Chem 116, Fall 2006
Prof. Sevian
Study guide for Exam 3

The exam will consist of two sections: short answer and problems. The short answer questions could be multiple-choice, fill-in-the-blank, brief response, or short calculations. There will be two problems, which will involve showing your work on calculations and/or demonstrating complete and clear logical reasoning in an explanation. When doing calculations, if the answer you provide is off by more than one significant digit, one point will be deducted.

Exam 3 will cover material from homework assignments #8, 9 and 10. Relevant sections from text book chapters 15, 16 and 17 will be covered on the exam. Please see the course syllabus for a list of which sections in chapters 15 and 16 are being covered. In chapter 17, the exam covers sections 17.1, 2 and 3 *even though there are very few homework questions on these sections in assignment 10*. Material from these sections of chapter 17 that is covered in lecture on November 14 and 16 will be on the exam.

You will be provided with the following information on the exam:

Constants of nature

$K_w = 1.0 \times 10^{-14}$ at 25 ºC

Equations

$pH = -\log [H_3O^+]$

Short Answer and/or Problems

Things that you should know or be able to do (though there won't necessarily be a question on every single one of these items because that would make the exam too long):

1. Write the expressions for the reaction quotient for various reactions.
2. Given concentrations or partial pressures of chemicals in a reaction, determine the value of the equilibrium constant.
3. Calculate equilibrium values of chemical concentrations given initial conditions and the value of the equilibrium constant.
4. Predict in what direction a reaction shifts (toward reactants, toward products, no change) and in what direction the value of the equilibrium constant changes (increase, decrease, stay the same) when various experimental conditions change.
5. Identify conjugate acid-base pairs in a Bronsted acid-base reaction.
6. Given the reactants in a Bronsted acid-base reaction, predict the products.
7. Calculate the pH of any of the following kinds of solutions, given the initial molarity of each component that is mixed into the solution, or information from which the initial molarity could be calculated:
    a. A solution of strong acid or of strong base
    b. A solution of weak acid or of weak base
    c. A solution created by mixing a strong acid with a strong base
    d. A solution created by mixing a weak acid with a strong base
    e. A solution created by mixing a strong acid with a weak base
8. Determine the concentrations of all species present in solution if you add a certain number of moles of a given polyprotic acid to a given volume of water.
9. Calculate the equilibrium constant for a weak acid (K_a) or a weak base (K_b) when given experimental data.

10. Apply reasoning about when it is valid (or not) to make mathematical approximations ("small *x*" approximations) in solving equilibrium problems.
11. Calculate K_a for a weak acid if given K_b for its conjugate base, or vice versa.
12. Given an acid-base reaction, determine whether equilibrium favors reactants or products.
13. Compare the molecular structures of a series of compounds to determine relative acidic strengths of the compounds.
14. In a Lewis acid-base reaction, determine which reactant is the Lewis base (electron pair donor) and which reactant is the Lewis acid (electron pair acceptor).
15. Given equal moles of a selection of compounds, determine which one when added to water would produce a solution with the highest (or lowest) pH and/or calculate the pH of a solution of a particular ionic compound.
16. Given a weak acid (or weak base) of known concentration and a strong base (or strong acid) of known concentration, find the following points and sketch a titration curve:
    a. Initial pH
    b. pH at titration midpoint
    c. pH at equivalence point
    d. pH somewhere beyond equivalence point

Problems

1. A problem similar to one of the group problems
2. A mathematically-based problem involving one of the items in the list above

Additional Information About Exams

Exam 3 will take place during regular class time, 2:30-3:45 p.m., on Tuesday, November 21. You will have the entire class period to complete the exam, but you will need to work efficiently to complete it. All exams must be turned in by 3:50. If you arrive late to the exam, you will not be given extra time. If you arrive after the first exam has been turned in, you will not be allowed to take the exam. I urge you to leave home earlier than usual to allow for surprise commuting problems.

More information about exams in general can be found in the syllabus and in the "Additional Information" section at the end of the Exam 1 study guide.

Also, Practice Exam 3 and its answer key have been posted on the course website. Please be aware that some of the questions on Practice Exam 2 are also relevant to this exam.

Very important: DO NOT FORGET to bring your calculator to Exam 3.