CHEM 1215: General Chemistry I for STEM Majors

Spring 2020 – Section 501 – CRN 50420

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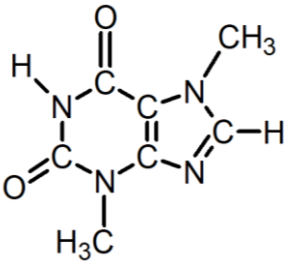
Office Hours: Monday 1:00 p.m. – 4:00 p.m.
Tuesday 2:00 p.m. – 4:00 p.m.
and other times by appointment

Meeting Times: Lecture: Monday & Wednesday 9:00 – 10:15 am, VAAS 140

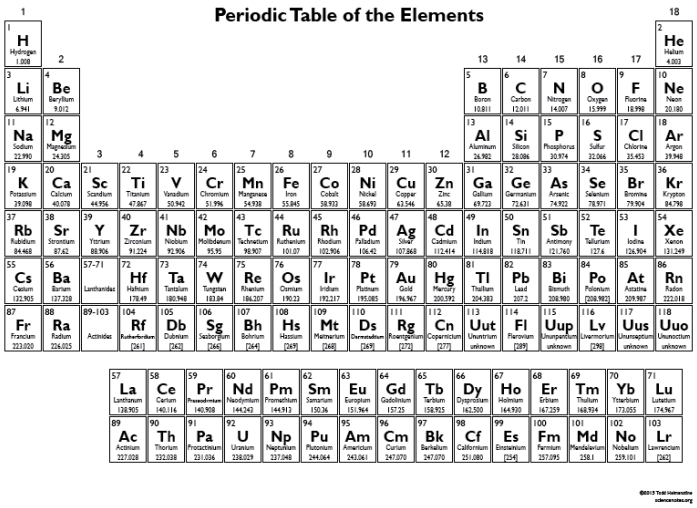
Course Description: The Study of stuff, and what it does (1st of a 2-course sequence)

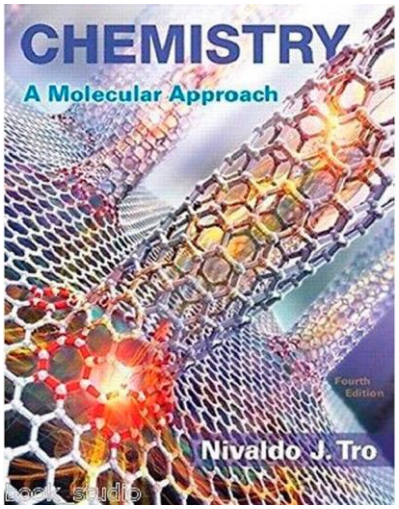
Course Description: Introduction to the chemical and physical behavior of matter. Credit for both this course and CHEM 1120C may not be applied toward a degree program. Meets New Mexico Lower-Division General Education Common Core Curriculum Area III: Science. Prerequisite: MATH 1220 or MATH 1230 or MATH 1240 or MATH 1250 or MATH 1430 or MATH 1440 or MATH 1512 or MATH 1522 or MATH 2530 or ACT Math =>25 or SAT Math Section =>590. Pre- or corequisite: 1215L.



What is this molecule? Tell me (email) for some extra credit!

Guess which one is the instructor's, and guess which one is has gone through various committees and perhaps a lawyer or two?





WHAT YOU'LL NEED
(Required Resources)

- Chemistry: A Molecular Approach
- Mastering Chemistry Access Code
- Calculator (non-graphing) with log/antilog and exponential functions
- Internet Access: *Blackboard Learn* and *UNM email address* ***must be checked regularly (daily)***

WHAT IF YOU NEED HELP?
(UNM-Valencia Resources)

- **Instructor**: Office hours, STEM Center Hours, email
- **STEM Center**: Tutors*, molecular modelling kits, Laptops, textbooks

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

WHAT WILL EACH CLASS BE LIKE?

- **Quiz**: covering material recently covered and any assigned preparation (reading, video, etc)
- **Course Business**
- **Group Activity:** collaborative exercise to help you master that day's topic
- **Reflection:** an opportunity to put the day's lesson into larger perspective, and formulate/ask questions

WHAT WILL MY ROUTINE BE LIKE?

