Chemistry 211 Principles of Chemistry I
Spring 2018 Section 201 CRN: 2366

Instructor: Phil Alexander **Phone:** 304-696-4808 **Office:** 408
Email: alexand1@marshall.edu **Class Time:** M, W, F, 9-9:50 **Classroom:** 473
Office Hours: 8:30-9AM M, W, F; 11-12 M, W; 12:15-1 T, R, 10-11R or by appointment

Text: *Principles of General Chemistry,* 3rd Edition, Silberberg; McGraw-Hill, 2013

Purpose of Course: To begin the general study of chemistry emphasizing the problem solving skills necessary to apply the concepts of chemistry to a variety of situations. Several basic topics will be explored this term. These topics include properties of matter, atomic structure, chemical reactions and stoichiometry, the periodic table, thermochemistry, introductory acid-base and oxidation-reduction reactions, electronic structure of atoms and quantum mechanics, bonding, molecular geometry, gas laws, and intermolecular forces. This course is intended for chemistry majors and pre-professional students.

Catalogue Description of the course: Principles of Chemistry I. 3 hrs. I, II, S.
A study of the properties of materials and their interactions with each other. Development of theories and applications of the principles of energetics, dynamics and structure. Intended primarily for science majors and pre-professional students. 3 lec. (PR or CR: CHM 217; PR: MTH ACT of 23 or better or *C* or better in CHM 111 or pass placement exam)

Course content and grading: Five tests will be given composed of multiple choice and free response (including problems) questions. The tests will make up 60% of the final grade. The final exam will count as 20% of the grade. Approximately 15 quizzes will be given and will represent 10% of the final grade. Approximately 1 in 5 quizzes will be dropped.
ALEKS online homework will represent 10% of your grade. The grading scale will be no higher than **A** $\geq$ 90%, **B** 80 to 89%, **C** 70 to 79%, **D** 60 to 69%, and **F** < 60%. I reserve the right to use any modification to this system leading to no lower grades.

Attendance:
Regular attendance is expected. No makeup tests or quizzes will be given unless prompt arrangements are made. Prompt makeup work is allowed. Makeup days are 2/22 or 4/26 (signup and a university excuse are required) for items not made up promptly.
Homework problems will be assigned for each chapter, will need to be completed online in ALEKS, and will be collected automatically for a grade. Problems similar to those on the homework will be included on the tests and quizzes.
Attendance, reading, and working the homework are essential for successful completion of this course. You should plan on working at least 2 hours outside of class for each hour in class.
Please seek me out if you want or need help. Should attendance problems arise, contact me before you miss if at all possible. Please be on time and do not disrupt class by coming in late.

The minimum ACT math score required as a prerequisite for CHM 211 is 23. A grade of C or better in CHM 211 is required for entry into CHM 212

Required Materials:

Text book as listed above

ALEKS (online homework) access for the textbook. This is available online from the publisher or with the textbook or alone from the bookstore. You must enter ALEKS through MUOnline

Simple non-programmable calculator: Please use a simple non-programmable calculator for exams and quizzes. Using a calculator to store information for a test is a reason for receiving a zero on that test. Academic dishonesty will not be tolerated. No alphanumeric calculators or cellphones, etc. are permitted during quizzes or tests.

Comments on success in this class:

1. **Keep up.** Do reading, videos, problems, etc. promptly.
2. **Ask for help.** Ask questions in class and seek out other students and the instructor during office hours for help. Study/homework groups are often helpful.
3. **Read before class to improve understanding.**
4. **Do the homework. View the posted PowerPoint's and videos.**
5. **Form a study group.** Study/homework groups are often helpful.

Electronic Device Policy: All cell phones and pagers must be turned to vibrate during class. The instructor reserves the right to answer any ringing cell phones during lecture, or to dismiss the offending student. Recording of lectures without the instructor's permission is prohibited. During examinations, all electronic devices except non-programmable calculators must be inaccessible. Students **MUST BRING A CALCULATOR** to class for all lectures and exams. Calculators that are part of a cell phone or PDA are not acceptable during an exam or quiz.

University Policies: All university policies, which can be found at this link http://www.marshall.edu /academic-affairs/policies/ will be observed.

Approximate Schedule*

Week of	Chapters	Week of	Chapters
1/8	1, 2	3/5	7
1/15	2, 3	3/12	7, 8
1/22	3	3/19	Spring Break
1/29	4	3/26	8, 9
2/5	4, 5	4/2	9
2/12	5	4/9	10
2/19	6	4/16	10, 11
2/26	6, 7	4/23	11

Tentative exam schedule*

Exam	Week of	Chapters
Exam I	1/29	1-3
Exam II	2/12	4, 5
Exam III	3/12	6, 7
Exam IV	4/9	8, 9
Exam V	4/23	10-11

Final Exam SATURDAY 4/28 9:50 AM

***The exam and lecture schedule may change based on the rate the class is progressing.**

If a test falls on a day that is cancelled by the university (e.g. a snow day), the test will occur on the next period the class meets. Please turn off cell phone ringers before class. Failure to do so may result in you being removed from the room, even during a test. You may not record my lectures without my permission and under no circumstances may they be posted, transferred, or reproduced to any form of media (Internet, print, television, and the like) without my permission.

