AP CHEMISTRY COURSE SYLLABUS
FIRST SEMESTER

Instructor: Ken MacGillivray - kenneth.macgillivray@nhcs.net

Textbook: Chemistry-Zumdahl, 9th edition, 2014. ISBN: 978-1-133-61109-7

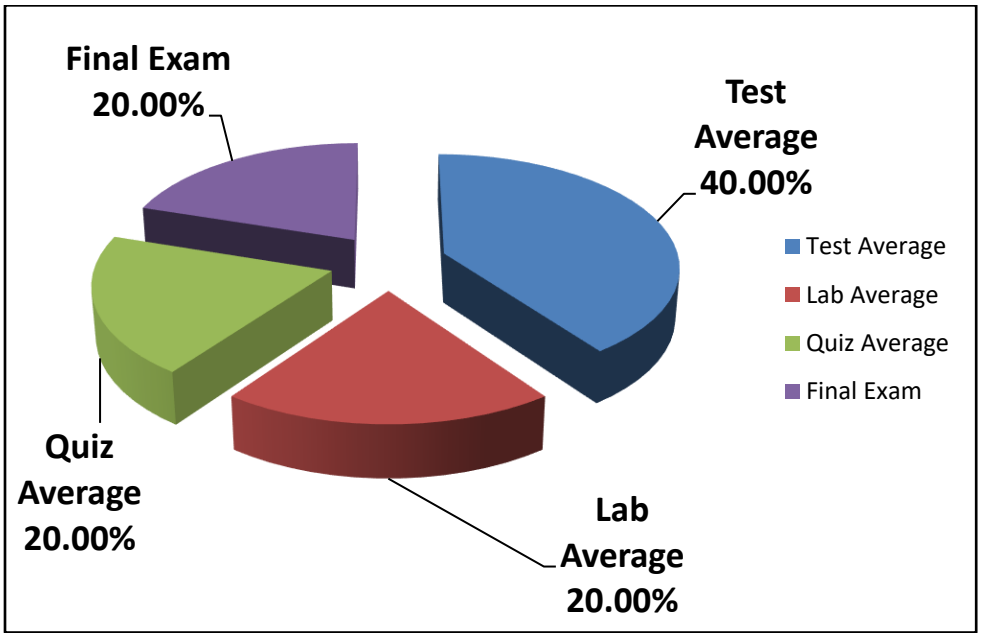
Supplies: notebook, lab notebook (will be supplied), graph paper, calculator

Extra Help: by appointment

GRADING SCALE:

A: 90-100 **B**: 80-89 **C**: 70-79 **D**: 60-69 **F**: 59 & below

GRADING SCHEME:



TOPICS TO BE COVERED:

Chapter 1 **Chemical Foundations (5 days)**

- Chemistry & science
- Measurement, uncertainty, significant figures
- Dimensional analysis
- Classifying matter

Chapter 2 **Atoms, Molecules, Ions (7 days)**

- Law of conservation of mass
- Atomic structure
- Molecules & ions
- The periodic table
- Naming simple compounds

Chapter 3 **Stoichiometry (8 days)**

- Atomic mass

- Molar mass
- Percent composition
- Determining the formula of a compound from lab (i.e., mass) data
- Chemical equations
- Stoichiometry, including limiting reagent calculations and percent yield calculations

Chapter 4 Chemical Reactions (8 days)

- Water, the common solvent
- Strong & weak electrolytes
- The composition of solutions
- A review of reaction types: synthesis, decomposition, single- and double-replacement, and combustion
- Precipitation reactions
- Acid-base reactions
- Oxidation-reduction reactions
- Balancing redox equations using the method of half-reactions

Chapter 5 Gases (8 days)

- Pressure
- Gas laws: Boyle's, Charles's, & Avogadro's Laws
- Dalton's Law
- Kinetic molecular theory of gases
- Graham's Law
- Real vs. ideal gases
- Chemistry in the atmosphere

Chapter 6 Thermochemistry (8 days)

