

CHEM 331, Organic Chemistry I

Western Illinois University, Fall 2009

Instructor: Dr. Jin Jin, Currens Hall 430-A (email: j-jin@wiu.edu) (phone 298-2261)

Lecture: 8:00-8:50 am; M,T,W,F in Currens 203; **Lab:** Tuesday or Thursday in Currens 423

Office Hours: Monday, Wednesday, Friday 9:00-11:00 am. Feel free to stop by my office when my door is open, or make an appointment by email or sign up sheet.

Textbook and materials:

1. Organic Chemistry: Structure and Function (9th Edition) by Solomons & Fryhle (ISBN-13:978-0-471-68496-1) (**Required**)
2. Introduction to Organic Laboratory Techniques: A Microscale Approach by Pavia, Lampman, Kriz, and Engel (**Required**)
3. HGS Molecular Model Set (**highly recommended**)
4. Laboratory Notebook (Carbonless Copy Sheets, **Required**)

Grading:

Lecture Examinations (100 pts x 3)	300 pts
Final Examination	200 pts
Quizzes (15 pts x 10)	150 pts
Problem set (20 pts x 5)	100 pts
<u>Lab Grade</u>	<u>250 pts</u>
TOTAL	1000

Tentative Grading Scheme

Total Pts	Grade
875 - 1000	A
750 - 874	B
650 - 749	C
550 - 649	D
0 - 549	F

Exams: There will be three 100-point lecture exams and a 200-point comprehensive final exam this semester. Each exam will cover material from lectures, any handouts, and your textbook. You will be responsible for all material up to each test. It is important to remember organic chemistry builds upon previous topics throughout the semester. This means the material on each test will be primarily from new material, but an understanding of previous topics will also be necessary.

Do not be late (you have limited time) or miss exams. You will not be able to make them up unless you have a written medical excuse or documentation otherwise justifying your absence. There is no leniency on this policy!!!

Quizzes: A quiz will be given every Friday this semester except the week when there is a lecture exam. The highest 10 scores of the quizzes will be counted. The quizzes will be given at any point during lecture and will be open note. You will have a *maximum* of 15 minutes to complete the quiz. Like exams no make up quizzes are allowed.

Homework: *Homework assignments will be provided on Western Online, and will not be distributed in class. Due dates are posted on the top of all homework assignments.*

Five problem sets will be given throughout the semester and are due at the beginning of class on their due date (you will lose points for being late). Each problem set is worth 20 points and will encompass material from your text and lecture. The problem sets will be designed to aid in your understanding of the course material and act as an additional guide for test preparation. Generally they will be designed to start off with general (easier) questions and build into more complex and challenging exercises. Additional problems can be found at the end of each chapter in your textbook and some will be assigned after learning each chapter (but not to be handed in); I highly recommend completing these as well, as these problems will from time to time find themselves onto an exam.

Attendance: You are expected to attend class regularly and punctually. Excessive absences will be reported to the financial aid office. If you anticipate or suffer an absence by emergency or tragedy, it may be possible to make up missed work. Notify the course instructor at the earliest opportunity. Students who are called away from the campus to participate in University sponsored trips such as athletics or professional meeting may be allowed to up missed work if the student provides a signed memo from the faculty sponsor.

Studying Tips: Organic chemistry is often perceived as a very difficult course. Unless you keep pace with the presented material, the course will undoubtedly be extremely challenging and stress-inducing for you. The course work is cumulative and will become increasingly difficult as the semester progresses. **DO NOT FALL BEHIND!**

Make sure you come to lecture *prepared*. This means reading through the material we will cover in class before you arrive. The best way to accomplish this is through a two-step process. Quickly (10 minutes) scan the section you are reading. After familiarizing yourself with the section reread it in more detail (45 minutes), taking a few notes on the way. It is also necessary to reread the section after lecture to reinforce the concepts or to clarify any difficult material.

Do Not become frustrated if you do not understand a topic the first time it is presented. I encourage you to ask questions during lecture and office hours.

Do Not wait until the week of the exam to begin studying. The easiest and wisest way to approach the course is to study and practice problems a few hours each day. Ask for help if you need it, my office will typically have an open door feel free to drop in or send me an email. The success in organic chemistry is through reading, learning, doing problems and understanding.

