Chem 1215-501 **Fall 2019** **Course Syllabus**

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Course Overview

This course is the first of a two-semester introduction to the chemical and physical behavior of matter designed for science and engineering majors with a strong algebra background. Chem 1215 prepares students to succeed in science and engineering courses through the development of the quantitative and qualitative problem solving methods used in these fields of study.

Course Format

This is a 16-week fully online course. Assignments (reading quizzes, problem sets, and activities) will be accessed online through BBLearn or Mastering Chemistry and will count for 40% of your grade. Exams will be proctored in person and will count for 60% of your grade.

Course Requirements

- Chemistry: A Molecular Approach, 2nd, 3rd, or 4th Ed. by Nivaldo Tro
    - You can purchase or rent the e-text, hardcover, softcover, or loose leaf versions.
    - Mastering Chemistry Access Code – online homework
- Passing grade in Math121 (College Algebra) or its equivalent.
- Calculator with log/antilog and exponential functions (available for under $15)
- Access to the Internet: Blackboard Learn, Mastering Chemistry, and UNM email must be checked regularly.
- Access to a printer and file scanner (there are phone apps that work).
- Time: Each weekly unit will require 10-15 hours of work.

Instructor Contact Information

Instructor: Dr. Terry

Use any, or all, of the following to contact me throughout the semester. The best method is the method that is most convenient for you.

- **Course Messages**: I will check **Course Messages** in BBLearn each weekday and will respond within 24-48 hours to messages.
- **On-site office hours**: I will be on the UNM-Valencia campus on Tuesdays and Thursdays to teach the laboratory sections. I will be available to answer questions related to the course from 9-10:30 am. Please come during this time to discuss homework problems or other issues related to Chem 1215.
- **Zoom office hours**: Mon, Wed, and Friday 9-10:30 am or by appointment
- **UNM Email**: tjterry@unm.edu I check my email regularly, but student emails sometimes get buried in other campus emails. If I do not reply within 24 hours, send me a reminder email.

Course Help

- **Instructor**: The course instructor is the main source of information pertaining to the course. See the 'Instructor Contact Information' above to determine how best to contact the instructor.
- **BBLearn Discussion**: You may ask and answer student questions in the **Discussion Forum** on BBLearn.
- **On-Campus Tutoring**: The STEM Resource Center at the UNM-Valencia campus has tutors available for chemistry courses. You can drop-in, or call/email to make appointments. Phone: 505-925-8907 Email: tutor@unm.edu
- **Online Videos**: Each Unit in BBLearn contains links to various web sites that provide videos discussing many of the topics covered in this course. I will also post videos to assist in problem solving.

Time Frame

The course is divided into **16 Units**, one per week. Most units will require approximately 10-15 hours of effort by the student. Plan your schedule accordingly.

Units

Each Unit of new information will contain the following information:

- The Learning Objectives for the Unit.
- A checklist of the required work for the unit.
- A reading assignment from the textbook.
- Informational and problem solving videos.
- A reading quiz due **Monday**.
- A discussion board activity with a posting due by **Wednesday**.
- A problem set and/or an online activity that will be due by **Friday**.

You may work ahead as units are posted into BBLearn.
The units that include MidTerm Exams, Fall Break, and the Final Exam vary from the above schedule.

Sample Weekly Schedule

- Sat/Sun Read the assigned text and take bullet point notes. (2-4 hrs)
- Mon Watch videos to supplement information from the reading. (30 min)
  Complete the reading quiz. (15-30 min)
- Tue Begin the problem set/activity. (2 hrs)
  Refer to samples problems in the text and videos for guidance as needed.
- Wed Complete the Discussion Board posting. (10-20 min)
  Attend Zoom office hours to get help with problems. (1 hr as needed)
- Thurs Watch videos and complete problem set/activity. (2 hrs)
- Fri Attend Zoom office hours to get help with any problems. (1 hr)
  Correct problem set from the previous unit. (1 hr)
  Scan and submit problem sets.

Assignments

Reading Quizzes

Reading quizzes will consist of multiple-choice questions covering definitions, concepts, and simple calculations covered in the assigned text sections. They can be accessed in the appropriate Unit Folder and completed within BBLearn for immediate grading and feedback. These should be completed by **Monday**.

Discussion Board

A Unit Discussion Board prompt will be assigned for each unit. Respond to the prompt as requested. These prompts should be completed by **Wednesday**.

