

## Chem101 Sec. #1 Summary (Spring 2007)

### Part I: Molecular Structure and Chemical Bonding (approximately 50%)

1. Units of measurement: S.I. units, conversions, simple calculations.
2. Phases of matter: molecular picture, properties (shape, volume, density), change of phase when P and T change, competition of attractive forces between particles and kinetic energy of particles.
3. Definitions: atom, element, molecule, compound; physical and chemical changes; homogeneous and heterogeneous mixtures and how to separate them.
4. Names of binary elements.
5. General features of the periodic table: location of metals and nonmetals; explain the arrangement in terms of columns and chemistry; how atomic size and electronegativity change down a row and across a column; noble gases and stability.
6. Atomic Structure: three subatomic particles and their properties; Rutherford experiment and model of the atom; definitions: atomic number, mass number, isotope; relative abundance of isotopes;  ${}^Z_A X$  notation.
7. Nuclear Chemistry: three types of radiation and their properties; solving nuclear equations; half-life (definition, calculations); stability curve (ratio of # protons to # neutrons); applications of radioisotopes (radiometric dating, radiotherapy, tracers); nuclear reactions (fission, fusion, chain reactions, missing mass, Fe as the endpoint).
8. Electronic Structure: electromagnetic radiation spectrum; features of a wave and the relationship between wavelength, frequency and energy of waves; Bohr model of the atom and its limitations; relating line spectra to energy transitions; how to write the Bohr and modern electron configurations; orbitals as a probability distribution of electrons.
9. Ionic Bonding: how and why ionic bonds form; formulae of ionic compounds; describe the four properties of ionic compounds and explain from structure.
10. Covalent Bonding: how and why covalent bonds form; draw Lewis structures; predict molecular shape based on VSEPR theory; predict if molecule has a net dipole (making use of shape and electronegativity); giant covalent networks (diamond, SiO<sub>2</sub>, graphite) and their properties.
11. Metallic Bonding: picture of bonding in metals; three properties of metallic compounds.
12. Intermolecular Forces: identify and explain the origin of the three types (temporary dipole, permanent dipole, hydrogen bonding) and relate them to boiling points and phase of matter; effect of size and polarity on boiling points.
13. Liquids and Solutions: explain five properties of water and list applications where applicable; identify energy changes when water changes phase; explain how P and T affect phase, melting points, boiling points; explain shape of meniscus and droplets; explain how ionic solids affect melting and boiling points; explain miscibility of solutions; explain solubility of gases and solids in water and the effect of temperature; explain how soap works.

Part II: Chemical Equations and Reactions (approximately 17%)

14. Stoichiometry: Balance chemical equations; calculations involving mole/Avogadro's number, molar mass, # of molecules or atoms.
15. Energetics of reactions: First Law of Thermodynamics; endothermic and exothermic reactions; draw energy diagrams; calculations using bond energies.
16. Entropy: Second Law of Thermodynamics; disorder in a system relating to intermolecular forces, number of atoms in a molecule, temperature.
17. Kinetics: how fast a reaction takes place; what is necessary for a reaction to take place; how to increase the rate of a reaction; activation energy barrier and draw energy diagrams; effect of a catalyst.
18. Acids and Bases: Identify strong/weak acids and bases and calculate concentrations; calculate pH of a solution; pH scale; reactions of acids and bases; applications of acids/bases (antacids, baking, acid rain)
19. Redox: identify what is being oxidized, reduced, and the oxidising and reducing agents; write simple half equations; Daniell cell experiment and observations; applications of redox reactions (electrolysis, batteries, electroplating).

Part III: Organic Chemistry (approximately 33%)

20. Name and draw simple organic compounds; identify functional groups in more complicated compounds (alkanes, alkenes, aromatic compounds, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, amides); explain trends in boiling point and solubility.
21. Isomerism: Name, draw and identify simple structural isomers; define optical isomers and identify chiral centers.
22. Reactions of organic molecules: addition in alkenes, condensation in many of the other functional groups.
23. Applications and characteristics mentioned in class (e.g., fuels, fractional distillation, octane rating, solvents, smells, precursors to polymers, etc.).
24. Polymers: addition polymers (name, draw); condensation polymers (identify starting monomers, draw); applications mentioned in class.
25. Lipids: recognize steroids; explain what fats and oils are, the different types (saturated, unsaturated, cis/trans) and how they are formed; detergents.
26. Proteins: draw generic amino acid; defining characteristics (20 natural, L-enantiomers, different flavors of side-chains); condensation polymerization to form polypeptides; four levels of structure in proteins; importance of specific 3-dimensional shape for function of protein and the forces that hold the specific shape in place; enzymes.
27. Carbohydrates: identify monosaccharides and disaccharides; condensation polymerization of glucose to form starch (helical) and cellulose (long strands with inter-strand H-bonding).
28. Nucleic Acids: three parts of a nucleotide; base-pairing rules; structure of DNA; differences between DNA and RNA; replication of DNA; protein synthesis (transcription, translation).