- The nature of energy
- Heat, enthalpy, and calorimetry
- Hess's Law
- Standard enthalpies of formation

Chapter 7 Atomic Structure and Periodicity (8 days)

- Electromagnetic radiation
- Black body radiation and Planck
- Atomic spectrum of hydrogen
- Quantum mechanical model of the atom
- Quantum numbers and orbital shapes
- Electron configurations of polyelectronic atoms
- Periodic and group trends – atomic radii, ionic radii, electronegativity, ionization energy, electron affinity – and their observable manifestation in chemical behavior

Chapter 8 Bonding: General Concepts (7 days)

- Types of chemical bonds
- Electronegativity
- Bond polarity & dipole moments
- Ions: electron configurations & sizes
- Lattice energy calculations
- Partial ionic character of covalent bonds
- Covalent chemical bonds: a model
- Covalent bond energies & chemical reactions
- The localized electron bonding model
- Lewis structures
- Exceptions to the octet rule

- Resonance
- VSEPR & molecular geometry

Chapter 9 Covalent Bonding: Orbitals (7 days)

- Hybridization & the localized electron model
- The molecular orbital model
- Bonding in homonuclear diatomic molecules
- Bonding in heteronuclear diatomic molecules
- Paramagnetism, diamagnetism, ferromagnetism
- Delocalization of electrons

Chapter 10 Liquids and Solids (7 days)

- Intermolecular forces – hydrogen bonding, dipole-dipole interactions, London dispersion forces
- Liquids
- Types of solids – amorphous, crystalline, metallic
- Bonding in metals
- Network solids, molecular solids, ionic solids
- Vapor pressure & changes of state
- Evaporation vs. boiling, vaporization, and boiling point vs. normal boiling point
- Boiling point vs. intermolecular forces of attraction
- Phase diagrams

Chapter 11 Properties of Solutions (7 days)

- Solution composition and solution formation – a microscopic model
- Expressing solution concentration as molarity, molality, % volume by mass, and mole fraction
- The energies of solution formation
- Factors affecting solubility
- Vapor pressure of solutions
- Boiling-point elevation and freezing-point depression
- Osmotic pressure
- Colligative properties and electrolyte solutions

Chapter 12 Chemical Kinetics (10 days)

- Reaction rates
- Rate laws and the rate constant, *k*
- Determining the form of a rate law
- The integrated rate law
- Graphical analysis of time, concentration, and rate data to determine reaction order and the values of the rate constant
- Reaction mechanisms, activation energy, intermediates, and transition states
- A model for chemical kinetics
- The Arrhenius equation

PROBLEM SETS (Chemistry-Zumdahl, 9th edition, 2014)

Chapter 1	all odd problems	**Chapter 9**	all odd problems
Chapter 2	all odd problems	**Chapter 10**	all odd problems
Chapter 3	all odd problems	**Chapter 11**	all odd problems
Chapter 4	all odd problems	**Chapter 12**	all odd problems
Chapter 5	all odd problems		
Chapter 6	all odd problems		
Chapter 7	all odd problems		
Chapter 8	all odd problems		

LABS:

Title	AP Suggested Experiment
1. Significant figures, units, and density	
2. Paper chromatography	Separation by chromatography
3. Fractional crystallization	
4. Distillation	
5. Chemical formulas & Equations	
6. Chemical interactions (precipitation reactions)	
7. Gravimetric determination of silver in a dime	Analytical gravimetric determination
8. Formula of a hydrated crystal	Determination of the percentage of water in a hydrate
9. Synthesis of magnesium oxide	Determination of the formula of a compound
10. Mass-mole relationships in a chemical reaction	Determination of mass and mole relationship in a chemical reaction
11. Molar volume of H_2 gas	Determination of the molar volume of a gas
12. The ideal gas law (molar mass of butane)	Determination of molar mass by vapor density
13. Qualitative analysis: Group I cations	Separation and qualitative analysis of cations and anions
14. Qualitative analysis: Group III cations **– 2 days**	Separation and qualitative analysis of cations and anions
15. Qualitative analysis: spot tests	Separation and qualitative analysis of cations and anions
16. Redox Titration: Percent iron (II) in a salt by permanganate titration – **2 days**	Determination of concentration by oxidation-reduction titration (and standardization of a solution using a primary standard)
17. Constructing molecular models (molecular geometry lab)	(A hands-on activity; no formal lab report will be submitted)
18. Calorimetry: determination of specific heat of a metal	
19. Calorimetry: Hess's Law	Determination of enthalpy change associated with a reaction
20. Determination of molar mass by freezing-point depression	Determination of molar mass by freezing-point depression
21. Acid-catalyzed iodination of acetone	Determination of the rate of a reaction and its order

