Chem 121-501   **Fall 2018**

General Chemistry I

Instructor: Dr. Terry   Office A102a   tjterry@unm.edu
Lecture: T/Th 9 - 10:15 am in C 101
Tutoring Hours: Mon 1:30-2:30 (Office)
                              Tues 2:30 – 4:00 (STEM Center)
                              Wed 10:30 am – 12 pm, 1:00-3:00 pm

Course Description
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.

REQUIRED Resources
- Chemistry: A Molecular Approach, 2nd, 3rd, or 4th Ed. by Nivaldo Tro
- Mastering Chemistry access code
- Calculator with log/antilog and exponential functions
- Passing grade in Math121 or its equivalent.
- Internet Access: *Blackboard Learn, Mastering Chemistry, and UNM email must be checked regularly*.

Recommended Resources
- 3-ring binder for handouts notes, worksheets, and pen/pencil for note-taking.
- Periodic Table for use in class.
- Mastering Chemistry notebook: problem solving notes, identify important problem solving patterns, record problems you need to get help with and problems you need to repeat before taking the exam.

Additional Resources at UNM-VC
- **Instructor** – STEM Center Hours, Office Hours, Email, Review Sessions (times TBD)
- **STEM Center –**Tutors, Molecular Modeling Kits, Laptops, Textbook Copies
- **SI Class** – STEM Center (TBD)

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

Grading
 5 %   iClicker
30 %   Homework (MC, Worksheets, BBLearn Quizzes, Exam Debriefs, Classroom Activities and Quizzes)
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

Global Course Goals
Develop student skills necessary for success in science and engineering fields such as pre-class preparation, notetaking, working in groups, post-class review, and homework completion.

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 of iClicker problems activities**
- **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.
- **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. (Thursday exams must be taken by COB on Friday.)
- The last day to drop the course without a grade is <mark>Sept 7th</mark>. *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 (ie, iPad) use, for any reason, during quizzes or exams will be considered cheating.

Mastering Chemistry (MC) Homework
- <mark>Completion of the first homework in Mastering Chemistry **mandatory**. The **assignment is due by midnight August 28th**. You may be dropped from the course without notice for not completing the assignment by by midnight Wednesday, Sept 5th.</mark>
- Computers with updated internet browsers and plug-ins are advised.
- The Learning Center and the STEM Center have computers that will be updated throughout the semester.
- 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.

Reading Quizzes: Reading Quizzes will be assigned in BBLearn for EACH lecture and count toward your homework grade. They contain about 10 questions on the assigned reading for the lecture and are due before lecture begins.

In-Class Activities: Come prepared to participate on In-Class Activities (Worksheets and Clicker questions) by **actively** reading the assigned sections.
Worksheets: Worksheets and activities must be turned in on the due date either during class, to the Academics Office where they are time-stamped, or over email as a pdf file. No late worksheets are accepted.

In-class Clicker Problems: iClickers will be provided as needed and assigned to each student. Arrive early enough to get your Clicker from the instructor. Return the Clickers at the end of class. You cannot make up missed Clicker points.

Exam Debriefs: You are expected to correct each mid-term exam and review your progress in the course. Turn in the corrected exam along with the debrief worksheet one week after each exam is returned in class. You may use ANY source necessary to correct your exams (instructor, tutors, classmates, etc.)

Exams
- Each exam is cumulative with the mid-term exams focusing on the specified chapters.
- Exams may be rescheduled at the discretion of the instructor, but they MUST BE completed within 48 hours of the scheduled exam.
- You may use a 3x5 inch index card with handwritten notes for each midterm exam.
- Bring a calculator with log/antilog/exponential functions for each exam. No calculators will be provided and phones may not be used during exams.
- **Cheating on exams is taken very seriously and results in automatic and immediate failure of the course.**
- **If you average above 90% on the mid-term exams, you do not have to take the final exam.**

Where to get help

- **Ask questions in class**. During lecture, ask the instructor, during activities ask your teammates, the instructor, or the tutor.
- **Attend office hours, STEM Center hours, and extra study sessions** held by the instructor. The instructor is your #1 source for course information.
- **Attend SI sessions** held each week. The SI instructor is your #2 source for course information.
- **STEM Center:** You may make appointments with specific tutors or drop-in.
- **Form a study group**.
- **Read the textbook** and work through the sample problems in the chapter, then complete the end of chapter homework problems in blue, which have answers at the back of the book.
- **Email the instructor** at tjterry@unm.edu. If you do not receive a reply within 48 hours, send a reminder email. Your original email could have gotten lost.

How to succeed in Chem121

- **Read** the text before class. You don't have to understand it, but you'll know what you need more help with before class begins.
- **Work all 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 sessions.
- **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!

