

AP Chemistry/Lab

Course Code: 447 and 464

CREDITS: 5

GRADE: 11 & 12

Recommendation: Chemistry 441 (B or better; or department head recommendation)

BASIC TEXT: Chemistry The Central Science 10th Edition 2006 Brown, Lemay, Bursten

REQUIRED MATERIALS: notebook, pen/pencils, and scientific calculator

COURSE DESCRIPTION: The Advanced Placement Chemistry course is designed to be the equivalent of the General Chemistry course taken during the first year of college. This course requires students to work on a mathematical and conceptual level far above that of regular Chemistry 1. Topics such as structure of matter, kinetic molecular theory, chemical equilibrium, and kinetics will be covered in depth. Recommended laboratory experiments will be performed. Enrolled students are expected to take the AP Chemistry Exam in May.

Unit Information

Unit Name or Timeframe:

Matter and Moles: Nomenclature and Measurement

Content and/or Skills Taught:

Inorganic and Molecular Nomenclature

Significant figures, Metric System & Scientific Notation

Moles, Avogadro's Number, % composition, Empirical & Molecular Formulas

Major Assignments and/or Assessments:

Lab: Percent Oxygen in Potassium Chlorate

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Reactions in Aqueous Solution Stoichiometry

Content and/or Skills Taught:

Combustion Analysis; Mass/mass, volume/volume, Mass/Volume Stoichiometry;

Dilution formula, Serial dilution, Solution Stoichiometry;

Limiting Reagent and Reagent in Excess;

Determine the concentration of all species after a reaction is complete;

Balance Redox Equation by the electron transfer method;

Study and Memorize Oxidizing and Reducing Agents and their half reactions.

Predict Products of Redox Reactions & net ionic equations

Major Assignments and/or Assessments:

Lab: Serial Dilution of Sulfuric Acid

Volumetric analysis of [Final solution] by titration

Gravimetric Analysis of [Final Solution] by precipitation of Barium Sulfate

Review packet with multiple choice and open response questions

Several Quizzes and unit test

Unit Name or Timeframe:

Reaction Patterns and Equations

Content and/or Skills Taught:

Solubility Rules; Dissociation and Ionization;

Reaction Types and Patterns: Synthesis, Analysis, Combustion, Oxidation-Reduction, Single & Double Replacement, Neutralization, Precipitation & Gas Producers

Major Assignments and/or Assessments:

Lab: Activity Series

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Thermodynamics and Calorimetry

Content and/or Skills Taught:

Heat Transfer, Heat Capacity and Heat of Fusion/Vaporization

Hess' Law of Heat Summation

The Laws of thermodynamics

The Driving Forces: Enthalpy, Entropy and Gibbs Free Energy

The Gibbs-Helmholz Equation, Spontaneity and Temperature

Enthalpy Graphs

Major Assignments and/or Assessments:

Lab: Specific Heat Capacity of a Metal

Lab: Heat of Fusion of water

Lab: Hess' Law

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Structure of Matter (Atomic theory and atomic Structure)

Atomic and Quantum Theory; Periodicity;

Descriptive Chemistry (Relationships in the periodic table)

Content and/or Skills Taught:

Development & History of Modern Atomic theory

Quantum Theory: Quantum Numbers are solutions to the Wave Equation

Periodic Table and Periodicity: atomic & ionic radii, ionization energies, electron affinities and electronegativity

Major Assignments and/or Assessments:

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Chemical Bonding, Molecular Geometry and Intermolecular Forces of Attraction

States of Matter: Gases, Liquids, Solids and Solutions

Content and/or Skills Taught:

