

## Elements of Chemistry

**Instructor:** Dr. Terry                      Office A102a                      [tjerry@unm.edu](mailto:tjerry@unm.edu)  
**Lecture:** M/W 9-10:15 C101  
                 M 10:30-12:30 A128  
**Instructor Tutoring Hours:** Mon 1-3 pm (office)  
   **Tue 2-4 pm (STEM Center)**  
   Wed 10:30-12 am (office)  
   **Thurs 10:30-12 am (STEM Center)**

**Course Description:** Chem111 introduces the foundation of chemistry concepts exploring the connections between the atomic and the macroscopic world.

**Required Resources**

- Internet access: *Blackboard Learn and UNM email address must be checked regularly*
- A scientific calculator (have log, anti-log, exponential functions)
- Passing grade in Math 120

**Recommended Resources**

- 3-ring binder and paper for worksheets and notes, and pen/pencil for note-taking

**Additional Resources at UNM-VC**

- **Instructor** – STEM Center hours, Office hours, email, workshops, and review sessions
- **STEM Center** –tutors, molecular modeling kits, laptops, internet access
  - **Chemistry tutors and their hours will be posted on BBLearn**

*Reminder: When using tutors, it is the **students'** responsibility to make sure they understand well enough to complete the problems **on their own**.*

**Global Course Objectives:**

1. Increase student understanding of the chemical foundations of allied health applications.
2. Increase student confidence in applied math and science courses.
3. Increase student skills such as note taking, reading a textbook, and time management.
4. Increase student effectiveness at applying scientific concepts and principles to problem solving.

**Grading**

5 % iClicker Participation  
30 % Homework  
50 % Mid-Term Exams (5 exams, each count ~10% of the final grade)  
15 % Cumulative Final Exam

**Passing Grades:** 98-100% A+; 92-97% A; 90-92% A-; 88-89% B+; 83-87% B; 80-82% B-;  
78-79% C+; 73-78% C;                      **Non-passing Grades:** 69-72% C-; 60-68% D; <60% F

## Course Expectations

- **You are expected to bring a scientific calculator, pen/pencil, and paper to *each* class.**
- If you miss lecture, use your textbook, watch classroom capture, use other online resources, or ask another student for help filling in your notes. You CANNOT make-up missed in-class activities.
- Classroom behavior is expected to be professional and respectful of other students and the instructor:
  - **Arrive on time**
  - **Do not distract your classmates or the instructor away from the material**
  - **Actively participate in discussions, iClicker problems, and working groups**
- Students are responsible for all assignments regardless of attendance. You may submit worksheets via email or to the Academic Affairs Office **on the due date** for full credit.
- The last day to drop the course without a grade is **Feb 1<sup>st</sup>**. *If you have **any** unexcused absences before then, you may be dropped from the course without notice.*
- The UNM Blackboard Learn system will be used for class announcements and organization. Keep your contact information up to date and check the course page often.
- **NO CELL PHONES MAY BE USED DURING QUIZZES OR EXAMS.** Phone or smart pad (ie, iPad) use, for any reason, during quizzes or exams will be considered cheating.

## Textbook

- Selections from the OpenStax Chemistry textbook will be posted into weekly folders in BBLearn. This reference will be used for reading assignments, pre-class quizzes, and homework problems.

## In-class Clicker Problems

- iClickers will be provided by the instructor as needed. Arrive early enough to get your iClicker from the instructor BEFORE class begins. Return the Clickers at the end of class.
- Participation is mandatory and counts toward your grade.
- iClicker points are earned by student participation regardless of the answer.

## Homework (Classroom Activities, Worksheets, Quizzes, Textbook Problems, Exam Debriefs)

A variety of homework methods will be used in this class. Assignments and due dates will be posted in weekly folders in BBLearn. These assignments may include reading quizzes, worksheets, textbook problems, classroom activities, and classroom quizzes.

- All homework assignments must be turned in on the due date.
- Classroom activities, iClicker points, and quizzes must be completed during class. Quizzes take place at the beginning of class time. If you are late, you may miss the quiz entirely.

## BlackBoardLearn (BBLearn)

**\*\*\*Check BBLearn daily\*\*\***

All course information will be posted into BBLearn and organized into weekly folders. The folders will contain

- |                          |                          |
|--------------------------|--------------------------|
| • The reading assignment | • Worksheets             |
| • Due dates              | • Textbook problems      |
| • Reading quizzes        | • Supplemental resources |

## Exams

Each exam is cumulative with the five mid-term exams focusing on the specified chapters.

