

## CHEMISTRY 111, INTRODUCTORY CHEMISTRY

Instructor: Dr. Rickard  
Office: Caputo Hall 215  
Phone: 871-7142  
e-mail: [Lyman.Rickard@millersville.edu](mailto:Lyman.Rickard@millersville.edu)  
Zoom: 468-878-2686

### COURSE MATERIALS

1. Text: Chemistry: Structure and Dynamics, 5th Edition; J. N. Spencer, G. M. Bodner and L. H. Rickard; John Wiley & Sons, 2012, ISBN-13 978-0-470-587119
2. Chemistry: A Guided Inquiry, 7th Edition; Richard S. Moog and John J. Farrell, John Wiley & Sons, 2017. ISBN-9781119110705 .

A grade of C- or better (C or better for chemistry majors) in CHEM 111 is prerequisite for CHEM 112.

### TENTATIVE EXAM SCHEDULE

Exam 1	Chapters 1 - 2	February 10
Exam 2	Chapters 3 - 4	March 12
Exam 3	Chapters 5 - 6	April 7
Exam 4	Chapters 7 - 8	April 30
Final	Chapters 1 - 9	May 6 10:15-12:15

### HOMEWORK

Answers to the odd numbered homework problems are found in Appendix C. Answers to the Checkpoints are in Appendix D. Chapter 1: 4, 9, 10, 11, 14, 23, 27, 28, 30, 31, 35, 41, 43, 45, 47, 50, 53, 56, 57, 58, 61, 63, 65, 66, 67, 70, 73, 81, 83, 87, 89, 91, 95, 101, 103, 105 Know the name and symbols of the following elements: H, He, Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br, Sr, Ag, Sn, I, Ba, Pt, Au, Hg, Pb, Bi, U Name and symbols of the polyatomic ions in Table 1.6

Chapter 2: 3, 5, 9, 15, 17, 21, 23, 24, 27, 28, 29, 31, 33, 35, 41, 42, 45, 49, 51, 53, 57, 69, 71, 75, 79, 81, 85, 89, 91, 95, 96, 97, 99, 100, 103, 113, 114, 115, 19, 123, 127, 131, 133, 141

Chapter 3: 5, 7, 9, 11, 17, 19, 21, 23, 27, 28, 29, 31, 33, 37, 39, 41, 43, 45, 47, 50, 51, 54, 55, 57, 61, 63, 65, 75, 76, 77, 88, 89, 91, 113, 115, 116, 117, 121, 126, 127, 128, 131, 132, 133, 134, 136, 139, 141, 145, 147, 149, 151, 153, 155, 157, 162, 163, 165, 166, 169, 173, 177, 187

Chapter 4: 1, 3, 5, 9, 13, 15, 19, 25, 29, 31, 33, 35, 39, 43, 47, 51, 55, 57, 59, 67, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95, 103, 105, 109, 111, 113, 118, 121, 127

Chapter 5: 3, 7, 10, 16, 17, 25, 27, 29, 31, 35, 37, 41, 43, 47, 57, 63, 64, 65, 66, 67, 71, 72, 75, 76, 83, 87, 91, 95, 97, 99, 103, 107, 111, 113, 117, 119, 123, 125, 129, 131, 133, 138, 141

Chapter 6: 3, 5, 6, 7, 10, 15, 16, 19, 21, 25, 27, 29, 31, 35, 39, 41, 42, 44, 45, 51, 53, 57, 59, 61, 67, 71, 75, 77, 79, 81, 108

Chapter 7: 5, 6, 9, 15, 16, 19, 21, 31, 33, 40, 42, 44, 47, 51, 53, 55, 57, 59, 66, 70, 71, 75, 77, 81, 83, 91, 92, 107

Chapter 8: 1, 2, 7, 9, 10, 11, 13, 20, 23, 24, 29, 37, 38, 40, 45, 47, 55, 60, 63, 74, 75, 77, 79, 80, 81, 83, 90, 92

Chapter 9: 1, 5, 7, 8, 13, 17, 33, 36, 37, 39, 41

### GRADING SYSTEM

Exams (4)	400 pts
Quizzes\Worksheets	100 pts
Final Exam	100 pts
Laboratory:	<u>200 pts</u>
Total	800 pts

The lowest lecture quiz grade will be dropped at the end of the semester.

Letter Grade	Points	Percentage
A	736 - 800	92 - 100
A-	720 - 735	90 - 92
B+	704 - 719	88 - 90
B	656 - 703	82 - 88
B-	640 - 655	80 - 82
C+	616 - 639	77 - 80
C	544 - 615	68 - 77
C-	520 - 543	65 - 68
D+	512 - 519	64 - 65
D	488 - 511	61 - 64
D-	480 - 487	60 - 61
F	Below 480	< 60

A passing grade in the lecture component (360 pts of the possible 600) of the course must be achieved in order to receive a passing grade in the course. A grade of C for chemistry majors and C- for non-chemistry majors is required for second semester Introductory Chemistry, CHEM 112.

