Centro Universitario Internacional

CHE 210E Organic Chemistry I

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Course Information:
Fall 2016

"If you wish to understand the fragrance of the rose or the tenacity of the oak; if you are not satisfied until you know the secret paths by which the sunshine and the air achieve these wonders; if you wish see to the pattern which underlies one large field of human experience and human measurement, then take up Chemistry."

Charles Coulson – Professor of Chemistry, Oxford University

Course materials (required):

1) D.E. Klein, *Organic Chemistry*, 1st Ed., John Wiley&Sons, 2012
2) Brooks-Cole, *Organic Chemistry Laboratory Notebook* (100 carbonless duplicate pages).

Course materials (optional):

1) Darling, Molecular Visions Organic Model Kit.
2 Harwood and Claridge, Introduction to Organic Spectroscopy, Oxford University Press, 1996.

Course Assessment:

Lab	25 points
Problem sets	15 points (6 @3 points each, drop one)
Midterm exams	25 points (2 @ 12.5 points each)
Final exam	30 points
Dictionary	3 points
In-class quizzes	2 points (5 @ 0.5 points each, drop one)
Total	**100 points**

Lab (25 points): Please see separate syllabus for laboratory component. Your grade will be based on both submitted lab reports and pre-lab quizzes.

Problem sets (15 points): You will complete 6 problem sets throughout the semester; of these, I will take the best 5 out of 6 and assign each a grade out of 3 for a total of 15 points. The problem sets will be posted online in the morning of the day specified and will be due in class on the due date – no exceptions! The answers for the previous problem set will be posted online immediately following submission; therefore late assignments will not be accepted. The problem sets are designed as a tool for you to practice and master the course material in preparation for the midterms and final exam and will be comprised of

both routine “practice” problems and more challenging “applied theory” problems. Please see the course schedule below for posting and submission dates and note them accordingly in your personal agenda.

Midterm exams (25 points): Two midterm exams will be held throughout the semester. While I aim to have certain material covered for the midterms, the pace of the course indicated in the lecture outline might not coincide with the midterm date. I will confirm in class and through online communications what material will be included on the midterm in advance. In general, the material on the midterm exams will be up to and including the end of lecture on the Monday of the same week.

Final exam (30 points): The final exam will take place during the final exam period (last week of the semester). You must take the final exam to pass the course, but you do not have to pass the final exam to pass the course. The final exam will encompass all material covered in the semester, but not equally weighted.

Dictionary (3 points): In order to be successful in Organic Chemistry, one must think and talk like an Organic Chemist, yet the volume of new terminology and phrases can be overwhelming to students learning the subject for the first time. To assist you in keeping all of these new words in order, you will create and maintain an “Organic Chemistry Dictionary” during the course. Please see the separate document detailing how you should organize your dictionary and what material it should contain. Your dictionary is due when you write your final exam and will be returned to you once graded.

In-class quizzes (2 points): Five in-class “pop” quizzes will be held during the semester, on dates selected at my discretion; of these, I take the best 4 out of 5 and assign each a grade out of 0.5 for a total of two points. The quizzes may be held during our regular morning lectures or during the Friday lab lecture period, and may include both closed-book and open-book quizzes.

Class policies

Cell phones: Absolutely no cell phones in class! Please turn your cell phones to silent or off during lecture and during exams. No texting. If you anticipate an emergency and are expecting a call, please set your phone to vibrate, sit near the exit and excuse yourself if it rings. Likewise, no cell phones in the lab – please leave them in your bags.

Attendance Policy

Attendance in both lecture and lab are necessary and expected. Exams missed due to an excused (medical) absence must be made up within a week of returning to classes. It is each student’s responsibility to be informed of exam dates, paper due dates, required course activities, etc. before making any travel plans during the semester.

Exams: You are expected to take the midterm exams at the scheduled time. If you are suddenly ill or there is an emergency, please contact me in advance or as soon as possible after the exam, by 9 am the next morning. Documentation of your emergency will be necessary. A final exam will be held during the last week of the semester and you must take the exam at the appointed time; please plan your travel accordingly.

Academic Honesty

Academic Integrity is a guiding principle for all academic activity at Pablo de Olavide University. Cheating on exams and plagiarism (which includes copying from the Internet) are clear violations of academic honesty. A student is guilty of plagiarism when he or she presents another person's intellectual property as his or her own.

