Chem 201
Fall 2011

EXAM 2 STUDY GUIDE

The exam will consist of 20 multiple choice questions with 70% "C" questions, 20% "B" questions, and 10% "A" questions. In general, "C" questions are those involving the most basic concepts, particularly ones that you have used before. "C" calculation problems typically involve one major step with 1-2 more minor steps. (Examples of minor steps would be calculating molecular weights or converting $[H_3O^+]$ to pH.) "B" questions involve more difficult concepts, particularly ones that are new. "B" calculation questions typically involve at least two major steps with 1-4 minor steps. "A" questions are those involving the most difficult concepts or those that require a thorough understanding in order to answer correctly. Often "A" questions require bringing together different concepts to solve the problem and 2+ calculation steps. Note also that concepts listed under the "C" or "B" categories below can be converted to harder questions, depending on how I ask the question.

Background Concepts [Homework Examples; *similar questions in italic that weren't previously assigned*]

- **Know the names, molecular formulas and charges of common ions.** [Common Ion handout]
- Calculate molar mass, convert between grams and moles using the molar mass. [Homework 1, *3.14*]
- Calculate concentrations in molarity, convert between liters and moles using molarity. [Homework 1, quiz 1, *3.9,*]
- Calculate concentrations after dilution. [Exp. 2, *3.96*]
- Identify Bronsted acids, bases and conjugate acid-base pairs. [quiz 2, 18.43, 18.45, 18,47]
- Convert back and forth between $[H_3O^+]$,$[OH^-]$, pH and pH with correct sig. figs. [quiz 3, 18.27, 18.29]
- Know the strong bases (OH^- salts) and the 6 strong acids (HCl, HBr, HI, HNO_3, $HClO_4$, H_2SO_4).[18.15, 18.17]
- Calculate pH of strong acid, strong base solutions. [quiz 3,18.25, 18.23]
- Calculate pH (or pOH, $[H_3O^+]$,$[OH^-]$) of a weak acid or base solution knowing Ka or Kb and the initial concentration. [quiz 3, 18.65,*18.67*, 18.73, 18.90, 18.92]

"C" Questions [Homework Examples; *similar questions in italic that weren't previously assigned*]

- Understand Beer's Law. Be able to calculate concentrations of unknown solutions from absorbance values knowing the absorbance value of a solution of known concentration. [Exp 2, Exp. 5]
- Be able to recognize the common types of acids and bases, including ionic acids and bases.
- Convert between Ka and Kb values for conjugate acid-base pairs. [18.94]
- Know what a buffer solution is, what it does (resists changes in pH) and how it works. [quiz 4,19.2]
- Calculate pH of a buffer solution using Henderson-Hasselbach equation. [quiz 4,19.11, *19.15*, 19.17, 19.21]
- Determine the ratio of acid to base needed for making a buffer solution at a certain pH. [quiz 4,19.23, *19.38*]
- Know what will be a good acid,base pair to make a buffer solution of a certain pH. [quiz 4, 19.35, *19.33*]
- Know that for a conjugate acid base pair, if pH = pKa then [base] = [acid], if pH > pKa then [base] > [acid], and if pH < pKa then [base] < [acid]. Use these relationships to predict whether the acid or base form of a given conjugate acid/base pair will dominate at a particular pH. [Quiz 5]
- Calculate the equivalence point for an acid-base titration. [quiz 5, part of 19.58 and 19.60,]
- Predict what will be in solution at different points during a pH titration.[quiz 4]
- Know expected differences in the shape of a pH titration curve for strong acid-strong base, weak acid-strong base, strong acid-weak base. [19.44]
- Calculate pH's at different points on a strong acid/strong base titration curve. [quiz 5,19.54, 19.55]
- Write out the Ksp expression for a solubility equilibria [quiz 5,19.66]
- Calculate Ksp from solubility data [19.70, 19.72]
- Calculate solubility from Ksp. [Quiz 5, 19.74a]
- Understand LeChatelier's Principle [Chapter 17 sect. 6, *17.63*]
- Predict how solubility of an ionic compound changes in the presence of another source of one of the

ions (common ion effect). Calculate the solubility of an ionic compound in the presence of another source of one of the ions. [19.74b, 19,76]

- Know what complex ions are and be able to write out the formation reaction and Kf expression. [Exp. 5]
- Predict how the solubility of ionic compound changes at different pHs or in the presence of compounds that form a complex ion. [19.82, 19.94]
- Predict whether a precipitate will like form when two ionic compounds are mixed using general guidelines for solubility.
- Know what enthalpy and entropy are. Which direction of change is favorable for each?
- What is an exothermic rxn? What is an endothermic rxn? What is the sign of ΔH for each?
- Predict the sign of ΔS for physical processes and chemical reactions. [*20.16, 20.18*, part of 20.33]. Predict the relative order in magnitude of S° values for a series of related compounds. [20.22, 20.28]
- Calculate $\Delta S°$ values from S° values. [part of 20.33, part of 20.52]
- Calculate $\Delta H°$ values from $\Delta H_f°$ values. [part of 20.52]
- Know how to calculate $\Delta G°$ from $\Delta G_f°$ values, or $\Delta H_f°$ and $\Delta S°$ values. [20.50, 20.52]
- Understand the difference between ΔG and $\Delta G°$. Understand the relationship between ΔG and spontaneous change. Be able to interpret free energy diagrams like those in Figure 20.15.
- Predict whether $K>1$ or <1 from $\Delta G°$
- Calculate K from $\Delta G°$, and $\Delta G°$ from K. [20.68, 20.76, 78a]

<u>"B" Questions [Homework Examples]</u>

- Calculate pH of a solution of a cationic weak acid or anionic weak base knowing Kb or Ka of their neutral conjugates and the initial concentration. [18.98, 18.100]
- Calculate pH's at different points on a weak acid/strong base or weak base/strong acid titration curve. [quiz 5, 19.56, 19.57, 19.58a, 19.60a]
- Determine the pKa of a weak acid from a titration curve. [Exp. 4]
- Determine whether a precipitate will form using Ksp values. [19.86, 19.88, 19.110]

Concepts listed under the "C" category can be converted to B questions by combining them and/or requiring a better understanding of the concept in order to be solved.

<u>"A" Questions (Homework Examples)</u>

- More complicated questions involving buffers, such as determining how much strong acid or strong base should be added to a solution of a weak base or weak acid to make a buffer solution of a certain pH. [19.27, 19.31, *19.108*]

Concepts listed under the "C" or "B" categories can be converted to A questions by combining them and/or asking the question in such a way that the route to the answer is not straightforward and requires a thorough understanding of the concepts.

<u>Information that will be given with exam:</u>
Periodic Table
Henderson-Hasselbach equation, Chap. 20 eqns
Table of Ka and Kb values
Table of thermodynamic properties

<u>Equations you need to know:</u>
$[H_3O^+][OH^-] = Kw = 1.008\times10^{-14}$; $pH + pOH = 13.9965$
$pH = -\log[H_3O^+]$; $pOH = -\log[OH^-]$
$[H_3O^+] = 10^{-pH}$; $[OH^-] = 10^{-pOH}$