CHM 110 / CHM 111
Chapter 10 study guide / learning objectives

Chapter 10 in your textbook deals with geometry and bonding. We will not cover molecular orbital theory in this course (sections 10.5 through 10.7), but if you are planning to continue your study of chemistry by taking an organic chemistry course, you should read up on molecular orbital theory.

This chapter deals primarily with the geometry (or shape) of a molecule (the VSEPR model), an explanation of the polarity of a molecule based on the VSEPR model, and valence bond theory (a theory that explains much about Lewis structures and molecular shapes).

At the end of chapter 10, you should be able to:

[Definitions / Terminology]
- Describe the **VSEPR model** of molecular shape (Valence Shell Electron Pair Repulsion Model)
- Define terms related to valence bond theory: **orbital**, **hybrid orbital**, **sigma (σ) bond**, **pi (π) bond**, **bond energy, isomer**.

[VSEPR]
- **Predict the shape** of a molecule from a Lewis structure. (Memorize the common molecular shapes. Most simple molecules are based on the geometries of one to four groups around a central atom.)
- **Predict the shape** of a molecule given the molecular formula. This will require you to draw a Lewis structure. Ex: NH_3 is pyramidal, CO_2 is linear, CH_4 is tetrahedral, H_2O is bent, O_3 is bent, CH_2O is trigonal planar.
- **Draw** the 3D representation of any simple molecule using the structural notation discussed in class. See pages 377 and 381 in your textbook for examples.

[Polarity]
- Use electronegativity trends to **predict** whether a bond is polar.
- Use electronegativity trends and molecular shape to **predict** whether a molecule is polar. Remember, polar bonds symmetrically arranged around the center of the molecule can cancel each other out, giving a nonpolar molecule. A good example of this effect is CCl_4.
- **Determine whether a molecule is polar**, given a molecular formula. This will require you to draw a Lewis structure, find the shape, and determine whether the bonds in the molecule are polar or not.

[Valence bond theory]

- Describe **how a bond is formed** in valence bond theory (half-full orbitals overlap and electrons are shared).
- **Draw** an orbital diagram showing the valence orbitals (and hybrid orbitals) of a bonded atom in a simple molecule.
- Given a molecule, **describe what type of bonds** (sigma, pi) are present and what type of orbitals (s, p, sp^3 hybrids, etc.) form those bonds. To do this, you will need to be able to draw the Lewis structure and find the shape of the molecule.
- Describe how pi bonds fix the structure of molecules and cause compounds like $C_2H_2Cl_2$ to have multiple isomers with different physical and chemical properties.

[Practice exercises from the textbook]

- 10.23, 10.33, 10.35, 10.37, 10.39, 10.43, 10.45, 10.49, 10.57, 10.59