There will also be space in the Discussion Board to ask for help. Please check in periodically.

Discussion Board etiquette:

- Stay on topic.
- Be polite.
  I will delete posts if they stray too far off topic or are not polite.
- Posts and responses should be thorough and thoughtful. (Go beyond "I agree" and explain why or why not.)
- Use complete sentences.
- Include references. If another student is having trouble with a topic and you have a link to a good video that addresses it, or you know the paragraph in the text that answers their question, include that information in your response.

Problem Sets

Problem sets will be posted in Mastering Chemistry. The problem sets must be completed by **Friday** of each week. Late assignments will be given partial credit automatically through the Mastering Chemistry online system.

Activities

Other activities may be assigned for a unit. These activities may include case studies or online simulations. These may require worksheets that are completed online through BBLearn, or by hand and scanned with the problem sets. These will be due on **Friday**. There are apps that allow you to scan documents with the camera on your phone. Scanner Pro is the one I use and costs $4.

Exams

Exams must be taken in person at a pre-determined participating proctoring facility. You may choose the Student Testing Center at any UNM campus or another exam proctoring facility of your choice. Contact your instructor with your preferred testing facility by the end of week 2 of the semester. (This is a Unit 2 assignment.)

Bonus Points

Participation/Communication
Asking questions during office hours, either online through Zoom, or in person on campus, will count towards bonus points on your final grade of up to 3%.

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. It is up to you to obtain documentation of a disability. I will not guarantee accommodation without the appropriate documentation.

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 (see pg 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf). 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

Netiquette

One of the overriding principles in online conversations is to "craft your responses effectively." It is sometimes difficult to remember that there are real people reading posted messages. This is especially true of online communication where others do not have the opportunity to see body language or hear tone of voice; therefore, misunderstandings are more likely.

Please, follow these guidelines in all of your online responses and discussion postings.

- Honor everyone's right to an opinion.
- Respect the right of each person to disagree with others.
- Respond honestly but thoughtfully and respectfully; use language which others will not consider foul or abusive. You may also use emoticons to convey a lighter tone.
- Respect your own privacy and the privacy of others by not revealing information which you deem private and which you feel might embarrass you or others
- Be prepared to clarify statements which might be misunderstood or misinterpreted by others.

A Special Note about Anger

- Do not send messages that you have written when you are angry, even anonymous ones. In the online world, angry messages are known as "flaming" and are considered bad behavior. Venting and flaming are two different things. It is possible to vent without becoming "ugly." Stick to the facts, without name calling, of what is causing you frustration.
- Do not send messages that are written all in upper case; this is the visual equivalent of SHOUTING. It is considered aggressive and is considered bad behavior. If you ever feel like shouting a message, take a deep breath and wait until you have calmed down before responding. Then, respond in a calm and factual manner. Sometimes I type it all out in a Word Document to get it out of my system and then immediately delete it and start over.

Student Learning Objectives

Course Level Learning Objectives

1.Use dimensional analysis, the SI system of units and appropriate significant figures to solve quantitative calculations in science.
2.Explain the structure of atoms, isotopes and ions in terms of subatomic particles.
3.Understand the differences between physical and chemical changes to matter, and utilize the IUPAC system of nomenclature and knowledge of reaction types to describe chemical changes, predict products and represent the process as a balanced equation.
4.Apply the mole concept to amounts on a macroscopic and a microscopic level and use this to perform stoichiometric calculations including for reactions in solution, gases and thermochemistry.
5.Apply the gas laws and kinetic molecular theory to relate atomic level behavior to macroscopic properties.
6.Describe the energy conversions that occur in chemical reactions and state changes, relating heat of reaction to thermodynamic properties such as enthalpy and internal energy, and apply these principles to measure and calculate energy changes in reaction.
7.Use different bonding models to describe formation of compounds (ionic and covalent), and apply knowledge of electronic structure to determine molecular spatial arrangement and polarity.
8.Analyze how periodic properties (e.g. electronegativity, atomic and ionic radii, ionization energy, electron affinity, metallic character) and reactivity of elements results from electron configurations of atoms.

