CHEM 1225: General Chemistry II for STEM Majors

Fall 2019 – Section 501 – CRN 64774

Instructor: Dr. Jerry Godbout

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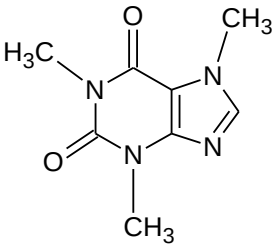
Office Hours: Monday 1:00 pm – 4:00 pm, Tuesday, 3:30 – 4:30 pm
Wednesday 3:00 pm – 4:00 pm, Thursday 9:00 am – 10:00 am,
and anytime by appointment

Meeting Times: Lecture: Monday & Wednesday 9:00 – 10:15 am, VAAS 127
Laboratory: Wednesday 10:30 am – 1:15 pm, VAAS 128

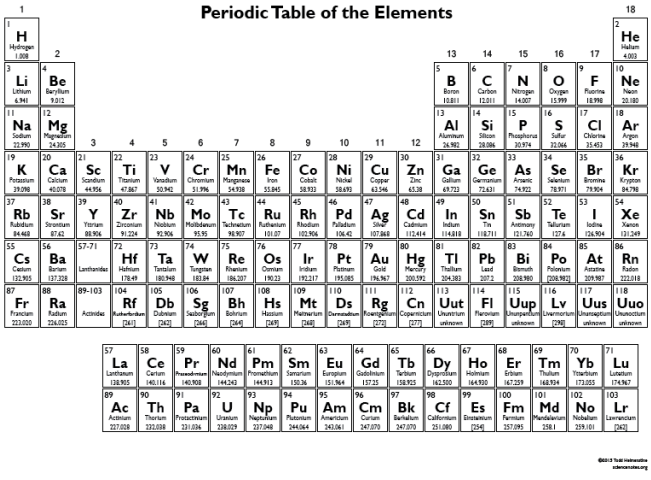
Course Description(s): The Study of stuff, and what it does (2nd of a 2-course sequence)
This course is intended to serve as a continuation of general chemistry prin ciples for students enrolled in science, engineering, and certain preprofes- sional programs. The course includes, but is not limited to a theoretical and quantitative coverage of solutions and their properties, kinetics, chemical equilibrium, acids and bases, entropy and free energy, electrochemistry, and nuclear chemistry. Additional topics may include (as time permits) organic, polymer, atmospheric, and biochemistry.

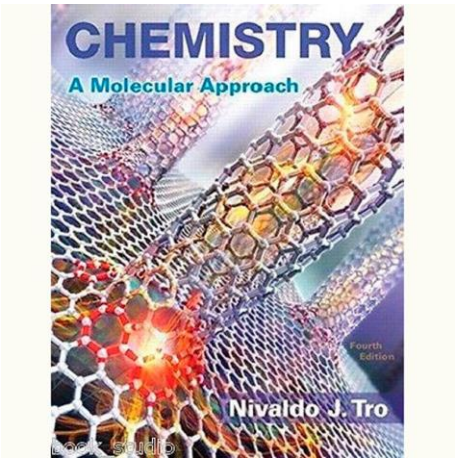


What is this mole- cule? Tell me (email) for some extra credit!

(3) Continuation of CHEM 1215 (121). Lecture: 3 hours. Co-requisite: CHEM 1225L. Prerequisite: CHEM 1215 (121) and CHEM 1215L (123L) or CHEM 131 with a grade of C or higher; ACT =>25 or SAT =>590 or MATH 1220 (121) or MATH 1230 (123) or MATH 1240 (150) or MATH 1250 (153) or MATH 1430 (180) or MATH 1440 (181) or MATH 1512 (162) or MATH 1522 (163) or MATH 2530 (264).Meets UNMCC – Area 3: Physical and Natural Sci- ences; meets NMCC– Area III: Laboratory Science.

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





COURSE/INSTRUCTOR COMMUNICATIONS

- Email is the most effective. Electronic communication for this course **MUST** be through your UNM email.
- When requesting an appointment (which I am always happy to schedule), please propose three (3) times that work for you in your initial request. This will simplify and quicken the process
- It is the responsibility of the student to keep up with course announcements. ***Check your UNM email and Blackboard Learn daily!***

WHAT YOU'LL NEED (Required Resources)

- Chemistry: A Molecular Approach (3rd or 4th ed)
- Mastering Chemistry Access Code (link on UNM Learn, course ID is MCGODBOUT0754646)
- Calculator (non-graphing) with log/antilog and exponential functions
- Internet Access: *Blackboard Learn* and *UNM email address* ***must be checked daily!***

WHAT YOU'LL FIND USEFUL (Recommended Resources)

- 3-ring binder for lecture notes, handouts, group activities
- Periodic table (on paper)
- Mastering Chemistry notebook: keep track of problem solving, identify patterns, record areas of difficulty

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**.