### **OFFICE HOURS**

Monday, Tuesday, Wednesday & Friday 9:00-11:00; Wednesday 10:00-11:00. I will be available in my office and on Zoom during office hours. Feel free to come by any time that I am in my office. If you have difficulty finding a time to meet with me, please make an appointment to see me.

### **ATTENDANCE**

Regular attendance is expected for all lectures, recitations and laboratories. If an absence results in a missed exam or quiz a Request For Excused Absence Form (attached to the end of the syllabus) must be submitted to the instructor. Absences are excused for personal illness, death or critical illness in the family, participation in a university-sponsored activity, jury duty, military duties, and religious holidays. Absences due to university activities must be discussed with the instructor in advance and arrangements made for making up the missed work. All missed work must be made up within one week of the student's return to class. If an exam or quiz is missed and the absence is excused, the final exam grade will be substituted for the missed work unless other arrangements have been made with the instructor.

### **STUDENT RESPONSIBILITIES**

You are responsible for all assigned work and material covered in class and lab. The average student will need to spend approximately 1 hour and 15 minutes preparation time for the course every day (including weekends) in order to receive an average grade. A higher grade will normally require additional study time. Two days of 5 hours each are not equivalent to an hour and 15 minutes each day. You should diligently prepare all assignments. When you encounter material which you cannot master alone you should seek help immediately. The primary source of help should be the course instructor. You will find my office hours listed in the syllabus and posted on my office door. If you are having difficulty in the course I expect you to come see me.

### **PROBLEM ASSIGNMENTS/QUIZZES**

Frequent problem assignments will be made from the text. The problem assignments will not be collected and graded. Instead there will be frequent quizzes taken from the assigned problems and recitation worksheets. You are expected to read each chapter as it is being covered in lecture. Study the chapter in detail to increase your understanding of the material. In some cases reading assignments will be made which will not be covered in lecture. Study all assigned homework problems until you understand them (not just until you obtain an answer). Plan to work only a few new problems each night plus reading (60 minutes). Then review the problems from the previous night (15 minutes). You should be confident of the homework assignment before coming to class. The homework problems assigned are the minimum number of problems you are expected to work. They represent a broad overview of the types of problems you are expected to understand. You are expected to work additional problems and to spend additional time on those problems that give you difficulty.

### **ACADEMIC HONESTY**

Students are expected to be familiar with the University's policy on academic honesty and dishonesty found in the *Student Handbook* and the *Academic Honesty and Dishonesty* brochure. Academic dishonesty includes cheating on an

exam or quiz, presenting another student's work as one's own in a laboratory report or notebook, fabricating data in a laboratory experiment. Students are encouraged to work together on homework assignments, preparation for exams and laboratory reports. However, the results submitted in a laboratory report must represent the students own work.

### **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

Eligibility for academic accommodations and related services for students with learning disabilities are coordinated by the Director and staff of the Office of Learning Services. Initial screening assessments for students who would like to determine if a learning disability exists should make an appointment. Students are made eligible for services on an individualized basis. Accommodations may include but are not limited to academic accommodations, auxiliary aids, extended test times, and note takers.

### **TITLE IX POLICY**

Millersville University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment, comply with Title IX of the Education Amendments of 1972, 20 U.S.C. §1681, et seq., and act in accordance with guidance from the Office for Civil Rights, the University requires faculty members to report to the University's Title IX Coordinator incidents of sexual violence shared by students.

The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report to the person designated in the University Protection of Minors policy incidents of sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred.

Information regarding the reporting of sexual violence, and the resources that are available to victims of sexual violence, is available at <http://www.millersville.edu/socialq/title-ix-sexual-misconduct/index.php>

### **COURSE OUTLINE**

Chapter	Topic
1	Chemistry: A Definition Elements, Compounds, and Mixtures Atomic Symbols Chemical Formulas Evidence for the Existence of Atoms The Role of Measurement in Chemistry The Structure of Atoms Atomic Number and Mass Number Isotopes The Difference Between Atoms and Ions Polyatomic Ions The Periodic Table The Macroscopic, Atomic and Symbolic Worlds of Chemistry The Mass of an Atom Chemical Reactions and the Law of Conservation of Atoms Chemical Equations as a Representation of Chemical Reactions Balancing Chemical Equations
2	The Mole as the Bridge Between the Macroscopic and Atomic Scales The Mole as a Collection of Atoms Converting Grams into Moles and Number of Atoms The Mole as a Collection of Molecules Percent by Mass Determining the Formula of a Compound Two Views of Chemical Equations: Molecules Versus Moles Mole Ratios and Chemical Equations Stoichiometry The Stoichiometry of the Breathalyzer