Exam level learning objectives

At the end of most learning objectives, there is a reference to a sample problem. These references are the same for both the 3rd and 4th editions of the textbook. The following symbols are used for these references:

CC = Conceptual connection problem within the chapter (answers at the end of the chapter)
Ex = Example within the chapter
EoC = End of chapter problems (answers in Appendix III)

Exam 1 Ch 1-3

By the end of these chapters, students will be able to…

Ch 1: Matter, Measurement, and Problem Solving

1. Define matter and classify a given substance by physical state.
2. Classify changes in matter as physical or chemical. (Ex 1.1 p 10)

3. Use the appropriate SI units and metric prefixes to express numbers in scientific notation. (Ex 1.4 p 21, Ex 1.5 p 23)
4. Use the concept of density in quantitative and qualitative problems involving masses and volumes. (Ex 1.8 p 29, Ex 1.10 p 31)
5. Report the result of any measurement to the appropriate number of significant figures. (Ex 1.6 p 24)
6. Express the result of any set of simple mathematical operations on measurements to the appropriate number of significant figures. (Ex 1.4 p 21, Ex 1.5 p 23, Ex 1.6 p 24)
7. Analyze a set of measurements for precision and or accuracy. (Ex 1.7-1.8 p 29)
8. Convert between units and prefixed units using dimensional analysis and develop a systematic approach to solving problems involving unit conversion and equations, including the conversion between the three commonly used temperature scales. (Ex 9 p 30, Ex 1.10 p 31)

Ch 2: Atoms and Elements

1. Use the laws of conservation of mass, definite proportions, and multiple proportions to justify Dalton's atomic theory. (Ex 2.1 p 49, Ex 2.2 p 50, CC 2.2 p 50)
2. Justify the nuclear model of the atom with reference to Rutherford, Thompson's, Millikan's experiments, and the scientific method. (CC 2.3 p 53).
3. Identify a set of isotopes from information on the composition of the nucleus. Use atomic notation to write the symbol of any isotope. (Ex 2.3 p 59, CC 2.4 p 59)
4. Identify an element or ion based on the composition of the nucleus and number of electrons. (CC 2.5 p 61, Ex 2.4 p 65)
5. Use the periodic table to classify an element as being a metal (forms cations), 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.
6. Define the mole and calculate and use average atomic masses to convert between mass, moles and numbers of atoms. (Ex 2.6 p 71, Ex 2.7 p 72, Ex 2.8 p 73, Ex 2.9 p 74)

Ch 3: Molecules, Compounds, Chemical Equations

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. (EoC 29 p 130)
2. Determine formulas of ionic compounds, including the use of polyatomic ions, and molecules from their systematic names. (EoC 33 & 35 p 131, Ex 3.2 p 95)
3. Name molecular and ionic compounds using their systematic names. (EoC 37, 41, 47, 49 p131)
4. Determine and use molar mass to convert between mass, moles, and numbers of molecules and atoms in molecules. (Ex 3.13 p 108)
5. Write and balance chemical equations to describe reactions. (Ex 3.22, 3.23, 3.24 p 120-122)

Exam 2 (Ch 4-6)

By the end of these chapters, students will be able to…

Ch 4: Chemical Quantities and Aqueous Reactions

1. Define molarity and perform calculations involving the composition of solutions, including dilution calculations. (Ex 4.1 p 143, Ex 4.2 p 144, Ex 4.5 p 153, Ex 4.7 p 156)
2. Define and give examples of strong electrolytes, weak electrolytes, and non-electrolytes. Draw molecular level pictures of each type of electrolyte to illustrate the relative degree of ionization in each.
3. Determine the products of a given precipitation reaction by considering the species present in solution and using a solubility table. (Ex 4.10 & 4.11 p 165)
4. Represent precipitation, acid-base, and gas evolution reactions in solution by molecular, complete ionic, and net ionic equations. (Ex 4.12 p 168, Ex 4.13 p 171)
5. Perform stoichiometric calculations involving precipitation reactions or acid-base neutralization reactions, including those involving limiting reagent. (Ex 4.14 p 173)
6. Define oxidation and reduction in terms of electron loss and gain. (Ex 4.17 p 179)
7. Assign oxidation states to simple ionic compounds and use oxidation state changes to identify redox reactions, oxidizing and reducing agents. (Ex 4.16 p 178, CC 4.8 p 179)
8. Write balanced equations for combustion reactions, precipitation, and acid-base reactions. (Ex 4.18 p 180, Ex 4.19 p 182)

