**Chemistry 122 – 501** **Sp 2019**

**General Chemistry II**

**Instructor**: Dr. Terry Office A102a tjterry@unm.edu
**Lecture:** Tu/Th 9-10:15 am in C 101
**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:** Chem122 *continues* the General Chemistry sequence building upon the foundation of concepts established in Chem121 to explore connections between the atomic and the macroscopic world.

**Required Resources**

- Chemistry, A Molecular Approach, By Nivaldo Tro, 3rd or 4th Ed. preferred
- Internet access: *Blackboard Learn and UNM email address must be checked regularly*
- Mastering Chemistry (MC) access code
- A scientific calculator to bring to each class (log, anti-log, exponential functions required)
- Passing grade in Chem 121
- Time: You are expected to spend 6-10 hours a week on homework and reading.

**Recommended Resources**

- 3-ring binder and paper for worksheets and notes, and pen/pencil for note-taking
- Periodic Table for use in class
- Mastering Chemistry notebook: record important concepts, problem solving techniques, problems you need to get help with, problems you need to practice before taking the exam

**Additional Resources at UNM-VC**

- **Instructor** – STEM Center Hours, Office Hours, Email, Workshops and Review Sessions
- **STEM Center –**Tutors, Molecular Modeling Kits, Laptops, Textbook

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

**Grading**

5 % iClicker Classroom Participation
35 % Homework (includes MC, Classroom Activities/Worksheets, Quizzes, Exam Debriefs)
40 % Mid-Term Exams (4 exams, each count ~11% of the final grade)
20 % 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 online resources, or ask another student or tutor for help filling in your notes.
- Classroom behavior is expected to be professional and respectful of other students and the instructor:
    - **Do not distract your classmates from the material.**
      **If it is rude in a movie theater, it is rude during lecture!**
        - Arrive on time.
        - Do not come and go during lecture.
        - Do not use your cell phone during lecture.
    - **Actively participate in discussions, iClicker problems, and working groups.**

  **Failure to behave responsibly may lead to deduction of iClicker points for the class period.**
- 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 instructor is available after each class to assist with any last minute homework/worksheet problems.**
- **LATE WORK:** No worksheets will be taken after the due date. Due dates for online activities may be modified with sufficient justification such as late registration for the course. Exams may be rescheduled, but must be taken within 48 hours of the originally scheduled time. In-class activities such as iClicker questions CANNOT be made-up.
- The last day to drop the course without a grade is **Feb 1st.** *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, handouts, and assignments. 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 use, for any reason, during quizzes or exams will be considered cheating and will result in 0 points on the assignment.

**Mastering Chemistry (MC) Homework**

- Completion of the first Mastering Chemistry homework, **due by Jan 25th**, is **mandatory**. You may be dropped from the course for not completing the assignment **by midnight Jan 30th**.
- Computers with updated internet browsers and plug-ins are advised.
- The Learning Center and the STEM Center have computers and tablets that will be updated throughout the semester. If you have trouble with these computers, notify your instructor *immediately*.
- The grading policy on MC is very generous. Attempt the problems and be comfortable making mistakes, but always continue to work the problem until you get it right. **There is no deduction for using hints.**
- Six attempts are allowed for fill-in-the-blank questions with a 3% deduction per incorrect answer.
  ***This is your opportunity to make mistakes and learn how to work the problems that will be on the exams. You will not learn how to answer questions if you never practice and make mistakes.***
- Take notes on problems that you have trouble with. Get help from your instructor, tutors, or classmates.
- Due dates are posted on the MC program. There is a 20% deduction in points for every day late.
  **It is best to complete homework as soon after the related lecture as possible to reinforce learning.**

**In-class iClicker Problems**

- iClickers will be provided and assigned to each student. Arrive early enough to get your iClicker from the instructor. Return the iClickers at the end of class.
- Points are awarded for participation and no points are deducted for incorrect answers.

## Mid-Term Exams

Each exam is cumulative with the four 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.
**Cheating on exams is taken very seriously and results in automatic and immediate failure of the course.**

## Final Exam

If you earn an average of 90% or higher on the mid-term exams, you are exempt from taking the final exam.
In addition to a calculator, you may use one side of a 8.5x11" sheet of paper with handwritten notes on the final exam.

## How to succeed in chem122

- **Use learning objectives as a study guide**. Refer to the syllabus/BBLearn for each section and identify the learning outcomes that tell you what you need to be able to do to show mastery of the material and hence **what will be on the exam**.
- **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 sample problems** referenced in the Learning Objectives.
- **Attend class, take notes** during lecture ESPECIALLY when covering example problems.
- **Ask questions** during class, during office hours, and during tutoring.
- **Attempt MC and other homework within 24 hrs of the lecture topic** while it is still fresh in your mind. This will deepen your understanding of the material and save you time.
- **Use resources** including instructor office hours, tutors, SI sessions, workshops, study groups, and online help.
- **If you start to feel overwhelmed, GET HELP IMMEDIATELY!** Make an appointment with the instructor, the earlier the better!

## Global Course Objectives:

1. Increase appreciation of the impacts of chemistry in everyday life.
2. Increase confidence in applied math and science courses.
3. Increase student skills such as note taking, reading a textbook, and problem solving.
4. Become more effective at applying concepts and principles to problem solving in the natural world.
5. Become a more responsible citizen by thinking scientifically about contemporary issues.

