Department of Chemistry
University of Vermont

Chemistry 143 Fall, 2012
Organic Chemistry
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Office hours:

Mon	3:00-4:00
Th	2:30-3:30
Fri	1:00-2:00

or by appointment

Text: Solomons & Fryhle "Organic Chemistry" 10th ed., Wiley, 2011 and Study Guide.
Suggested Molecular Models: Molecular Structure Models
Course Prerequisite: Chemistry 32 or 36.

General Comments

In Chemistry 143 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 formal relationships 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 master the writing of proper Lewis structures with the correct number of bonds, formal charges, and unshared pairs of electrons will pay off handsomely as the course progresses. Also, an early and thorough understanding of the relative electronegativity of atoms, Lewis acid-base theory, Bronstead-Lowry acid-base theory, and the rules for writing proper contributing "structures" to resonance hybrids will make the understanding of reaction mechanisms considerably easier.

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. The study of Organic Chemistry is a highly structured cumulative intellectual enterprise. Cramming does not work well in this subject!

Web page: https://bb.uvm.edu/webapps/portal/frameset.jsp
Log on with you UVM username and password.

Exams

Your course grade will be based on three examinations, a cumulative final examination, and your laboratory grade.

Lab	20%
Exam 1	20%
Exam 2	20%
Exam 3	20%
Cumulative Final	20%

Midterm Dates:

Monday, September 24	6:00 P.M.-8:00 P.M.	Angell B112
Monday, October 22	6:00 P.M.-8:00 P.M.	Angell B112
Monday, December 3	6:00 P.M.-8:00 P.M.	Angell B112

Final Exam Date:

Friday December 7th	7:30 A.M.-10:30 A.M.	Jeffords 127

No exam grades are dropped. The only valid excuses for missing an exam are medical or other true emergency situations. If you miss an exam for such a reason, you must inform me of it promptly, present appropriate documentation of your excuse, and receive formal approval to take a make up exam. If you miss an exam for any other reason, you will receive a grade of zero for that exam.

The answers to exam problems will be posted after each exam. 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. Exams must be taken in ink to insure that you can get points for a grading error.

Outline

Chapter 1. Bonding and Chemical Structure.
Sections 1.1-1.8, 1.11-1.14, 1.16-1.17
Suggested Problems: 1.5-1.10 1.13-1.16, 1.18-1.25, 1.28-1.38, 1.42, 1.45

Chapter 2. Representative Carbon Compounds.
Sections 2.1-2.14
Suggested Problems: 2.2-2.7, 2.9-2.25, 2.29-2.37, 2.45, 2.46

Chapter 4. Alkanes.
Sections 4.1-4.6 4.8-4.17B
Suggested Problems: 4.1-4.13, 4.15-4.19, 4.23-4.29 4.31-4.45

Chapter 5. Stereochemistry.

Sections 5.1-5.15
Suggested Problems: 5.2-5.6, 5.8-5.14, 5.16-5.30, 5.33-5.39, 5.41-5.49

Chapter 3. Intro to Organic Reactions.
Sections 3.2, 3.4-3.7, 3.10-3.12, 3.14
Suggested Problems: 3.1-3.3, 3.5, 3.7, 3.8, 3.9, 3.13, 3.14, 3.16-3.36

Chapter 6. Ionic Reactions.
All Sections
Suggested Problems: 6.1-6.47

Chapter 7. Alkenes and Alkynes I. Synthesis.
All Sections
Suggested Problems: 7.1, 7.2, 7.6-7.22, 7.25-7. 44

Chapter 8. Alkenes and Alkynes II. Addition Reactions.
All Sections
Suggested Problems: 8.1-8.21, 8.23-8.27, 8.32, 8.33, 8.36, 8.39

Chapter 10. Radical Reactions.
All Sections
Suggested Problems: 10.4, 10.12, 10.13, 10.14, 10.16, 10.17, 10.19, 10.21, 10.25

Chapter 11. Alcohols and Ethers.
All Sections
Suggested Problems: 11.4-11.8, 11.10, 11.14, 11.15, 11.17, 11.20, 11.21, 11.23, 11.25-11.28, 11.33- 11.35, 11.36, 11.38-11.40, 11.42, 11.46