AP CHEMISTRY COURSE SYLLABUS
SECOND SEMESTER

Instructor: Ken MacGillivray - kenneth.macgillivray@nhcs.net

Textbook: Chemistry-Zumdahl, 9th edition, 2014. ISBN: 978-1-133-61109-7

Extra Help: by appointment

Lab Manuals:

Lab Manual for UNC Wilmington Chemistry 101L/102L, R. Ward and C. Kieber, Burgess Publishing, 1998. ISBN: 0-8087-7053-5

Laboratory Experiments for Advanced Placement Chemistry, Sally Ann Vonderbrink, Flinn Scientific, Inc., 1995. ISBN: 1-877991-34-1

Experiments provided at the AP Summer Institute (Wake Forest University, June 11-15, 2012)

SUPPLIES: notebook, lab notebook (will be supplied), graph paper, calculator

GRADING SCALE:
A: 90-100 **B**: 80-89 **C**: 70-79 **D**: 60-69 **F**: 59 & below

GRADING PROCEDURE:
1. MAJOR TESTS: 40% (8)
2. QUIZ/HW GRADES: 20% (20) These consist of free response questions from previous years and questions based on assigned book HW problems
3. LAB REPORTS: 20% (13) Lab reports include purpose, procedure, data analysis, error analysis and conclusion in student lab notebook
4. FINAL EXAM: 20%

TOPICS TO BE COVERED:

Chapter 13: Chemical Equilibrium (9 days) pp. 611 – 649

- Equilibrium – a microscopic description
- Equilibrium constant
- Equilibrium constant involving pressures
- Heterogeneous equilibria
- Applications of the equilibrium constant
- Solving equilibrium problems
- Calculating Q (reaction quotient) and using it to determine if a reaction is at equilibrium
- Using Q to predict the direction in which a reaction must proceed in order to reach equilibrium
- LeChâtelier's principle – shifting left, shifting right, and not changing in response to various factors

Chapter 14: Acid and Bases (9 days) pp. 657 – 711

- The nature of acids and bases
- Acid strength
- The pH scale
- Calculating pH of strong acid solutions
- Calculating pH of weak acid solutions
- Bases
- Polyprotic acids
- Acid-base properties of salts
- The effect of structure on acid-base properties
- Acid-base properties of oxides
- The Lewis acid-base model

Chapter 15: Applications of Aqueous Equilibria (10 days) pp. 719 – 781

- Solutions of acids or bases containing a common ion
- Buffered solutions
- Buffer capacity
- Titrations and pH curves
- Acid-base indicators
- Solubility equilibria and the solubility product
- Precipitation and qualitative analysis
- Equilibria involving complex ions

Chapter 16: Spontaneity, Entropy, & Free Energy (10 days) pp. 791 – 828

- Spontaneous processes and entropy
- Entropy and the Second Law of Thermodynamics
- The effect of temperature on spontaneity
- Gibbs free energy
- Entropy changes in chemical reactions
- Free energy, chemical reactions, and ΔG
- The dependence of free energy on pressure
- Free energy & equilibrium
- Free energy & work