Important Dates

1/8 First Day of Class, 1/15 MLK Day Holiday, 2/26 Freshman D &F midterm grades
3/16 Last day to drop individual courses, 3/19-3/24 Spring Break,
4/23- 4/27 Dead Week, 4/28 Final Exam **Saturday** 9:50 AM

The following objectives will be taught through 1) Reading text assignments, 2) Lectures, 3) ALEKS exercises, 4) Lab corequisite, students not taking CHM 217 are expected to review the concepts from the lab activities 5) quizzes and 6) questions assigned from each chapter.

Objectives will be assessed by 1) Quizzes (≅ 15), 2) Tests (5), 3) ALEKS exercises, and

4) Comprehensive final exam

Objectives for CHM 211:

At the end of each of the following chapters successful students will be able to:

Chapter 1 Keys to the Study of Chemistry

1. Distinguish between physical and chemical properties and changes
2. Define the features of the states of matter
3. Understand the nature of potential energy and kinetic energy and their interconversion
4. Understand the scientific approach to studying phenomena and distinguish between observation, hypothesis, experiment, and model
5. Use conversion factors in calculations
6. Distinguish between mass and weight, heat and temperature, and intensive and extensive properties
7. Use numerical prefixes and common units of length, mass, volume, and temperature in unit-conversion calculations
8. Understand scientific notation and the meaning of uncertainty; determine the number of significant figures and the number of digits after rounding
9. Distinguish between accuracy and precision and between systematic and random error

Chapter 2 The Components of Matter

1. Define the characteristics of the three types of matter—element, compound, and mixture—on the macroscopic and atomic levels
2. Understand the laws of mass conservation, definite composition, and multiple proportions; use the mass ratio of element-to-compound to find the mass of an element in a compound

3. Understand Dalton's atomic theory and how it explains the mass laws
4. Describe the results of the key experiments by Thomson, Millikan, and Rutherford concerning atomic structure
5. Explain the structure of the atom, the main features of the subatomic particles, and the significance of isotopes; use atomic notation to express the subatomic makeup of an isotope; calculate the atomic mass of an element from its isotopic composition
6. Describe the format of the periodic table and the general location and characteristics of metals, metalloids, and nonmetals
7. Explain the essential features of ionic and covalent compounds and distinguish between them; predict the monatomic ion formed from a main-group element
8. Name, write the formula, and calculate the molecular (or formula) mass of ionic and binary covalent compounds
9. Describe the types of mixtures and their properties

Chapter 3 Stoichiometry of Formulas and Equations

1. Realize the usefulness of the mole concept, and use the relation between molecular (or formula) mass and molar mass to calculate the molar mass of any substance
2. Understand the relationships among amount of substance (in moles), mass (in grams), and number of chemical entities and convert form one to any other
3. Find a mass percent and use it to find the mass of element in a given mass of compound
4. Determine the empirical and molecular formulas of a compound from mass analysis of its elements
5. Balance an equation given formulas or names, and use molar ratios to calculate amounts of reactants, and products for reactions of pure or dissolved substances
6. Understand why one reactant limits the yield of product, and solve limiting-reactant problems for reactions of pure or dissolved substances
7. Explain the reasons for lower-than-expected yields and the distinction between theoretical and actual yields, and calculate percent yield
8. Understand the meaning of concentration and the effect of dilution, and calculate molarity or mass of dissolved solute

Chapter 4 Three Major Classes of Chemical Reactions

1. Understand how water dissolves an ionic compound compared to a covalent compound and which solution contains an electrolyte; use a compound's formula to find moles of ions in solution
2. Understand the key events in precipitation and acid-base reactions and use ionic equations to describe them; distinguish between strong and weak acids and bases and calculate an unknown concentration from a titration
3. Understand the key event in the redox process; determine the oxidation number of any element in a compound; identify the oxidizing and reducing agents in a reaction
4. Identify three important types of redox reactions that involve elements; combination, decomposition, displacement

Chapter 5 Gases and the Kinetic-Molecular Theory

1. Explain how gases differ from liquids and solids
2. Understand how a barometer works and interconvert units of pressure

