Organic Chemistry II Laboratory (1 Unit)
CHEM 2096L

Spring 2020

ST 219 - 3.5 hours per week 1/21-5/1

Instructor: Dr. Marc Perry / Dr. Matthieu Rouffet/ Dr. Jonathan Lockner
Office: RS366 / 340/ 318
Phone: Perry: 619-849-2976
Rouffet: 619-849-3278
Lockner: 619-849-2900

e-mail: mperry1@pointloma.edu , mrouffet@pointloma.edu, jlockner@pointloma.edu

1. **Student Outcomes:** The following outcomes are expected and will be assessed on laboratory reports, quizzes, and evaluation by the instructor. Upon completion of this course, students will have demonstrated the ability to:

    a) Purify organic compounds by recrystallization, liquid-liquid and liquid-solid extraction, column chromatography, and distillation.
    b) Perform synthetic transformations requiring reflux temperatures, solventless, or air-sensitive conditions, and monitor their progress.
    c) Obtain and use spectroscopic, GC-MS, TLC, melting point, and boiling point data to support or refute the expected identity of experimental products.
    d) Obtain and use infrared and NMR spectroscopic and GC-MS data to elucidate the chemical structure of an unknown compound.
    e) Communicate the results of experiments clearly and concisely.

    Program Learnning Outcomes: CHEM PLO 2 (GC, IR) and BCHM PLO 3 (GC, IR) will be assessed directly by faculty laboratory instructors' observation of students' use of instruments.

2. **Texts:** *Organic Chemistry Laboratory CHE 294 & CHE 304* with experiments from Lehman, J.W. *Microscale Operational Organic Chemistry: A Problem-Solving Approach to the Laboratory Course*; Pearson Learning Solutions, Inc.: Boston, 2010. You are required to purchase a copy of this text as it contains all of the information pertinent to the experiments that you will perform.

3. **Safety:** Safety is a priority in the lab. You will be required to sign a safety agreement form before you can take part in the lab. If you fail to comply with any one of the rules set forth by the department contained in the safety agreement you may be excluded from the lab.

4. **Lab Reports:** Lab reports will be due one week after completion of an experiment. Reports handed in late will be penalized 10% per day up to 50%. The reports will consist of 4 major parts: pre-lab, observations, results, and conclusions.

    a) **Pre-lab:** Your typed pre-lab is your ticket to lab. It ensures that you are arriving prepared and aware of the potential hazards of that week's lab. It should include:
        i) Your Name and Lab Section
        ii) The experiment Title
        iii) The Chemical Information, including **safety information** (hazards and 1st aid) for *all chemicals*, **molecular weight**, and **expected grams & moles** for *all reagents*, **boiling point** and **density** for any *liquid reagents*, and **melting point** for any *solid reagents*.

iv) A balanced Equation for the reaction showing all *chemical structures (not formulas)*, *or* the Structure(s) if the lab is not a 'reaction' per se. (This may be hand-drawn.)

v) The Procedure as a step-by-step list of tasks.

vi) The Expected Results, including **theoretical yield** and any **expected physical characteristics** of the product (*i.e.* color, state – solid or liquid, melting point or boiling point, characteristic spectral data, etc.) *This is what your TA or instructor will point to when you ask "is this what it's supposed to look like?"*

b) **Observations:** This section is completed during lab (handwritten on your pre-lab or on an attached sheet) *and will be evaluated at the time of check-out from the lab.* This section should include:

i) All data measurements (including tare and sample weights, melting point range, temperature, etc.)

ii) Any deviation from the typed procedure. (You may cross out/annotate your typed procedure as long as it is legible.) Also include sketches of any unusual apparatus. *(Unusual = different from what is shown in Lehman…)* Mention any spills or product losses here as well.

iii) Spectra printouts (from the NMR, GC, IR, GCMS, etc.) should be attached. Descriptive observations. If you noticed a particular smell, color, temperature, clarity, bubbles, phase change, etc., *write it down*. If you were expecting a color/smell/etc. change and did not see it, write that down.

c) **Results:** Each lab should include all relevant calculations (*e.g.* limiting reagent, theoretical yield, actual yield, % composition,…) In addition, a specific set of results for each experiment will be provided on the board at the start of lab. *This may often include assigned problems from Lehman.*

d) **Conclusions:** This section should include:

i) A one-sentence summary of what was done in the experiment.

ii) A comparison of the results you obtained with what you expected (mentioning your yield), referring to your specific data values as relevant.

iii) A compelling case for the identity and purity of your product (referring to your yield and melting point if relevant). If you do not believe you obtained the desired product (or if you obtained it in poor yield/purity), you should include an explanation for why you think your results deviated from expectation.

For Experiments 2, 4, 6, and 9, you will complete a **worksheet** worth 35 points in place of the Observations, Results & Discussion sections. (A Pre-lab and Quiz is required for every lab.)

5. **Quizzes**: There will be a quiz given at the beginning of each class on the day that a new experiment is to begin. The quiz will contain material from the previous lab as well as on the experiment to be performed on that day.