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

Unit Level Learning Objectives: Exam 1 Ch 1-2

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)

By the end of the chapter, students will be able to…
    <u>Ch 1: Matter, Measurement, and Problem Solving</u>
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)

    <u>Ch 2: Atoms and Elements</u>
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)

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

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)

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. (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)

    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)

Unit Level Learning Outcomes: Exam 3 (Ch 5-6)

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)

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. (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)

Unit Level Learning Outcomes: Exam 4 (Ch 7-8)

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. (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)

Unit Level Learning Outcomes: Exam 5 (Ch 9, 10)

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

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)

WEEK	CHEM 121 TOPICS	Due: RQ = due by 9 am WS = due in class Check Mastering Chemistry for online homework due dates.
1 Aug 21/23	**Tue–** (Ch 1.6, 1.8) Using the Textbook (BPR), Metric System, Unit Conversions, Problem Solving **Thu–** (Ch 1.4, 1.7-1.8) Chemical/Physical Properties and Changes, Problem Solving, Significant Figures, Precision vs Accuracy	**Tue -** Online Survey **Thu–** RQ (BBL)
2 Aug 28/30	**Tue-** (Ch 2.2-2.6) Dalton's atomic theory Class Activity, Isotopes **Thu-** (Ch 2.6-2.7) Isotopes & Ions Activity, Periodic Table	**Tue** – RQ (BBL) **Thu** – RQ
3 Sep 4/6	**Mastering Chemistry assignment due (TIME)** **Tue –** (Ch 2.8-2.9) Periodic Table, Mole calculations **Thu – Exam 1(Ch 1,2)** **FRIDAY Sep 7th – Last day to drop 16 wk courses with full refund**	**Tue** – RQ **Thu** – Exam 1
4 Sep 11/13	**Tue** – (Ch 3.1-3.6) Chemical Bonds, Chemical Formulas, Naming Inorganic and Molecular Compounds **Thu-** (Ch 3.8-12) Using Molar Mass, Balanced Chemical Equations	**Tue** – RQ **Thu** – RQ
5 Sep 18/20	**Tue** – (Ch 4.1-4.3) Stoichiometry, Limiting Reagent, %Yield, Concentration (Stoichiometry by Mass WS) **Thu** –(Ch 4.4-4.6) Aqueous Solutions, Molarity (Molarity WS, Stoichiometry by Vol WS)	**Tue –** RQ **Thu** – RQ, ws
6 Sep 25/27	**Tue** – Ch 4.7 – 4.9 - Reactions: Acid/Base, Precipitation, Redox, Ionic; Writing Ionic and Net Ionic Equations **Thu** – Flint Water Crisis Activity	**Tue –** RQ, WS **Thu** – RQ
7 Oct 2/4	**Tue – Exam 2 (Ch 3,4)** **Thu** – Ch 5.1-5.4 – Ideal Gas Equation	**Thu -** RQ
8 Oct 9	**Tue** – Ch 5.6-5.7 – Gas Mixtures, Gas Stoichiometry, Activity **Oct 11-12 : Fall Break**	**Tue** – RQ **Sun Midnight –** BBL Activity
9 Oct 16/18	**Tue-**– 5.8, 5.10, 6.1-6.3 – Kinetic Molecular Theory, Real Gasses, Intro to Thermo **Thu –** Ch 6.3 – 6.7 – Thermo and Calorimetry	**Tue** – RQ **Thu –** RQ
10 Oct 23/25	**Tue –** Ch 6.8-6.9 – Hess's Law & Heat Stoichiometry **Thu – Exam 3 (Ch 5,6)**	**Tue** – RQ
11 Oct 30 Nov 1	**Tue** – Ch 7.5-7.6 - Atomic orbital shapes and sizes **Thu** – Ch 8.1-8.5 – Periodic Table, Valence Electrons, e⁻ Configuration	**Tue** – RQ **Thu**- RQ
12 Nov 6/8	**Tue** – Ch 8.6-8.9 – Periodic Trends: Size, Effective Nuclear Charge, Ionic Radii, Electron Configuration, Ionization Energy, Electronegativity **Thu -** In Class Review Activity Ch 7-8	**Tue** – RQ **Thu** – RQ

13 Nov 13/15	<mark>Tue –Exam 4 (Ch 7,8)</mark> **Thu** – Ch 9 –Lewis Dot Structures, Resonance Structures, Formal Charges, Octet Exceptions	**Thu –** RQ
14 Nov 20	**Tue** – 9.6 – 9.11 – Bond Polarity, Dipoles, Bond Characteristics, (Bond Polarity WS) **Nov 22 - Thanksgiving**	**Tue** – RQ
15 Nov 27/29	**Tue** – Ch 10.1-10.5 – VSEPR Theory – predict molecular geometry and polarity - Activity **Thu** – 10.6 – 10.7 – Valence Bond Theory**,** predict hybridization	**Tue** – RQ, WS **Thurs** – RQ
16 Dec 5/7	**Tue** – 10.8 – Molecular Orbital Theory <mark>**Thu** – Exam 5 Ch 9, 10</mark>	**Tue**- RQ
Study Session TBD **Cumulative Final Exam** **Tuesday, Dec 11, 9-11 am, C101**		