Web Resources: The course homepage is on the Western Online. Information for this class will be posted there, including the course syllabus, homework problem sets, quizzes, exams, their answers and your grades. Any class announcements will also be posted here.

Laboratory: Your safety in the laboratory is of paramount importance and thus your instructor and the Department of Chemistry will ensure that you are informed of all potential hazards associated with each and every experiment. As students enrolled in an organic chemistry course with a laboratory component you have certain responsibilities too. First and foremost is that Safety Goggles must be worn at all times while you are inside the laboratory. The Right to Know Law protects each and every citizen of our State and require employers and people of authority to let you, the citizen, be informed of the hazards associated with toxic substances that you may come into contact with as part of your employment or training. As your organic chemistry instructor I will do the same.

Material Safety Data Sheets (MSDS) information about all chemicals utilized in the laboratory can be found at the following web site. <http://physchem.ox.ac.uk/MSDS/#MSDS>. As a responsible student (citizen) you should visit this site and learn more about the various hazards associated with the different chemicals that you will be working with in the laboratory.

Hands-on experience is a vital factor in learning chemistry. All organic laboratories will be using microscale methods and equipment. Instead of using gram quantities of reagents, milligram quantities will be used thereby reducing reaction times, chemicals used, and waste generated. Consequently, great care must be taken in using the new equipment and employing impeccable microscale laboratory technique. The laboratory grade will be based upon your completion of the experiments, lab reports, technique evaluation, and lab quizzes. *Since the laboratory experience is integral to the overall course, failure to earn a passing grade in the lab will result in automatic failure for the course.*

It is extremely important to keep a careful and complete record of the experiments in your laboratory notebook. Your notebook must be permanently bound and have the carbonless copy (or carbon-copy) numbered pages. All entries in your notebook must be done with a pen and be clear, complete, and erasure free. Any inadvertent errors may be struck through with a single line and an explanation, if necessary. Since you will not be working singly, it is important that you do keep your notebook separately and uniquely. When a lab is completed, you must submit a report comprised of the copy sheets from your notebook and any other forms/papers that are required by the instructor for a particular experiment.

Please note on the schedule that there is one week's worth of make-up lab sections. The following restrictions apply: You **may only makeup ONE lab exercise**, and you must submit a "Make-Up Lab Request" Form by the deadline specified by the instructor.

Course Objectives:

1. Know the language and grammar of Organic Chemistry.
 - Draw organic molecules with appropriate electrons and charges.
 - Name organic molecules
 - Classify organic molecules by functional group
 - Represent and recognize three-dimensional shapes on paper...
 - using the wedge-dash formalism
 - using Newman projections
 - for different conformations of cyclohexanes

- Classify any two molecules as being...
 - identical or different
 - constitutional isomers or stereoisomers
 - enantiomers or diastereomers
 - Represent reactions and reaction mechanisms using the appropriate arrow formalisms.
2. Analyze the stability of organic molecules using bond strengths, electronegativities, resonance theory, molecular orbital theory, analysis of electronic and steric interactions.
 3. Evaluate molecular reactivity.
 - Predict products based on reactants (and vice versa).
 - Use molecular orbital theory, resonance theory, and reaction coordinate diagrams, and mechanisms to understand reactivity patterns.
 4. Apply the mechanism of reactivity to ...
 - Compose a reaction coordinate diagram
 - Predict reaction selectivity
 - Explain new results
 5. Compose the synthesis of an organic molecule by ...
 - Using the retrosynthetic method
 - Assembling learned reactions
 - Evaluating multiple pathways
 6. Determine organic structures by MS, NMR, IR...

Emergency evacuation: If a **fire alarm** should happen to ring, or if students are ordered to evacuate a lab or classroom by the instructor, the students should walk to the nearest stairwell (Do not use the elevators) and proceed to the ground floor and out the building. Any student on an upper floor who cannot physically proceed down the stairs should go to the southernmost stairwell and await assistance. If the building should be evacuated all students and personnel should gather at the southwest corner of the Higgins Parking lot near the fence (parking lot just outside the building) to wait further instructions.

