

Organic Chemistry for Majors 2

Chemistry 48

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Pronouns: he/him

BlackBoard Site: bb.uvm.edu

Lecture: MWF 10:50-11:40 am in Innovation E432

Office Hours: Monday/Wednesday 11:40am – 12:20 pm, Friday 11:40 – 2 pm, or by appointment

Required Course Materials

- Organic Chemistry 7th ed., Loudon and Parise, Roberts and Co., 2021 (ISBN: 978- 1319363772)
- Organic Chemistry Study Guide and Solutions Manual 7th ed., Loudon and Parise, Roberts and Co., 2021 (ISBN: 978-1319335915)
- Achieve account: account can be purchased as part of book order.

Recommended Course Materials

- Molecular Structure Models (e.g.: ISBN: 0471-362719)

Course Prerequisites: Chemistry 47

General Course Comments

In Chemistry 48 we continue to explore the basic principles of Organic Chemistry with a greater emphasis on the chemical reactivity of various functional groups (i.e. more similar to the last 1/3 of the first semester course).

By now you have probably noticed that Organic Chemistry involves many new concepts, a large number of rules and a very large number of reaction mechanisms. However, as the course progresses and your organic “repertoire” grows, you will also find that a relatively small subset of rules serves to tie together the vast amount of information contained in the text. A special effort made at the beginning of the course to review and master important concepts from Chemistry 47 will pay off as the course progresses. Topics that are especially important to review include:

Arrow Pushing: Arrow pushing is one of the most important “tools” of organic chemistry because it allows you to show a pictorial representation of a reaction mechanism. When done properly, arrow pushing will allow you to keep track of **electrons** as bonds are made and broken throughout the course of a reaction, as well as keep track of any formal charges that develop. Having a good grasp of arrow pushing will make learning the large number of reactions you will see in this course easier, because you will then understand the underlying mechanism of the reaction rather than trying to memorize it as a “fact”. ***I can’t overemphasize the importance of having a good working knowledge of arrow pushing.*** Be forewarned that arrow pushing will be used on a daily basis in class and you will be expected to write mechanisms using correct arrow pushing on exams.

Resonance: This is a very important concept and you have already seen that resonance can help rationalize why carboxylic acids are more acidic than alcohols. You will see resonance used over and over again to rationalize why molecules react the way they do, and a good understanding of the rules for writing proper contributing “structures” to resonance hybrids will make the understanding of reaction mechanisms considerably easier. In order to have a good understanding of resonance you must also have a good grasp of electronegativity and arrow pushing.

Electronegativity: Knowledge of the relative electronegativities of atoms is essential to understanding why molecules react the way they do. For example, the concept of electronegativity allows you to rationalize why some atoms are good leaving groups and others are not.

Chemical Reactions: You will be expected to know all the chemical reactions we covered in Chem. 47.

Nomenclature: I will assume you know the names of all the functional groups as well as the standard IUPAC rules for naming simple organic compounds. If you don’t know the functional groups, you will not be able to follow the discussion in class. In my view, it is more important that you be able to draw a structure from a given name than write a name for a given structure.

Stereochemistry: Determining R/S designations as well as E/Z. Understanding the difference between different types of stereoisomers (enantiomers/diastereomers) and being able to correctly identify the stereochemical relationship between compounds (i.e. are they diastereomers, enantiomers, constitutional isomers, different molecules, etc.).

Keys to Success

- Do not try to cram!
- **Work as many practice problems as possible.** Practice problems reinforce the new concepts and are the only way to test your understanding of the material. There are many organic chemistry textbooks in the library and they all cover similar material. Work problems in other books once you have finished the problems in our book.
- Do not look at a problem's answer until you have really tried the problem. After seeing the answer, it often seems obvious and you may assume you understand.
- When you get a problem wrong, try to understand where your thinking was in error and attempt to identify what concept you missed.
- You will see many new concepts in this course. Try to write out an explanation of the concepts in your own words as if explaining them to someone else.
- Ask questions! Come to office hours or make an appointment with me or your T.A. to resolve any questions early!
- Review the material frequently... many people find that flash cards are a good way to learn this material.

For each chapter you should work as many of the suggested problems as possible. I strongly urge you to keep up with your reading and problem solving. Learning organic chemistry takes a combination of **patience, practice, and repetition**. Cramming does not work well in this subject!

Academic Conduct: Cheating will be considered grounds for failing the course. All graded assignments must be your own work. Cases of cheating or plagiarism *will* lead to further disciplinary action which may include dismissal from the University according to the rules set forth in The University of Vermont's *Code of Academic Integrity*.

Policy of Electronic Device Usage on Exams: In short, you can't use them! The use of any electronic device (calculator, cell phone, ipod, or anything else with batteries or a solar cell) is strictly forbidden on exams and will be considered cheating.

Grading: Your course grade will be based on on-line homework assignments, three examinations, a cumulative final examination, and your laboratory grade. (**Note:** You must earn a passing grade in the laboratory to receive a passing grade for the course. More than two laboratories missed for any reason will result in a failing grade for the course unless you are granted an incomplete by your Dean).

- Lab 20%
- Quizzes 15%
- Online Homework 5%
- 3 Midterm Exams 40%
- Cumulative Final 20%

On-line homework: We will continue to use Achieve this semester. No homework grades will be dropped.