You may use a 3x5 inch index card with handwritten notes for each exam. You are expected to bring a calculator with log/antilog/exponential functions for each exam. You may not use your phone during exams. If you earn an average of 90% or higher on the mid-term exams, you are exempt from taking the final exam.

**Cheating on exams is taken very seriously and results in automatic and immediate failure of the course.**

### **How to succeed in Chem111**

- **Use learning objectives (see below) as a study guide.**
- **Read** the text before class. You don't have to understand it all, but you'll know what you need more help with before class begins and most of the terms discussed in class will be familiar.
- **Work all relevant sample problems** in the textbook.
- **Attend class, take notes** during lecture ESPECIALLY when covering example problems.
- **Ask questions** during class, during office hours, and during SI.
- **Attempt homework within 24 hrs of the lecture topic** while it is still fresh in your mind.
- **Use resources** including instructor office hours, tutors, SI sessions, workshops, study groups, and online help.
- **If you start to feel overwhelmed, GET HELP IMMEDIATELY!**

### **General Campus Policies**

#### **Academic Honesty**

*Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, including dismissal, against any student who is found responsible for academic dishonesty. Any student who has been judged to have engaged in academic dishonesty in course work may receive a reduced or failing grade for the work in question and/or for the course.*

*Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; and misrepresenting academic or professional qualifications within or outside the University.*

#### **Equal Access**

If you have a documented disability, please make sure Equal Access Services has contacted me as soon as possible to ensure that your accommodations are provided in a timely manner.

#### **Title IX**

In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education. This designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see:

<https://policy.unm.edu/university-policies/2000/2740.html>

#### **Equal Opportunity**

Harassment is a form of discrimination. When University faculty, administrators, and supervisors witness or receive a written or oral report or complaint of discrimination or harassment, they are required to engage in appropriate measures to prevent violations of this policy and promptly notify OEO, including notification of any actions taken to achieve informal resolution of the complaint. The University relies on its employees to notify the University's OEO office of all disclosures of discrimination and harassment as defined in this policy.

<https://policy.unm.edu/university-policies/2000/2720.html>

## **Exam 1 Material**

### **Elements, Atoms, Subatomic Particles, Isotopes**

Students should be able to...

1. Diagram the structure of an atom in terms of its subatomic particles.
2. Identify and correctly label elements, isotopes, and ions based on the composition of the nucleus and number of electrons.
3. Use the periodic table to classify an element as being a metal (forms cations) or nonmetal (forms anions). Identify main group elements and transition elements. Also identify the following groups: alkali metals, alkaline earth metals and halogens and recall the ions commonly formed by elements in these groups.
4. Justify the nuclear model of the atom with reference to Rutherford, Thompson's, Millikan's experiments, and the scientific method.

### **Combining Atoms: Ionic and Covalent Compounds and Their Names**

Students should be able to...

1. Describe the two different forms of bonding that connect atoms - IONIC or COVALENT. Use the periodic table to determine whether a species is molecular or ionic based on chemical formula.
2. Determine formulas of ionic compounds, including the use of polyatomic ions, and molecules from their systematic names.
3. Name molecular and ionic compounds using the IUPAC system of nomenclature.

### **Chemical Reactions: Classify, Balance, and Describe**

Students should be able to...

1. Identify and balance acid base, precipitation, and oxidation-reduction reactions.
2. Predict products of precipitation reactions using solubility rules and represent the process as a balanced chemical equation.
3. Predict the products of acid base reactions and represent the process as a balanced chemical equation.
4. Identify oxidizing and reducing agents in oxidation-reduction reactions.
5. Use the IUPAC system of nomenclature to describe chemical changes: convert from a descriptive sentence to a balanced chemical equation or from a balanced chemical equation to a descriptive sentence.

## **Exam 2 Material**

### **SI System, Calculations, Significant Figures**

Students should be able to...

1. Use the appropriate SI units and metric prefixes to express numbers in scientific notation.
2. Express the result of any set of simple mathematical operations on measurements to the appropriate number of significant figures.
3. Convert between units and prefixed units using dimensional analysis and develop a systematic approach to solving problems involving unit conversions and equations.

