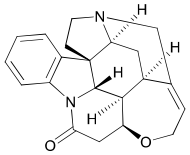
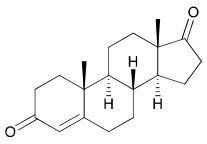


Strychnine
(poison)



Androstenedione
(estrogen and testosterone precursor)

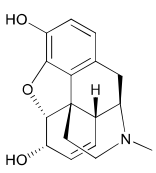
Organic Chemistry 1

Chemistry 047

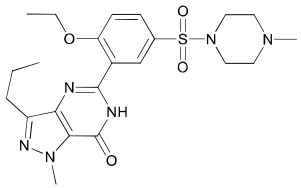
Section A

4 Credits

Fall 2020



Morphine
(opiate analgesic drug)



Viagra
(vasodilation by inhibition of PDE5)

Instructor: Matthias Brewer (he/him), Innovation Hall 343, Matthias.Brewer@uvm.edu

Office hours: Monday, Tuesday, Friday 2:00pm-3:00pm on TEAMS

Lecture: 10:50am – 11:40am MWF, Votey Hall 205

Laboratory: Monday 5:05 – 7:50pm; Tuesday 2:50 – 5:35pm; 6:00 – 8:45pm Discovery Building, Room 409

Laboratory Check-in – September 14/15

When to attend lecture: To accommodate for social distancing room capacity is limited, so the class will be broken into three groups. Each group will attend lecture in person one day per week. When not attending in person, students will view the lecture during the normal class time in Microsoft Teams. The groups are:

Team Amide will attend class on Monday: Last names start with A-H
Team Aldehyde will attend class on Wednesday: Last names start with I-R
Team Ketone will attend class on Friday: Last names start with S-Z

When to attend Lab in-person: Each lab section will be broken into two groups. Each group will come to lab every other week, and conduct on-line assignments during the intervening weeks. Each student will be assigned a group before the start of lab. ***All students will attend lab on September 14th or 15th to check in.*** However, this will be done in two waves. Group A will attend first and Group B will attend later in the lab period. More details will follow.

Required Course Materials:

(The first three items are available as a package from the UVM bookstore.)

Organic Chemistry 6th ed., Loudon and Parise, Roberts and Co., 2016 (ISBN: 978-1936221349)

Organic Chemistry Study Guide and Solutions Manual 6th ed., Loudon and Parise, Roberts and Co., 2016 (ISBN: 978-1936221868)

Sapling Learning account: account can be purchased as part of book order, or separately

Techniques and Experiments for Organic Chemistry" 6th Ed., Ault, "University Science Books, 1998. Purchase or Rent from: University Science Books: http://www.uscibooks.com/

Recommended Course Materials:

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

Books in the Howe library that may be useful:

Organic Chemistry I as a Second Language: Translating the Basic Concepts 2nd ed., D. Klein; ISBN: (978-0470-12929-6)

Organic Chemistry II as a Second Language: Second Semester Topics 2nd ed., D. Klein; ISBN: (978-0-471-73808-4)

The Art of Writing Reasonable Organic Reaction Mechanisms R.B. Grossman ISBN:0-387-95468-6

Writing Reaction Mechanisms in Organic Chemistry A. Miller ISBN: 0-12-496711-6

Course Prerequisite: Chem 31/32 or solid high school chemistry experience (AP or Honors).

This course will address learning goals 1, 2, 3, and 5 below for chemistry and Biochemistry 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.

Course Description

In Chemistry 047 we begin an exploration of the basic principles of Organic Chemistry. You will find that Organic Chemistry involves many new concepts, a large number of rules and (by the end of the second semester) a large number of reaction mechanisms. However, as the course progresses and your knowledge grows, you will find that a relatively small subset of concepts tie together the vast amount of information contained in the text. Learning these underlying principles and knowing when and how to apply them to solve problems is the key to success. You have seen many of these concepts in General Chemistry, but here they will be considered from a different point of view. For example, knowing the relative electronegativity of atoms is essential to understanding why molecules react the way they do – electronegativity allows you to rationalize why some atoms are good leaving groups and others are not. *A special effort made at the beginning of the course to learn how to write proper structures with the correct number of bonds, formal charges, and unshared pairs of electrons is important. Knowing the relative electronegativity of atoms, knowing Lewis acid-base theory, Bronstead-Lowry acid-base theory, and the rules for writing proper contributing "structures" to resonance hybrids will make understanding reaction mechanisms considerably easier.*

Organic Chemistry is not inherently difficult, but it is different than any chemistry you have seen so far. Although the lecture only meets for 3 hours a week, you will need to do a substantial amount of work outside of class (figure at least 2 to 3 hours per lecture) to learn and practice the material. I strongly urge you to keep up with reading the textbook outside of class and work as many of the suggested problems as possible – you will need to learn new concepts and then apply those concepts in new situations, which will take a slow and steady approach…*cramming does not work well in this subject*! Understanding the material and being able to apply that understanding to solve problems are two different things! Problem solving is the best way to learn this material!