6. **Grades**: Grades will be calculated based on your best 8 experiments. (Your lowest score will be dropped, provided that you complete each lab and turn in a report.) Reports will be graded as follows:

Prelab	5 pts
Observations	10 pts
Results	16 pts
Conclusions	9 pts
Quiz	10 pts
Total	**50 pts**

There are a total of 400 points possible. Your total score will be divided by 400 and then multiplied by 100 to get your lab percentage. This percentage will determine your lab grade as shown below.

92 – 100%	A
90- 92%	A^-
88-90%	B^+
82-88%	B
80-82%	B^-
78-80%	C^+
72-78%	C
70-72%	C^-
68-70%	D^+
62-68%	D
60-62%	D^-
<60%	F

7. **Make-Up Labs:** Due to the busy room, faculty, and student schedules, no make-up labs will be given. We understand that unforeseeable events might arise which prevent you from coming to lab. For this reason you will be able to drop your lowest lab grade. If you miss a lab with an excused absence, then that lab will be the lab grade that is dropped. If you miss a lab and do not have an excused absence, you will receive a zero for that lab and that zero will not be dropped. Other missed labs will be counted as a zero unless prior arrangements are made.

8. **Student Code of Conduct:** You are expected to conduct yourself in an upright and ethical manner. If you are caught cheating in any form (plagiarism, copying, reporting data fraudulently, etc.) you will be given a failing grade for that course activity. In addition, you will be subject to further disciplinary action as set forth by university policy.

9. **Office Hours:** We will make every effort to be available in our office during the times we've indicated below for office hours. You are welcome to schedule an appointment or take your chances and drop by, especially if you find these hours inconvenient.

Office Hours

Perry
Monday: 3-4,
Tuesday: 10:30-12
Wednesday: 1:30-2:30
Friday: 1:30-3

Rouffet
Monday: 10:30-12
Wednesday: 10:30-12

Lockner
Monday: 2-3
Wednesday: 2-3
Friday: 2-3

10. **Laboratory Schedule:** Below is a schedule of the experiments to be performed.

Week of	Experiment	relevant concepts *lab techniques*	Tentative Due Date*
January 20	**Experiment 1** Reaction of iodoethane with sodium saccharin *pp. 115-120*	the S_N2 reaction resonance *filtration* *melting point* *^1H NMR spectroscopy*	
January 27	**Experiment 2** Stereochemistry of bromine addition to *trans*-cinnamic acid *pp. 131-138*	addition reactions of alkenes reaction stereochemistry *recrystallization* *melting point*	Experiment 1 report due

Week of	Experiment	relevant concepts *lab techniques*	Tentative Due Date*
February 3	**Experiment 3** Isolation and isomerization of lycopene from tomato paste *pp. 85-92*	conjugated π systems alkene isomerization *liquid-solid extraction* *column chromatography* *UV-vis spectrophotometry*	Experiment 2 worksheet* due
February 10	**Experiment 4** Dehydration of methylcyclohexanol *pp. 121-130*	E1 & E2 reactions cyclohexane conformations mechanistic reasoning *distillation* *gas chromatography*	Experiment 3 report due
February 17	**Experiment 5** Anise seed oil *Handout*	natural products structure elucidation *GCMS* *infrared spectroscopy* *1D and 2D NMR spectroscopy*	Experiment 4 worksheet* and ***Experiment 7 procedure*** due
February 24			Revised *Experiment 7 procedure* due
March 2	**Experiment 6** Borohydride reduction of vanillin *pp. 147-156*	Reduction reactions at the carbonyl natural products *experiment design*	Experiment 5 report due
March 9	*Spring Break – <u>No lab</u> this week*		
March 16	**Experiment 7** A green, nickel-catalyzed Suzuki cross-coupling reaction *Handout*	green chemistry catalysis cross-coupling *TLC* *column chromatography* *^{1}H and ^{13}C NMR spectroscopy*	Experiment 6 worksheet* due
March 23			
April 6	*Easter Recess – No Lab this week*		
March 30	**Experiment 8** A green Diels-Alder Reaction *Handout*	Diels-Alder reaction carboxylic anhydrides green chemistry *solventless reactions* *infrared spectroscopy* *1D and 2D NMR spectroscopy*	Experiment 7 report due
April 13			*No lab April 4 (due to ACS Meeting) or April 13 (due to Easter Break)*

Week of	Experiment	relevant concepts *lab techniques*	Tentative Due Date*
April 20	**Experiment 9** Synthesis of triphenylmethanol and the trityl carbocation *Handout and pp. 157-166*	Grignard reaction carbocations organic dyes *moisture-sensitive rxn conditions* *recrystallization* *melting point* *infrared spectroscopy*	Experiment 8 report due
April 27			Experiment 9 worksheet* due

11. **Academic Accommodations:** While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center. (DRC@pointloma.edu or 619-849-2486). The DRC's policies and procedures for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and guarantees all qualified students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.

    If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

12. **University Mission:** Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

13. **Copyright:** Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

19. **Academic Honosty:** Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.