Students committing acts of academic dishonesty shall be penalized by a failing grade for the assignment and a failing grade for the course.

Extra credit: Students will not have additional "extra credit" opportunities during the course semester; only the items listed in the course assessment table above will be used to calculate the grade. However, bonus questions may be offered on exams and assignments at the discretion of the Instructor.

Grading Scale (per UPO student handbook)

Grade Conversion Scale:

Spanish Grade:	10	9.5-9.9	9 - 9.4	8.5-8.9	8-8.4	7.5-7.9	7-7.4	6.5-6.9	6-6.4	5.5-5.9	5-5.4	0-4.9
U.S. grade:	A+	A	A-	B+	B	B	B-	C+	C	C	C-	F

Resources:

There are several resources available to you. In addition to my listed office hours, you can make an appointment to meet with me. I will hold extra office hours and/or tutorial sessions prior to midterm and exam dates as my schedule permits. We have also arranged for weekly tutorial sessions; please make a note of the session times once they are posted.

Your textbook is a fantastic resource, and for that reason, I have assigned reading sections and practice problems from the book. This material is meant to supplement, not replace, the lecture component, but I expect that you will read the assigned material and take it as seriously as attending class. The assigned problems will not be graded, but I expect you to do them as they are an excellent way to learn the material and practice for midterm exams and your graded assignments.

Communication

The primary mode of communication will be through the WebCT. I will post most announcements for the class on this portal; e-mail will only be used if the message is urgent or highly important (e.g., class cancellation, typo in problem set). Lecture notes, answer keys for the problem sets and exams, extra practice problems and their answers, etc. will be posted on the WebCT in the appropriate folder. Grades WILL NOT be posted on the WebCT. Pertinent class dates have been entered in the The WebCT calendar function. If you need to contact me, please e -mail (preferred) or phone as listed above. I will reply at the earliest opportunity but please understand that it might not be right away as I am not always in my office!

Strategies for success

Organic Chemistry has a reputation as one of the most difficult classes that a student takes during their undergraduate career but it's not impossible; you can succeed and there are many way s in which to do that. The first is to recognize that the material is cumulative: what you learn in the early lectures is material that you will need to help you solve problems

later in the course. You can't just compartmentalize it, instead you build on your knowledge throughout the course. For this reason, it is very important that you have a thorough understanding of the material covered in the early lectures and that you stay on top of the class. This takes both hard work and dedication. The second way to succeed is to pay attention to detail; what might seem to you like a negligible difference in chemical structure or reaction conditions can completely change the nature of the molecule or how it reacts, so it is very important on exams and assignments to make sure that you pay attention to the details of the question to arrive at the correct answer. In other words, make sure you say what you mean and mean what you say!

Most students find that the real key to success in Organic Chemistry is practice, practice, and more practice. The amount of material that is covered and the way that I teach both make it practically impossible to memorize the content of the course – plus, you don't learn nearly as much when you memorize and you certainly don't retain the material. On the other hand, working through lots of examples and doing as many practice problems as possible will help you to learn and remember the material. After a certain point, you will start to recognize patterns and get a feel for how molecules react – in other words, you will develop your chemical intuition. This takes longer for some than others, but don't be discouraged; stay focused and keep at it!

My teaching Strategies

There are a couple of different ways that I could teach this course: I could stand up at the front of the room and give you umpteen different reactions and molecules to memorize, or I could actually help you gain a fundamental understanding of Organic Chemistry. I prefer the latter approach; you will retain the material long after the course is completed (and will be able to apply it to your chosen field of study!) and you will develop your critical thinking skills. Unfortunately, there will be some things that you just need to memorize – there is no way around it. But I try to keep this to a minimum and strongly discourage you from trying to memorize everything that we will cover in class – it will be both overwhelming and unproductive. Instead, I hope that by taking the assignments seriously, completing the in-chapter practice problems and using your dictionary as suggested, you will join me in thinking like an Organic Chemist and gain an appreciation for the subject.

Expectations

What I expect from you: I expect that you will have a thorough knowledge of the topics covered in CHE 110 (General Chemistry); this course is a pre-requisite, and if you are weak in some areas or feel you require a refresher, the onus is on you to get caught up ASAP, by your own. Specifically, I expect you to have an understanding of chemical bonding, Lewis structures, orbitals and electron configurations, VSEPR theory and intermolecular forces. We will briefly review these topics in relation to Organic Chemistry but you will have a much deeper appreciation for the material if you have a good understanding of the fundamentals from General Chemistry.