Ch 5: Gases

1. Recall and use the gas laws (Boyle, Charles and Avogadro) to calculate properties of an ideal gas under changing conditions. (Ex 5.2 p 202, Ex 5.3 p 205, CC 5.1 p 205)
2. Recall and use the ideal gas law, PV = nRT to calculate P, V, n or T given three of the four parameters. (Ex 5.5 p 208, Ex 5.6 p 209)
3. Recall and use the molar volume for an ideal gas 22.42 L at STP (recall that STP is 0 °C (273K) and 1atm). (CC 5.2 p 210, CC 5.3 p 211, Ex 5.7 p 213)
4. Recall and apply Dalton's Law of Partial Pressures to calculate properties relating to mixtures of gases. Use and calculate mole fractions. (CC 5.4 p 216, Ex 5.9 p 216, Ex 5.10 p 218)
5. Apply the ideal gas law to find number of moles from P, V and T conditions, and use this information in stoichiometric calculations. (Ex 5.12 p 221, Ex 5.13 p 223)
6. Recall the three assumptions of Kinetic Molecular Theory and identify situations in which these assumptions fail.

Ch 6: Thermochemistry

1. Define potential energy, kinetic energy and work.
2. State the first law of thermodynamics.
3. Distinguish between heat and temperature. (CC 6.2 p 257)
4. Identify chemical bonds as the source of chemical potential energy.
5. Define energy flow INTO a system as a positive quantity, and energy flow OUT of a system as a negative quantity for the system. Apply the terms 'endothermic' and

'exothermic' to describe the flow of heat between a reaction and its surroundings. Relate these terms to the relative chemical potential energy of reactant and products. (Table 6.3 p 256)
6. Define and use specific and molar heat capacities to calculate temperature changes when heat is applied or removed. (CC 6.3 p 260, Ex 6.3 p 261)
7. Apply stoichimetry to determine enthalpy changes associated with reactions of particular masses of reactants or to form particular amounts of products. (Ex 6.7 p 270, CC 6.5 p 267)
8. Use specific or molar heat capacities to calculate the enthalpy of a reaction in a calorimeter (constant pressure or constant volume). (Ex 6.5 p 266, Ex 6.8 p 271)
9. Use the properties of enthalpy to calculate ΔH for a chemical reaction using Hess's Law. (Ex 6.9 p 274)
10. Look up standard enthalpies of formation for any substance and apply these to calculate $\Delta H°$ for a reaction. (Ex 6.10 p 276)

Exam 3 (Ch 7-10)

By the end of these chapters, students will be able to…

Ch 7: Electronic Structure of Atoms

1. Use the emission spectrum of hydrogen in the visible region to explain how this line spectrum supports a quantized model of energy levels in hydrogen. (Ex 7.7 p 322)
2. Describe the Bohr model of the hydrogen atom in terms of quantized circular orbits.
3. Use quantum numbers n, l, and m_l to describe orbitals. Recall and use the relationships between n, l and m_l to determine if any orbital is an allowed one, what type of orbital it is (s, p, d or f orbital), and how many orbitals there are in each l level. (CC 7.4-7.5 p 318, Ex 7.5-7.6 p 320)
4. Sketch the shapes of orbitals designated by s, p, and d. (Figure 7.28 p 327)

Ch 8: Periodic Properties

1. Write electron configurations and orbital diagrams for ground state atoms by applying the Pauli exclusion principle, Hund's rule, the Aufbau principle, and the position of the atom in the Periodic Table. Identify atoms based on electron configurations and orbital diagrams. (Fig 8.5 p 343, Ex 8.1-8.2 p 346)
2. Identify the principle quantum number and the number of valence electrons for an atom or ion and use this information to predict the relative reactivity, size, magnetism, and ionization energy of the atom or ion. (Ex 8.3 p 347, Ex 8.4 p 350)
3. Understand the concept of effective nuclear charge and how it affects atomic size. (Ex 8.5 p 356, Fig 8.12 p 359)

Ch 9: Lewis Model of Bonding

1. Describe covalent and ionic bonding with respect to orbitals. (CC 9.1 p 386, Ex 9.3 p 400)

2. Use Lewis structures to represent the valence electrons of molecules and determine bond order and placement of non-bonding electrons. (Ex 9.1 p 388, Ex 9.4-9.5 p 401, Ex 9.6 p 402)
3. Use formal charge considerations to determine the lowest energy resonance structure for a molecule. (Ex 9.7 p 404, Ex 9.8 p 406)
4. Use trends in electronegativity to determine bond polarity. Predict the relative polarity of covalent bonds. (CC 9.4 p 398)
5. Predict relative bond energies and bond lengths in related molecules. (CC 9.8 p 414, Ex 9.11 p 414)