**SI Workshops**

Monday 3-4 pm every week – STEM Center
Tutors lead selected activities to support understanding of lecture topics and problem solving.
Follow-up assistance is available on Tuesday 2-4 pm in STEM Center.

## 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 (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

# 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:

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

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

## Exam 1

### General Chemistry I 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.

## 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)

## 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 $K_a$ (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 $K_a$ 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 $K_a$ 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 $K_b$ 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.

## Exam 4

**Thermodynamics**

1. Demonstrate an understanding of entropy by making qualitative predictions of the sign of $\Delta S$ for various processes and chemical reactions (CC 18.2 p 848, Ex. 18.1 p 850)
2. Calculate numerical values for $\Delta S$ (Ex. 18.2 p 851) and $\Delta G$ (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 $\Delta G$ 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 $\Delta S$ and $\Delta H$, and their effect on the sign of $\Delta G$ (Ex. 18.6 p 864)
6. Correlate values of $\Delta G$, $\Delta S$, and $\Delta H$ 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 $E_{cell}$, $\Delta G$, $K_{eq}$, and position of equilibrium (Figure 19.2 p 920)
7. Relate cell current to electron transfer rates in electrolytic cells (Ex. 19.9 p 923)

| WEEK | CHEM 122 TOPIC Schedule – Spring 2019<br>*Tro 3rd Ed and 4th Ed differ in chapter number, 4th Ed used here.<br>Pay attention to topic description. | Monday SI Workshop Topic<br>Activities provided in STEM Center |
|---|---|---|
| 1<br>Jan 15/17 | **Tue –** Syllabus, Review: Molecular Polarity<br>**Th –** Ch11 - IMFs, Phase Changes/Diagrams, relative bp & solubility<br>**Friday 18th Workshop – 10 – 2 pm –STEM Center – Chem121 Review:**<br>Stoichiometry, Enthalpy, Molecular Polarity, Nomenclature | Tutor available to help with online review assignment. |
| 2<br>Jan 22/24 | **Tue** – 13.1-13.5 – Solutions and Solubility, Concentration Units<br>**Th** – 13.5-13.8 – Molality, Colligative Properties<br>**Fri 25th - MC Review due** | IMFs, solubility, bp<br>Phase Changes |
| 3<br>Jan 29/31 | **Monday 29th Study Session – 1:30-2:30 pm STEM Center**<br>**Tue** –Exam 1 (Chem121 Review, Ch11, Ch12)<br>**Th** – Ch14.1-14.4 – Kinetics Intro<br>**FRIDAY Feb 1st – Last day to drop with full refund** | Concentration Unit Conversions<br>E1 Practice Test |
| 4<br>Feb 05/07 | **Tue – Kinetics Worksheet 1**<br>**Th** – 14.4-14.7 - Kinetics | Kinetics Math –<br>fractions, natural logs, exponents, isolating variables |
| 5<br>Feb 12/14 | **Tue – Kinetics Worksheet 2** – Kinetics Review<br>**Th** – 15.1-15.5 – Chemical Equilibrium | Time dependent rates |
| 6<br>Feb 19/21 | **Tue** – 15.1-15.8 - ICE Tables<br>**Th – Equilibrium Worksheet 1** | Activation Energy |
| 7<br>Feb 26/28 | **Tu** – 15.9 Le Chatelier Principle<br>**Th – Exam 2** – Kinetics and Equilibrium | Equilibrium and ICE Tables |
| 8<br>Mar 05/07 | **Tu -** Ch 16.1-16.5 – Acids/Bases, Ka, Kw, pH scale<br>**Th –** 16.5-16.6 – **ICE Activity** | A/B Math<br>Logs, exponents, isolating variables |
| 9 | **Spring Break** | |
| 10<br>Mar 19/21 | **Tu -** Ch 16.7-16.9<br>**Th** – Ch 16 Review/Activity | ICE Tables practice |
| 11<br>Mar 26/28 | **Tu** – 17.2-17.4 – Buffers<br>**Th - Buffer Titration Activity**, Review Ch16/17 | A/B Review |
| 12<br>Apr 02/04 | **Tu – Exam 3** – Acid/Bases, Buffers, and Titrations<br>**Th** – Ch 18.1-18.4 Thermodynamics:Entropy – Online Activity BBL | Buffer/Titration pH calculations |
| 13<br>Apr 09/11 | **Tu** – 18.5-18.8 Thermo: Gibbs Free Energy<br>**Th – Thermo Activity** – 18.9 | Enthalpy and Hess's Law Review |
| 14<br>Apr 16/18 | **Tu** – 19.1-19.3 Electrochem/RedOx<br>**Th** – 19.4-19.6 Echem Calculations | Thermodynamics |
| 15<br>Apr 23/25 | **Tu –** Echem Activity<br>**Th** – Batteries, Electrolysis, Corrossion | Balancing Redox Eqns |
| 16<br>Apr 30<br>May 02 | **Tu – Exam 4 –** Thermodynamics and Electrochemistry<br>**Th** – Exam 3 and 4 Corrections/Review | E4 Practice Test |
| **Finals Week – Thursday 9-11 am, C101** | | |

Dates are subject to change. Any changes will be discussed in class and posted onto Blackboard Learn with a revised schedule. Sign in to Mastering Chemistry (MC) for online homework assignments and due dates.