

Content Outline for Physical Sciences Section of the MCAT

GENERAL CHEMISTRY

ELECTRONIC STRUCTURE AND PERIODIC TABLE

A. Electronic Structure

1. Orbital structure of hydrogen atom, principal quantum number n , number of electrons per orbital
2. Ground state, excited states
3. Absorption and emission spectra
4. Quantum numbers l , m , s , and number of electrons per orbital
5. Common names and geometric shapes for orbitals s , p , d
6. Conventional notation for electronic structure
7. Bohr atom
8. Effective nuclear charge

B. The Periodic Table: Classification of Elements into Groups by Electronic Structure; Physical and Chemical Properties of Elements

1. Alkali metals
2. Alkaline earth metals
3. Halogens
4. Noble gases
5. Transition metals
6. Representative elements
7. Metals and nonmetals
8. Oxygen group

C. The Periodic Table: Variations of Chemical Properties with Group and Row

1. Electronic structure
 - a. representative elements
 - b. noble gases
 - c. transition metals
2. Valence electrons
3. First and second ionization energies
 - a. definition
 - b. prediction from electronic structure for elements in different groups or rows
4. Electron affinity
 - a. definition
 - b. variations with group and row
5. Electronegativity
 - a. definition
 - b. comparative values for some representative elements and important groups
6. Electron shells and the sizes of atoms

BONDING

A. The Ionic Bond (Electrostatic Forces Between Ions)

1. Electrostatic energy $\propto q_1q_2/r$
2. Electrostatic energy \propto lattice energy
3. Electrostatic force $\propto q_1q_2/r^2$

B. The Covalent Bond

1. Sigma and pi bonds
 - a. hybrid orbitals (sp^3 , sp^2 , sp , and respective geometries)
 - b. valence shell electron-pair repulsion (VSEPR) theory, predictions of shapes of molecules (e.g., NH_3 , H_2O , CO_2)
2. Lewis electron dot formulas
 - a. resonance structures
 - b. formal charge
 - c. Lewis acids and bases
3. Partial ionic character
 - a. role of electronegativity in determining charge distribution
 - b. dipole moment

PHASES AND PHASE EQUILIBRIA

A. Gas Phase

1. Absolute temperature, K
2. Pressure, simple mercury barometer
3. Molar volume at 0°C and 1 atm = 22.4 L/mol
4. Ideal gas
 - a. definition
 - b. ideal gas law ($PV = nRT$)
 - i. Boyle's law
 - ii. Charles's law
 - iii. Avogadro's law
4. Kinetic theory of gases
5. Deviation of real-gas behavior from ideal gas law
 - a. qualitative
 - b. quantitative (van der Waals equation)
6. Partial pressure, mole fraction
7. Dalton's law relating partial pressure to composition

B. Intermolecular Forces

1. Hydrogen bonding
2. Dipole interactions
3. London dispersion forces