I expect you to stay on top of the material and not fall behind; you can accomplish this by regularly attending class, reviewing your lecture notes after class and making note of any trouble areas, and using your textbook to complement your lecture notes. You can also accomplish this by starting your assignments or studying for your exams early and not waiting until the last minute. Part of the "incentive" for staying on top of the material are the five "pop" quizzes that will be held during the semester.

I expect you to use the resources that I provide for you to your best advantage; this includes following up with answer keys to midterms or assignments, lecture notes or handouts that I put online, and completing the assigned problems from the text and/or extra problem sets that I make for you. This also includes attending tutorial sessions and visiting me during my office hours for extra help.

What you can expect from me: You can expect me to return your work to you as soon as possible and with as much feedback as I can provide; yes, it might be a lot of "red pen" but I'd rather explain to you why something is wrong, so that you can use this feedback to obtain the correct answer in the future. Please understand that I do most of my own grading and with the large number of students that I have, this sort of thorough grading can take some time.

You can expect me to communicate with you as much as possible: I try very hard to answer student e-mails quickly (although it helps if you are very clear and/or specific in what you are asking me!) and if there is any additional information or clarification about assignments or something we discussed in lecture, I will relay this information as soon as possible.

You can expect me to post lecture notes when applicable; I use a combination of chalkboard and Power Point as appropriate – I'll post the Power Point notes online when I use them, and will try hard to have them available for you before class.

You can expect me to be committed to your success in this course ; I will always make the extra effort to help you succeed in Organic Chemistry, but please remember that learning is a two-way street and that I expect you to be committed to your success, as well.

Lecture Outline:**

Lecture #	Topics	Section of Texts$	Class Schedule
1	Course intro, model of the atom, electron configurations	1.1-1.4	
2	Bonding patterns, valency, octet rule, Lewis structures, FCs	1.5-1.7, 2.1	
3	Valence bond theory, MO theory and hybridization	2.2, 3.1-3.5	A1 out
4	VSEPR theory and polarity, electronegativity, IMFs	1.9-1.11	
5	Physical properties: mp, bp, solubility trends	2.5, 2.6	
6	Functional gps, structure drawing, DU, nomenclature, isomers	2.3, 2.4, 2.7, 5.1-5.6	A1 due, A2 out
7	Functional gps, structure drawing, DU, nomenclature, isomers	2.3, 2.4, 2.7, 5.7-5.10	
8	Functional gps, structure drawing, DU, nomenclature, isomers	2.3, 2.4, 2.7, 12.1 -12.7	
9	Infrared Spectroscopy 1: intro to IR spectroscopy	OS1.1-1.3, OS3.1-3.4 13.1-1 3.4	
10	Infrared Spectroscopy 2: using IR spectroscopy	OS 3.5, 13.5-13.9	
11	Infrared Spectroscopy 3: using IR spectroscopy	13.10	
12	Resonance, curly arrows and electron pushing 1	1.8, 3.6, 3.7, 3.8	A2 due, A3 out
13	Resonance, curly arrows and electron pushing 2	1.8, 3.6, 3.7, 3.8	
14	Resonance, curly arrows and electron pushing 3	1.8, 3.6, 3.7, 3.8	
15	Acid-base chemistry: general reaction and equilibrium	4.1,4.2,4.3	
16	Acid-base chemistry: identifying acidic protons	4.4	
17	Acid-base chemistry: structure-acidity relationships 1	4.5-4.8	A3 due
18	Acid-base chemistry: structure-acidity relationships 2	4.9, 4.10	MT1
19	Conformational Analysis 1: alkenes and priority rules	6.1-6.2	
20	Conformational Analysis 2: alkanes, drawing structures in 3D	6.3	A4 out
21	Conformational Analysis 3: cycloalkanes	6.4-6.7	
22	Conformational Analysis 4: cycloalkanes	6.8	
23	Stereochemistry: chirality and enantiomers	7.1, 7.2	
24	Stereochemistry: assigning absolute configuration	7.3, 7.4	
25	Stereochemistry: multiple chirality centers	7.5, 7.6, 7.7	
26	Stereochemistry: Fischer projections and wrapup	7.8, 7.10	A4 due, A5 out
27	Substitution reactions 1: intro to reaction, terminology	8.1, 8.2	
28	Substitution reactions 2: S_N2 reaction and mechanism	8.3, 8.4, 8.5	
29	Substitution reactions 3: S_N1 reaction and mechanism	8.6, 8.7, 8.8	A5 due
30	Substitution reactions4: competition between S_N1 and S_N2	8.9, 8.10, 8.11, 8.12	
31	Substitution reactions 5: competing reactions, epoxides	8.13, 8.14, 10.10	MT2
32	Synthesis using substitution reactions	10.1-10.9, 10.15	
33	Elimination reactions 1: E2 reaction and mechanism	9.1, 9.2, 9.3,	A6 out
34	Elimination reactions 2: regiochemistry of elimination rxns	9.4	
35	Elimination reactions 3: E1 rxn/mech, comp. E1 and E2	9.5, 9.6,	
36	Elimination reactions 4: synthesis with elimination rxns	10.11,10.12,10.13	
37	Competition between substitution and elimination	9.7	
38	Mass Spectrometry 1: intro	OS6.1,-6.3, 15.4, 15.5	
39	Mass Spectrometry 2: using mass spectrometry	OS 6.4-6.7, 15.6	A6 due
40	Mass Spectrometry 3: using mass spectrometry	OS 6.4-6.7, 15.6	
	Final Exam Period		