HOW IS YOUR GRADE DETERMINED?

(Exams, Quizzes, Homework, and the Like)

	How Many	Weight
Class Points	1	10 %
Quizzes	15*	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

WHAT WILL MY ROUTINE BE LIKE?

- **Before Class**: complete any prepatory assignment (quiz, 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, **WORK ON PROBLEMS,** etc.
- **Repeat 30 times!**

WHAT WILL EACH CLASS BE LIKE?

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

Other Things That Aren't Chemistry, But Are Still Important
(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 4 total 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 and late assignments 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	
Fri, 30 Aug 2019	Last day to register, ADD sections, and change credit hours on LoboWeb Enrollment cancellation for non-payment
Mon, 02 Sep 2019	University Holiday – Labor Day
Fri, 06 Sep 2019	Last Day to DROP without "W" grade and 100% tuition refund on LoboWEB, Last Day to CHANGE grade option
Thu, 10 Oct 2019	University Holiday – Fall Break
Fri, 08 Nov 2019	Last Day to withdraw **WITHOUT** Dean's Permission
Thu, 28 Nov 2019	University Holiday – Thanksgiving
Fri, 07 Dec 2019	Last day to change grading options Last Day to withdraw **WITH** Dean's Permission
Wed 12 Dec 2018	Final Exam (for this section)

WHEN WE LEARN THIS STUFF?

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

Meeting	Date	Topics/Events
1	Mon 19 Aug	Syllabus, Review: Lewis Structures, VSEPR, Polarity
2	Wed 21 Aug	Intermolecular Forces, Phase Changes, Relative BP (11.4 – 11.8)
3	Mon 26 Aug	Solutions and Solubility (13.1 – 13.5)
4	Wed 28 Aug	Colligative Properties (13.6 – 13.7)
	Mon 02 Sep	Labor Day – No Meeting
5	**Wed04 Sep**	**Exam 1: CHEM 121 Review, Chapters 11, 13**
6	Mon 09 Sep	Kinetics: Introduction (14.1 – 14.3)
7	Wed 11 Sep	Kinetics: Integrated Rate Laws (14.4)
8	Mon 16 Sep	Kinetics: Temp Dependence and Mechanisms (14.5 – 14.7)
9	Wed 18 Sep	Kinetics: Review
10	Mon 23 Sep	Equilibrium: Intro (15.1 – 15.5)
11	Wed 25 Sep	Equilibrium: ICE Tables (15.1 – 15.8)
12	Mon 30 Sep	Equilibrium: Q and LeChâtelier's Principle (15.7 – 15.9)
13	Wed 02 Oct	Equilibrium: Review
14	**Mon07 Oct**	**Exam 2: Kinetics and Equilibrium (Chapters 14, 15)**
15	Wed 09 Oct	Acids/Bases: Definitions, K_a, K_w, pH scale (16.1 -16.5)
16	Mon 14 Oct	Acids/Bases: Weak acid/base equilibria (16.6 – 16.7)
17	Wed 16 Oct	Acids/Bases: Weak acid/base equilibria (cont) (16.6 – 16.7)
18	Mon 21 Oct	Acids/Bases: Salts, Polyprotic Acids, Lewis Definition
19	Wed 23 Oct	Equilibrium: Buffers (17.1 – 17.3)
20	Mon 28 Oct	Equilibrium: Weak A/B titrations (17.4)
21	Wed 30 Oct	Equilibrium: Solubility
22	**Mon04 Nov**	**Exam 3: AB Equilibria, Solubility (Chapters 16, 17)**
23	Wed 06 Nov	Thermodynamics: Entropy (18.1 -18.5)
24	Mon 11 Nov	Thermodynamics: Gibbs Free Energy (18.6 – 18.9)
25	Wed 13 Nov	Thermodynamics: GFE and Equilibrium and Review (18.10)
26	Mon 18 Nov	Electrochemistry: Intro and Balancing (19.1 – 19.2)
27	Wed 20 Nov	Electrochemistry: Galvanic and Electrolytic Cells (19.3 – 19.6)
28	Mon 25 Nov	Electrochemistry: Batteries and Corrosion
29	Wed 27 Nov	Thermodynamics and Electrochemistry Review/Catch Up
30	**Mon02 Dec**	**Exam 4: Thermodynamics and E-Chem (Chapters 18, 19)**
31	Wed 04 Dec	Review of CHEM 122 Topics and Learning Objectives
	Wed11 Dec	**Final Exam (9:00 – 11:00 a.m.)**