Chapter 12. Alcohols from Carbonyl Compounds.
All Sections
Suggested Problems: 12.4, 12.5, 12.8-12.20, 12.21

Chemistry 143 Laboratory
Fall, 2012

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

General Considerations:

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

Date	Exp #	Topic	Reading
9/4,6	-	Introduction, Safety, Check in	1-41
9/11,13	handout	Solventless aldol condensation	44-59, 150-158
9/18,20	handout	Solvent recycling	62-78, 138-149
9/25,27	handout	Fractional distillation, GLC	62-78, 70-72
10/2,4	handout	Thin layer chromatography	109-119
10/9,11	E5	Caffeine from Vivarin	317-318, 332
10/16,18	E9	Eugenol from clove oil	92-106, 346
10/23,25	handout	Liq. CO_2 Extraction of Limonene	
10/30-11/1	E18	Dehydration of methyl-cyclohexanol	381-384
11/6,8	E25	Preparation of an *n*-alkylbromide	402-403
11/13,15	E28	Nucleophilic competition	407-409
11/20-11/22	handout	Synthesis of 5,10,15,20-tetraphenylporphyrin	109-116

Notes

Introduction, Safety, Check-in. Be sure to check your equipment carefully. Any broken or missing items which are cracked, chipped or otherwise in less than perfect shape should be replaced by the stockroom. You will be required to replace any missing or defective items at your expense at the end of the semester, so make sure you start with a well-stocked drawer of unbroken equipment. Make sure your glassware is clean and dry before you begin your first experiment next week.

Melting point and Solventless aldol. The purpose of this lab is to explore the technique of melting point determination and the effect of impurities on melting point. You will achieve this by determining the melting point of two solid samples that will be provided. You will also run a reaction that is an example of an "Aldol condensation reaction"; a reaction in which two molecules are combined into one product with extrusion of water. This particular reaction is unique in that no solvents are used. Solventless reactions are not always possible, but when it is possible to omit solvents it makes the reaction more environmentally friendly ("green"). You will collect the product of this reaction by filtration, dry it and determine its melting point as well. You will also determine the yield of the recovered material, bottle it, label it, and keep it in your draw for a future experiment.

Solvent Recycling: In this experiment you will be provided with dirty acetone (acetone is a common organic solvent used in many different cleaning applications) that must be purified so that we can use it throughout the rest of the semester as a cleaning agent. In this process you will learn the experimental setup for simple distillation, which is a technique commonly used for the purification of liquid chemicals. Recycling this solvent through purification by distillation is an effective means of limiting the volume of hazardous waste that must be disposed of.

Fractional distillation, GLC. Fractional distillation is more effective than simple distillation at separating compounds that have similar boiling points. In this lab you will be assigned a mixture of liquids for separation by fractional distillation. Save 1 mL of this sample for GLC analysis and fractionally distill the remainder using a stainless steel sponge-packed column. Be careful not to cut your hands on the stainless steel wire; it is sharp and very strong and should only be cut with scissors.

Thin layer chromatography. You will identify components of common analgesics by comparing the Rf of the components to Rf of standards. Silica gel plates will be available to you.

Caffeine from Vivarin. This lab introduces extraction and recrystallization as a purification technique. Experimental is noted in the text book. You will also recrystallize the product formed in the first experiment, determine the melting point of the purified material, and compare it to the melting point of the impure material.

Eugenol from clove oil. Use 10 grams of clove oil (instead of 5) and methylene chloride as solvent (instead of carbon tetrachloride). After drying the eugenol solution, rotovap the solvent before vacuum distilling the product.

Liquid CO_2 Extraction of Limonene: The use of liquid CO_2 as an extraction solvent offers many safety and environmental benefits over standard organic solvents. For example, it is nonflammable, relatively nontoxic, readily available and environmentally benign. In industrial applications it is easy to recover the CO_2 (by controlling the pressure), thus making it possible to reuse the solvent many times with no net environmental impact. Liquid CO_2 has been used industrially for the extraction of essential oils, and in new greener methods of dry cleaning. In this laboratory we will generate liquid CO_2 and use it to extract limonene (an essential oil found in citrus fruits) from orange peel.

Dehydration of methyl-cyclohexanol. Each student will dehydrate one of the methycyclohexanols (2-, 3, or 4-). The product obtained will be analyzed by GLC.