** Please note that this lecture outline is tentative and subject to change depending on the pace and progress of the class.

$ The indicated text sections are assigned reading. While I will cover the fundamentals in class, there is not sufficient lecture time to discuss all the details of each topic, thus the onus is on you to complement the lecture material with that in your textbook and do the assigned in-chapter practice problems. These readings might change depending on the progress and flow of the class; I might also assign additional reading throughout the semester – both modifications will be communicated in class and online.

≠ OS refers to the softcover text Introduction to Organic Spectroscopy. All other assigned readings are from Hornback's Organic Chemistry.

Assigned Reading and Problems Organized According to Lecture Units

Section One: Structure and Bonding (Lectures 1-8)
Reading: Chapter 1 (1.1-1.10), Chapter 2 (2.1-2.7), Chapter 3 (3.1-3.5), Chapter 5 (5.1 -5.10), Chapter 12 (12.1-12.7)
Assigned Problems: 1.5, 1.6, 1.8, 1.12, 1.24, 1.31, 1.40, 2.1, 2.2, 2.4, 2.5, 2.6, 2.10, 2.14, 2.16, 2.19, 2.20, 2.23, 2.27, 2.29, 2.34, 2.35, 2.46, 3.5, 3.8
Suggested Problems: 1.9, 1.11, 1.13, 1.18, 1.20, 1.22, 1.23, 1.27, 1.36, 2.3, 2.7, 2.8, 2.9, 2.11, 2.15, 2.17, 2.18, 2.21, 2.22, 2.25, 2.26, 2.28,2.30, 2.31, 2.32, 2.33, 2.42 , 2.43, 2.44, 2.45, 3.6, 3.7, 3.9, 3.20, 3.21, 3.22, 3.23, 3.34

Section Two: Infrared Spectroscopy (Lectures 9, 10, 11)
Reading: Chapter 13 (13.1-13.10) and OS Chapter 1 (1.1-1.3) and OS Chapter 3 (3.1-3.5)
Assigned Problems: 13.5, 13.9, 13.11, 13.14, 13.16, 13.19, 13.22, 13.23
Suggested Problems: 13.8, 13.10, 13.13, 13.15, 13.17, 13.18, 13.20, 13.21, 13.24, 13.26

Section Three: Resonance and Electron Delocalization/Curly Arrows (Lectures 12, 13, 14)
Reading: 1.8 and 3.6-3.8
Assigned Problems: 1.10, 3.12, 3.13, 3.14, 3.16, 3.17, 3.26, 3.27
Suggested Problems: 1.19, 1.39, 3.15, 3.24, 3.25, 3.28, 3.29, 3.36, 3.38, 3.41

