First-Year HL Chemistry

3. Atomic Theory: Electronic Structure

Read: Zumdahl[2] Chapter 7: Sections 1-4 (pp. 289-299), 5 (pp. 304-305), 6-8, 10-11;
Green & Damji Chapter 2: Sections 2-4.

Presumed knowledge (from GCSE)

- Electronic structure, main level electron configuration, shell, outer shell, core shell, outer electron, core electron, noble (inert) gas configuration

Concepts to be mastered:

To master a concept, you must be able to do three things:

1. define the concept
2. explain the concept, and
3. give an example of the concept.

- Dalton's Atomic Theory, Bohr's Quantized Planetary Model
- Line spectrum, continuous spectrum, electronic transition, excited state, ground state, quantization, Energy level, shell, valence shell, valence electron
- Hydrogen emission spectra, Lyman, Balmer, Paschen, Brackett, Pfund, Rydberg
- Schrödinger atomic model, principle quantum number, angular quantum number, magnetic quantum number, spin quantum number
- Aufbau principle, Pauli exclusion principle, Hund's rule, orbital, s orbital, p orbital, d orbital, f orbital, lobe, node, phase
- valence electron, valence shell, pigeonhole, inert gas configuration, condensed, pigeonhole with inert gas notation, condensed with inert gas notation, half-shell stability, full-shell stability, monatomic ion electron configuration
- electron density, unpaired electron, free radical

Skills to be mastered:

To master a skill, you must be able to

1. recognize when the skill is needed,
2. recognize what information is needed to execute the skill,
3. execute the skill, and
4. assess whether the skill has been executed correctly.

	Zumdahl[2] problems
• Provide a ground state electron configuration of the type desired for an atom or a monatomic ion up to Z = 56 using s, p, d, f notation	**7**. 71-74, 77, 78, 81-84, **8**.29, 30
• Give a sequence of orbitals from lowest energy to highest	
• Give a sequence of orbitals from closest to the nucleus to furthest out	
• Draw and name the s, p or d orbitals	
• Determine the number of valence and core electrons for an atom or a monatomic ion	**8**.31, 32
• Give a simple description of an orbital in terms of probabilities	

- State the relationship between energy and frequency or wavelength of electromagnetic radiation
- Explain the emission of light by atoms in excited states
- Describe and explain the difference between a continuous spectrum and a line spectrum
- Explain how the lines in an emission spectrum are related to the energy levels of electrons
- State the rules governing the order in which orbitals are filled
- Relate the electron configuration of an atom to its position in the periodic table **7**.124
- Account for the existence of energy levels using evidence from successive ionization energies **8**.133

Additional problems from Zumdahl

7.1, 3, 4, 16, 18, 20, 24-26, 33, 34, 35, 67, 68, 116, 123, 128a.

Further problems:

1. List the products of the following reaction and indicate whether or not the equation is balanced:
   $Fe_2O_3 + 2\ CO \rightarrow 2Fe + 2CO_2$
2. Which electron transition involves greater energy change, $n = 3 \rightarrow n = 2$ or $n = 2 \rightarrow n = 1$? Explain.
3. Write the electronic configuration for each of the following atoms. (a) C, (b) P, (c) Ca, (d) Zn, (e) Cr, (f) Br^-, (g) Na^+
4. For an electron in a 1s orbital, where is the electron density greatest? What does this mean in terms of the location of the electron?
5. What is the energy level for which there are three and only three different types of orbitals?
6. Give an example of a d-orbital that is of lower energy than a p-orbital.
7. Indicate the atoms which have the following electron arrangements:
   (a) 3d electrons, but no electrons of higher energy
   (b) 3p electrons, but no electrons of higher energy
   (c) 6s electrons, but no electrons of higher energy