CHEM 107 Course Objectives

Chapter 1 – Basic Definitions, Significant Figures, and Unit Conversions

1a) classify matter in terms of elements, compounds, mixtures, atoms and molecules
1b) distinguish properties of matter as physical, chemical, intensive, and extensive
1c) be familiar with the SI base units and the following metric system prefixes: giga-, mega-, kilo-, deca-, deci-, centi, milli-, micro-, and nano- (possibly including others).
1d) define and use density in calculations
1e) be familiar with the Temperature scales and conversions for Celsius, Fahrenheit, and Kelvin
1f) use Scientific Notation with a scientific calculator
1g) utilize Significant Figures in problem solving
1h) solve one- and multi-step unit conversion problems using dimensional analysis

Chapter 2 – Atoms, Molecules, Ions, Ionic and Molecular Compounds

2a) understand and explain Dalton's atomic theory
2b) describe the subatomic particles in terms of their charges, masses, locations, and numbers present in an atom
2c) compose and interpret isotopic symbol (isotope notation)
2d) understand the organization of the periodic table by group and period
2e) identify the metal, nonmetal, and metalloid regions of the periodic table and the definitions of these
2f) identify the diatomic elements
2g) understand the formation of cations and anions from atoms
2h) use the Periodic Table to predict common monoatomic ion charge
2i) give the formula, charge and name for the majority of Polyatomic Ions.
2j) distinguish between molecular and empirical formulas
2k) compose and interpret the empirical formula and name of ionic compounds (including transitional metal compounds) and hydrates
2l) compose and interpret the names of molecular compounds
2m) learn the nomenclature of key acids and bases

Chapter 3 – Stoichiometry

3a) obtain atomic mass from the periodic table
3b) calculate average atomic mass from isotopic masses and relative abundances
3c) define Avogadro's number and the mole
3d) interconvert between moles and atoms, molecules, or formula units using Avogadro's number
3e) define and calculate molar mass, molecular mass, and formula mass from a Periodic Table
3f) interconvert between mass and moles of an element or compound
3g) calculate the Percent Composition of an element within a compound
3h) determine the Empirical Formula of a compound from Percent Composition or experimental data
3i) determine Molecular Formulas from Empirical Formulas
3j) balance and define the parts of a Chemical Equation
3k) perform stoichiometric calculations involving grams and/or moles
3l) determine Limiting Reactant, Theoretical Yield, and Percent Yield

Chapter 4 – Reactions in Aqueous

4a) distinguish between strong and weak electrolytes and non-electrolytes
4b) use the solubility rules to write balanced molecular, total ionic, and net ionic equations of precipitation reactions
4c) define and understand the properties of both Arrhenius and Bronsted-Lowry Acids and Bases
4d) identify Bronsted-Lowry acids and bases in an acid-base equilibrium
4e) write balanced molecular, total ionic, and net ionic equations of acid-base neutralization reactions, including both strong and weak acids and bases
4f) assign oxidation numbers to elements and species within ionic and molecular compounds
4g) differentiate between oxidation and reduction reaction by using oxidation numbers
4h) identify oxidizing and reducing agents
4i) recognize a combustion reaction
4j) define and perform calculations involving Molarity
4k) utilize the dilution formula
4l) understanding the concept and definitions of titration
4m) perform solution stoichiometry calculations involving titrations

Chapter 5 – Gases

5a) understand the definition and units of Pressure, including atm, mm Hg, torr, Pa, and psi.
5b) explain the uses of a barometer and manometer in measuring pressure
5c) understand and perform calculations using the empirical Gas Laws for both static and changing conditions
5d) perform calculations using the ideal Gas Equation in both static and changing conditions
5e) perform calculations using the Ideal Gas Equation involving density and Molar Mass
5f) perform calculations involving Gas Stoichiometry
5g) define and perform calculations with Dalton's Law of Partial Pressures
5h) calculate the mole fraction and partial pressure of a gas within a mixture
5i) understand the assumptions of the kinetic molecular theory of gases
5j) understand the concepts of the root-mean-square speed of a gas particle
5k) recognize the effects of T and M on molecular speed within the root-mean-square speed equation
5l) define diffusion and effusion
5m) perform calculations using Graham's Law of Diffusion involving either rate or time
5n) recognize the deviation from Ideal Gas behavior and the conditions which decrease deviation

Chapter 6 – Energy Relationships in Chemical Reactions

6a) define potential and kinetic energy in terms of chemistry
6b) understand the basic definitions of heat, Thermochemistry, and Thermodynamic systems
6c) distinguishing between state functions and non-state functions
6d) define the First Law of Thermodynamics in both paragraph and equation form
6e) calculate the work of expansion/compression
6f) relate the sign of the value of heat or work to the direction of the heat or work
6g) relate heat and enthalpy
6h) define Thermochemical Equation and enthalpy of reaction and their relationship
6i) perform stoichiometric calculations with enthalpy of reaction values
6j) discuss the relationship between ΔH, ΔU and moles of gas (n)
6k) definitions and relationship of heat capacity and specific heat

6l) carry out all calculations involving the constant-volume (bomb) calorimeter and the constant-pressure (coffee-cup) calorimeter
6m) Utilize standard enthalpy of formation to calculate standard enthalpy of reactions directly
6n) Use Hess's Law to calculate standard enthalpy of reactions indirectly

Chapter 7 – Electronic Structure of Atoms

7a) understand the basic definitions of waves, frequency, wavelength, amplitude, and the Hertz unit
7b) perform calculations relating wavelength, frequency, speed of light, energy of electromagnetic radiation, and photons.
7c) understand the concepts of excitation and relaxation of an electron
7d) define the basic concepts of quantum numbers, shells, subshells, orbitals, and their relative energies.
7e) use the periodic table to assign an electron configuration and orbital diagram according to the Aufbau principle for the majority of the main group and transitional elements
7f) identify with a set of quantum numbers any electron in any element
7g) correctly identify paramagnetic and diamagnetic atoms

Chapter 8 – The Periodic Table

8a) write the electron configuration for any cation or anion
8b) identify the number of valence electrons in an atom of any element
8c) explain the general trends of atomic size, sizes of ions, ionization energy, and electron affinity

Chapter 9 – The Covalent Bond I

9a) write the Lewis Dot Symbol for any representative (Main-Group) element
9b) use dot symbols to represent ionic bonds
9c) draw the Lewis Dot Structure for covalent compounds and polyatomic ions using the octet rule
9d) calculate formal charge within a Lewis Dot Structure and develop resonance structures
9e) understand the exceptions to the octet rule
9f) use electronegativity to identify polar covalent bonds
9g) use bond enthalpy to calculate ΔH_{rxn} (*optional)
9h) have a conceptual understanding of lattuce energy (*optional)

Chapter 10 – The Covalent Bond II

10a) utilize the VSEPR theory to determine the electron pair arrangement and molecular geometry of covalent compounds
10b) relate molecular geometry and electronegativity in identifying polar and nonpolar molecules
10c) describe covalent bonding in term of hybridization of atomic orbitals, including sigma and pi bonding