Section Four: Acid-Base Chemistry (Lectures 15-18)
Reading: Chapter 4 (4.1-4.10)
Assigned Problems: 4.4,4.9,4.13,4.15,4.16,4.19,4.29,4.30,4.31,4.32,4.35 (good one!), 4.41,4.47
Suggested Problems: 4.2, 4.3, 4.5, 4.6,4.7,4.8,4.14,4.17,4.20, 4.21, 4.22,4.23,4.24,4.25,4.26,4.33, 4.34,4.36,4.37,4.40,4.42,4.46

Section Five: Conformational Analysis (Lectures 19-22)
Reading: Chapter 6 (6.1-6.8)
Assigned Problems: 6.2, 6.4, 6.7, 6.12, 6.17, 6.23, 6.25, 6.30, 6.31
Suggested Problems: 6.1, 6.3, 6.5, 6.6, 6.8, 6.10, 6.11, 6.13, 6.14, 6.15, 6.16, 6.19, 6.24, 6.26, 6.27, 6.28, 6.29

Section Six: Stereochemistry (Lectures 23-26)
Reading: Chapter 7 (7.1-7.8 and 7.10)
Assigned Problems: 7.2, 7.4, 7.5, 7.8, 7.10, 7.13, 7.16, 7.20, 7.22 (good one!), 7.27
Suggested Problems: 7.3, 7.6, 7.7, 7.9, 7.11, 7.12, 7.17, 7.18, 7.19, 7.21, 7.23, 7.25, 7.28, 7.29

Section Seven: Substitution Reactions (Lectures 27-3 1)
Reading: Chapter8 (8.1-8.14) and section 10.10
Assigned Problems: 8.2, 8.7, 8.8, 8.9, 8.12, 8.16, 8.19, 8.21, 8.26, 8.28 (good one!), 8.30,8.53, 10.25, 10.7, 10.13, 10.17, 10.23
Suggested Problems: 8.1, 8.3, 8.4, 8.5, 8.6, 8.10, 8.11, 8.13, 8.15, 8.17, 8.20, 8.22, 8.23, 8.24, 8.25, 8.27, 8.29, 8.31, 8.32, 8.33, 8.34, 8.35, 8.36,8.37,8.38,8.40, 8.42,8.44,8.52, 10.1,10.4, 10.5,10.9,10.11,10.14,10.15, 10.16, 10.18, 10.22

Section Eight: Elimination Reactions (Lectures 32-37)
Reading: Chapter 9 (9.1-9.7 – not E1cb), 10.11, 10.12, 10.13

Assigned Problems: 9.1, 9.2, 9.4, 9.6, 9.10, 9.12, 9.13, 9.16, 9.17, 9.18, 9.24, 9.33, 10.27, 10.28, 10.30 Suggested Problems: 9.3, 9.5, 9.7, 9.8, 9.9, 9.11, 9.15, 9.19, 9.20, 9.21, 9.22, 9.23, 9.26, 9.27, 9.28, 10.26, 10.29

Section Nine: Mass Spectrometry (Lectures 38, 39, 40)
Reading: Chapter 15, sections 15.4-15.6 only and OS Chapter 6 (6.1-6.7) Assigned Problems: 15.14, 15.20, 15.21, 15.23, 15.24
Suggested Problems: 15.7, 15.8, 15.11, 15.12, 15.18, 15.19, 15.22

Creating an Organic Chemistry Dictionary

One common frustration that students have about Organic Chemistry is that there are "too many new terms to remember". This is true; your vocabulary will expand significantly in this course, since in order to think like an Organic Chemist, you need to talk like an Organic Chemist. The objective in creating an Organic Chemistry dictionary is to provide you with a way to keep track of all of these new words, and to help you remember them. By having an organized volume, you will easily be able to look up a word that you can't quite remember, and the simple act of creating the dictionary will help you become more familiar with the terminology and examples.

How to set up your dictionary: you will want to use a notebook of some sort - a coil-bound notebook with at least 50 pages is recommended (100 pages will definitely be more than enough!). Binders are not recommended as pages can be removed and lost. You will divide the notebook into alphabetical sections (A,B,C, etc.) and the amount of room that you will need per letter will depend on how much detail you include, how large you write and how many words fit in that section. At least two pages per letter are recommended. Be creative - use color to keep your dictionary organized and attractive, but also be sure to be scientifically accurate and thorough.