Also, the **campus emergency management office** has two videos at the beginning of the semester. These videos are titled "Shots fired and College Fire Survival" and can be found at the following web site: <http://www.wiu.edu/rmep/resources.php>.

WIU Policies: It is the policy of Western Illinois University to accommodate individuals with disabilities pursuant to federal law and the University's commitment to equal educational opportunities. It is the responsibility of the student to inform the instructor of any necessary accommodations at the beginning of the course. Any student with a disability requiring accommodations should contact the Office of Disability Support Services.

Tentative Lecture & Exam Schedule and Problem Set (PS) Due Date

Date	Topic	Quizzes & PS (due date)
Aug 24-Aug 28	Chapter 1	Quiz 1
Aug 31-Sept 4	Chapter 2	Quiz 2
Sept 7-Sept 11	Chapter 3	PS#1 (Sept 11), Quiz 3
Sept 14-Sept 18	<i>Review</i>	Exam #1 (Chapter 1-3)
Sept 21-Sept 25	Chapter 4	Quiz 4
Sept 28-Oct 2	Chapter 5	PS#2 (Oct 2), Quiz 5
Oct 5-Oct 9	Chapter 6	Quiz 6
Oct 12-Oct 16	<i>Review</i>	PS #3 (Oct 16), Exam #2 (Chapter 4-6)
Oct 19-Oct 23	Chapter 7	Quiz 7
Oct 26-Oct 30	Chapter 8	Quiz 8
Nov 2-Nov 6	<i>Review</i>	PS #4 (Nov 6), Quiz 9
Nov 9-Nov 13	Chapter 9	Quiz 10
Nov 16-Nov 20	<i>Review</i>	Exam #3 (7-9)
Nov 23-Nov 27	Thanksgiving break	
Nov 30-Dec 4	Chapter 10	Quiz 11
Dec 7-Dec 11	<i>Review</i>	PS #5 (Dec 7), Quiz 12
Dec 14	Final Exam	8:00-9:50 am

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Laboratory meeting time, place and TA

Sec 21	9:00 - 11:50	Tu	Cu 423	Dr. Jin Jin; Gottam, Himabindu
Sec 23	3:00 - 5:50	Tu	Cu 423	Vegesna, Vijaya Sree
Sec 22	8:00 - 10:50	Th	Cu 423	Gottam, Himabindu
Sec 24	2:00 - 4:50	Th	Cu 423	Vegesna, Vijaya Sree

Lab manual and required materials

1. Introduction to Organic Laboratory Techniques: A Microscale Approach by Pavia, Lampman, Kriz, and Engel
2. Laboratory Notebook (Carbonless Copy Sheets)

Laboratory safety rules

- Wear safety goggles (eye protection) at all times when in the laboratory. This is a departmental and state regulation.
- Do not eat or drink in the laboratory.
- Know the location and use of the nearest fire extinguisher, nearest First Aid kit, nearest eye wash station, nearest safety shower, and nearest exit designated for evacuation. You will be advised of the locations on the first day of the lab.
- Know the location of the Material Safety Data Sheets (MSDS) and know that you have access to them. You are protected by the right to know law.
- Know the NFPA (National Fire Protection Association) Hazardous Material Classification Codes.
- Report all accidents, even minor injuries, to the instructor at once.
- In case of an organic chemical spilled on your person, flush with water, wash with soap, rinse with water, rinse with ethyl alcohol, wash with soap, and rinse with water. Pat dry.
- Never taste chemicals or solutions. Minimize the inhalation of organic vapors by using the smallest amounts of materials and utilizing the hood as much as possible. Check the MSDS if you have questions.
- Dispose of all wastes properly. Read labels on bottles! Keep bench and floor clean.
- Before leaving the laboratory, be sure that the water, steam, heaters, and gas cocks are shut off.

