AP Chemistry
Syllabus

Course Description:

In keeping with the objectives of the College Board, students enrolled in AP Chemistry will cover content equivalent to what is presented in two semesters of college general chemistry. Upon successful completion of this course and achievement of a satisfactory score on the AP Chemistry Examination, students may have the opportunity to receive general chemistry credits or place out of general chemistry classes and move into more advanced science courses during their first years in college.

During the first semester, students will review concepts presented during their first course of high school chemistry beginning with problem solving skills, data collection, significant figures, stoichiometry, and the basics of the periodic table and general properties of matter. Moving from this review foundation, students will study chemical reactions, solutions, properties of gases and thermochemistry before focusing in on a more in depth examination of the periodic table and chemical bonding.

Students will explore the intricate differences between solids and liquids as they begin the second semester. Properties of solutions and reactions of acids and bases follow logically after. In addition students will also study chemical kinetics, equilibria, spontaneity, free energy, entropy, and electrochemistry during the second half of this course.

Throughout both semesters of AP Chemistry, an emphasis will be placed upon problem solving skills, descriptive chemistry, development and use of models to explain chemical principles, and the prediction of products in chemical reactions. The skills and content offered in this course along with those in the laboratory and review components have been chosen to adequately prepare students for the AP Chemistry Examination and future success in college science courses.

Text:

Zumdahl, S. S. *Chemistry*, 6th ed. Boston: Houghton Mifflin, 2003.

Student edition with technology package: ISBN 0-618-34231-1
Student Solutions Manual ISBN 0-618-22163-8
Study Guide ISBN 0-618-22162-X (optional but suggested)

Calculator:

Any scientific calculator may be used.

Topic Outline – (for detailed schedule see the course outline)

- Chemical Foundations
- Atoms, Molecules, and Ions
- Stoichiometry
- Types of Chemical Reactions and Solution Stoichiometry
- Gases

    - Midterm Examination
- Thermochemistry
- Atomic Structure and Periodicity
- Bonding: General Concepts
- Covalent Bonding: Orbitals
    - Final Examination

Learning Outcomes

(Taken from the Instructor's Resource Guide for the text.)

CHAPTER ONE: CHEMICAL FOUNDATIONS

Section One:	To appreciate the importance of creative problem solving.
Section Two:	To identify the principal operations and limitations of the scientific method.
Section Three:	To describe the SI system of units and prefixes.
Section Four:	To identify causes of uncertainty in measurement. To show how significant figures are used. To compare precision and accuracy in measurement.
Section Five:	To show how to determine the number of significant figures in a calculated result.
Section Six:	To show how to convert units between the English and metric systems.
Section Seven:	To demonstrate conversions among the Fahrenheit, Celsius, and Kelvin temperature scales.
Section Eight:	To illustrate calculations involving density.
Section Nine:	To show how matter can be classified into subgroups.

CHAPTER TWO: ATOMS, MOLECULES, AND IONS

Chapter Learning Goals:

Section One:	To give a brief account of early chemical discoveries.
Section Two:	To describe and illustrate the laws of conservation of mass, definite proportion, and multiple proportions.
Section Three:	To describe Dalton's theory of atoms and show the significance of Gay-Lussac's experiments.
Section Four:	To summarize the experiments that characterized the structure of the atom.
Section Five:	To describe features of subatomic particles.
Section Six:	To introduce basic ideas of bonding in molecules. To show various ways of representing molecules.
Section Seven:	To introduce various features of the periodic table.
Section Eight:	To demonstrate how to name compounds given their formulas and to write formulas given their names.

CHAPTER THREE: STOICHIOMETRY

Chapter Learning Goals:

Section One:	To describe the modern atomic mass scale and explain how atomic masses are determined experimentally.
Section Two:	To explain the importance of the mole concept.

To show how to convert among moles, mass, and number of particles for a given sample.

