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| Unit/Topic | highlights |
| Intro & Stoichiometry | Balancing equations, mole ratios/basic stoichiometry, limiting reactants, nomenclature, percent composition, combustion analysis, empirical/molecular formulas, molecular pictures, mass spectra and atomic wts |
| Solution Stoichiometry | Solution formation (molecular pictures) and properties of solutions, molarity and concentration calculations, solubility rules, factors affecting solubility, precipitation reactions, redox reactions and balancing, acid-base neutralization reactions and balancing, net ionic equations, reactions of acids with carbonates/bicarbonates, solution stoichiometry, colors of ions in solution, spectroscopy, |
| Gas Stoichiometry | Kinetic theory: pressure, temperature and gas laws, Ideal gas law (PV=nRT) and simpler gas laws from it, density, molar mass of gases, behavior of gases, gas reaction stoichiometry, rms velocity and Maxwell-Boltzmann distribution, Graham's law-diffusion/effusion |
| Heat and Thermochemistry | Energy-heat, work(PV) and 1st law of Thermo; heat and calorimetry: specific heat capacity and heat flow problems; q = mc$Δ$T; heat and changes of state:heating/cooling curves and energy calculations throughout; thermochemical equations and heat stoichiometry; Hess’s Law; heats of formation |
| Atomic Structure & Periodicity  | Subatomic particles and properties: (nucleus)proton/neutron and electrons; wave/particle nature of light (EM spectrum and photons) and light calculations; quantum mechanical atom: energy levels, sublevels, orbitals; electron configurations, PES (photoelectron spectroscopy); valence electrons, shielding electrons, Coulomb’s law and Zeff--periodic trends: atomic radius, ionization energy, electronegativity, ionic radii |
| Bonding | Bond types based on elements and electronegativity differences: ionic, covalent, metallic-properties of substances; ionic bond strength and lattice energy (charge/size effects); Covalent bonding: Lewis structures, multiple bond formation, resonance structures, formal charges (drawing/calculating); bond enthalpies and predicting reaction enthalpies; molecular geometry and VSEPR--molecular shape and polarity |
| Intermolecular Forces | Types and strengths of intermolecular forces-dispersion (electrons/polarizability), dipole-dipole, hydrogen bonding; application in describing properties of substances: vapor pressure (and graphs describing boiling pt. at different pressures), boiling point, solubility, viscosity, surface tension; solids: ionic, metallic (alloys), network covalent (doping), molecular-comparison of structures and properties; paper chromatography and Rf values/predictions; interpreting phase diagrams: triple point, critical point, states of matter and equilibrium between |
| Kinetics | Collision theory and Reaction rates, stoichiometric relations, interpreting concentration time graphs for average and instantaneous rates; initial rate data (tables) and writing differential rate laws: find orders by comparing experiments, write rate law, find rate constant; integrated rate laws (oth/1st/2nd order); rate plots to determine order (and how to use your calculator!) using integrated rate laws to find concentration and times; half life for different rate laws; reaction mechanisms and molecularity: potential energy diagrams; deducing a rate law from mechanism; effect of concentration, catalysts, and temperature on rate; types of catalysts; Arrhenius equation/plots and relationship of k to T. |
| Equilibrium | Concept of dynamic equilibrium; writing equilibrium constant expressions (homogeneous.heterogeneous); calculations with equilibrium constant expressions; interpreting the size of K and position of equilibrium; Q vs K and direction of reaction; ICE tables and determining extent of reaction (calculator methods vs 5% rule); Le Chatelier’ Principle; Slightly soluble salts, Ksp and common ion effect--solubility and precipitate formation |
| Thermodynamics | Spontaneity and entropy (conceptual); Free energy calculations $Δ$G = $Δ$H -T$Δ$S using tables of standard values; nonstandard conditions, Gibbs energy and equilibrium--interconverting $Δ$G and K and predicting size of K/spontaneity |
| Acids & Bases I | acid/base definitions and properties: Arrhenius,Bronsted-Lowry; conjugate acids and bases, strong vs. weak acids and bases; autoionization of water Kw; pH concept; pH for strong acids and bases; weak acids and bases (Ka/Kb) and pH of their solutions (ICE-solver vs 5% rule); size of K relates to acid/base strength / % ionization salt hydrolysis and pH = is salt acid/base/neutral? |
| Acids & Bases II | Buffers (weak acid/conjugate base)/Henderson-Hasselbalch equation; finding pH of buffer, choosing a buffer system, making a buffer mixture to a specific pH; buffer capacity; titration curves: SA-SB, WA-SB, WB-SA, calculating pH and key points of each; equivalence point stoichiometry--finding unknown concentration; choosing the right indicator |
| Electrochemistry | Review oxidation and reduction: assigning ox states/ oxidizing and reducing agents; balancing using half reaction method; voltaic/galvanic cells--producing electricity with spontaneous reaction: build/label cell--electrodes,salt bridge, flow of charge throughout, anode/cathode, net ionic equation; calculate standard cell potential using table of standard reduction potentials; relate free energy and cell potential $Δ$G=-nFE; predict spontaneity of process;Nernst and nonstandard conditions--calculate new cell potential (predict with Le Chatelier also); relate E to K using Nernst; concentration cells and voltage; electrolysis: electrolytic cells use voltage to drive nonspontaneous reaction; metal plating; calculating mass of material plated based on current and time; electrolysis of water; predicting which reaction is “easier” in a solution (ions vs water) |