Unit 2 – Student Objectives

Chapter 6

1. Calculate the wavelength of electromagnetic radiation given its frequency or its frequency given its wavelength. (6.1)
2. Order the common types of radiation in the electromagnetic spectrum according to their wavelengths, frequencies and energies. (6.1)
3. Explain what photons are and be able to calculate their energies given either their frequency or wavelength. (6.2)
4. Relate quantum numbers to the number and type of orbitals and recognize the different orbital shapes. (6.5)
5. Explain how and why the energies of the orbitals are different in a many-electron atom from those in a hydrogen atom (degenerate orbitals). (6.7)
6. Describe how electrons populate the orbitals in the ground state atom using the Pauli exclusion principle and Hund’s rule. (6.8)
7. Use the periodic table to write electron configurations and determine the number of unpaired electrons in an atom. (6.9)

Chapter 7

1. Explain the meaning of effective nuclear charge and how effective nuclear charge depends on nuclear charge and electron configuration. No math, just relationships. (7.2)
2. Use the periodic table to predict the trends in atomic radii, ionic radii, ionization energy, and electron affinity. (7.2, 7.3, 7.4, 7.5)
3. Explain how the radius of an atom changes upon losing electrons to form a cation or gaining electrons to form an anion. (7.3)
4. Use the periodic table to determine the electron configurations of ions. (7.3)
5. Predict the trends in ionization energy as successive electrons are removed, including the discontinuous increase that occurs when the ionization corresponds to removing a core electron. (7.4)
6. Explain how electron affinity and ionization energy are related. Recognize and write equations representing each process. Explain energy changes involved in each process. (7.5)
7. Explain the differences in chemical and physical properties of metals and nonmetals, including the basicity of metal oxides and the acidity of nonmetal oxides. This is a review of a pattern that we learned when studying types of reactions. (7.6) Know which is ductile, malleable, brittle, lustrous, solids, liquids, gases, conducting.
8. Explain how atomic properties, such as ionization energy and electron affinity, relate to the chemical reactivity of the alkali and alkaline earth metals. (7.7) Explain how the atomic properties, such as ionization energy and electron affinity, relate to the chemical reactivity of elements in groups 16, 17, and 18. (7.8) For example, how do these properties determine whether or not an atom (metal or nonmetal) will gain or lose electrons?

Chapter 8

1. Write Lewis symbols for atoms and ions. (8.1)
2. Define lattice energy and be able to arrange compounds in order on increasing lattice energy based on the charges and sizes of the ions. (8.2) Coulomb’s law! p. 303
3. Use a Born-Haber cycle to determine the lattice energy of an ionic solid. Write equations for each step. (p. 305)
4. Use atomic electron configurations and the octet rule to draw Lewis structures for molecules and polyatomic ions. (8.3) NASU
5. Define electronegativity. Use the periodic trend in electronegativity to rank bonds from most polar to least polar. (8.4)
6. Indicate the polarity of a molecule using an arrow or delta symbols. (p. 311)
7. Calculate formal charges from Lewis structures and use those formal charges to identify the dominant Lewis structure for a molecule or ion. (8.5)
8. Recognize molecules where resonance structures are needed to describe the bonding and draw resonance Lewis structures. (8.6) Including benzene (p. 321)
9. Recognize exceptions to the octet rule (odd-electron particles, less than an octet, expanded octets) and draw accurate Lewis structures even when the octet rule is not obeyed. (8.7)
10. Predict the relationship between bond type (single, double, triple), bond strength and bond length. (8.8)
11. Calculate the enthalpy of a reaction using bond energies. (8.8)

Chapter 9

1. Draw and name the predicted three-dimensional shapes of molecules using the VSEPR model. (9.2) Know the approximate bond angles for all shapes.
2. Determine whether a molecule is polar or nonpolar based on its geometry and individual bond dipole moments. (9.3)
3. Explain the role of orbital overlap in the formation of covalent bonds. (9.4)
4. Determine the hybridization of atoms in molecules based on observed molecular structures. (9.5)

A video to teach hybridization if you need it: <https://www.youtube.com/watch?v=vHXViZTxLXo>

1. Sketch how orbitals overlap to form sigma and pi bonds. Know the different ways that sigma and pi bonds are formed. (9.6)

Good video to watch on hybrid orbitals and sigma and pi bonds: <https://www.youtube.com/watch?v=voIpywwj2Ks>

1. Explain the existence of delocalized pi bonds in molecules such as benzene. (9.6)
2. Explain paramagnetism and diamagnetism and how each relates to electrons. (p. 377)
3. Calculate bond order and explain how bond order is related to bond length and bond strength. (p. 378)

YOU DO NOT NEED TO KNOW ANYTHING ABOUT MOLECULAR ORBITAL THEORY (9.7 AND 9.8)