- **Before Class**: complete any prepatory assignment (reading, video, etc.)
- **During Class:** work with your group to master concepts. The more you put in, the more you'll get out
- **After Class:** work on homework assignment relevant to that day's topic (review notes, **WORK ON PROBLEMS**, think of questions for office hour visits, etc.
- **Repeat 28 times!**

WHAT YOU'LL FIND USEFUL
(Recommended Resources)

- Notebook or binder for lecture notes, handouts, group activities
- Periodic table (on paper)
- Calculator (non-graphing) with log/antilog and exponential functions
- Mastering Chemistry notebook: keep track of problem solving, identify patterns, record areas of difficulty

HOW IS YOUR GRADE DETERMINED?
(Exams, Quizzes, Homework, and the Like)

	How Many	Weight
Class Points	1	10 %
Quizzes	24*	10 %
Homework	10	15 %
Exams	4	50 %
Final Exam	1	15 %
Total		**100 %**

* Approximate values

** Each equally weighted, 12.5 % each

WHAT DO I NEED FOR AN A?
(What's the grading scale?)

Earn This %	Get This Grade
98	A+
92	A
90	A-
88	B+
83	B
80	B-
78	C+
73	C
69	C-
67	D+
62	D
60	D-
55	F+
0	F

WHEN WE LEARN THIS STUFF?

(Schedule is approximate and subject to change by the instructor)

Class	Date	Topics/Events
1	Mon 20 Jan	Martin Luther King Day – No meeting
2	Wed 22 Jan	Nuclear Atom GA (2.5 – 2.6)
3	Mon 27 Jan	Dimensional Analysis GA (1.6 – 1.8)
4	Wed 29 Jan	Dalton's Atomic Theory (2.1 – 2.5)
5	Mon 03 Feb	Periodic Table, Average Atomic Mass GA (2.7 – 2.8)
6	Wed 05 Feb	Molar Mass (Counting by Weighing GA) (2.8)
7	Mon 10 Feb	Chemical Bonding, Formulas and Naming (3.1 – 3.7)
8	**Wed 12 Feb**	**Exam 1 (Chapters 1 & 2)**
9	Mon 17 Feb	Molar Mass, Balanced Chemical Equations (3.8 – 3.12)
10	Wed 19 Feb	Stoichiometry, L.R., % Yield, (4.1 – 4.2)
11	Mon 24 Feb	Solution Stoichiometry. Aqueous Solutions, Molarity (4.3 – 4.6)
12	Wed 26 Feb	Aqueous Reactions, Net Ionic Equations (4.7 – 4.9)
13	Mon 02 Mar	Ideal Gas Equation (5.1 – 5.4)
14	**Wed 04 Mar**	**Exam 2 (Chapters 3 – 4)**
15	Mon 09 Mar	Gas Mixtures, Gas Stoichiometry (5.6 – 5.7)
16	Wed 11 Mar	Kinetic Molecular Theory, Real Gases, Thermodynamics Intro (5.8, 5.10, 6.1 – 6.3)
	Mon 16 Mar	Spring Break (no meeting)
	Wed 18 Mar	Spring Break (no meeting)
17	Mon 23 Mar	Thermochemistry and Calorimetry (6.3 – 6.7)
18	Wed 25 Mar	Hess' Law and Reaction Enthalpies (6.8 – 6.9)
19	Mon 30 Mar	Atomic Orbitals and Shapes (7.5 – 7.6)
20	Wed 01 Apr	Electronic Configurations and Periodic Table (8.1 – 8.5)
21	Mon 06 Apr	**Exam 3 (Chapters 5 – 7)**
22	Wed 08 Apr	Periodic Trends (8.6 – 8.9)
23	Mon 13 Apr	Lewis Dot Structures (9.1 – 9.5)
24	**Wed 15 Apr**	Bond Polarity, Dipoles, Bond Characteristics (9.6 – 9.11)
25	Mon 20 Apr	VSEPR Theory (10.1 – 10.5)
26	Wed 22 Apr	Hybridization (10.6 – 10.7)
27	Mon 27 Apr	Bonding Review
28	Wed 29 Apr	**Exam 4 (Chapters 8 – 10)**
29	Mon 04 May	Molecular Orbital Theory (10.8)
30	**Wed 06 May**	Molecular Orbital Theory (10.8)
	Mon 11 May	**Final Exam (9:00 – 11:00 a.m.)**

