CHEMISTRY 111, INTRODUCTORY CHEMISTRY

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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
3. Laboratory Notebook: Duplicate page Laboratory Notebook; quadrille-ruled
4. Safety Glasses

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 11
Exam 2	Chapters 3 - 4	March 18
Exam 3	Chapters 5 - 6	April 8
Exam 4	Chapters 7 - 8	April 29
Final	Chapters 1 - 9	

LABORATORY SCHEDULE

Jan 19 & 20	Expt. 1	Measurements and Density; Part II
Jan 26 & 27	Expt. 2	Formula and Composition of a Hydrate; Part A
Feb 2 & 3	Expt. 2	Formula and Composition of a Hydrate; Part B
Feb 9 & 10	Expt. 6	Identification of Common Chemicals
Feb 16 & 17	Expt. 6	Identification of Common Chemicals
Feb 23 & 24	Expt.7	Titration of Acids and Bases; Part B only
March 2 & 3	Expt. 6	Identification of Common Chemicals
March 9 & 10		Spring Break
March 16 & 17	Expt.13	Molecular Models and Covalent Bonding
March 23 & 24	Handout	Boyle's Law
March 30 & 31	Handout	Pressure-Temperature
April 6 & 7	Expt. 12	Spectrophotometric Analysis of Aspirin, Part B
April 13 & 14	Expt. 12	Spectrophotometric Analysis of Aspirin, Part C
April 20 & 21	Expt. 11	Thermochemistry: The Heat of Reaction
April 27 & 28	Expt. 6	Identification of Common Chemicals Timed Test

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

CHEMISTRY PEER LEARNING HOURS: RODDY 256 Drop in – no appointment necessary.
Wednesday & Thursday: 2:00-4:00 and Tuesday, Wednesday & Thursday 5:00-7:00

GRADING SYSTEM

Exams (4)		400 pts
Quizzes\Worksheets		100 pts
Final Exam		100 pts
Laboratory:	Lab Notebooks (7 x 17 pts)	119 pts
	Experiment 6 flow chart	9 pts
	Timed Test	32 pts
	Lab Quizzes (8 x 5 pts)	40 pts
	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, Wednesday & Friday 9:00-10:30; Thursday 1:00-2:00
Feel free to come by any time that I am in my office. If you have difficulty finding a time to meet with me, 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, quiz or lab a Request For Excused Absence Form (attached to the end of the syllabus) must be submitted to the instructor. Absences are excused for illness, family emergencies or university activities. 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.

STUDENT RESPONSIBILITIES
You are responsible for all assigned work and material covered in class and lab. Work submitted after the due date will have points deducted unless prior arrangements have been made. 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 pop quizzes in lecture or recitation 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.

LABORATORY

You should read the lab safety rules found in the introduction of the laboratory manual. A copy of these rules must be signed and returned to the instructor at the first lab. You should bring your laboratory manual, laboratory notebook, and safety goggles to the first lab. Laboratory experiments should be done during the assigned laboratory period. Any work outside of this period must be approved by the course instructor; a chemistry faculty member must be available to supervise your work, and another student must be in the lab with you at all times. Before coming to lab you are expected to have diligently studied the experiment, written a one sentence purpose and outlined the procedure in your laboratory notebook. The pre-lab assignment should be completed but will not be handed in to the instructor. There will be a pre-lab quiz given in lab at the beginning of each new experiment.

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.

CLASSROOM ETIQUETTE

Arrive for class, recitation and laboratory on time. Turn off all cell phones while in class, recitation or lab. Cell phones may *not* be used as a calculator during quizzes or tests. Talking during lecture is a distraction to others who are trying to listen.

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
Solution Stoichiometry
3 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
9	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.

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/socialeq/title-ix-sexual-misconduct/index.php.

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

Student Name:

Dates of Absence:

Reason for Absence (circle one): Illness, Family Emergency, University Activity

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

_____ my final exam grade be substituted for the missed lecture quiz.

_____ my final exam grade be substituted for the missed test.

_____ my final exam grade be substituted for the missed pre-lab quiz.

_____ I be allowed to make-up the missed laboratory experiment. The lab must be made-up and the laboratory report submitted for grading within one week of returning to class.

Attach documentation to support the request for an excused absence.

THE LABORATORY NOTEBOOK

The laboratory notebook is a permanent record of your work in the laboratory. You must have your notebook with you in order to work in the lab. All notebooks must be permanently bound and begin with a table of contents. All entries should be in ink. Each page must be consecutively numbered and bear your name and date. The title, purpose, an outline of the procedure, and list of safety precautions must be in the notebook before coming to lab. Each section should have a clear label: (purpose, safety hazards, procedure, data). All data must be recorded in the notebook using correct significant figures and proper units. **Never write data on another sheet of paper with the idea of transferring it to the** notebook. Notebooks should be relatively neat and orderly, however, data should never be recopied into another notebook. If an error is made, do not obliterate the data (also do not use white out, tear out pages or tape in new pages). Draw a single line through any errors and record the correct value to the side.

The notebook is a record of your work as it is done. The notebook should be kept in such a way that the instructor can turn to any experiment and tell exactly what you did during the experiment. All data must include the appropriate units and be labeled to identify the data. All calculations, graphs, tables and assigned questions must be included in the notebook. You should review pages ten and eleven of your laboratory manual for more information on the laboratory notebook. All lab notebooks should be reviewed and initialed by the instructor at the end of each laboratory period.

A conclusion will be required for some lab reports. The conclusion should be one paragraph. It should list the major results of the experiment. This list of results should agree with the purpose of the experiment written at the beginning of the report. This should be followed by a statement describing whether you are confident in the results. The remainder of the conclusion should be an argument to convince the reader why you feel your results are appropriate or not. This argument can refer to the agreement between multiple trials, agreement with other student results, trends in the data such as a linear graph or other observations from the experiment.

Laboratory notebooks will be evaluated on the following criteria:

1. Each page: date completed and initials or signature
2. Format: organization, neatness, completeness
3. Purpose: describe what is being measured or determined
4. Procedure: outline of the procedure
5. Safety precautions
6. Data Presentation: significant figures, labels, neat tables and units
7. Results: quality of results
8. Conclusions: one paragraph (when requested)
9. Questions
10. Graphs: title, labels, units, equal increments on axis, full page size

Submitted Lab Reports must have the pages Stapled together.