Section Three: To show how to calculate values for molar mass.
To show how to convert among molar mass, moles, and number of particles in a given sample.

Section Four: To demonstrate the calculation of the mass percent of a given element in a compound.

Section Five: To demonstrate the calculation of the empirical formula of a compound.
To show how to obtain the molecular formula, given the empirical formula and the molar mass.

Section Six: To identify the characteristics of a chemical reaction and the information given by a chemical equation.

Section Seven: To show how to write a balanced equation to describe a chemical reaction.

Section Eight: To show how to calculate the masses of reactants and products using the chemical equation.

Section Nine: To show how to recognize the limiting reactant.
To demonstrate the use of the limiting reactant in stoichiometric calculations.

CHAPTER FOUR: TYPES OF CHEMICAL REACTIONS AND SOLUTION STOICHIOMETRY

Chapter Learning Goals:

Section One: To show why the polar nature of water makes it an effective solvent.

Section Two: To characterize strong electrolytes, weak electrolytes, and non-electrolytes.

Section Three: To define molarity and demonstrate calculations involving the composition of solutions.

Section Four: To introduce several types of solution reactions.

Section Five: To show how to predict whether a solid will form in a solution reaction.

Section Six: To describe reactions in solution by molecular, complete ionic, and net ionic equations.

Section Seven: To demonstrate stoichiometric calculations involving precipitation reactions.

Section Eight: To show how to perform calculations involved in acid-base volumetric analysis.

Section Nine: To characterize oxidation-reduction reactions.
To describe how to assign oxidation states.
To identify oxidizing and reducing agents.

Section Ten: To describe the half reaction method for balancing oxidation reduction reactions.

CHAPTER FIVE: GASES

Chapter Learning Goals:

Section One: To demonstrate atmospheric pressure and explain how barometers work.
To define the various units of pressure.
Section Two: To describe certain laws that relate the volume, pressure, and temperature of a gas and to do calculations involving these laws.
Section Three: To define the ideal gas law.
To show how to do calculations involving the ideal gas law.
Section Four: To define the molar volume for an ideal gas.
To define STP.
To show how to do stoichiometric calculations for reactions involving gases.
To show how to calculate molar mass from gas density.
Section Five: To state the relationship between partial pressures and total pressure and between partial pressure and mole fraction.
To show how to obtain the molecular formula, given the empirical formula and the molar mass.
Section Six: To present the basic postulates of the kinetic molecular theory.
To define temperature.
To show how to calculate and use root mean square velocity.
Section Seven: To describe effusion and diffusion.
To show the relationship between effusion and diffusion.
Section Eight: To describe how real gases deviate from ideal behavior.
To show how van der Waals's equation allows for real conditions.
Section Nine: To characterize the composition of the atmosphere.
To describe some of the chemistry of air pollution.

CHAPTER SIX: THERMOCHEMISTRY

Chapter Learning Goals:

Section One: To describe the energy flow between a system and its surroundings.
To discuss the first law of thermodynamics.
To show how to calculate the work that results from changing the volume of a gas at constant pressure.
Section Two: To define enthalpy and demonstrate calculations of the change in enthalpy in a chemical reaction.
To show how a change in enthalpy is measured by calorimetry.
Section Three: To discuss the characteristics of enthalpy changes.
To show how to calculate ΔH for a chemical reaction.
Section Four: To define standard states.
To show how to use standard enthalpies of formation to calculate ΔH° for a reaction.
Section Five: To discuss fossil fuels and the effects of their use on climate.
Section Six: To discuss energy alternatives.
To compare the available energy of various fuels.