Academic Conduct:

Cheating will be considered grounds for failing the course. Cases of cheating or plagiarism on the lecture exams or laboratory reports and laboratory quizzes *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*.

NOTE: You may discuss take home quizzes and sapling assignments with your peers and use these as group study aids. However, these exercises are *learning opportunities* and should be used as such. If you just blindly copy your friend's work you *will not* get anything from the exercise, which will become painfully clear to you on the exam!

Grading:

Your course grade will be based on on-line homework assignments, take home quizzes, 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 will result in a failing grade for the course unless they are excused by the instructor or you are granted an incomplete by your Dean).

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

Midterm exams will be multiple choice and will be administered through Blackboard. The exams will be open book/open notes but you must work independently with not help from others. **Once you start taking the exam you will need to finish it in one sitting**. You will have 2 hours to finish the exam, but you can't start it, put it down, and come back to it later in the day. Please let me know if you are allowed extended time through ACESS accommodations. In addition, backtracking will be disabled. This means that once you answer a question you will not be able to go back and change your answer - all answers will be final. Blank answers will not be given credit, so you won't be able to skip around and come back to the same problem later. The best strategy is to be methodical with each question and be certain of the answer before moving on to the next question. Why so austere? This is the best way to ensure that each person submits their own work.

The exams will be given on Thursday:

September 24
October 22
November 19

Final Exam Date: (Based on current information)

Monday, Dec 7 10:30 A.M.- 1:15 P.M.

Tutoring Center: Many students benefit from extra help with this subject matter. The Tutoring Center at UVM (https://www.uvm.edu/academicsuccess/tutoring_center) offers free tutoring to students, as well as supplemental instruction and study skill development programs. This is a great resource **that should be taken advantage of.** Many students are hesitant to use these services because they "never needed them before" and want to "do it on their own". That is nonsense! You are here to learn, not prove yourself! So, take advantage of all opportunities to ensure you are getting the most out of this experience!

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.

Book problems to work

Chapter 1. Chemical Bonding and Chemical Structure.
Sections: All sections
Suggested Problems: 1.3-1.6, 1.8, 1.9, 1.12, 1.13, 1.22-1.25, 1.30-1.32, 1.44, 1.48

Chapter 3. Acids and Bases: The curved arrow notation
Sections: 3.1-3.6
Suggested Problems: 3.1-3.15, 3.18, 3.19, 3.24-3.45, 3.54-3.55, 3.58

Chapter 2. Alkanes.
Sections: 2.1-2.5, 2.8
Suggested Problems: 2.1, 2.3-2.18, 2.23, 2.24, 2.26-2.39, 2.47-2.50

Chapter 4. Introduction to Alkenes: Structure and Reactivity
Sections: All sections
Suggested Problems: 4.2-4.10, 4.13, 4.14, 4.16-4.48, 4.50-4.60a, 4.61, 4.62, 4.64-4.67

Chapter 5. Addition Reactions of Alkenes
Sections: All sections
Suggested Problems: 5.1-5.52a, 5.52d-g

Chapter 6. Principles of Stereochemistry
Sections: All sections
Suggested Problems: 1-6, 9, 11, 15, 16, 19-22, 26-31, 34-39, 45-59

Chapter 7. Cyclic Compounds: Stereochemistry of reactions
Sections: All Sections
Suggested Problems: 1, 5-13, 15-22, 25-24, 36-38, 40-51, 53-60, 63-65, 69-71

Chapter 8. Noncovalent Intermolecular Interactions
Sections: 8.1-8.3
Suggested Problems: 1-8, 15, 28, 32

Chapter 9. The Chemistry of Alkyl Halides
Sections: All Sections
Suggested Problems: 1-5, 11-16, 21-25, 44c,d,e,f, 45a-e, 46b,-f, 49, 50a,c, 51-56, 61, 67