	The Nuts and Bolts of Limiting Reagents
	Density
	Solute, Solvent, and Solution
	Concentration
	Molarity as a Way to Count Particles in a Solution
	Dilution Calculations
3	Solution Stoichiometry
	Rutherford's Model of the Atom
	Particles and Waves
	Light and Other Forms of Electromagnetic Radiation
	Atomic Spectra
	The Wave-Packet Model of Electromagnetic Radiation
	The Bohr Model of the Atom
	The Energy States of the Hydrogen Atom
	Electromagnetic Radiation and Color
	The First Ionization Energy
	The Shell Model
	The Shell Model and the Periodic Table
	Photoelectron Spectroscopy and the Structure of Atoms
	Electron Configurations from Photoelectron Spectroscopy
	Shells and Subshells of Orbitals
	Orbitals and the Pauli Exclusion Principle
	Predicting Electron Configurations
	Electron Configurations and the Periodic Table
	Electron Configurations and Hund's Rules
	The Sizes of Atoms: Metallic Radii
	The Sizes of Atoms: Covalent Radii
	The Relative Sizes of Atoms and Their Ions
	Patterns in Ionic Radii
	Second, Third, Fourth, and Higher Ionization Energies
	Average Valence Electron Energy (AVEE)
	AVEE and Metallicity
4	Valence Electrons
	The Covalent Bond
	How Does the Sharing of Electrons Bond Atoms?
	Using Lewis Structures to Understand the Formation of Bonds
	Drawing Skeleton Structures
	A Step-by-Step Approach to Writing Lewis Structures
	Molecules That Don't Seem to Satisfy the Octet Rule
	Bond Lengths
	Resonance Hybrids
	Electronegativity
	Partial Charge
	Formal Charge
	The Shapes of Molecules
	Predicting the Shapes of Molecules (The Electron Domain Model)
	The Role of Nonbonding Electrons in the ED Model
	Bond Angles
	The Difference Between Polar Bonds and Polar Molecules
5	Metals, Nonmetals, and Semimetals
	The Active Metals
	Main-Group Metals and Their Ions
	Main-Group Nonmetals and Their Ions
	Transition Metals and Their Ions
	Predicting the Formulas of Ionic Compounds
	Predicting the Products of Reactions That Produce Ionic Compounds

	The Ionic Bond
	Structures of Ionic Compounds
	Metallic Bonds
	The Relationship among Ionic, Covalent, and Metallic Bonds
	Bond-Type Triangles
	Properties of Metallic, Covalent, and Ionic Compounds
	Oxidation Numbers
	Calculating Oxidation Numbers
	Oxidation–Reduction Reactions
	Nomenclature
6	Temperature
	Temperature as a Property of Matter
	The States of Matter
	Elements or Compounds That Are Gases at Room Temperature
	The Properties of Gases
	Pressure versus Force
	Atmospheric Pressure
	Boyle’s Law
	Amontons’ Law
	Charles’ Law
	Gay-Lussac’s Law
	Avogadro’s Hypothesis
	The Ideal Gas Equation
	Dalton’s Law of Partial Pressures
	Ideal Gas Calculations:
	The Kinetic Molecular Theory
	How the Kinetic Molecular Theory Explains the Gas Laws
7	Energy
	Heat
	Heat and the Kinetic Molecular Theory
	Specific Heat
	State Functions
	The First Law of Thermodynamics
	Work
	The Enthalpy of a System
	Enthalpies of Reaction
	Enthalpy as a State Function
	Standard-State Enthalpies of Reaction
	Calculating Enthalpies of Reaction
	Enthalpies of Atom Combination
	Using Enthalpies of Atom Combination to Probe Chemical Reactions
	Bond Length and the Enthalpy of Atom Combination
	Hess’s Law
	Enthalpies of Formation
8	The Structure of Gases, Liquids, and Solids
	Intermolecular Forces
	Relative Strengths of Intermolecular Forces
	The Kinetic Theory of Liquids
	The Vapor Pressure of a Liquid
	Melting Point and Freezing Point
	Boiling Point
	Phase Diagrams
	Hydrogen Bonding and the Anomalous Properties of Water
	Solutions: Like Dissolves Like
	Hydrophilic and Hydrophobic Molecules
	Why Do Some Solids Dissolve in Water?

