

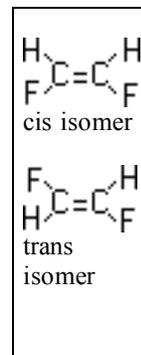
The test will mainly focus on material in Chapters 8, 9 & 10. The midterm exam will include multiple choice questions. Students need to bring scantrons. Study your lecture notes, and homework assignments. Expect to solve problems. Test yourselves by doing problems similar to the homework under time constraints. 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.

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. Describe the polar properties of the compound.
- 2) Be able to write the molecular orbital electronic configurations & energy diagrams for homonuclear diatomic molecules (try the first 10 elements), and to predict their bond order and magnetic properties.
- 3) Know factors affecting bond lengths and bond energies. Recall how to calculate reaction energies using bond energies. Be able to recognize the presence of intermolecular interactions, their type and their relative strengths.
- 4) Describe the properties of ideal gases using the kinetic molecular theory. Deduce the various gas laws using the ideal gas equation as a start. Calculate the molar volume, the 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. What do the various parameters, a and b signify?

Sample Questions:

- 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)?



- 2) Name and briefly describe the (anomalous) property of water which :
 - a) Lowers attraction between charged ions allowing them to remain separated in solution
 - b) Stabilizes the temperature by resisting sudden changes in temperature near the oceans.
 - c) Allows our body to cool down on a hot summer day.

3) Draw the structure for dimethyl hydrazine ($\text{CH}_3)_2\text{N-NH}_2$. 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) 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.