CHAPTER SEVEN: ATOMIC STRUCTURE AND PERIODICITY

Chapter Learning Goals:

Section One:	To characterize electromagnetic radiation in terms of wavelength, frequency, and speed.
Section Two:	To introduce the concept of quantized energy. To show that light has both wave and particulate properties. To describe how diffraction experiments were used to demonstrate the dual nature of all matter.
Section Three:	To show that the line spectrum of hydrogen demonstrates the quantized nature of the energy of its electron.
Section Four:	To describe the development of the Bohr model for the hydrogen atom.
Section Five:	To show how standing waves can be used to describe electrons in atoms. To describe the Heisenberg uncertainty principle. To explain the significance of electron probability distributions.
Section Six:	To explain the quantum numbers n, l, and m_l.
Section Seven:	To describe the shapes of orbitals designated by s, p, d, and f and to discuss orbital energies.
Section Eight:	To define electron spin and the electron spin quantum number. To explain the Pauli exclusion principle.
Section Nine:	To show how the quantum mechanical model can be applied to atoms besides hydrogen.
Section Ten:	To trace the development of the periodic table.
Section Eleven:	To explain the Aufbau principle.
Section Twelve:	To show general trends in ionization energy, electron affinity, and atomic radius in the periodic table.
Section Thirteen:	To show what types of information can be obtained from the periodic table.

CHAPTER EIGHT: BONDING: GENERAL CONCEPTS

Chapter Learning Goals:

Section One:	To explain why an ionic bond is formed. To explain why a covalent bond is formed. To introduce the polar covalent bond.
Section Two:	To discuss the nature of a bond in terms of electronegativity.
Section Three:	To define the relationship between bond polarity and molecular polarity.
Section Four:	To show how to predict the formulas of ionic compounds. To discuss the factors governing ion size.
Section Five:	To define lattice energy and show how it can be calculated.
Section Six:	To show the relationship between electronegativity and the ionic character of a bond.
Section Seven:	To discuss the covalent bonding model.
Section Eight:	To show how bond energies can be used to calculate heats of reaction.

Section Nine:	To introduce the localized electron model.
Section Ten:	To show how to write Lewis structures.
Section Eleven:	To show how to write Lewis structures for certain special cases.
Section Twelve:	To illustrate the concept of resonance. To show how to write resonance structures.
Section Thirteen:	To describe how molecular geometry can be predicted from the number of electron pairs.

CHAPTER NINE: COVALENT BONDING: ORBITALS

Chapter Learning Goals:

Section One:	To show how special atomic orbitals are formed in covalent bonding.
Section Two:	To show how molecular orbitals are formed in a molecule. To define bond order and demonstrate how to calculate it.
Section Three:	To discuss the bonding in certain molecules of the general formula X_2. To relate paramagnetism to the filling of molecular orbitals. To correlate bond order, bond energy, and bond length.
Section Four:	To use the molecular orbital model to treat bonding between two different atoms.
Section Five:	To show how the need for resonance is eliminated if the localized electron and molecular orbital models are combined.

Assignments and Grading

There are four major types of assignments for this course: homework, discussion tasks, weekly quizzes and examinations. A brief description of each and the associated policies follows.

- ***Homework*** – Students will have a homework task that should be completed each day. The homework corresponds to the topics presented in the reading and lecture for a particular day and often requires the student to synthesize information and concepts from prior lessons. The majority of homework problems have been taken from the text, however there are also simulated lab exercises, questions about the AP examination, and other forms of homework.

  Homework solutions being submitted for grading should not only show the answer to a given problem, but should also clearly show all work involved in order to determine a final solution or an explanation of the problem-solving process used to determine the final answer. Homework will be uploaded for instructor review by the end of the day on which it is assigned and before students move to the next day's tasks. The instructor will review all homework submissions, add comments, and return the annotated work to the individual student.

  Homework will be graded for both completeness and accuracy. Students will receive 7 points for each assignment that is complete and submitted on time. In addition, the instructor will randomly select and grade the same 6

questions/problems on each student's homework for accuracy. The student will receive 0.5 points for each of these responses that is correct. The maximum score for each homework assignment is 10 points.

The homework grades for each particular student will be averaged and will constitute 20% of the student's final grade for the course.