Class Policies and Important Dates

- **Be There** Attendance in lecture and lab/recitation is mandatory. Students are expected to attend all meetings of the classes in which they are enrolled.
  - A student with excessive absences may be dropped from a course by the instructor with a grade of WP or WF or the student may receive a grade of F at the end of the semester.
  - I will exercise my discretion without notice to drop any student who:
    - misses the first two meetings;
    - has not completed any assignments in BB Learn and/or Mastering Chemistry by the end of the 2nd week;
    - after 2 consecutive unexcused absences; or after 4 total absences.
  - Excused absences must be authorized.
- **Be on time.** Lectures and labs/recitations will begin promptly. After 10 minutes, a student will be counted absent. Late arrival or early departure is unacceptable. Absences due to illness or any mitigating circumstance are unavoidable but must be documented or approved in advance. If you must miss a lecture or lab, email me ASAP in order to get your absence excused and discuss when you will turn in or make up any allowable assignments. Students are responsible for all assignments regardless of attendance.
- **Your job begins when class ends:** Electronic homework will be assigned regularly. Your answers are to be submitted and scored on Mastering Chemistry. Late homework will not be accepted.

Important Dates & Holidays	
Mon, 20 Jan 2020	University Holiday – Martin Luther King Day
Fri, 31 Jan 2020	Last day to register, ADD sections, and change credit hours on LoboWeb Enrollment cancellation for non-payment
Fri, 07 Feb 2020	Last Day to DROP without "W" grade and 100% tuition refund on LoboWEB,
Fri, 14 Feb 2020	Last Day to CHANGE grade option
Sun, 15 Mar 2020	University Holiday – Spring Break (through Sat, 22 Mar 2020)
Fri, 17 Apr 2020	Last Day to withdraw **WITHOUT** Dean's Permission
Fri, 08 May 2020	Last Day to withdraw **WITH** Dean's Permission
Mon 11 May 2020	Final Exam (for this section)

Course Learning Objectives

Unit Level Learning Objectives: Exam 1 (Chapters 1-2)

By the end of the chapter, 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.
3. Use the appropriate SI units and metric prefixes to express numbers in scientific notation.
4. Use the concept of density in quantitative and qualitative problems involving masses and volumes.
5. Report the result of any measurement to the appropriate number of significant figures.
6. Express the result of any set of simple mathematical operations on measurements to the appropriate number of significant figures.
7. Analyze a set of measurements for precision and or accuracy.
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.

Ch 2: Atoms and Elements

1. Use the laws of conservation of mass, definite proportions, and multiple proportions to justify Dalton's atomic theory.
2. Justify the nuclear model of the atom with reference to Rutherford, Thompson's, Millikan's experiments, and the scientific method.
3. Identify a set of isotopes from information on the composition of the nucleus. Use atomic notation to write the symbol of any isotope.
4. Identify an element or ion based on the composition of the nucleus and number of electrons.
5. Use the periodic table to classify an element as being a metal (forms cations), nonmetal (forms anions).
6. 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.
7. Define the mole and calculate and use average atomic masses to convert between mass, moles and numbers of atoms.

Unit Level Learning Outcomes: Exam 2 (Chapters 3-4)

By the end of the chapter, students will be able to…

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.
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 their systematic names.
4. Determine and use molar mass to convert between mass, moles, and numbers of molecules and atoms in molecules.
5. Write and balance chemical equations to describe reactions.

Ch 4: Chemical Quantities and Aqueous Reactions

1. Define molarity and perform calculations involving the composition of solutions, including dilution calculations.

2. Define and give examples of strong electrolytes, weak electrolytes, and non-electrolytes. Draw molecular
1. level pictures of each type of electrolyte to illustrate the relative degree of ionization in each.
2. Determine the products of a given precipitation reaction by considering the species present in solution and using a solubility table.
3. Represent precipitation, acid-base, and gas evolution reactions in solution by molecular, complete ionic, and net ionic equations.
4. Perform stoichiometric calculations involving precipitation reactions or acid-base neutralization reactions,
5. including those involving limiting reagent.
6. Define oxidation and reduction in terms of electron loss and gain.
7. Assign oxidation states to simple ionic compounds and use oxidation state changes to identify redox
8. reactions, oxidizing and reducing agents.
9. Write balanced equations for combustion reactions, precipitation, and acid-base reactions.