Preparation of an *n*-alkylbromide. Adapt the procedure in the book to prepare an alkyl bromide from the primary alcohol furnished to you.

Nucleophilic competition. Carry out the experiment with the butyl alcohol assigned to you. Product analysis should be accomplished by GLC.

Synthesis of 5,10,15,20-tetraphenylporphyrin. In this experiment you will synthesize 5,10,15,20- tetraphenylporphyrin from pyrrole and benzaldehyde. This reaction occurs in the gas phase at high temperature and thus is another example of a green (solventless) reaction. These reaction conditions are also green because they avoid the use of a strong acid promoter, which is typically required to effect this transformation under standard reaction conditions. You will purify the product by column chromatography, which is a standard and very important method of purification.

Grading for the Laboratory:

The guidelines for keeping a laboratory notebook will be distributed separately. The laboratory grade will be based on your general ability to carry out the experiments, the accuracy with which you record and interpret your results, your performance on laboratory quizzes. The total laboratory grade will be based on the following distribution of points:

Notebook	80
Quizzes	15
TA evaluation	5
TOTAL POINTS	100

There are no make-up lab sessions. If you miss a lab for a valid (i.e., medical or other true emergency) reason, you must provide your TA with a documented excuse for the absence.

Laboratory Safety:

The organic laboratory is a very safe place to work if safety precautions are always observed. Caution, as well as careful thought and knowledge of the characteristics of what one is working with are necessary to avoid accidents and injuries. Potentially hazardous apparatus and flammable, toxic, and/or corrosive chemicals are sometimes used. The following rules and procedures will be observed at all times.

Rules:

1. You must wear safety goggles or OSHA approved glasses in the laboratory. Do not wear contact lenses.

2. Avoid personal contact with chemicals. Many chemicals have an adverse physiological effect (e.g. narcosis, toxicity, alergenicity, etc.). It is best to wear protective gloves. If you spill any chemical on your skin, wash it off at once with soap and water and tell your TA. Do not inhale chemicals or put them in your mouth.

3. Performance of unauthorized experiments is not allowed.

4. Horseplay in the laboratory is strictly forbidden.

5. Drinking, eating, or smoking in the laboratory is prohibited.

6. Removal of chemicals and equipment from the laboratory is forbidden.

7. Report all accidents and injuries, however minor, to the instructor.

8. Extraneous sources of sound are not allowed.

9. Do not work in the laboratory while under the influence of drugs or alcohol.

10. Dress properly. Do not wear open shoes or sandals. Do not wear baggy clothes. Long hair must be tied back.

11. Do not pipette by mouth.

12. When leaving the laboratory make sure all gas, air, water, steam, and electricity are turned off.

13. Know the location of exits, safety showers and eye-wash fountains.

14. Protect your hands with gloves or a towel when pushing glass tubing or thermometers into stoppers or rubber tubing. Lubricate the hole.

15. The working space, drawers, cabinet, and shelf above your bench should be neat and clean at all times.

16. The balances and balance area should be cleaned of any chemical spill.

17. Put glass in the broken glass disposal box; not in the trash.

18. Always point test tubes, flasks, and separatory funnels away from you or other passers by.

19. Follow the instructions in you laboratory text for proper waste disposal.

In case of accident

1. Fire. Personal safety is most important. Make sure everyone gets out of the room and the building. After the safety of all is assured, you may extinguish the fire. If a person's clothing catches fire, he or she needs help. Prevent the person from running. Put him or her under the safety shower and pull the chain. (It is less effective to smother flames with a fire blanket. Never spray a person with a carbon dioxide fire extinguisher.

2. Chemicals. If corrosive chemicals are spilled on clothing, immediate showering with the clothes on is the best remedy. If chemicals are spilled on the skin, wash them off with large volumes of water. If the chemical is pilled in the eyes, it should be washed immediately at the aye wash fountain.

3. Injuries. All injuries, no matter how minor must be treated immediately by competent medical staff at the University infirmary. Report the injury to your lab instructor.

My signature below indicates that I have read, understood and will comply with the safety rules. I understand that my lab grade will be penalized and I may be dismissed from lab if I do not comply.

Signature:_____ Date:_____