Organic chemistry I laboratory - CHEM341 - Summer 2017

June 8th – 29th, 2017 Thursday 8:00am – 6:00pm TCCW 432

Instructor:

Dr. Lawrence Hill Office: TCCW 115 Phone: 270-745-2136 Email: <u>lawrence.hill@wku.edu</u> (I generally respond within one business day) Office hours: Monday, Wednesday, and Friday from 12:30 – 1:30 pm in TCCW 115

Course materials:

Goggles, closed toe shoes, and appropriate clothing for laboratory work (no skin showing from the hips to the floor, including feet). No text book is required.

Prerequisites: CHEM 222-223 (C or better); Corequisite: CHEM 340 (or prior credit for CHEM340)

Course description:

This course covers basic techniques used to separate, purify, and characterize organic compounds. Students will gain hands-on laboratory experience while learning the fundamental principles underlying each technique they use. Experiments are chosen to allow students to independently practice these techniques while observing best practices in laboratory safety and data management.

Student learning objectives:

By the end of this course, students will learn to:

- 1. Separate and purify organic compounds using extraction, filtration, and distillation.
- 2. Characterize a compound using melting point, chromatography, and spectroscopy.
- 3. Identify an unknown compound as one of many possible known compounds using characterization techniques.

Grading:

Your grade will be determined based on the percentage of points earned out of possible points in the course.

- Prelab quizzes and other formative assessments: 9 x 10 points each = 90 points
- **Spectroscopy packets:** 2 x 20 points each = **40 points**
- Written assignments: 3 x 40 points each = 120 points
- Summative assessments: 3 x 50 points each = 150 points

Total = **400 possible points**

Due to the limited number of class meetings during the summer, 20 points will be deducted from the total earned points for each missed experiment or packet session. Note that we will have multiple experiments/packet sessions per lab day.

Letter grade scale:

You should plan on the following assignment of letter grades for CHEM341. I reserve the right to change the grading scale, but I will never make the grading scale more difficult than shown below.

A = (100 - 90%), B = (80 - 89%), C = (70 - 79%), D = (60 - 69%), F = (0 - 59%)

Grades will not be discussed by email or by phone. You must speak to me in person about your grade.

Some tips for succeeding in this course:

- *Come prepared for lab.* Read all materials and outline your experiment in your lab notebook before coming to class. Prepare your table of physical constants before class. Wear appropriate shoes and clothing on lab day.
- **Be safe!** Keep your goggles on and move slowly. Think about how to best protect yourself and your neighbor when handling reagents or glassware. Speak up promptly if an accident happens in lab.
- Understand why you are performing each step in lab.
- Ask questions and speak up if you are confused. Your peers will thank you for helping them understand.
- *Come to office hours* with questions about the problems. Bring your friends groups are best. Email me for an appointment if you can't make it to regularly scheduled office hours.

Students with disabilities:

In compliance with University policy, students with disabilities who require academic and/or auxiliary accommodations for this course must contact the Student Accessibility Resource Center located in Downing Student Union, 1074. SARC can be reached by phone number at 270-745-5004 [270-745-3030 TTY] or via email at <u>sarc.connect@wku.edu</u>. Please do not request accommodations directly from the professor or instructor without a faculty notification letter (FNL) from The Student Accessibility Resource Center.

Title IX Discrimination and Harassment

Western Kentucky University (WKU) is committed to supporting faculty, staff and students by upholding WKU's Title IX Sexual Misconduct/Assault Policy (#0.2070) at

https://wku.edu/eoo/documents/titleix/wkutitleixpolicyandgrievanceprocedure.pdf

and Discrimination and Harassment Policy (#0.2040) at

https://wku.edu/policies/hr_policies/2040_discrimination_harassment_policy.pdf.

Under these policies, discrimination, harassment and/or sexual misconduct based on sex/gender are prohibited. If you experience an incident of sex/gender-based discrimination, harassment and/or sexual misconduct, you are encouraged to report it to the Title IX Coordinator, Andrea Anderson, 270-745-5398 or Title IX Investigators, Michael Crowe, 270-745-5429 or Joshua Hayes, 270-745-5121.Please note that while you may report an incident of sex/gender based discrimination, harassment and/or sexual misconduct to a faculty member, WKU faculty are "Responsible Employees" of the University and MUST report what you share to WKU's Title IX Coordinator or Title IX Investigator. If you would like to speak with someone who may be able to afford you confidentiality, you may contact WKU's <u>Counseling and Testing Center</u> at 270-745-3159.

Attendance:

There are no make-up labs or assignments without prior agreement from your instructor.

Technology (e.g., phones, computers, tablets)

Use of technology must be approved by the instructor **prior to the start of class.** For example: if you are expecting a truly urgent phone call, you must approach me in person before class and tell me that you may need to leave to take an important call. I will ask you to put your phone on vibrate and sit near the door in case you need to leave. Otherwise, phones must be off before coming to class. Computers and tablets are generally not allowed. Texting, typing, or other distractions are not allowed during class.

Acceptable behavior:

You are expected to prepare for class, exercise safe laboratory practices, interact respectfully with your peers, ask relevant questions, and be a good citizen. Any other behavior is likely to be unacceptable.

Academic dishonesty (https://www.wku.edu/handbook/academic-dishonesty.php/):

"Students who commit any act of academic dishonesty may receive from the instructor a failing grade in that portion of the course work in which the act is detected or a failing grade in a course without possibility of withdrawal."

Changes to the syllabus

I reserve the right to change the syllabus as needed during the semester. I will post any changes to Blackboard.