Standardized Exam: To assess student learning over this yearlong course sequence the ACS standardized exam will be given during your normal laboratory time on May 2nd. If you choose to, you may use the grade you obtain on this exam as your final exam grade.

Exam Re-grades: If you have any questions concerning the grading of an exam, you must see me within one week after the day the exam is returned to the class.

Midterm Exams will be given during the Chem. 52 Lab slots in Discov. W211, which meet:

Thursdays from 1:15 - 5:15. The exams will held on:

- February 16th
- March 23rd
- April 20th

Final Exam Date and Location: Friday, May 12th, 10:30 – 1:15 in Innovation E432

This course will address learning goals 1,2,3, and 5 below for chemistry majors:

1. Students will demonstrate general knowledge in chemistry and will be able to apply chemical and physical principles in the solution of qualitative and quantitative chemical problems.
2. Students will understand the interplay of observational data, hypotheses, and hypothesis-driven experimentation through application of the scientific method.
3. Students will become proficient in chemical laboratory techniques and be able to apply these to practical and current problems in research.
4. Students will be able to read and critically evaluate the chemical and scientific literature.
5. The students will learn to present scientific data clearly and effectively through both written and verbal communication.

Religious Holidays: Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors by the end of the second full week of classes their documented religious holiday schedule for the semester. Faculty must permit students who miss work for the purpose of religious observance to make up this work.

NOTE: The following two chapters cover material you will see in CHEM 052. *However, you will be responsible for knowing this material for our class. We will work some practice problems in class and in lab, but your primary introduction to this material will occur in CHEM 052:*

Chapter 13: Introduction to spectroscopy. IR and MS All sections (13.6C will not be covered in depth)

Chapter 14: Nuclear Magnetic Resonance Spectroscopy

Sections: Read 13.1 first 14.1-14.7, 14.9-14.11

Problems: 3, 6-9, 10-12, 13-21, 22, 24-28, 31-37, 39-48, 51-59, 62

Tentative Order of Topics

Chapter and Topic	Suggested Book Problems
Chapter 11: The Chemistry of Alcohols and Thiols	5-10, 16, 17, 19-21, 29, 30 45, 46, 53
Integrated NMR and IR Problems	See above and handouts
Chapter 12: The Chemistry of Ethers Epoxides etc	2-26, 54, 55, 57, 66a-c,
Chapter 19: The Chemistry of Aldehydes/Ketones etc	10-14, 16-18, 21-32, 34-36, 44, 49-51
Chapter 20: The Chemistry of Carboxylic Acids	9-16, 40, 43, 45, 47, 48, 69
Chapter 21: The Chemistry of Carboxylic Acid Derivatives	10-12,14-16, 17a, 18-22, 33, 38, 39, 41, 42, 44 a-c,
Chapter 22: The Chemistry of Enolates, Enols etc	1, 3, 5-8, 11, 14-16, 19, 22, 28, 29, 34, 35, 39, 43, 44, 46, 49, 50, 62, 67, 70, 79
Chapter 15: Dienes and aromaticity	13-24, 45-47, 50, 55-57, 60
Chapter 16: The Chemistry of Benzene and Derivatives	13-21, 23, 26, 30-32, 45-48, 51
Chapter 17: Allylic and Benzylic reactivity	See class notes
Chapter 27: Amino acids, peptides, and proteins	See class notes

Chemistry 48 Laboratory Information

Text: Ault, "Techniques and Experiments for Organic Chemistry" 6th Ed., University Science Books, 1998.

General Considerations

Read the entire chapter/handout before doing the experimental work. The experiments designated within each chapter describe the procedures that you will actually carry out in the laboratory.

PLEASE NOTE THE FOLLOWING

- Week 1:** There are no CH 48 labs. CH 52 will still meet as scheduled.
- Week 2:** There are no CH 48 lab. ALL students are to attend CH 52 on Thursday 1:15 – 5:15 in Discov. 211
- Week 3:** All students will attend both CH 48 and CH 52.

Date	Experiment	Ault Expt. or Handout	Notes
Jan 17 th	No Class		
Jan 24 th	No CH 48 Lab	Spectroscopy Overview	All students attend CH 52
Jan 31 st	Check-in and Spectroscopy Bootcamp <u>AND</u> attend CH 52	Handout	All students attend <u>both</u> CH 48 and 52 labs
Feb 7 th	Generation and Reaction of an Organometallic Compound Part 1	Handout	
Feb 14 th	Generation and Reaction of an Organometallic Compound Part 1	Handout	
Feb 21 st	Biodiesel	Handout	
Feb 28 th	Vanillin oxime from vanillin	Ault expt. 58 pg 490	
Mar 7 th	No Class – Town Meeting Day		
Mar 14 th	No Class – Spring Recess		
Mar 21 st	Prep trans,trans-1,4-diphenylbutadiene	Ault expt 71 pg 524	
Mar 28 th	Prep of methyl salicylate: oil of wintergreen	Ault expt 77 pg 538	
Apr 4 th	Tetraphenylcyclopentadienone	Ault expt 95 pg 595	
Apr 11 th	Diels-Alder Reaction	Ault expt 66 pg 508	
Apr 18 th	Nitration of Methyl benzoate	Handout	
Apr 25 th	Super Critical CO ₂ Extraction of Limonene & Check out	Handout	
May 2 nd	ACS Exam		