Unit Level Learning Outcomes: Exam 3 (Chapters 5-7)

By the end of the chapter, students will be able to…

Ch 5: Gases

1. Recall and use the gas laws (Boyle, Charles and Avogadro) to calculate properties of an ideal gas under changing conditions.
2. Recall and use the ideal gas law, PV = nRT to calculate P, V, n or T given three of the four parameters.
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).
4. Recall and apply Dalton's Law of Partial Pressures to calculate properties relating to mixtures of gases. Use and calculate mole fractions.
5. Apply the ideal gas law to find number of moles from P, V and T conditions, and use this information in stoichiometric calculations.
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.
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.
6. Define and use specific and molar heat capacities to calculate temperature changes when heat is applied or removed.
7. Apply stoichimetry to determine enthalpy changes associated with reactions of particular masses of reactants or to form particular amounts of products.
8. Use specific or molar heat capacities to calculate the enthalpy of a reaction in a calorimeter (constant pressure or constant volume).
9. Use the properties of enthalpy to calculate ?H for a chemical reaction using Hess's Law.
10. Look up standard enthalpies of formation for any substance and apply these to calculate ΔH° for a reaction.

By the end of the chapter, 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.
2. Describe the Bohr model of the hydrogen atom in terms of quantized circular orbits.
3. Use quantum numbers n, l, and ml to describe orbitals. Recall and use the relationships between n, l and ml 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.
4. Sketch the shapes of orbitals designated by s, p, and d.

Unit Level Learning Outcomes: Exam 4 (Chapters 8-10)

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.
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.
3. Understand the concept of effective nuclear charge and how it affects atomic size.

By the end of the chapter, students will be able to…

1. **Ch 9: Lewis Model of Bonding**
1. Describe covalent and ionic bonding with respect to orbitals.
2. Use Lewis structures to represent the valence electrons of molecules and determine bond order and placement of non-bonding electrons.
3. Use formal charge considerations to determine the lowest energy resonance structure for a molecule.
4. Use trends in electronegativity to determine bond polarity. Predict the relative polarity of covalent bonds.
5. Predict relative bond energies and bond lengths in related molecules.

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.
2. Compare bond angles in the series methane, ammonia and water to demonstrate that lone pairs repel more than bonded pairs of electrons.
3. Draw dipole moments for bonds in molecules, and use these to predict whether a molecule will have a net dipole moment.
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).
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.
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.
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.

Other Things That Aren't Chemistry, But Are Still Important

(University Policies)

Equal Access Services

If you have a documented disability or psychological/medical condition that may affect your performance in this class, please register with Equal Access Services as soon as possible so I can provide your accommodations in a timely manner. EAS can provide a quiet place to take exams, additional time, and additional services if there is a documented need. For more information, please see their website at https://valencia.unm.edu/students/advisement-and-counseling/equal-access-services.html, or scan the following QR code:

Equal Access Services

A complete list of student services available in the UNM Valencia campus may also be found on the course UNM-Learn page.

Academic Integrity

Having academic integrity is paramount to your success in any class. Plagiarism or cheating is not tolerated. Any instance of this will result in a grade of zero for that assignment. Here is a QR code and link to the UNM Academic Dishonesty Policy:

Academic Integrity Policy

https://policy.unm.edu/regents-policies/section-4/4-8.html. The policy states:

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, up to and including dismissal, against any student who is found guilty of academic dishonesty or who otherwise fails to meet the expected standards. Any student 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 is defined as:

"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; misrepresenting academic or professional qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Sexual Misconduct and Gender Discrimination

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 page 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf). This designation requires that any report made to a faculty member, TA, or GA regarding sexual misconduct or gender discrimination must be reported to the Office of Equal Opportunity and the Title IX Coordinator. For more information on this policy, https://policy.unm.edu/university-policies/2000/2740.html or scan the QR Code below:

Title IX Policy