Each notebook entry should include a) the term, b) its definition, c) the date this term was introduced in class (so you can refer to your class notes), and d) the page or section in the book where it is introduced/defined. You must also include an example if relevant (for example, the term "Lewis structure" needs an example as does "conjugate base", but something like "polarimeter" is hard to give an example for since it is a piece of equipment). You are welcome to include any additional information/personal hints/mnemonic devices that you think will be useful to you but be careful not to make it too cluttered.

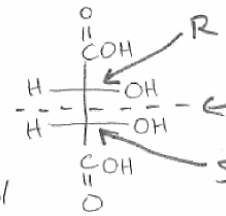
Sample entry:

meso See section 7.5 (pg 233) in Hornback & class notes October 30th.

A meso compound is a special type of stereoisomer that contains 2 or more stereocenters but is not optically active since it possesses an internal plane of symmetry.

Example

Shown in Fischer projection but can be shown as dash/wedge



note that the two chiral centers have opposite configuration – hint!!

Remember: you are making this dictionary for you, so the more effort that you put into it, the more it will help you with the course. Have fun!

LABORATORY SCHEDULE FOR CHE 210

Week #	Experiment Title	Laboratory Report	Assigned Reading Technique	Lab Quiz	Lab Due
1	Check-in / Thin Layer Chromatography (TLC) of	Experiment 1	TLC	Yes	
2	Purification of a Solid: Week 1	Experiment 2	Recrystallization	Yes	Expt 1
3	Purification of a Solid: Week 2	Experiment 2	Melting Point	Yes	
4	Unknown Identification of a Liquid	Experiment 3	Boiling Point Refractive Index IR Spectroscopy	Yes	Expt 2
5	**No Lab**				
6	Unknown Identification	Experiment 3		No	
7	Extraction of an Mixture: Week 1	Experiment 4	Extraction	Yes	Expt 3
8	Conformational Analysis	Handout 1		No	
9	Extraction of an Mixture: Week 2 (Analysis)	Experiment 4	Extraction/MP/I	No	
10	Stereochemical Analysis	Handout 2		No	Expt 4
11	Extraction of Caffeine from Tea: Week 1	Experiment 5	Sublimation	Yes	
12	***No Lab***				
13	Extraction of Caffeine from Tea: Week 2	Experiment 5	MP, IR, TLC	Yes	
14	**Review Problems/Check-Out**				Expt 5

All references to “techniques” are found in:

Mohrig, et. al. Techniques in Organic Chemistry: **3rd** Edition, W. H. Freeman, 2010.

Grading Breakdown for Lab

		250 pts total	25 % of total grade
Lab Quizzes	7 X 10 pts each (drop one)	60	6%
Lab Notebooks	5 X 10 pts	50	5%
Lab Reports	5 X 20 pts	100	10%
Handouts	2 X 15 pts	30	3%
Presentation	10 pts	10	1 %

Overall, your laboratory grade will be based upon:

1. preparation (pre-lab write-up & quizzes)
2. performance (lab notebook, documented results, calculations, and quizzes)
3. comprehension (lab reports: analysis & discussions of results)
4. communication (presentations, ability to impart comprehension of material)

These factors will be assessed in the following ways: a) lab quizzes, b) an overall lab notebook grade (reports and carbonless notebook), c) handouts and d) presentations.

a) Laboratory Quizzes - 10 points each

Quizzes will take place at the beginning of each lab period according to the schedule above and last for approximately 10-15 minutes at the discretion of the Instructor. During the quizzes, you will be allowed to *use your lab notebook only (**NO** loose paper, calculators or cell phones are permitted)*. Quizzes will cover the pre-lab material from the current week's lab. In the case of an unexcused absence, the missed lab quiz will be taken as a "zero". Make-up quizzes will only be allowed if there is a documented medical or personal emergency that permitted your absence from lab. Students who are more than 10 minutes late to lab will not be permitted to write the quiz.

b) Laboratory Notebooks - 10 points each

A carbonless copy laboratory notebook must be purchased and maintained as a record of your experimental work in this course. To be considered a permanent record **NOTEBOOKS MUST BE BOUND**. Actively maintain your laboratory notebook according to the guidelines below and strongly consider the feedback from your Instructor in preparing

future laboratory reports. All lab data should be recorded in ink directly in the notebook (not on scrap paper & copied in later). Errors should be crossed out with a single line so that all information is still legible. Any in-lab data should be stapled or taped into your notebook. **NOTE**: 3 ring binders or the equivalent with loose-leaf paper inserted is NOT considered "bound", and is not acceptable as a lab notebook in this course. Furthermore, photocopying portions of the lab text and taping into your notebook is NOT ALLOWED. The general criteria for grading lab notebooks are given below. Also note that your lab notebook will be your only source of information for completing the laboratory experiment and quiz. No lab handouts or photocopies will be permitted during the lab section.