### **Chemical Quantities: Moles, Molar Mass, Molarity, Reaction Stoichiometry**

Students should be able to...

1. Determine and use molar mass to convert between mass, moles, and numbers of molecules.
2. Perform stoichiometric calculations for solids (relate the mass of reagents and products in a chemical reaction).
3. Define molarity and perform calculations involving the composition of solutions, including dilution calculations.
4. Perform stoichiometric calculations for solutions (relate volumes of reagents to quantities of products).

### **Gas Laws and Reactions of Gases**

Students should be able to...

1. Recall and use the gas laws (Boyle, Charles and Avogadro) to calculate properties of an ideal gas under changing conditions.
2. Relate atomic level behavior to macroscopic properties of gases.
3. Recall and use the ideal gas law,  $PV = nRT$  to calculate P, V, n or T given three of the four parameters.
4. Apply the ideal gas law to find number of moles from P, V and T conditions, and use this information in stoichiometric calculations.

### **Exam 3 Material**

#### **Electronic Structure of the Atom**

Students should be able to...

1. Describe the Bohr model of the hydrogen atom in terms of quantized circular orbits.
2. Sketch the shapes of orbitals designated by s, p, and d.
3. Write electron configurations and orbital diagrams for ground state atoms and ions by applying the Pauli exclusion principle, Hund's rule, the Aufbau principle, and the position of the atom in the Periodic Table.
4. Identify atoms based on electron configurations and orbital diagrams.
5. Use the positions of atoms in the Periodic Table to predict the relative values of periodic properties: atomic size, chemical reactivity, ion size, electronegativity.

#### **Chemical Bonding**

Students should be able to...

1. Define and describe how atoms form ionic and covalent molecules.
2. Use Lewis structures to represent the valence electrons of molecules and determine bond order and placement of non-bonding electrons.
3. Predict the shape of any given molecule by writing the Lewis structure and applying VSEPR to assign the positions of the bonding and non-bonding electrons pairs.
4. Use trends in electronegativity to determine bond polarity. Predict the relative polarity of covalent bonds.
5. Predict the relative polarity of covalent molecules using the bond polarity and VSEPR predicted shape of the molecule.

#### **Intermolecular Forces and Related Molecular Properties**

Students should be able to...

1. Use structure to classify molecules by their strongest intermolecular force: London Dispersion, Dipole-Dipole, or Hydrogen Bonding.

2. Use structure and intermolecular attractive forces to qualitatively predict the relative physical properties of molecules: solubility in water, solubility in nonpolar solvents, and boiling point.

## **Exam 4 Material**

### **Chemical Kinetics**

Students should be able to...

1. Tell the effects of variables (temperature, concentration, collision factors, catalysts, activation energy) on rate of reaction based on the collision model of reaction dynamics.
2. Explain rates and rate laws.
3. Determine reaction order/rate law/rate constant using the isolation method
4. Derive a rate law from a reaction mechanism; evaluate the consistency of a mechanism with a given rate law
5. Use the integrated rate law to calculate the concentration of a reactant at a given time, or calculate reaction time from a given concentration for a first order reaction.

### **Chemical Equilibrium**

Students should be able to...

1. Explain dynamic chemical equilibrium and its relation to reaction rates.
2. Describe the numerical meaning of the equilibrium constant  $K$ .
3. Write an equilibrium constant expression for a given chemical reaction.
4. Qualitatively and quantitatively relate the numerical value of the equilibrium constant to the equilibrium position and reactant/product concentrations, predict the direction of the reaction.
5. Predict how changes in reaction conditions (heat/pressure/addition or removal of a reactant or product) will affect the equilibrium position (Le Châtelier).

## **Exam 5 Material**

### **Acid-Base Reactions and Equilibria**

Students should be able to...

1. Describe the different models of acid-base behavior (Arrhenius, Brønsted-Lowry, and Lewis).
2. Recognize common acids and bases as strong or weak.
3. Calculate the pH and species concentrations for strong acid and base solutions.
4. Use ICE tables to calculate the pH when given a  $K_a$  and initial weak acid concentration.
5. Determine appropriate species and concentrations to create a buffer solution of a given pH.

