STUDY GUIDE FOR EXAM 2
CHEM 5
Spring, 2009

Note: this is a study GUIDE. It's very comprehensive but may not cover 100% of the material that might be on the exam. You are responsible for ALL material given in class and ALL of the homework problems.

Chapter 5 – Energy and matter

- Understand the difference between kinetic and potential energy
- Be able to do energy calculations involving phase and temperature changes (given the required constants including specific heat, heat of fusion, heat of vaporization)
- Be able to define or explain enthalpy, entropy, spontaneity, and free energy. Be able to apply these concepts to changes of state and to chemical reactions
- Know the general properties of the three states of matter
- Understand the relationship between boiling temperature and non-covalent interactions
- Know the various gas laws and how to use them in calcuations (Gay-Lussac's, Boyle's, Charles', Avogadro's, Ideal Gas Laws). Note: this is much easier to do if you understand the relationships between temperature, pressure, volume and amount of gases, most of which is intuitive.
- Know how a sphygmomanometer works
- Know and be able to do calculations using Dalton's Law of Partial Pressures
- Be able to do density and specific activity calculations
- Be able to explain the relationship between vapor pressure and non-covalent forces

Chapter 6 – Reactions

- Note: you should also consult the reactions handout I gave you
- Be able to recognize and classify reactions according to type
- Be able to complete and balance all the reaction types we encountered in class and homework (see reactions handout for examples)
    - addition (synthesis; hydration is an addition reaction)
    - elimination (decomposition; dehydration is an elimination reaction)
    - redox (especially combustion)
    - single displacement
    - double displacement
    - hydrolysis (especially of esters)
- Identify oxidizing and reducing agents in redox reactions, the substance that was oxidized and the substance that was reduced
- Be able to do calculations involving reaction stoichiometry
    - Convert between grams and moles, as needed
    - Determine the limiting reactant of a reaction, including the total amount of product that can be made in a reaction
    - Determine theoretical and percent yields
- Know how to recognize and draw reaction coordinate diagrams.
- Understand and be able to differentiate between free energy, activation energy, rate, catalysis
- Be able to indicate how a reaction rate can be increased

Chapter 7 – Solutions

- Solubility of solids, liquids and gases according to increasing or decreasing temperature
- Explain what is meant by a saturated solution

- Be able to use solubility rules to write complete, ionic, and net ionic reactions for precipitation reactions.
- Understand the effect of reactions on the solubility of substances in water (e.g. the reaction of water and carbon dioxide to make carbonic acid)
- Define or explain Henry's law. Use it in discussing the use of hyperbaric chambers on different medical problems (e.g. gangrene).
- Identify or describe the different non-covalent forces: ion-ion, ion-dipole, dipole-dipole (hydrogen bonds are in this category), temporary dipoles (London dispersion forces)
- Predict solubility of compounds in either organic solvents or water
- Describe the hydrophobic effect
- Be able to identify hydrophilic, hydrophobic, and amphipathic compounds
- Be able to identify different types of amphiphathic assemblies (micelles, films, bilayers, liposomes)
- Explain the use of prodrugs to increase membrane solubility (and delivery to tissues)
- Understand that concentration is a ratio
- Be able to do concentration calculations using:
    - w/w percent, v/v percent, w/v percent
    - molarity
    - ppt, ppm, ppb
    - medical units (these vary)
        - mEqs. Recal mEgs must take into account the charge on the ion
- Be able to do dilution problems
- Define and differentiate between solutions, colloids and suspensions
- Define and explain diffusion and osmosis
- Be able to tell whether a solution is hypotonic (less concentrated than a reference like 5% glucose) or hypertonic (more concentrated than a reference). RBC's in hypotonic solution swell (hemolysis) whereas RBC's in hypertonic solution shrink (crenation).
- Understand the basic features of dialysis

Chapter 9 – Acids and Bases

- Understand the various aspects of equilibrium
    - Reversible reactions tend towards equilibrium
    - At equilibrium, the rate of the forward and reverse reactions are equal (but NOT the product and reactant concentrations – that would happen very rarely).
    - Under the same conditions, the same equilibrium point will be reached regardless of where you start from (e.g. all reactant, or all product)
    - Be able to write a Keq equation given the reaction and vice versa (write the reaction given the Keq equation)
    - Understand relative Keq's
        - Keq > 1, products are more concentrated and equilibrium lies to the right
        - Keq < 1, reactants are more concentrated and equilibrium lies to the left
        - Keq ~ 1, products and reactants are present in similar amounts (this is pretty rare)
- Understand and make predictions about reaction changes using LeChatelier's Principle
- Understand how catalysts relate to equilibrium – catalysts can only change the rate at which equilibrium is arrived at; they cannot change the position of the equilibrium. In other words, they cannot change the equilibrium product and reactant concentrations.
- Understand and do calculations involving the ionization of water
    - Be able to write the ionization reaction
    - Know Kw and how to find [H+], Kw, or [OH-] if 2 of the other variables are known
    - Be able to do calculations involving pH. Be able to find [H+] given the pH and vice versa.

  - Know the relationship between pH and acidity or basicity of a solution
- Acids and bases
  - Know the Bronsted-Lowry definition of acids and bases
  - Know the difference between strong and weak acids
  - Draw reactions involving dissociation of an acid or reaction of a base with water
  - Be able to identify acid/conjugate base pairs
  - Be able to correlate conjugate base strength with the corresponding acid strength (the stronger the acid, the weaker the conjugate base)
  - Be able to write Ka expressions for the dissociation of weak acids
  - Be able to do calculations involving Ka and pKa. Know the relationship between these parameters and acid strength (i.e. the stronger the acid, the bigger the Ka and the smaller the pKa).
  - Be able to recognize and complete neutralization reactions. The net ionic reaction of neutralization is [H+] + [OH-] makes water.
  - Explain the properties of a buffer and predict which of a set of solutions could be a buffer (buffers consists of weak acids plus their conjugate bases)
  - Understand the effect of pH on the acid/conjugate base ratio. The lower the pH, the higher the acid/conjugate base ratio because more acid is present at low pH
  - Be able to predict how the carbonic acid equilibrium will change in response to added acid or base
  - Explain how too much acid or base can effect the activity of an enzyme
  - Know what is meant by acidosis and alkalosis

HOW TO STUDY

1. Use the study guide and your lecture notes to review material, in particular making sure you understand the key concepts.
2. Memorize the things I asked you to memorize. This is best done by practicing writing it out on paper until you can do it completely from memory (note: this way is much better than flash cards).
3. Work the homework problems again, the practice problems I gave in class, and (if you have any time left!) the homework problems that were not assigned.