Lab notebooks will be graded based on the pre- and post-lab expectations for each laboratory experiment.

Do not be intimidated by how large of an undertaking maintaining a notebook seems. It does require a lot of work, but once you have gone through a couple of experiments it should be rather straightforward to keep things in order.

You will submit a carbonless copy of your notebook entry (as indicated in the lab schedule) after the completion of the lab (worth 10 points each). Please follow the guidelines outlined below to ensure that you earn full points!

Please write darkly and neatly so that your Instructor can read your report!

Before coming to lab (pre-lab):

Header: name and date on every page.

Title: must be a title that fully describes the experiment.

Purpose: must explicitly state the purpose(s) of the experiment. "What is the point of this experiment?"

Table of materials: must include ALL reagents, solvents and chemical materials to be used in the lab as well as any product(s) formed. Include names, structures, relevant physical constants, and safety information (hazards). Also include literature IR and/or NMR and/or UVVis spectra of reagent AND product(s), as applicable. (In other words, if you will analyze your product by IR spectroscopy, include the IR spectra of your expected product as well as that of starting materials so that you can accurately assess your experimental results.) Staple or tape these spectra to your notebook page, reducing the size of the spectra so they do not take up multiple pages in your laboratory notebook.

To find information on physical data and spectra visit the following websites: http://www.aldrich.com, www.acros.com, http://www.msdsonline.com, or riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre index.cgi?lang=eng (search SDBS). The Aldrich Library of IR Spectra is available on reserve in the library, and the CRC Handbook of Chemistry and Physics and Merck Index are available for use in the reference section. Sometimes you might need to combine print searches with on-line searches to find the information you need.

Reactions and mechanisms: write the balanced reaction that is being carried out in the lab (if applicable). Write the full reaction mechanism including all intermediates and curly arrows if known for the experiment.

Procedure: the written procedure should be descriptive (not directly copied from your lab manual) and will be the only resource you have for carrying out the lab. Be sure to specifically cite the experiment and page number from the lab manual at the beginning of your procedure. Be sure to include all steps; if you are taking a melting point or IR spectrum or completing a technique previously described in your lab notebook, you can write "refer to page X of notebook". If you have not previously done the technique then write out the steps necessary to complete it. It is recommended to write out your procedure as a bulleted or numbered list as this will provide an efficient way to complete the experiment. It is also recommended that you divide your procedure into two sections vertically on the page so any changes made during the experiment can be noted next to the written experiment. Any changes made to the procedure need to be written in your lab notebook. PASTING THE PROCEDURE DIRECTLY INTO YOUR NOTEBOOK IS NOT ALLOWED.

During lab and post-lab:

Data: Data includes any values recorded in the lab (*e.g.,* the recovered mass of your product as well as values such as 'mass of empty watch glass', 'watch glass + product', etc.) and any measurements (melting point, TLC, etc.) or spectra (NMR, IR, UV-Vis) obtained in the lab. Any spectra that are obtained must be placed in both copies of the lab notebook and not just stapled to your final lab report. This information needs to be included in your notebook when performing the experiment. Arrange your data in a clear, labeled and well organized fashion in the notebook. The instructor should not have to search to find your data. DO NOT WRITE INFORMATION ON SCRAPS OF PAPER TO LATER BE TRANSFERRED TO YOUR NOTEBOOK.

Conclusions: When writing the conclusion, write in the third person *e.g.,* "the percent yield obtained was 64%", not "I obtained a 64% yield". Also remember to use proper spelling, grammar and punctuation. Grades may be deduced for spelling mistakes or improper written English. The conclusions do not need to be generally more than a few sentences; work hard to be concise, in other words "say what you mean and mean what you say"

References: Make sure to always include references at the end of the notebook entry or on the same page if any information in the report was obtained through another source (not from the experimental data).

c) Laboratory Reports – 20 points each

The laboratory report is a summary of the data and calculations performed in the experiment. It is also an interpretation of these results. This interpretation of the results will be heavily weighed and is important in determining your understanding of the laboratory's material.