3. Describe Boyle's, Charles's, and Avogadro's laws, understand how they relate to the ideal gas law, and apply them in calculations
4. Apply the ideal gas law to determine the density of a gas at different temperatures, the molar mass of a gas, and the partial pressure (or mole fraction) of each gas in a mixture (Dalton's law)
5. Use stoichiometry and the gas laws to calculate amounts of reactants and products
6. Understand the kinetic-molecular theory and how it explains the gas laws, average molecular speed and kinetic energy, and the processes of effusion and diffusion
7. Explain why interparticle attractions and particle volume cause real gases to deviate from ideal behavior and how the van der Waals equation correct for the deviations

Chapter 6 Thermochemistry: Energy Flow and Chemical Change

1. Interconvert energy units; understand that ΔE of a system appears as the total heat and/or work transferred to or from its surroundings; understand the meaning of a state function
2. Understand the meaning of H, why we measure ΔH, and the distinction between exothermic and endothermic reactions; draw enthalpy diagrams for chemical and physical changes
3. Understand the relation between specific heat capacity and heat transferred in both constant-pressure (coffee-cup) and constant-volume (bomb) calorimeters
4. Understand the relation between heat of reaction and amount of substance
5. Explain the importance of Hess's law and use it to find an unknown ΔH
6. View a reaction as the decomposition of reactants followed by the formation of products; understand formation equations and how to use ΔH_f° values to find ΔH_{rxn}°

Chapter 7 Quantum Theory and Atomic Structure

1. Describe the relationships among frequency, wavelength, and energy of light, and know the meaning of amplitude; have a general understanding of the electromagnetic
2. Understand how particles and waves differ and how the work of Planck (quantization of energy) and Einstein (photon theory) changed thinking about it
3. Explain the Bohr model and the importance of discrete atomic energy levels
4. Describe the wave-particle duality of matter and energy and the theories and experiments that revealed it (particle wavelength, electron diffraction, photon, momentum, uncertainty principle)
5. Distinguish between ψ (wave function) and ψ^2 (probability density); understand the meaning of electron density diagrams and radial probability distribution plots; describe the hierarchy of quantum numbers, the hierarchy of levels, sublevels, and orbitals, and the shapes and nodes of s, p, and d orbitals; and determine quantum numbers and sublevel designations

Chapter 8 Electron configuration and Chemical Periodicity

1. Understand the periodic law and the arrangement of elements by atomic number
2. Describe the importance of the spin quantum number (m_s) and the exclusion principle for populating an orbital; understand how shielding and penetration lead to the splitting of energy levels into sublevels

3. Understand orbital filling order, how outer configuration correlates with chemical behavior, and the distinction among inner, outer, and valence electrons; write the set of quantum numbers for any electron in an atom as well as full and condensed electron configurations and orbital diagrams for the atoms of any element
4. Describe atomic size, ionization energy, and electron affinity and their periodic trends; explain patterns in successive ionization energies and identify which electrons are involved in ion formation (to yield a noble gas or pseudo—noble gas electron configuration)
5. Describe the general properties of metals and nonmetals and understand how trends in metallic behavior relate to ion formation, oxide acidity, and magnetic behavior; understand the relation between atomic and ionic size and write ion electron configurations

Chapter 9 Models of Chemical Bonding

1. Explain how differences in atomic properties lead to the three types of chemical bonding
2. Depict main-group atoms with Lewis electron-dot symbols
3. Understand the key features of ionic bonding, the significance of the lattice energy, and how the model explains the properties of ionic compounds
4. Depict the formation of binary ionic compounds with electron configurations, partial orbital diagrams, and Lewis electron-dot symbols
5. Describe the formation of a covalent bond, the interrelationship among bond length, strength, and order, and how the model explains the properties of covalent compounds
6. Understand how changes in bond energy account for ΔH°_{rxn} and be able to divide a reaction into bond-breaking and bond-forming steps
7. Describe the trends in electronegativity, and understand how the polarity of a bond and the partial ionic character of a compound relate to ΔEN of the bonded atoms

Chapter 10 The Shapes of Molecules

1. Use the octet rule to write a Lewis structure form a molecular formula
2. Understand how electron delocalization explains bond properties, and write resonance structures
3. Describe the three types of exceptions to the octet rule, draw Lewis structures for such molecules, and use formal charges to select the most important resonance structure
4. Describe the five electron-group arrangements and associated molecular shapes, predict molecular shapes from Lewis structures, and explain deviations from ideal bond angles
5. Understand how a molecule's polarity arises, and use molecular shaper and EN values to predict the direction of a dipole

Chapter 11 Theories of Covalent Bonding

1. Describe how isolated atomic orbitals mix to from hybrid atomic orbitals, and use the electron-group arrangement from VSEPR theory to postulate the hybrid orbitals of a central atom
2. Describe the modes of overlap that give sigma (σ) or pi (π) bonds, and explain the makeup of single and multiple bonds
3. Understand how MOs arise from AOs; describe the shapes of MOs, and draw MO diagrams, with electron configurations and bond orders; and explain properties of homonuclear diatomic species from Periods 1 and 2