Course-Level Student Learning Outcomes

1. Explain the intermolecular attractive forces that determine physical properties and phase transitions, and apply this knowledge to qualitatively evaluate these forces from structure and to predict the physical properties that result.
2. Calculate solution concentrations in various units, explain the effects of temperature, pressure and structure on solubility, and describe the colligative properties of solutions, and determine solution concentrations using colligative property values and vice versa.
3. Explain rates of reaction, rate laws, and half-life, determine the rate, rate law and rate constant of a reaction and calculate concentration as a function of time and vice versa, as well as explain the collision model of reaction dynamics and derive a rate law from a reaction mechanism, evaluating the consistency of a mechanism of a given rate law.
4. Describe the dynamic nature of chemical equilibrium and its relation to reaction rates, and apply Le Chatelier's Principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures as well as describe the equilibrium constant and use it to determine whether equilibrium has been established, and calculate equilibrium constants from equilibrium concentrations and vice versa.
5. Describe the different models of acids and base behavior and the molecular basis for acid strength, as well as apply equilibrium principles to aqueous solutions, including acid base and solubility reactions, and calculate pH and species concentrations in buffered and unbuffered solutions.
6. Explain titration curves and speciation diagrams, as well as calculate concentrations of reactants from the former and determine dominant species as a function of pH from the latter.
7. Explain and calculate the thermodynamic functions, enthalpy, entropy and Gibbs free energy, for a chemical system, and relate these functions to equilibrium constants and reaction spontaneity; balance redox equations, express them as two half reactions and evaluate the potential, free energy and equilibrium *K* for the reaction, as well as predict the spontaneous direction.
8. Construct a model of a galvanic or electrolytic cell; or describe organic reactions.
9. Describe bonding theories, such as valence and molecular orbital theory.

Topic Specific 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:

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

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

Unit Level Learning Outcomes: Exam 1

Generally Chemistry I (CHEM 121) Review

1. Setup and evaluate stoichiometry problems related to mass, volume/concentration, gasses, and energy.
2. Complete Enthalpy calculations using Hess's Law.
3. Describe the characteristics of and identify the different types of bonding.
4. Describe how differences in electronegativity affect bond polarity and molecular polarity.
5. Draw Lewis Dot Structures for simple molecules and polyatomic ions and determine molecular/ion shape.

Intermolecular Forces

1. Identify the IMFs experienced by a molecule or between molecules (CC 11.2 p 492, Ex. 11.1 p 494, Ex. 11.2 p 497)
2. Describe how intermolecular forces affect phase changes (Ex. 11.2 p 497) and solubility (p 517-519).
3. Predict relative solubility and boiling points of molecules based on structures.
4. Label and interpret phase diagrams (Figure 11.38 p 518)

Solutions

1. Define the terms solute, solvent, miscible, solubility.
2. Describe the intermolecular forces present in various types of solutions (Table 13.2 p 575)
3. Use "like dissolves like" to determine relative solubilities of molecules based on chemical formula or skeletal structure (Ex. 13.1 p 576)
4. Relate solubility of solids and gasses in terms of temperature and pressure (CC 13.3 p 583)
5. Calculate molarity, molality, mole fraction, and mass percent of a solution given sufficient information and interconvert between these units (Table 13.5 p 587, Ex. 13.3 p 589, Ex. 13.4 p 591, Ex 13.5 p 592)
6. Calculate the freezing point or boiling point of a solution, given sufficient information on solution concentrations (Ex. 13.8 & 13.9 p 601).
7. Calculate the solution concentration given the freezing point or boiling point of a solution.

Unit Level Learning Outcomes: Exam 2

Kinetics

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. (EoC 79,81,85 p 668)
2. Write rate expressions (EoC 25,27,29 p 663)
3. Determine reaction order/rate law/rate constant using the isolation method (EoC 35,39,41 p 664)
4. Derive a rate law from a reaction mechanism; evaluate the consistency of a mechanism with a give rate law (EoC 75,77 p 664).
5. Determine reaction order/rate law/rate constant graphically (EoC 119 p 671)
6. Use the integrated rate law to calculate the concentration of a reactant at a given time, or calculate reaction time from a given concentration.

