

**CHM 110: Chapter 7 study guide / learning objectives**

Chapter 7 in the OpenStax book deals with chemical bonding and the three dimensional structures of molecules. You are required to know the terminology of bonding and how to draw Lewis structures representing atomic species, ions, and covalently-bonded molecules. You will also need to predict the three dimensional geometry, shape, and polarity of simple molecules using the VSEPR model.

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

*[Definitions]*

- Define terms related to chemical bonding: **bond, ionic bond, covalent bond, ionic compound, molecular compound, polar, nonpolar, electronegativity, delocalized bonding, resonance, formal charge, octet rule, bond length, bond order, bond energy.**
- Describe the **VSEPR model** of molecular shape (Valence Shell Electron Pair Repulsion Model)

*[Chemical bonds]*

- Describe the two major types of bonding: ionic and covalent
- Determine whether a bond between two atoms is ionic or covalent.
- Use the periodic table to estimate whether the electronegativity of one atom is higher or lower than another. (hint: the closer to fluorine the element is in the periodic table, the higher the electronegativity tends to be)
- Determine whether a *bond* is polar or nonpolar.
- Describe how the number of electrons shared by two atoms relates to the distance between the atoms (bond length) and the energy required to break the bond (bond energy).

*[Simple Lewis structures]*

- Draw **Lewis structures** for a given molecule (or polyatomic ion) using the procedure discussed in class.
- Use the **octet rule** to determine whether or not atoms share more than one pair of electrons in a bond.

*[More complex Lewis structures]*

- Draw **resonance structures** for compounds that have delocalized bonds.
- Draw Lewis structures for compounds that contain *exceptions* to the octet rule (Ex: some P compounds, some B compounds, some Xe compounds).
- Calculate **formal charges**.
- Use formal charges to determine which possible Lewis structure for a compound is the best.

*[VSEPR]*

- **Predict the shape** of a molecule from a Lewis structure. (Memorize the common molecular shapes for simple molecules. 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:  $\text{NH}_3$  is pyramidal,  $\text{CO}_2$  is linear,  $\text{CH}_4$  is tetrahedral,  $\text{H}_2\text{O}$  is bent,  $\text{O}_3$  is bent,  $\text{CH}_2\text{O}$  is trigonal planar.
- **Draw** the 3D representation of a simple molecule using wedge-and-dash notation.

*[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  $\text{CCl}_4$ .
- **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.

*[Practice problems from the textbook]*

- 13, 15, 19, 21, 23, 25, 29, 35, 37, 43, 45, 47, 51, 57, 73, 89, 91, 95, 99, 101, 105