

Chemistry 64

REVIEW TOPICS

Just as you need to know the alphabet in order to spell words in the English language, **I also expect you to know from memory the names and symbols of the first 86 elements of the Periodic Table.** These are the component parts from which almost all known materials are made. The Periodic Table is your guide to the chemistry of the elements and their compounds. You should know your way around it, and **be able to calculate quickly the valence electron configuration of any element in any oxidation state.**

I will expect you to be familiar with the following terms, concepts and topics from your General Chemistry and Organic Chemistry courses. Some of these topics are reviewed in your text, primarily in Chapters 1 and 2, and in some class handouts. You may need to go back to your General Chemistry text to freshen up on other subjects.

IF YOU HAVE ANY PROBLEMS WITH THIS MATERIAL, COME AND ASK FOR HELP!!

A. General Chemistry (Chem 3/5 and Chem 6, or Chem 10)

Atomic orbitals: s, p, d

mathematical description and spatial visualization
(you should be able to draw them correctly from various perspectives)
angular portion (shape) & radial portion (size and penetration)
core and valence orbitals
change of phase of wavefunction in different orbital lobes - nodal characteristics
energies in hydrogen atom and in multielectron atoms and ions

Periodic table and periodic trends

electronic configuration, Aufbau Principle, Hund's Rule
symbols and names of the elements
main group, transition metals, lanthanides, actinides
ionization potential and electron affinity - electronegativity
polarizability

Thermodynamics

enthalpy (H); enthalpy-driven reaction
entropy (S); entropy-driven reaction
free energy (G) and its relation to H and S
equilibrium constant (K) and its relation to ΔG°
redox potential (E°) and its relation to ΔG°

Kinetics

rate expressions for 1st and 2nd order reactions - mechanistic implications
activation energy; Arrhenius equation, rate determining step
catalysis, effect of catalyst on equilibrium constants and rate constants
reaction coordinate; free energy reaction profile

Valence Electron Bonding Theory (coordinate covalent 2-e⁻ bonds)

octet rule, and exceptions to it

Valence Shell Electron Pair Repulsion Theory (VSEPR)

hybridization - hybrid atomic orbitals

resonance forms - evaluation of their relative importance

isoelectronic atoms ions and molecules

Lewis Base (e⁻pair donor) and **Acid** (e⁻pair acceptor)

bond lengths and bond strengths

bond polarity - molecular dipoles

Molecular Orbital Theory

homonuclear diatomic **M.O. energy level diagrams**

bonding, nonbonding, and antibonding molecular orbitals

calculation of **bond order**

σ-bonds - nodal characteristics

π-bonds - nodal characteristics

δ-bonds - nodal characteristics [*new; to be introduced soon*]

B. Organic Chemistry (Chem 51-52, or 57-58)

nomenclature

nucleophile (Lewis Base); S_N1 and S_N2 mechanisms

electrophile (Lewis Acid)

IR spectroscopy

identification of **functional groups**

transitions between **vibrational** states

UV spectroscopy

transitions of electrons from ground state to excited **electronic** states

Mass Spectrometry

parent (molecular) ion; fragmentation patterns

Nuclear Magnetic Resonance Spectrometry

chemical shift (δ); units ppm

spin-spin coupling; coupling constants (J); units Hz

magnetic equivalence; symmetrical equivalence

dynamics

conformational exchange

chemical exchange

I = 1/2 nuclei ¹H, ¹³C: & ¹⁹F, ³¹P, ¹⁰³Rh, ¹¹³Cd, ¹⁹⁵Pt, etc.

C. Important Terms

ligand - atom, ion or molecule bonded to a metal

oxidation state - formal charge on a metal ion

dⁿ configuration - number of valence d electrons

coordination number - number of ligands directly bound to a metal

first (inner) coordination shell - set of ligands bound directly to a metal

second (outer) coordination shell - solvent or counter ions not directly bound to the metal

electronic structure - the spatial and nodal character, electron population and energies of the orbitals (usually only the valence orbitals are considered) of an atom, ion or molecule