Solubility Equilibria  
 Solubility Rules  
 Net Ionic Equations  
 Types of Solids  
 Molecular and Network Covalent Solids  
 The Physical Properties of Molecular and Network Covalent Solids  
 Metallic Solids  
 Physical Properties That Result from the Structure of Metals  
 The Structure of Metals  
 Ionic Solids

### Chemistry 111 Objectives:

Students are expected to:

#### Chapter 1

1. Classify matter into categories of elements, compounds and mixtures.
2. Learn the names and symbols of the common elements.
3. Use the SI system of units. Convert between the common SI units and SI and English units.
4. Maintain appropriate significant figures when performing calculations.
5. Know the major components of the atom and their relative masses and charges.
6. Distinguish between isotopes and ions.
7. Predict the formula of ionic compounds
8. Distinguish between metals, nonmetals and semimetals on the Periodic Table.
9. Describe the nomenclature of families, groups and periods in the Periodic Table.
10. Use and convert between temperature scales
11. Understand and use the concept of density.

#### Chapter 2

1. Determine the number of moles in a given mass.
2. Determine the mass of a given number of moles.
3. Determine the molar mass of a compound.
4. Determine the % composition from a molecular formula or the empirical formula from % composition.
5. Balance chemical equations.
6. Use stoichiometry to predict the moles or mass of a reactant or product.
7. Determine the limiting reagent and use it to predict the amount of product and the % yield.
8. Distinguish between solute, solvent and solution.
9. Determine the concentration of a solution from mass of solute or volume of known solution.

#### Chapter 3

1. Know the regions of the electromagnetic spectrum.
2. Calculate wavelength, frequency, and energy associated with electromagnetic radiation.
3. Understand how spectroscopy can be used as an investigative tool to understand the nature of the atom.
4. Understand the concept of energy levels and ionization energy of atoms.
5. Predict electron configuration of atoms. Relate electron configuration to position in the Periodic Table.
6. Know the periodic relationships of size of atoms and ions.
7. Determine the Average Valence Electron Energy (AVEE) for atoms. Relate AVEE to atomic properties.

#### Chapter 4

1. Determine the number of valence electrons for an atom.
2. Describe the sharing of electrons in a covalent bond.
3. Draw Lewis Structures for covalent molecules and polyatomic ions.
4. Use Lewis structure to describe resonance.
5. Use partial charge to explain the distribution of electrons in a bond.
6. Use formal charge to determine the best of several alternative Lewis structures.
7. Determine the shape of molecules and the electron distribution using Electron Domain Theory.
8. Determine if molecules are polar or nonpolar.

#### Chapter 5

1. Describe the main group metals, nonmetals and transition metals and their ions.
2. Predict the products of reactions that produce ionic compounds.

3. Describe the three dimensional structure of ionic compounds.
4. Describe and draw Lewis structures for ionic compounds.
5. Describe the electron distribution in metallic bonds.
6. Use bond type triangles to relate the bonding in metallic, covalent and ionic compounds.
7. Determine the oxidation number of an atom in a compound or ion.
8. Determine if a reaction is an oxidation-reduction reaction.
9. Name basic ionic compounds, binary covalent compounds and acids.

#### Chapter 6

1. Know the relationships in the simple gas laws.
2. Use the ideal gas law to calculate one of the variables.
3. Determine the density and molar mass of gasses.
4. Use Dalton's Law of Partial Pressures to describe mixtures of gasses.
5. Use the kinetic molecular theory to explain the gas laws on a molecular basis.

#### Chapter 7

1. Understand the First Law of Thermodynamics.
2. Understand the concept of a state function.
3. Use specific heat to determine the amount of heat gained or lost.
4. Calculate the enthalpy of reaction using enthalpies of atom combination.
5. Relate bond length to the enthalpy of atom combination.
6. Use Hess's Law and enthalpies of formation to determine the enthalpy of reaction.
7. Use calorimetry data to determine enthalpies of reaction.

#### Chapter 8

1. Describe the structure of gases, liquids and solids.
2. Describe the types and relative strengths of intermolecular forces.
3. Use intermolecular forces to predict relative boiling points and melting points of compounds.
4. Use phase diagrams to describe phase changes.
5. Describe phase equilibria and solubility equilibria.
6. Use intermolecular forces to predict the solubility of covalent molecules in molecular solvents.\
7. Use solubility rules to predict the solubility of ionic compounds in water.
8. Write net ionic equations to describe chemical reactions.

#### Chapter 9

1. Distinguish between ionic, network covalent, molecular and ionic solids.
2. Describe the forces that hold solids together.
3. Relate the structure of metals to their physical properties.
4. Determine the unit cell of a crystal.

**Request for Excused Absence** To be completed within one week of returning to class.

Student Name:

Dates of Absence:

Reason for Absence (circle one): personal illness, death or critical illness in the family, participation in a university-sponsored activity, jury duty, military duties, and religious holidays

I request this absence be excused and that: (check all that apply)

\_\_\_\_\_ my final exam grade be substituted for the missed lecture quiz or other arrangements with the instructor.

\_\_\_\_\_ my final exam grade be substituted for the missed test or other arrangements with the instructor.

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Attach documentation to support the request for an excused absence.