

Advanced Placement Chemistry

Course Text

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Course Description

AP Chemistry is designed as a first year college level course and is intended to prepare highly motivated students for the AP Chemistry exam. It is assumed that students taking this course have a thorough understanding of basic general chemistry from a year one course. Logical reasoning and problem solving skills are emphasized while presenting a balanced treatment of modern theoretical and descriptive chemistry. A high degree of analytical skill is needed in order to be successful in this class.

Course Syllabus

Semester I

1. Matter & Measurement
 - a. classification and properties of matter
 - b. units of measurement, SI and derived
 - c. significant figures in calculations
 - d. dimensional analysis (factor-label method)Summer Assignment

2. Atoms, Molecules, and Ions
 - a. atomic theory and structure
 - b. isotopes, mass numbers, atomic numbers
 - c. periodic table (groups, periods, metals, nonmetals, metalloids)
 - d. predicting ion charges from the periodic tableSummer Assignment

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3. Stoichiometry: Calculations with Chemical Formulas and Equations
 - a. atomic mass scale
 - b. determining average atomic mass based on % abundance and atomic mass of isotopes
 - c. % composition
 - d. mass, mole, particles conversions
 - e. deriving empirical and molecular formulas based on either % composition information or data from combustion analysis of a compound
 - f. stoichiometry of chemical reactions (standard problems, theoretical yield, limiting reactant)
 - g. molarity & dilution
 - h. acids, bases, salts, neutralization reactions
 - i. solution stoichiometry where one or both reactants are in aqueous form
 - j. titration

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4. Chemical Reactions
 - a. writing formulas of and naming ionic compounds
 - b. names and formulas of binary covalent compounds
 - c. names and formulas of acids
 - d. solubility rules for ionic compounds
 - e. metathesis reactions (formation of a precipitate, a gas, or a weak electrolyte)
 - f. writing net ionic equations
 - g. activity series, single replacement reactions, net ionic equations
 - h. combustion, decomposition, and composition reactions

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5. Thermochemistry & Thermodynamics
 - a. calorimetry (specific heat, heat capacity, bomb calorimetry)
 - b. Hess's Law
 - c. determining the enthalpy of a reaction with enthalpy of formation values or bond energies
 - d. stoichiometry involving thermochemical equations
 - e. laws of thermodynamics
 - f. calculation of entropy changes and Gibbs Free Energy
 - g. effect of temperature on reaction spontaneity
 - h. Gibbs Free Energy and the equilibrium constant

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6. Electronic Structure of Atoms and Periodicity
 - a. wave nature of light: wavelength, frequency, energy
 - b. line spectra: determining the frequency and wavelength of the electromagnetic radiation emitted when hydrogen electrons drop from higher to lower energy levels
 - c. aufbau order of atomic orbitals, based on the Periodic Table
 - d. orbital notation and electron configurations of atoms, including some exceptions
 - e. quantum numbers

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7. Periodic Table Trends Independent Assignment

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8. Ionic and Covalent Bonding
 - a. lattice energy: comparing lattice energies of various ionic compounds, making predictions
 - b. Born-Haber Cycle
 - c. electron configuration of ions
 - d. relative sizes of ions and atoms
 - e. Lewis structures and formal charge
 - f. electronegativity and bond polarity
 - g. formal charges
 - h. resonance hybrids, predicting relative importance (stability)
 - i. relating # of covalent bonds between two atoms to bond length and bond strength

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9. Molecular Geometry and Bonding Theories

- a. VSEPR method of predicting molecular shapes and polarities
- b. dipole moments and % ionic character of binary covalent molecules
- c. drawing orbital pictures of molecules
- d. sigma bonds, pi bonds
- e. hybridization of carbon in various molecules: sp , sp^2 , sp^3
- f. predicting hybridization of central atom and shape of molecule for other molecules

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10. Gases

- a. pressure, atmospheric pressure, barometers, manometers
- b. combined gas law
- c. ideal gas equation
- d. reactions involving gas volumes at non-STP conditions
- e. gas mixtures, mole fractions and partial pressures
- f. Graham's Law of Effusion
- g. van der Waals Equation

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11. Liquids and Solids

- a. intermolecular forces: dipole-dipole forces, London dispersion forces, hydrogen bonding
- b. relating intermolecular forces to melting/boiling points, vapor pressure, viscosity, surface tension
- c. heating curves
- d. phase diagrams, critical temperature, critical pressure, triple point, normal melting and boiling points
- e. Clausius-Clapeyron equation
- f. type of solids: molecular, network, metallic, ionic

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SEMESTER I EXAM

Semester II

12. Properties of Solutions

- a. solution process
- b. expressing concentration: mole fraction, molarity, molality, % by mass, ppm, ppb
- c. factors affecting solubility
- d. vapor pressure above a solution: Raoult's Law
- e. boiling point and freezing points of solutions
- f. electrolytes and the van't Hoff factor, i
- g. determination of molar mass based on freezing point or boiling point

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13. Chemical Kinetics

- a. reaction rates and concentration
- b. reaction orders
- c. determining rate laws
- d. first order reactions (half-life)
- e. second order reactions
- f. temperature and rate of reaction
- g. Arrhenius Equation
- h. reaction mechanisms
- i. molecularity of a reaction
- j. rate laws of elementary steps and multistep mechanisms
- k. catalysis

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14. Chemical Equilibrium

- a. equilibrium constant expression
- b. homogeneous and heterogeneous equilibria
- c. calculating equilibrium constants
- d. relationship between K_p and K_c
- e. using the equilibrium constant to predict reaction direction
- f. calculating equilibrium concentrations
- g. LeChatelier's Principle

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15. Acid Base Equilibria

- a. autoionization of water
- b. pH and pOH scales
- c. Bronsted-Lowry acids and bases
- d. conjugate acid base pairs and relative strength
- e. calculating pH and concentration for acids and bases
- f. calculating K or percent ionization for weak acids and weak bases
- g. common-ion effect
- h. buffered solutions
- i. solubility and K_{sp}
- j. solubility and pH
- k. precipitation and separation of ions

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16. Electrochemistry

- a. oxidation numbers
- b. oxidizing and reducing agents
- c. ion-electron method and oxidation number methods of balancing redox reactions
- d. galvanic cells
- e. electromotive force
- f. standard reduction potential
- g. Nernst equation
- h. electrolytic cells
- i. stoichiometry of electrolysis

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Additional Topics

17. Organic Chemistry

18. Nuclear Chemistry

Independent Assignment

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AP EXAM