WEEK	CHEM 111 TOPICS
1 Jan 14/16	<b>Monday</b> – Class Introduction, <b>What is an Atom WS</b> <b>Lab</b> – Create a Periodic Table, <b>Atom – Ion – Isotope WS</b> <b>Wednesday</b> – Nuclear model of the Atom
2 Jan 21-23	<b>Monday – MLK – no classes</b> <b>Wednesday</b> – <b>Element Quiz</b> , Naming of Ionic and Covalent Molecules
3 Jan 28/30	<b>Monday</b> – Polyatomic Ions and Nomenclature, <b>Nomenclature WS</b> <b>Monday Lab</b> - Balancing Precipitation and Acid/Base Reactions - <b>WS</b> <b>Wednesday</b> – <b>Polyatomic Ion Quiz</b> Predict Reaction Products, Identify Oxidizing and Reducing Agents <b>Friday, Feb 1<sup>st</sup> – Last day to drop with full refund</b>
4 Feb 04/06	<b>Monday</b> – Exam I (Atoms, Ions, Compounds, Reactions) <b>Monday Lab</b> – Unit Conversion Cards, SI System, and Significant Figures (WS) <b>Wednesday</b> – Moles, Mass, Molar Mass and Conversions
5 Feb 11/13	<b>Monday</b> – Stoichiometric calculations for solids in reactions using Molar Mass, <b>Stoich I WS</b> <b>Monday Lab</b> – Molarity, Solution Concentration Calculations, Dilution Calculations, <b>Molarity WS</b> <b>Wednesday</b> – Stoichiometry calculations for solutions in reactions using Molarity, <b>Stoich II Escape Room</b>
6 Feb 18/20	<b>Monday</b> – Boyle's, Charles' and Avagadro's Laws and Before/After gas calculations → PTV card trick <b>Monday Lab</b> – Ideal Gas Law and Stoichiometry Calculations <b>Wednesday</b> – <b>Gas Laws Escape Room</b>
7 Feb 25/27	<b>Monday</b> – Exam II (Unit Conversions, Sig Figs, Molar Mass, Molarity, Gas Stoichiometry) <b>Monday Lab</b> – Bohr Model of the Atom and Orbitals, Electron Config. <b>Wednesday</b> – <b>Electron Configurations WS</b> (Hund's Rule, Aufbau, and Pauli Exclusion Principles)
8 Mar 4/6	<b>Monday</b> – Periodic Trends <b>Monday Lab</b> – <b>Lewis Structures &amp; VSEPR Shapes WS</b> <b>Wednesday</b> – Bond and Molecular Polarity
9	<b>Spring Break</b> <b>Molecular Polarity Online Activity</b>
10 Mar 18/20	<b>Monday</b> – Intermolecular Forces WS <b>Monday Lab</b> - IMFs and Physical Properties Activity <b>Wednesday</b> – <b>Exam III (Electron Configurations, Molecular Structure and Polarity, Intermolecular Forces and Physical Properties)</b>
11 Mar 25/27	<b>Monday</b> – Collision Model of Kinetics, Rates, Rate Laws <b>Monday Lab</b> – Isolation Method of Determining Rate Laws <b>Wednesday</b> – Time Dependence of First Order Reactions and Calculations
12 Apr 1/3	<b>Monday</b> – Equilibrium Constant K <b>Monday Lab</b> – Calculate Concentrations Using K, Predict the Direction of Reactions <b>Wednesday</b> – Le Chatelier Principle
13 Apr 8/10	<b>Monday</b> – Review Kinetics <b>Monday Lab</b> - Le Chatelier Demos and WS <b>Wednesday</b> – <b>Exam IV (Kinetics and Equilibrium)</b>
14 Apr 15/17	<b>Monday</b> – Acid Base Definitions (Arrhenius, Bronsted Lowry, Lewis) and Examples, Strong Acids and Bases to KNOW <b>Monday Lab</b> – pH Scale, pH of Household Solutions <b>Wednesday</b> – Strong Acid/Base Calculations

15 Apr 22/24	<b>Monday</b> – Weak Acids and Ka Values <b>Monday Lab</b> – Buffered Solution Calculations
16 Apr 29 / May 01	<b>Monday</b> – Acid Base Review <b>Monday Lab</b> – Exam V - Acid Base and Buffers <b>Wednesday</b> – Exam I-II Review
Finals Week	<b>Review time TBD</b> <b>Final Exam (TBD)</b>

Dates are subject to change. Any changes will be discussed in class and posted onto Blackboard Learn with a revised schedule.