Chapter 17: Electrochemistry (10 days) pp. 837 – 879

- A review of redox reactions in aqueous solution
- A review of balancing reox reactions in acidic and basic solution
- Galvanic cells
- Standard reduction potentials
- Cell potential, electrical work, and free energy
- Dependence of cell potential on concentration
- Electrolysis

Chapter 18: Nuclear Chemistry (2 days) pp.878 – 901

- Nuclear stability & radioactive decay
- The kinetics of radioactive decay
- Nuclear transformations
- Nuclear fission and nuclear fusion

Chapter 22: **Organic Chemistry (2 days)** **pp. 1044-1063**

- Alkenes, alkynes, alkanes
- Aromatic hydrocarbons
- Functional groups
- Nomenclature of simple hydrocarbons and substituted hydrocarbons

Chs. 1-18, 22: **Review for AP Exam (20 days)**

Outside reading **Special topics in chemistry and completion of lab notebooks(18 days)**

LABS:

Title	AP Suggested Experiment
1. Hydrolyzing salts lab	Determination of appropriate indicators for various acid-base titrations; pH determination
2. Preparation and properties of buffer solutions	Preparation and properties of buffer solutions
3. Potentiometric titration – **2 days**	Standardization of a solution using a primary standard Determination of concentration by acid-base titration, including a weak acid or weak base
4. Determination of unknown concentration of Co^{2+} using Beer's Law	Colorimetric or spectrophotometric analysis
5. K_{eq} for formation of [$FeSCN^{2+}$] ion	Determination of the equilibrium constant for a chemical reaction
6. Synthesis and Analysis of a Coordination Compound – **3 days**	Synthesis of a coordination compound and its chemical analysis
7. Activity series of metals	Determination of electrochemical series
8. Electrochemical Cells	Measurements using electrochemical cells and electroplating
9. Synthesis of aspirin – **2 days**	Synthesis, purification, and analysis of an organic compound
10. Synthesis of a polymer	Synthesis, purification, and analysis of an organic compound

- **10 experiments**
- **requiring 14 days @ 1.5 hrs per day**
- **= 21 hours of lab time**

PROBLEM SETS (Chemistry-Zumdahl, 9th edition, 2014.)

Chapter 13 all odd problems
Chapter 14 all odd problems
Chapter 15 all odd problems
Chapter 16 all odd problems
Chapter 17 all odd problems
Chapter 18 all odd problems
Chapter 22 all odd problems

Notes about AP Chemistry

1. All labs are completed by the students individually or in groups of 2. Each student will submit an original lab report; lab reports are not submitted collaboratively even though the experiments are completed collaboratively. Students will keep their lab reports after they have been graded and returned; these lab reports will be kept as a portfolio to be shown to future college professors who might wish to see them.
2. Total lab time is approximately 54 hours.
3. Labs are graded both qualitatively and quantitatively over the year.
4. Students have numerous quizzes over covered topics (approximately 40 per year).
5. Students are given old AP free response questions (approximately 3 to 5 per chapter) for homework or quizzes, collected and graded AP-style.
6. Tests always include multiple choice and free response questions given after a unit.
7. Students spend time in lab during class (approximately 54 hours in class) plus before school, after school, and during lunch due to the nature of some labs which cannot be continued over two separate lab days.
8. Descriptive chemistry is taught throughout the year, not as a separate unit. Examples:
    a. colors of complex ions/ solutions during reactions
    b. Transition metals with incomplete *d* orbitals having different colors
    c. Spot tests for ions
9. Students meet 90 minutes per day, 5 days per week, for 36 weeks. The first day of school is August 27, 2018. Therefore there are 31 weeks (155 days, or 233 hrs) of chemistry instruction prior to the AP exam on May 9th, 2019. 90 minutes is considered a double period in our school system; most courses (including the first-year chemistry course) meet once per day and are completed in one 18-week semester. Therefore, every day that AP Chemistry meets is a double period, and students enrolled in AP Chemistry receive two course credits for completing the two semester (36-week) AP Chemistry course.