Binding forces: ionic, covalent and metallic bonding.
Molecular geometry and polarity
Lewis Structures, Resonance, radicals and formal charge analysis
Hybridization of atomic orbitals, sigma and pi bonds.
Lattice Enthalpy and the Born-Haber Cycle
Intermolecular Forces of Attraction
Relate forces of attraction to periodicity of elements and their physical properties.
The Phase Diagram: Pressure as a function of Temperature and the occurrence of Solids,
Liquids and Gases
The Triple Point and The Critical Temperature
Major Assignments and/or Assessments:
Lab: Molecular Models
Review packet with multiple choice and open response questions
Several Quizzes and a Unit Test

Unit Name or Timeframe:

Gas Laws & The Kinetic Molecular Theory

Content and/or Skills Taught:

Algebraic manipulation of all Gas Laws: Boyle, Charles, Gay-Lussac, Avogadro;
The Combined and the ideal Gas law; Mole Fraction & Dalton's Law of Partial
Pressures; Parameters for measuring and describing gases;
Postulates of the Kinetic Molecular Theory;
Deviations from Ideal Gas Behavior & Van der Waal's Equation
Gas Law Stoichiometry not at STP

Major Assignments and/or Assessments:

Lab: Molar Mass of a Volatile Liquid
Review packet with multiple choice and open response questions
Several Quizzes and a unit test

Unit Name or Timeframe:

Solutions and Colligative properties

Content and/or Skills Taught:

The Different Types of Solutions
The variety of methods to describe the concentration of a solution.
The Mechanics and Thermodynamics of the Solution Process
Factors affecting Solubility and Henry's Law
Ideal and Non-ideal Solutions
Vapor Pressures of a Solution: Raoult's Law
Colligative Properties Solutions
1. Boiling Point elevation
2. Freezing Point Depression
3. Osmotic Pressure
4. The Van't Hoff "i" Factor
Spectral Analysis and The Beer-Lambert Law

Major Assignments and/or Assessments:

Lab: Determining Concentration using the Beer-Lambert

Lab: Determine the Molar mass of an unknown solute
Review packet with multiple choice and open response questions
Several Quizzes and a Unit Test

Unit Name or Timeframe:

Kinetics, Rates of Reactions and Mechanisms

Content and/or Skills Taught:

Ways to Manipulate the Rate of a Chemical Reaction
The Method of Initial Rates & The Differential Rate Law
The Integrated Rate Laws: 1st, 2nd & '0'th order reactions
Determine the rate law from graphical analysis of data
The Arrhenius Equation: The Rate Constant, k as a function of temperature.
Reaction Mechanisms and the Rate Determining Step
Homogeneous and Heterogeneous Catalysis
The Haber Process and Rates of Reaction.

Major Assignments and/or Assessments:

Lab: Determine the Rate Law of the Reaction of Mg with HCl by Graphical Analysis.
Lab: Rates of Reaction and The Iodine Clock Reaction.
Review packet with multiple choice and open response questions
Several Quizzes and a Unit Test

Unit Name or Timeframe:

Chemical Equilibria

Content and/or Skills Taught:

The Law of Mass Action, The Mass-Action Expression and The Equilibrium Constant, K .
Calculations with K and The Mass-Action Expression.
 K_c & K_p .
The Reaction Quotient, Q and K : The Extinct of the Forward or Reverse Reactions.
Solving Equilibrium Problems by the ICE Box method using:
The Quadratic Formula; perfect squares;
Approximation and simplification techniques.
Le Chatelier's Principle and The Mass-Action Expression.
The Haber Process and the Economical Production of Ammonia.
Introduction to K_{sp} , the Solubility Product.

