UNIT 12 ATOMIC STRUCTURE, ELECTRON CONFIGURATION & PERIODICITY

Textbook References: *Chemistry* Zumdahl 5th Edition Chapters 7 and 8

1. review major events in developing atomic theory prior to Bohr: Dalton's Atomic Theory, JJ Thomson, Millikan, and Rutherford
2. describe electromagnetic radiation
3. state Bohr's theory and explain how it accounts for the line spectra of Hydrogen
4. state Dual Nature and Heisenberg's Uncertainty Principle and explain how they altered the model of the atom
5. describe the wave mechanics model of the atom
6. list and describe the four quantum numbers
7. determine the numerical values of n, l and m and
8. evaluate the allowed quantum numbers and their numerical values
9. write electron configurations and core notations for elements and ions
10. write orbital diagrams
11. calculate the energy or wavelength of a atomic spectral line
12. list and locate the major groups and series on the periodic table
13. explain the relationship between nuclear charge and electron shielding on the effective nuclear charge of an atom across a period and down a group
14. explain the general trends in atomic radius, ionization potential, activity of metals and nonmetals and electron affinity in terms of effective nuclear charge, atomic radius or electron shielding
15. explain the exceptions to the general trends in ionization potential and electron affinity
16. compare atomic radius to ionic radius

Vocabulary:

electromagnetic radiation
wavelength
frequency
crest
trough
standing wave
line spectrum
balmier series
ground state
excited state
energy level
Hund's Rule
Pauli's Exclusion Principle
quantum number
principle quantum number
angular momentum
electron spin magnetic quantum number
atomic radius
ionization potential
electron affinity
alkali metals
alkaline metals
noble gases
halogens
transitional metals
inner transitional metals
lanthanides
actininides
electron shielding
effective nuclear charge

AP Course Guide correlation:

I. Structure of Matter

A. Atomic theory and atomic structure

1. Evidence for the atomic theory
2. Atomic masses; determination by chemical and physical means
3. Atomic number and mass number; isotopes
4. Electron energy levels: atomic spectra, quantum numbers, atomic orbitals
5. Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states

IV. Descriptive Chemistry (10 –15%)

2. Relationships in the periodic table: horizontal, vertical, and diagonal with examples from alkali metals, alkaline earth metals, halogens, and the first series of transition elements

IB Course Outline correlations:

2.3.1 Describe the electromagnetic spectrum.
2.3.2 Distinguish between a *continuous spectrum* and a *line spectrum*.
2.3.3 Explain how the lines in the emission spectrum of hydrogen are related to electron energy levels.
2.3.4 Deduce the electron arrangement for atoms and ions up to $Z = 20$.
3.1.1 Describe the arrangement of elements in the periodic table in order of increasing atomic number.
3.1.2 Distinguish between the terms *group* and *period.*
3.1.3 Apply the relationship between the electron arrangement of elements and their position in the periodic table up to $Z = 20$.
3.1.4 Apply the relationship between the number of electrons in the highest occupied energy level for an element and its position in the periodic table.
3.2.1 Define the terms *first ionization energy* and *electronegativity*.
3.2.2 Describe and explain the trends in atomic radii, ionic radii, first ionization energies, electronegativities and melting points for the alkali metals (Li ⋅ Cs) and the halogens (F ⋅⋅ I).
3.2.3 Describe and explain the trends in atomic radii, ionic radii, first ionization energies and electronegativities for elements across period 3.
3.2.4 Compare the relative electronegativity values of two or more elements based on their positions in the periodic table.
3.3.1 Discuss the similarities and differences in the chemical properties of elements in the same group.
3 The following reactions should be covered.

- Alkali metals (Li, Na and K) with water
- Alkali metals (Li, Na and K) with halogens (Cl_2, $Br_2$and I_2)
- Halogens (Cl_2, Br_2 and I_2) with halide ions (Cl–,Br– and I–)

12.1.1 Explain how evidence from first ionization energies across periods accounts for the existence of main energy levels and sub-levels in atoms.
12.1.2 Explain how successive ionization energy data is related to the electron configuration of an atom.
12.1.3 State the relative energies of s, p, d and f orbitals in a single energy level.
12.1.4 State the maximum number of orbitals in a given energy level.
12.1.5 Draw the shape of an s orbital and the shapes of the px, py and pz orbitals.
12.1.6 Apply the Aufbau principle, Hund's rule and the Pauli exclusion principle to write electron configurations for atoms and ions up to $Z = 54$.