 times V_e , etc)

4. The concentration of Cl^- is determined in an unknown sample by one of the argentometric methods. 20.00 mL of the analyte sample is titrated with 25.00 mL of 0.0600 M silver nitrate.
 - a) What precautions must be taken before supernatant is titrated for excess Ag^+ ?
 - b) If the endpoint is reached at 11.50 mL of .0500 M KSCN (with Fe^{3+}), what is $[\text{Cl}^-]$ in the unknown sample?

5. From memory, write all the relevant chemical equations for
 - *Mohr Titration,* Fajans Titration, *Volhard and *Kjeldahl Methods.

6. Be prepared to determine V_e using only a few points *before* $V=V_e$. (graphically using only graphing paper and a few data points! (Hint be able to use the Gran Plot)
7. Lysine is an amino acid with the following K_a 's: 9.1×10^{-1} , 8.3×10^{-10} , and 2.0×10^{-11} . If the fully protonated form of lysine is of the form, H_3Lys^{2+} , at what pH would the lysine molecule in solution not be affected by an electric field? [10 pts]
8. What is the pH of a 0.10 M sodium glutarate (Na_2G) solution? (pK_a 's of glutaric acid: 4.34, 5.46) [10 pts]
9. Write down the equations used in the Volhard Method and name one precaution that must be taken.[6 pts]

2) A typical protein contains 16.2 wt % nitrogen. A 0.400 mL aliquot of protein solution was digested and the liberated NH_3 was distilled into 12.0 mL of 0.02000 M HCl. The unreacted HCl required 4.50 mL of .02000 M NaOH for complete titration.

- a) Find the concentration of protein (in mg/mL) in the original sample solution. [20 pts]
- b) Name this method and write down the equations used.

3) A student in an extreme rush was not able to complete the titration of 10.0 mL monobasic weak base with 0.10 M HCl using a pH meter – but never reaching the equivalence point. The data is:

mL of HCl added	10.0 mL	16.0 mL
pH of solution	9.903	9.097

- a) Assuming that the above data is very accurate, determine the molarity of the solution. (Hint: in answering this, assume that you have access to graphing paper) **0.18M**
- b) Using only the 10.0mL data, estimate what the pK_a of the conjugate acid of the weak base. **9.65**