

Chapter 10

Modern Atomic Theory and the Periodic Table

Advanced Chemistry

10.1 Electromagnetic Radiation

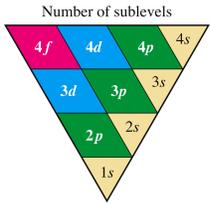
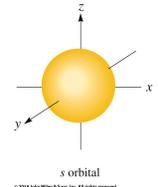
Learning Objective	
List the three basic characteristics of electromagnetic radiation.	<ul style="list-style-type: none">Basic wave characteristics include: wavelength (λ), frequency (ν), and speed (v) <i>Note: λ is the Greek letter lambda, ν is the Greek letter nu, and v is the Greek letter epsilon</i>
Key Terms	
Wavelength	The distance between consecutive peaks and troughs in a wave; symbolized by the Greek letter lambda.
Frequency	A measure of the number of waves that pass a particular point per second.
Speed	A measurement of how fast a wave travels through space.
Photons	Theoretically, a tiny packet of energy that streams with other of its kind to produce a beam of light.

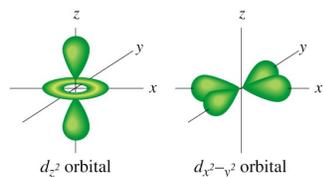
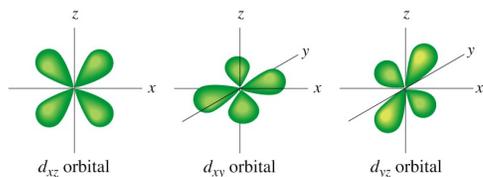
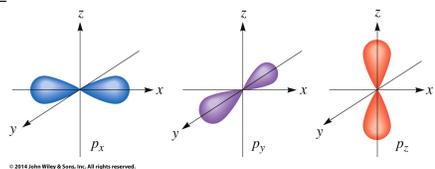
10.2 The Bohr Atom

Learning Objective	
Explain the relationship between the line spectrum and the quantized energy levels of an electron in an atom.	<ul style="list-style-type: none">Spectral lines result from the radiation of quanta of energy when the electron moves from a higher level to a lower level.
Key Terms	
Line spectrum	Colored lines generated when light emitted by a gas is passed through a spectroscope. Each element possesses a unique set of line spectra.

Quanta	Small discrete increments of energy. From the theory proposed by physicist Max Planck that energy is emitted in energy <i>quanta</i> rather than a continuous stream.
Ground state	The lowest available energy level within an atom.
Orbital	A cloudlike region around the nucleus where electrons are located. Orbitals are considered to be energy sublevels (s, p, d, f) within the principal energy levels.

10.3 Energy Levels of Electrons

Learning Objective	
Describe the principal energy levels, sublevels, and orbitals of an atom.	<ul style="list-style-type: none">Electrons are found in discrete principal energy levels ($n = 1, 2, 3...$)Energy levels contain sublevels: 
	<ul style="list-style-type: none">In each sublevel the electrons are found within specified orbitals (s, p, d, f). 



- Two electrons fit into each orbital but must have opposite spin to do so.

10.4 Atomic Structures of the First 18 Elements

Learning Objective

Use the guidelines to write electron configurations.

- Guidelines for writing electron configurations:
 - Not more than two electrons per orbital
 - Electrons fill lowest energy levels first: $s < p < d < f$ for a given value of n
 - Orbitals on a given sublevel are each filled with a single electron before pairing of electrons begins to occur

Key Terms

Electron configuration	The orbital arrangement of electrons in an atom.
Orbital diagram	A way of showing the arrangement of electrons in an atom, where boxes with small arrows indicating the electrons represent orbitals.
Valence electron	An electron in the outermost energy level of an atom; these electrons are the ones involved in bonding atoms together to form compounds.

Key Terms

Principal energy levels	Existing within the atom, these energy levels contain orbitals within which electrons are found.
Sublevels	Each principal energy level is divided into sublevels.
Spin	A property of an electron that describes its appearance of spinning on an axis like a globe; the electron can spin in only two directions, and, to occupy the same orbital, two electrons must spin in opposite directions.
Pauli exclusion principle	An atomic orbital can hold a maximum of two electrons, which must have opposite spins.

10.5 Electron Structures and the Periodic Table

Learning Objective	
Describe how the electron configurations of the atoms relate to their position on the periodic table and write electron configurations for elements based on their position on the periodic table	<ul style="list-style-type: none">• Elements in horizontal rows on the periodic table contain elements whose valence electrons (s and p) are generally on the same energy level as the number of the row.• The valence electron configurations of elements in a group or family are the same, but they are located in different principal energy levels.
Key Terms	
Period	The horizontal groupings (rows) of elements in the periodic table.
Groups or families (of elements)	Vertical groups of elements in the periodic table (1A, 2A, and so on). Families of elements that have similar outer-orbital electron structures.
Representative elements	An element in one of the A groups in the periodic table.
Transition elements	The metallic elements characterized by increasing numbers of d and f electrons. These elements are located in Groups 1B-8B of the periodic table.