June 8th

Student learning objectives

- 1. Respond appropriately to questions from lab safety seminar
- 2. Explain safety hazards of today's experiments
- 3. Identify points (solid, liquid, gas) and transitions (melting, boiling, subliming) on a phase diagram
- 4. Measure melting point of a solid
- 5. Report melting point as a range of temperatures
- 6. Predict effect of impurities on melting point
- 7. Use mixed melting point to determine identity of an unknown
- 8. Determine effect of heating rate on MP
- 9. Explain purpose of adding drying agents to organic solvents
- 10. Describe or identify solid/liquid extraction
- 11. Define TLC
- 12. Calculate R_f values
- 13. Predict relative R_f values for a series of compounds based on polarity
- 14. Predict effect of increasing eluent polarity on $R_{\rm f}$ values
- 15. Describe setup for TLC
- 16. Explain purpose of components used in TLC experiment (stationary phase, mobile phase, eluent, spotting solvent, jar, lid, filter paper)
- 17. Identify IR peaks using table and information provided in the slides
- 18. Predict IR spectra for a given compound using table and information provided in the slides
- 19. Identify the correct molecule among several options from IR spectra using table and information provided in the slides

<u>Agenda</u>

- Lab safety seminar
- Discuss syllabus
- Lab drawer check-in
- Prelab quiz + peer grading
- Break
- Melting point and TLC experiments (simultaneously)
- Break
- Formative assessment on melting point and TLC + peer grading
- IR spectroscopy packets

Student responsibilities after lab

- Write results and discussion for melting point experiment only due at start of lecture on Tuesday June 13th
- Prepare for summative assessment on student learning objectives at beginning of next class meeting
 - Note that assessment questions will be based on learning objectives, procedures, slides, and formative assessment questions

June 15th

Student learning objectives

- 1. Explain safety hazards of today's experiments
- 2. Collect IR data using salt plates
- 3. Identify IR peaks without a table
- 4. Predict IR spectra for a given compound without a table
- 5. Identify the correct molecule among several options from IR spectra without a table
- 6. Predict trend for frequency versus bond order
- 7. Predict trend for frequency of C-H stretch versus hybridization of carbon atoms
- 8. Explain why CDCl₃ is used instead of CHCl₃ for IR sample preparation
- 9. Conduct a liquid/liquid extraction
- 10. Conduct an acid/base extraction
- 11. Explain purpose of acid or base in an acid/base extraction
- 12. Predict chemical structure of compounds when treated with acidic or basic solution
- 13. Predict preferred phase (organic or aqueous) of compounds under acidic basic or neutral conditions
- 14. Propose a scheme to separate two compounds using liquid/liquid and/or acid/base extractions
- 15. Explain why slow addition of acid or base is necessary
- 16. Explain why concentrated acid or base is used when neutralizing a solution

<u>Agenda</u>

- Summative assessment of last week's learning objectives
- IR experiments
- Prelab quiz + peer grading
- Break
- Acid/base extraction experiment
- Break
- Formative assessment on IR experiments and acid/base extraction experiment + peer grading

Student responsibilities after lab

- Write results and discussion for acid/base extraction experiment only due at start of lecture on Tuesday June 20th
- Prepare for summative assessment on student learning objectives at beginning of next class meeting
 - Note that assessment questions will be based on learning objectives, procedures, slides, and formative assessment questions

June 22nd

Student learning objectives

- 1. Explain safety hazards of today's experiments
- 2. Define simple distillation
- 3. Define fractional distillation
- 4. Define steam distillation
- 5. Choose appropriate distillation method for a given separation (simple, fractional, or steam)
- 6. Explain role of fractionating column
- 7. Define theoretical plates
- 8. Conduct a steam distillation
- 9. Identify NMR signals for a given compound using table and information provided in the slides
- 10. Predict NMR spectra for a given compound using table and information provided in the slides
- 11. Identify the correct molecule among several options from NMR spectra using table and information provided in the slides
- 12. Predict chemical shift trends based on deshielding effects
- 13. Explain why CDCl₃ is used instead of CHCl₃ for NMR sample preparation
- 14. Identify suitable NMR solvents

<u>Agenda</u>

- Summative assessment of last week's learning objectives
- Prelab quiz + peer grading
- Break
- Distillation
- Formative assessment on distillation + peer grading
- Break
- NMR spectroscopy packets

Student responsibilities after lab

- Write results and discussion for distillation experiment only due at start of lecture on Tuesday June 27th
- Prepare for summative assessment on student learning objectives at beginning of next class meeting
 - Note that assessment questions will be based on learning objectives, procedures, slides, and formative assessment questions

June 29th

Student learning objectives

- 1. Explain safety hazards of today's experiments
- 2. Collect NMR data
- 3. Identify NMR peaks without a table
- 4. Predict NMR spectra for a given compound without a table
- 5. Identify the correct molecule among several options from NMR spectra without a table
- 6. Predict relative reaction rates for substrates conditions which favor SN1 mechanism
- 7. Predict relative reaction rates for substrates under conditions which favor SN2 conditions
- 8. Predict the products of SN1 and SN2 reactions
- 9. Identify conditions which favor SN1 or SN2 mechanisms

<u>Agenda</u>

- Summative assessment of last week's learning objectives
- Prelab quiz + peer grading
- Break
- NMR experiment
- Formative assessment on NMR experiment + peer grading
- Break
- SN1/SN2 experiment
- Formative assessment on SN1/SN2 experiment + peer grading
- Break
- Cleaning and check-out of lab drawers

Student responsibilities after lab

• None. Lab responsibilities are complete for the semester upon checking-out of lab drawers.