Laboratory Information

Hands-on experience is a vital factor in learning chemistry. For the first semester of this organic sequence, the emphasis of the laboratory exercises will be on microscale methods and techniques. The laboratory grade will be based upon your completion of the experiments, lab reports (pre-lab and post-lab), and technique evaluation. *Since the laboratory experience is integral to the overall course, failure to earn a passing grade in the lab will result in automatic failure for the course.* Notebooks will be checked to verify that they contain the information necessary for the day's experiment. If a student comes to the lab with an incomplete pre-lab

report or does not seem to be prepared to do the work, that student will not be allowed to continue in that day's lab until the lab instructor is convinced of the student's preparedness for the experiment.

Notebooks: It is extremely important to keep a careful and complete record of the experiments in your laboratory notebook. Your notebook must be permanently bound and have the carbonless copy (or carbon-copy) numbered pages. All entries in your notebook must be done with a pen and be clear, complete, and erasure free. Any inadvertent errors may be struck through with a single line and an explanation, if necessary. Since you will not be working singly, it is important that you do keep your notebook separately and uniquely.

The laboratory notebook is a record of what happened in the experiment. It should be understandable to others and should contain enough information such that the experiment could be repeated at a later date by you or by someone else. You are free to develop your own style for the notebook within some guidelines. Using your own style does not mean that you have license to be sloppy or careless. Much of the notebook will be data (descriptions, numbers, calculations, etc.), but a modicum of other information is also required. Procedural information, changes in method or technique, etc. should be recorded immediately, providing a complete narrative of everything you do as you are doing it. Therefore, you will have to do a little writing before, during, and after each lab. All entries in your notebook should be in pen. A table of contents in your notebook should also be kept current. Any graphs, computer print-outs, and spectra should be attached in the notebook (taped or stapled) for a permanent record of the data.

In addition, I would ask for two additional protocols: 1. Leave the first few pages of the notebook blank for a table of contents so that each experiment can be readily located. Pages should be numbered consecutively. 2. Write your experimental plan on the left hand page in your notebook, then record your observations and data on the right hand page.

Product. For synthesis lab, you are expected to turn in a labeled vial that contains product at the end of the lab. A typical label contains name, melting point, weight of the compound, your name and date.

Cleaning up. When you have finished your lab work, clean up your personal workspace by putting away your equipment, wiping or sweeping up spilled materials, disposing of waste chemicals in the proper containers in the waste hood, etc. Community areas (especially the instrument areas) are to be cleaned up immediately after you have used them. This would include the balances, the mp apparatus and used capillaries, the infrared cells, and the IR sample prep area.

Lab Reports: At the beginning of the next lab section, you must submit a lab report for the previous lab comprised of the copy sheets from your notebook and any other forms/papers, includes pre-lab, observation (in-lab), post-lab, copies of any graphs, print-outs, and spectra obtained during the experiment. Record all information in **ink!** (Since we are using carbonless-copy pages, make sure you use the cardboard backer sheet between copy sheets, and that you write firmly and legibly so the lab instructor may read and grade your reports!) Pre-lab and observation are to be handwritten; post-lab can be handwritten or typewritten. They should be stapled together and handed in.

Pre-lab should contain:

- 1. Heading.** Give the experiment letter, title, your name and the date.
- 2. Introduction.** Prepare a brief, clear statement of your experimental objectives.
- 3. References.** List references to relevant background, procedures, physical constants, experimental variations, etc.
- 4. Reaction Scheme.** Write the balanced equation for the experiment involving a synthesis. Solvents, catalysts, reaction conditions should appear above or below the reaction arrow. Whenever possible, include the mechanism(s) below the balanced equation(s) or any possible side reactions. Refer to your organic lecture text as necessary.
- 5. Table of Starting Material and Products.** List, in tabular form, each starting material under the following column headings:
 - (1) Compound
 - (2) Molecular Weight
 - (3) Amounts Used (subheadings for Weight, Volume and Moles)
 - (4) Physical Properties (include mp, bp, density, etc. as appropriate). Note that the data in the text is generally not sufficient. There are two reference works with physical properties in the laboratory (the CRC Handbook of Chemistry and Physics and the Merck Index); you should learn how to use these. There are also on-line resources such as the Aldrich Catalog.
 - (5) Determine the limiting reagent. State which starting material, if any, is the limiting reagent.
 - (6) Yield Data. Show your calculations for **theoretical yield (TY)**. Leave a space to insert the **percentage yield (Y%)** when your **actual yield (AY)** has been determined.