You will submit a typewritten and double-spaced lab report (as indicated in the lab schedule) after the completion of the lab (worth 20 points each). Please

follow the guidelines outlined below to ensure that you earn full points! This is not a full lab report only include the sections listed below!

Data: Data includes any values recorded in the lab (*e.g.,* the recovered mass of your product as well as values such as 'mass of empty watch glass', 'watch glass + product', etc.) and any measurements (melting point, TLC, etc.) or spectra (NMR, IR, UV-Vis) obtained in the lab. Any spectra that are obtained must be stapled to the final lab report. Also the data should be included in a well-organized fashion (*i.e*., in a table, chart or graph)

Calculations: Calculations include average melting point ranges, percent recovery or percent yield (must also have theoretical yield calculation) as applicable and any other calculations (*e.g.,* R_f value if doing TLC).

Discussion and conclusion: The discussion should be a concise account of the major findings obtained during the lab. This is not a summary of the lab (do not summarize the procedure), rather you should state your major results and what they mean/how they relate to the objectives of the lab (the purpose). The post-lab discussion should be concise and is expected to integrate **all the data/observations (with values from the data section)** that have been collected in the lab and use that information to then clarify the argument. Ideally all of the data should point to one conclusion and the "story" it tells is very clear. In reality, however, this rarely happens. One of the most important aspects of being a scientist is being able to explain the results and why these results differed from the expected results. Each week critically evaluate and interpret the experiment and its results. Interpreting data involves drawing the most logical connections from the data to explain why things occurred in the way they did.

For example, the discussion for a synthesis reaction should indicate what type of reaction it is (*e.g.,* a green oxidation reaction) and what the percent yield was. If there was not a 100% yield, discuss why the yield was lower than expected (or whether a 100% yield would even be expected). Then state the other major results, *e.g*., melting point, IR spectrum, and discuss them individually as they relate to the objective of the experiment; in other words, what does the data tell about the identity of the product? Is the material obtained the expected product? How does the data deviate from literature values (*e.g.,* lower melting point) and what does this mean? Is the product pure? How do you know? Finally, wrap up this section with a conclusion: state whether or not the experiment was a success (or what the final outcome is) and why it was successful or not. Be sure to include brief accounts of the data and how it helped determine the success or final outcome of the experiment. The concluding statement ("verdict") comes at the end of the section after you have presented the relevant results ("the evidence"), not at the beginning. The key to a good discussion is to answer the why questions that have surfaced during the experiment. Always be ready to explain why the experiment went as predicted or why the experiment did not.

For a lab where the identity of unknown is being determined, present the various data collected and discuss how they lead to determining the identity of the unknown. Indicate both positive and negative outcomes, e.g., "the melting point of the solid unknown was 83-86 ^{o}C, suggesting that it could be compounds W or X, but not Y and Z". Provide the data and formulate an argument that supports the upcoming conclusion. Finally, make a concluding statement about the identity of your unknown.

When writing the discussion and conclusion, it is expected to be in the third person *e.g.*, “the percent yield obtained was 64%”, not “I obtained a 64% yield”. Also use proper spelling, grammar and punctuation. Grades may be deduced for spelling mistakes or improper written English. The discussion and conclusion do not need to be long but they need to be thorough; work hard to be concise, in other words “say what you mean and mean what you say”. **Make sure to always include references at the end of the discussion if any information in the report was obtained through another source (not from the experimental data).**

d) Presentation - 10 points

As part of the laboratory there will be one presentation (in teams of two). The presentation should be made and delivered using PowerPoint (or equivalent) format. The presentation will be graded based on comprehension of the material, appropriate inclusion of all relevant data, comparison to literature data and references. The visual quality of the presentations and how well it is delivered will also be evaluated. Practice the presentation in advance! The presentation should be approximately 10 minutes in length and will include a question-and-answer section at the end of each talk. **Make sure to always include references either at the end of the presentation or on the slide with data that was obtained through another source.**

e) Handout - 15 points

Two “dry” laboratory sessions will be held to help reinforce concepts from the classroom and give students a chance to learn to work with their molecular models. Students must complete the exercises during the laboratory period in the lab notebook and submit a copy to the Instructor at the end of the lab period. The grading for these exercises will be similar to the format used for an assignment.