Review Guide for Chem 102 Midterm Exam #1 Winter, 2009

**ANNOUNCEMENT OF CHANGE OF DATE FOR EXAM:**
On Wednesday, I would like to get feedback on having the Midterm Exam #1 on February 2, 2009 (Monday of the 5th week). That way, we'll complete chapter 10 and have enough time for it to "sink in". A review session will be arranged before the test: Thursday – 2-3pm at PS 607 subject to availability.

The test will mainly focus on material in Chapters 8, 9 & 10 . The midterm exam may include multiple choice questions. No scantrons are necessary. Study your lecture notes, and homework assignments. Expect to solve problems. Test yourselves by doing problems similar to the homework under time constraints. If you understand the concepts fully, you should be able to do these problems within 10-15 minutes. If not, you need to study and practice further to improve your speed and test taking skills. It is our hope that you are here to learn Chemistry and not just to get a grade. So study hard test or no test.

The following topics are mentioned to help focus (but not limit) your review:

1) Know how to draw Lewis structures, deduce the shape of the molecule by VSEPR and predict the types of hybrid orbitals present using Valence Bond Theory. Describe the electron domain (ie electron pair) geometries and molecular geometries of given molecules. Name all of the possible molecular geometries. Describe the polar properties of a given compound. What determines the polarity of compounds? Know factors affecting bond lengths and bond energies. What affects the bond angles. Know the various types of isomers: structural, geometric, optical. Be able to describe the electron overlaps present in a given molecule. Discuss sigma and pi bonds. Explain fig. 9.21.

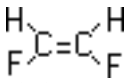
2) Noncovalent interactions: Be able to recognize the presence of intermolecular interactions, their type and their relative strengths: ionic, dipole-dipole, H-bonding, London dispersion forces, dipole-induced dipole etc. hydrophobic vs hydrophillic substances. Study the biological examples of intermolecular interactions in the textbook chapter and be able to explain how they function in determining the molecular structure of certain biological molecules – e.g. DNA, lipid bilayer membranes.

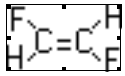
3) Know the laws that describe the properties of ideal gases: Boyle's Law, Charles' Law, Gay-Lussac's Law, Avogadro's Law. Describe completely the postulates of kinetic molecular theory. Deduce the various gas laws using the ideal gas equation (know this by heart) as a start. Know how to calculate the molar volume, density or the molar weight of a gas. Know the equations for effusion and diffusion. Gas mixtures: know Dalton's law of partial pressures. Use mole fractions. Know the Van der Waals Equation for nonideal gases and what the various parameters, a and b signify. (This may be modified according to how much we are able to cover in class.)

**Sample Questions:**

Note that students often find questions they have not anticipated in the test. It is an important part of the test to see whether students really know the material or just memorize solutions. So make sure you know the chapters being tested thoroughly.

1) Consider the 2 isomers of the planar compound 1,2-difluoroethylene given in the figure at right. Answer the following: a)Which has the higher Van der Waals constant a? (if any)
   b) Which one would have the higher Van der Waals constant b? (if any)
   c) Which one would have the higher boiling point? (if any)
   d) List all the types of intermolecular interactions expected for two neighboring cis isomer molecules (in a liquid of cis-difluoroethylene?
   e) what is the C-H bond an overlap of? How about the C-C bond?


cis isomer


trans isomer

2) Explain why water has such an unexpectedly high boiling point, even higher than ammonia. Why does ice float on water (most solids phases sink in their liquid phases).

3) Draw the structure for dimethyl hydrazine $(CH_3)_2N\text{-}NH_2$. How many atoms have tetrahedral geometry? pyramidal geometry? linear geometry? Describe each bond by stating the types of orbitals (including hybrids) overlapping. Indicate if the molecule is polar. Calculate the formal charges of all atoms. Indicate what the angles are and suggest how they are distorted (ie deviate from the ideal angle).

4) a) Explain why a Si-Cl bond is shorter than a Si-Br bond.
b) Draw a "side view" picture of ethylene, $C_2H_4$, showing all bonding and anti bonding orbitals between the two carbons.
c) Does $F_2O$ have a resonance structure?
d) What is electron configuration, bond order, spin, and relative bond strength (compared to $N_2$) of $N_2^-$?

5) Ideal gases: a) Be able to write all the gas laws (they will be supplied but only the bare minimum) and the conditions when they are valid: Boyle's, Charles, Avogadro's, Dalton's. Combined Gas Equation. Ideal Gas Equation.
b) Be able to do gas-involved stoichiometry problems, involving partial pressures, etc. Practice with the problem-solving practice examples in the book.

Sample stoichiometry problem: The gas mixture inside a 67.2 L metal container containing 40% $N_2$ and 60% $O_2$ (initially at STP) is made to react to form $NO_2$. If the reaction goes to completion and has a final temperature of 0°C, what are partial pressures of all the reactants initially? What is the pressure inside the tank after the reaction is complete (answer = .7 atm). Assume that only $NO_2$ is produced by the reaction and that all gases behave like ideal gases.

6) Nonideal gases. Explain regions in terms of a and b. At which point in the graph does the ideal gas equation hold?c) Draw different (but with similar molar masses) "line structures" of organic molecules and how they might interact by dipole-dipole, H-bonding and dispersion intermolecular forces.
d) Organize the above molecules that you drew in terms of expected increasing melting points.