- ***Discussion Tasks*** – There are two types of discussion tasks that will be used in this course, synchronous and asynchronous.

  During synchronous discussions students will "meet" with the instructor at least once per week in a one-hour chat. This forum provides an excellent opportunity for students to ask relevant questions, get help with problematic material, and make helpful suggestions to other students. There will be two synchronous discussions per week; students are required to attend at least one. Students are welcome to attend both discussions. There will be topics suggested in the Course Outline that will serve to guide the discussions, however any pertinent topic is allowed.

  Asynchronous discussions are threaded discussions during which students post responses to discussion questions that would be similar to those discussed in a face-to-face classroom setting. Students are required to post two answers each week to two separate questions (see Course Outline for questions and dates). By the last day of each week, students are required to read and respond to at least two of their classmates' postings.

  Discussions will comprise 20% of the student grade for this course. Each student response should be about 1-2 paragraphs in length. All responses should show that the student is not only reflecting on the question within the context of current material, but that he/she is also synthesizing ideas across topics addressed in the course. Students should provide support for their answers, citing examples from the text, the real world, and/or their own experiences. Postings will be graded on completeness, pertinence and accuracy of answer, timeliness of submission, and grammar and sentence structure.

- ***Weekly Quizzes*** – Each week students will complete a quiz on the current week's material. Quizzes are between 30 and 60 questions in length. Students will be required to complete each quiz within 2 hours of the time of download (force complete and 2 hour time limit). While completing the quizzes, students may use reference charts and a calculator as discussed in the class lecture notes. The questions on weekly quizzes are predominantly multiple-choice although the student may find a few true/false, problem solving, or fill in the blank. Each question on the quiz will be worth 1 point. Quiz grades will be averaged and will comprise 20% of the students' final grades for the course.

- ***Examinations*** – There are two examinations for this course. The midterm examination will be taken at the end of week four, before students begin week five. The final examination will be taken at the end of week eight and will be cumulative. Each examination will comprise 20% of the students' final grades for the class.

  The midterm examination does not have a multiple-choice component. The exam consists of 28 open-ended/free-response questions that will require students to show work while solving problems or to explain answers to conceptual questions. The point value associated with each question is written next to each item. Students may use calculators and the Periodic Table of the Elements while completing this examination. Students will have a maximum of four hours to complete this exam once they have downloaded it (force complete and time limit).

  The final examination has two parts. The first part of the exam consists of 100 multiple-choice questions (each question is worth 1 point and this section of the test is worth 50% of the students' final exam grades). Students may use a calculator and a Periodic Table of the Elements to complete this section. Students will have three hours to complete this section of the exam once they have downloaded it (force complete and time limit). The second section of the final examination contains 33 open-ended/free-response questions that will require students to show work while solving problems or to explain answers to conceptual questions. The point value associated with each question is written next to each item. This section of the exam is worth 50% of the students' final exam grades. Students may use calculators, a Periodic Table of the Elements, and the reference tables found in the Appendix of their text while completing this examination. Students will have a maximum of four hours to complete this portion of the exam once they have downloaded it (force complete and time limit).

Grading Scale

As a reminder from above, the students' grades for this class will be calculated on their average scores for each of the course assignments (homework, discussion tasks, quizzes, midterm examination and final examination).

The following weighting system will be used for the course:

Homework 20%
Discussion Tasks 20%
Weekly Quizzes 20%
Midterm Examination 20%
Final Examination 20%

The grading scale that will be used for the course is as follows:

A 90 –100%
B 80 – 89%
C 70 – 79%
D 60 – 69%

F 0 – 59%

Workload – Students should expect to spend a ***minimum*** of 15-20 hours a week studying and completing the course readings, lecture notes, homework sets, discussion tasks, weekly quizzes and examinations. Students must be self-motivated and inclined to keep a regular schedule in order to not only keep up with, but to achieve success in this rigorous course.