Major Assignments and/or Assessments:

Lab: Equilibrium and Le Chatelier's Principle
Lab: Determine the Solubility Product of Calcium Hydroxide
Review packet with multiple choice and open response questions
Several Quizzes and a Unit Test

Unit Name or Timeframe:

Applications of Aqueous Equilibria

Content and/or Skills Taught:

Review Arrhenius, Bronsted-Lowry and Lewis Acid/Base Theory

Review K_w , the Definition of pH & pOH: $\text{pH} + \text{pOH} = 14$

Solve a variety of Equilibrium/ice-box problems and

Determining the Concentration of all Species in the Beaker at Equilibrium

1. pH of a weak acid or base(aq)
 2. pH of a mixture of two weak acids or bases (aq)
 3. pH of a phosphoric acid (aq), a polyprotic acid
 4. pH of sulfuric acid
 5. pH of a Salt solution (hydrolysis)
 6. pH of a Buffered Solution, The Common ion Effect and The Henderson/Hasselbach Equation
 7. Develop graph for pH of a Weak Acid/Strong Base Titration
 8. Develop graph for pH of a Weak Base/Strong Acid Titration
- Selection and Mechanism of An appropriate Acid/Base indicator
Solubility Product and The Common Ion Effect
Solubility, pH; and the pH of insoluble hydroxides
Excess and Limiting Reagent Solution Stoichiometry Problem using Q , K_{sp} and then K_a or K_b if there is hydrolysis by a major species
Determine Initial Q ; Amount of precipitate; Concentration of all species at Equilibrium and pH of final solution if there is any hydrolysis by excess ions.
Selective Precipitation

Major Assignments and/or Assessments:

Lab: Effective pH range of a variety of indicators for Strong or Weak Acid Titration by a Strong Base.

Lab: Determine the $\text{p}K_a$ of a weak acid

Lab: Hydrolysis of Salt Solutions

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Electrochemistry

Content and/or Skills Taught:

Voltaic and electrolytic cells: Cell Diagrams;

The Nernst Equation to determine the cell potential at any time;

Algebraic cell Notation; Determine the Potential or the Voltage of a "battery"

A Concentration Cell

Electrolysis of water, $\text{NaCl}(l)$, $\text{NaCl}(aq)$ and various salt solutions.

Write Net Ionic Equations and determine the required cell potential.

Stoichiometry of Electrolysis and The Faraday Constant

Determine the Formation Constant of Tetraamminecopper(II)

Major Assignments and/or Assessments:

Lab: Electrochemical Cells: Develop a partial electrochemical 'activity' series.

A Concentration Cell

Lab: Determine the K_{sp} of AgCl

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Nuclear Chemistry, Radioactive decay, half-Life and the Rate Constant

Content and/or Skills Taught:

Nuclear Chemistry, Radioactive Decay, Half-Life and the Rate Constant

Major Assignments and/or Assessments:

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Intro to Organic Chemistry

Content and/or Skills Taught:

Structure, nomenclature, reaction patterns and properties of compounds with a variety of common organic functional groups.

Structural, geometric and optical isomers.

Oxidation and Reduction of organic compounds

Esterification, saponification and polymerization

Major Assignments and/or Assessments:

Lab: Do you smell? An Organic Odor/Functional Group Lab

Lab: Esterification; Emulsifying Agents and The Preparation and Properties of a Hand Cream.

Lab: Molecular Models and Isomers

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Complex ions and Coordination Compounds

A Lewis Acid Base interaction - Complex ions & Biochemistry

Content and/or Skills Taught:

Coordination compound & Complex ion nomenclature and formula writing.

Net Ionic equations: Formation and dissociation of Complex ions.

Lab: Make a silver mirror in a flask

Major Assignments and/or Assessments:

Review packet with multiple choice and open response questions

Several Quizzes and a Unit Test

Unit Name or Timeframe:

Review for The AP Chem Exam

Content and/or Skills Taught:

"Dress Rehearsal" a complete AP Chem Exam

Review Scoring rubrics for a selection of some old Open Response Questions

Students practice and present old AP Chem Open Response Questions on the Board

Students practice and present old Net Ionic Equations on the Board

Major Assignments and/or Assessments:

Students Practice the Full 2002 AP Chem exam and

Complete the Diagnostic Multiple Choice Analysis

Review packet with multiple choice and open response questions

Several Quizzes in style of AP Chem Open Response Questions.
At least one 90-minute 75-question multiple choice review test