Chapter 10. The Chemistry of Alcohols and Thiols
Sections: 10.1-10.7
Suggested Problems: 3-17, 19-21, 23-26, 28, 30-31, 38-40, 45, 47-51, 57, 59, 67, 68

Chapter 11. The Chemistry of Ethers, Epoxides, Glycols, and Sulfides.
Sections 11.1-11.6, 11.8, 11.10, and Chapter 14 Section 14.8
Suggested Problems: 1-28, 32, 38-40a,b,d, 44-45c-j, 46, 48, 50, 51, 53-60, 61a-c,e-k, 62-65, 69, 70, 72, 74, 77, 79, 80

Tentative Reading Schedule
(Note: some lectures will be filled with class visits or exam review)

Read for lecture	Book Sections	Topic
2	1.1, 1.2, 1.3	**Octet rule, bonding, geometry and shape**
3	1.5, 1.6, 1.7, 1.8, 1.9 Note: 1.6-1.8 is presented in more depth than you need to know, so don't worry if it's confusing to you	**Orbitals and Bonding**
4	1.4	**Resonance**
5	3.1-3.4 also read 2.8 and table on inside of front cover	**Acid Base reactions, Arrow Pushing, pKa.**
6	3.5, 3.6	**Equilibrium and factors that affect acidity**
7	2.1, 2.2, 2.4, 2.5, 2.8 and nomenclature handout	**Alkane Nomenclature**
8	2.3	**Conformational analysis**
9	4.1, 4.2, 4.3, 4.4	**Intro to alkenes, bonding and nomenclature and degree of unsaturation**
10	4.5, 4.6, 4.7	**Alkene addition reactions**
11	4.8, 4.9	**Energy controls rxn rate and equilibrium position, cation stability, cation rearrangements**
12	4.8, 4.9	**Energy controls rxn rate and equilibrium position, cation stability, cation rearrangements**
13	5.1, 5.2, 5.3	**Addition of halogen to alkenes, halohydrin formation**
14	5.4	**Converting alkenes to alcohols**
15	5.5, 5.6	**Ozonolysis of alkenes, Free radical addition to alkenes**
16	5.5, 5.6	**Ozonolysis of alkenes, Free radical addition to alkenes**
17	6.1, 6.6, 6.7	**Enantiomers, Diastereomers, and meso compounds**
18	6.2	**R/S Nomenclature**
19	6.3, 6.4, 6.9	**Physical properties of stereoisomers, enantiomeric excess, epimerization**
20	7.1, 7.2, 7.3	**Conformation of cyclohexane and derivatives**
21	7.4, 7.5	**Conformation of cyclohexane derivatives and other rings**
22	7.6	**polycyclic compounds, Bredt's rule**
23	7.7, 7.8	**Stereochemistry of reactions**
24	8.1, 8.2	**Alcohols and nomenclature**
25	8.4, 8.5, 9.1, 9.2, 9.3	**noncovalent interactions, alkyl halides, subsititution and elimination reactions, rate laws**
26	9.4	**S_N2 reactions**
27	9.4	**S_N2 reactions**
28	9.5, 9.6, 9.7, 9.8	**E2, S_N1 and E1 reactions, Organometallic reagents**
29	9.5, 9.6, 9.7, 9.8	**E2, S_N1 and E1 reactions, Organometallic reagents**
30	9.5, 9.6, 9.7, 9.8	**E2, S_N1 and E1 reactions, Organometallic reagents**
31	9.10, 10.1, 10.2	**Alkyl halide prep. Alcohol deprotonation, Alcohol dehydration, halogens from alcohols**
32	9.10, 10.1, 10.2	**Alkyl halide prep. Alcohol deprotonation, Alcohol dehydration, halogens from alcohols**

Concepts you should know and understand (or review) from High School / General Chemistry:

- Properties of covalent bonds
- The octet rule
- Structural isomers
- Lewis dot structures
- Formal charges
- Resonance
- Electronegativity and bond polarity
- VSEPR (Valence Shell Electron Pair Repulsion)
- Hybridization

Key's to success in Organic Chemistry:

- Do not try to cram!
- 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.
- Work as many practice problems as possible. Practice problem reinforce the new concepts and are the only way to test your understanding of the material.
- 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.
- Ask questions!
- Come to office hours to resolve any questions early!
- Review the material frequently.