Ch 10: VSEPR and Molecular Orbital Theory

1. 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. (CC 10.1 p 429, CC 10.2 p 431, Ex 10.1 p 432)
2. Compare bond angles in the series methane, ammonia and water to demonstrate that lone pairs repel more than bonded pairs of electrons. (Ex 10.2-10.3 p 438)
3. Draw dipole moments for bonds in molecules, and use these to predict whether a molecule will have a net dipole moment. (Ex 10.5 p 443)
4. Explain what hybridization is and why we invoke it in Valence Bond theory to describe bonding in covalent compounds.
5. Determine the appropriate hybridization of any atom in a molecule using the Lewis structure and the number of electron groups in it (2 to 6 groups). (CC 10.7 p 450)
6. Show how orbitals overlap to form new orbitals with sigma or pi symmetry. Explain why sigma overlap is greater than pi overlap and describe the implications for bond strength. (CC 10.8 p 454)
7. Analyze a given organic 'skeleton' structure to determine geometry of any given atom and the number of sigma bonds and pi-bonds in the structure. (Ex 10.6-10.7 p 459, Ex 10.8 p 460)
8. Draw molecular orbital diagrams for homonuclear diatomics from hydrogen to fluorine and their anion and cation forms. Use MO diagrams to predict bond order, relative bond lengths and strengths, and paramagnetism. (Ex 10.9 p 464, Fig 10.5 p 468)

Course Schedule (subject to change as needed)

Unit Date	Topics	Readings
1 **Aug**	Online Learning Bullet Point Reading Metric System Unit Conversions Chemical/Physical Properties/Changes Significant Figures Precision vs Accuracy	**BPR handout** **Ch 1.1-1.8**
2 **Aug**	Dalton's Atomic Theory Isotopes Ions Periodic Table Mole Calculations	**Ch 2.1-2.9**
3 **Sep**	Chemical Bonds Chemical Formula Naming Inorganic and Molecular Compounds Using Molar Mass Balanced Chemical Equations	**Ch 3.1-3.6** **Ch 3.8-3.12**
4 **Sep**	**Exam 1 Practice** **Exam 1** **<u>Post Exam New Material</u>** Stoichiometry Limiting Reagent % Yield	**Ch 4.1-4.3**
5 **Sep**	Concentration (Molarity) Acid-Base Reactions and Gas Producing Reactions Precipitation Reactions , Writing Ionic and Net Ionic Equations, Identifying Spectator Ions	**Ch 4.4-4.?**
6 **Sep**	Oxidation-Reduction Reactions and Identifying Oxidizing and Reducing Agents Gas Equations	**Ch 4.?-4.9** **Ch 5.1-5.4**
7 **Oct**	Gas Mixtures Gas Stoichiometry Kinetic Molecular Theory and Real Gases	**Ch 5.6-5.7, 5.8, 5.10**
8 **Oct**	**Fall Break** **Stoichiometry Review Worksheet using Molar Mass, Molarity, and Ideal Gas Law**	Stoichiometry Review Week
9 **Oct**	Thermodynamics Calorimetry Hess's Law Heat Stoichiometry	**Ch 6.1-6.9**
10 **Oct**	**Exam 2 Practice** **Exam 2**	
11 **Oct**	Atomic Orbital shapes and sizes Periodic Table Valence electrons Electron configuration	**Ch 7.5-7.6** **Ch 8.1-8.5**
12	Periodic Trends: Size, Effective Nuclear Charge, Ionic	**Ch 8.6-8.9**

Nov	Radii, Electron Configuration, Ionization Energy, Electronegativity	
13 Nov	Lewis Dot Structures, Resonance Structures, Formal Charges, Octet Exceptions	**Ch 9.1-9.5**
14 Nov	Bond Polarity, Dipoles, Bond Characteristics VSEPR Theory	**Ch 9.6-9.11** **Ch 10.1-10.5**
15 Nov	Valence Bond Theory Molecular Orbital Theory	**Ch 10.8**
16 Dec	**Exam 3 Practice** **Exam 3**	
	Cumulative Final Exam	