Compound	MW	Amount			Physical properties			Limiting reagent	Yield		
		g	mol	ml	mp	bp	d		TY (g)	AY (g)	Y%

6. Procedures (write left hand side in the notebook in order to leave space for observations). The detail should be sufficient so that your fellow students can read your report without any guessing. Any changes of procedures or concentration of solutions during lab sessions must be recorded. Do not copy procedures from the lab manual. You should use passive voice to write up the lab procedures in your own words.

7. Method of Purification (a flow chart). A very important phase of synthetic organic chemistry is the separation and purification of the desired product. Because of the many and varied reactions that organic compounds undergo, frequently the most difficult step in the preparation of a compound is not its actual formation but its isolation in pure form from byproducts, side products and unchanged starting materials. To accomplish this, determine all the compounds that could possibly be present on the basis of a consideration of the main and side reactions. Devise a purification scheme, using a flow chart to see how various purification procedures eliminate the undesired substances and yield the pure product. By examining a purification scheme in this manner, the purpose of each step in the procedure becomes clear, and one may be able to predict what impurities, if any, may contaminate the product.

Click the link to see a flow chart sample:

<http://www.chemistry.sjsu.edu/straus/EXPTF%20htms/EXPTF%20FlowDiagram.htm>

In the lab you record:

8. Observations, Data and Notes (right hand page corresponding to each procedure). During the experiment all such information should be recorded directly in the notebook (not transferred from other notebooks or scraps of paper, or recreated from memory at a later date). Record all

significant observations that you make, but be sure to point out any deviations from or difficulties with a published experimental procedure. Observed physical properties of your product(s) should always be accurately reported. Always record mp and bp as ranges (e.g., mp 123-4°C).

Post-lab should contain:

9. Results and Discussion. For results, briefly summarize how your compound was prepared; how it was isolated; what its properties were: mp, bp, spectroscopic (IR, NMR data), chromatographic, etc. Tables are often the most efficient and clearest way to present data. For discussion, the purpose is to interpret and compare results. In a synthetic experiment, the result is pretty obvious: you obtained a product. Is it the right stuff, however? What evidence do you have that it is or isn't? Was the recrystallization/distillation/chromatographic separation successful? How do your observations compare with literature reports of the same phenomenon (such as mp, bp, NMR or IR spectrum, etc.)? Keep your discussion short.

10. Conclusions. The conclusion is a short statement that puts your results in the context of the original problem. This may be a separate section or it may just be the final sentences of the discussion section.

11. Answer the assigned questions at the end of each experiment.

Tentative Laboratory Schedule

Week	Expt # (PLKE)	Topic
1 (Aug 25/27)		<i>No Lab</i>
2 (Sept 1/3)		Laboratory Check-in, Syllabus
3 (Sept 8/10)	#4D	Use of extraction to isolate a neutral compound from a mixture containing an acid
4 (Sept 15/17)	#8	Preparation of Aspirin
5 (Sept 22/30)	#11	TLC analysis of analgesic drugs
6 (Sept 29/Oct 1)	#10	Acetaminophen
7 (Oct 6/8)	#16	Isolation of Chlorophyll and Carotenoid pigments from spinach
8 (Oct 13/15)		Stereochemistry dry lab
9 (Oct 20/22)	#13	Isopentyl acetate (banana oil)
10 (Oct 27/29)	#35	Reduction of camphor to isborneol
11 (Nov 3/5)	#20	Reactivities of some alkyl halides
12 (Nov 10/12)	#25	Preparation of 4-methylcyclohexene
13 (Nov 17/19)		NMR dry lab
14 (Nov 24/26)		<i>Thanksgiving Holiday</i>
15 (Dec 1/3)		<i>Make-up Lab period and Laboratory Check-out</i>
16 (Dec 10/12)		<i>Laboratory Exam</i>

Grading Scheme

Pre-lab	Recorded Observation & Data	Result Discussion Conclusion	Post-lab questions	Organization Lab technique Product	Subtotal	Lab final exam	Total
4	4	4	4	4	20x11=220	30	250