Equilibrium

1. Explain dynamic chemical equilibrium and its relation to reaction rates.
2. Describe the numerical meaning of the equilibrium constant K (Ex. 15.1 p 681)
3. Write an equilibrium constant expression for a given chemical reaction (Ex. 15.2 p 684 Ex. 15.5,15.6 p 690)
4. Use ICE tables to calculate the equilibrium constant given equilibrium concentrations, or calculate equilibrium concentrations given the equilibrium constant.
5. Qualitatively and quantitatively relate the numerical value of the equilibrium constant to the equilibrium position and reactant/product concentrations (Ex. 15.7 p 693)
6. Judge how changes in reaction conditions (heat/pressure/addition or removal of a reactant or product, coupling of the reaction to a secondary reaction system), will affect the equilibrium position (Le Châtelier) (Ex. 15.14,15.15 p 706)

Unit Level Learning Outcomes: Exam 3

Acid-Base Equilibrium and pH

1. Compare and contrast the three major acid/base definitions (Arrhenius, Brønstead-Lowry, and Lewis) (Ex. 16.1 p 728, CC 16.1 p 729)
2. Describe the difference between weak and strong acids and the relation to Ka (CC 16.2,16.3 p 732)
3. Calculate pH and species concentrations given a molar concentration for strong acids or bases (Ex. 16.6,16.7 p 738)
4. Calculate the Ka of a weak acid given pH of its solution (EoC 143 p 775, Ex. 16.7 p 739)
5. Calculate the pH and species concentrations of a weak acid solution given the Ka of the acid (EoC 77 p 773, Ex. 16.7 p 739)
6. Calculate the pH and species concentrations of a weak base solution given the Kb of the base (EoC 91 p 773, Ex. 16.10 p 745)
7. Correlate molecular structure and acid strength (EoC 117,119,121 p 774)
8. Identify the Lewis acid and Lewis base in a reaction (EoC 123,125 p 774)

Equilibrium in Buffers

1. Explain what constitutes a buffer solution (CC 17.1 p 781, EoC 35 p 829)
2. Select an appropriate buffer system based on the desired pH of the solution (Ex. 17.1 p 783)
3. Calculate the concentrations needed to reach a specific pH in a buffer system (EoC 43 p 830)
4. Calculate the pH of a buffer using the Henderson-Hasselbalch equation (Ex. 17.2 p 784,17.4 p 791, EoC 47a p 830)
5. Calculate the pH of a buffer following the addition of a given amount of acid or base (Ex. 17.3 p 788, EoC 47b p 830)
6. Explain titration curves and calculate concentrations of reactants from a titration curve.
7. Explain speciation diagrams and determine dominant species as a function of pH.

Unit Level Learning Outcomes: Exam 4

Thermodynamics

1. Demonstrate an understanding of entropy by making qualitative predictions of the sign of ΔS for various processes and chemical reactions (CC 18.2 p 848, Ex. 18.1 p 850)
2. Calculate numerical values for ΔS (Ex. 18.2 p 851) and ΔG (EoC 43,45 p 880)
3. State the first, second, and third law of thermodynamics (EoC 1,11,17 p 879)
4. Demonstrate an understanding of Gibbs free energy by making qualitative predictions of the sign of ΔG for various processes and chemical reactions (Ex. 18.4 p 858, CC 18.4 p 859)
5. Assess the temperature dependence of a reaction's spontaneity by considering the signs of ΔS and ΔH, and their effect on the sign of ΔG (Ex. 18.6 p 864)
6. Correlate values of ΔG, ΔS, and ΔH with reaction spontaneity and the position of reaction equilibrium (CC 18.8 p 875, EoC 69,75 p 882)

Electrochemistry

1. Describe redox reactions in terms of gain/loss of electrons, changes in oxidation state, oxidizing vs reducing agents, and individual half reactions being coupled together (Ex. 19,1,19.2 p 891)
2. Be able to balance electrochemical (redox) reactions using half reactions (Ex. 19.3 p 892, EoC 37,39 p 931)
3. Employ standard cell notation to describe the operation of electrochemical cells (CC 19.1 p 896, EoC 49 p 932)
4. Differentiate between anodes and cathodes (CC 19.2 p 902, EoC 47 p 932)
5. Calculate cell potentials (Ex. 19.8 p 911) and determine spontaneous direction of the cell.
6. Distinguish between galvanic and electrolytic cells in terms of sign of Ecell, ΔG, Keq, and position of equilibrium (Figure 19.2 p 920)

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 QR code at right:

Equal Access Services

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 the link to the UNM Academic Dishonesty Policy:

https://policy.unm.edu/regents-policies/section-4/4-8.html. or scan the QR code at right:

Academic Integrity Policy

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 at right:

Title IX Policy