**Syllabus Chem 29B, Organic Chemistry Laboratory**

**V. Cornel, Reedley College, Spring 2014, #52674**

**Lab TTh 8:00-10:50 am in PHY-77**

**Office: PHY-78, phone # 559-638-3641 ext 3449**

**email: vmcornel3@verizon.net using “CHEM29” or “O-chem” as the subject**

**Office hours: 9:30-10:30am MWF**

**Course web site: blackboard.reedleycollege.edu**

**Course corequisite: Chem 28A**

Textbooks:

* 1. Svoronos/Sarlo, Organic Chemistry Laboratory Manual, 2nd edition.
  2. McMurray: Organic Chemistry. A Biological Approach. 2nd edition

Required Materials:

1. A lab research notebook with duplicate pages **or** ordinary notebook. (Original pages or photocopies need to be turned in with each lab report) (Keep the book of duplicate pages with an Index in the front to turn in to the University you transfer to).
2. Safety glasses with Z-87 safety code
3. A lab coat.
4. A calculator.

Course objectives and outcomes: Students will become familiar with safety procedures and lab equipment for semi-micro organic experiments. They will be capable of synthesizing and purifying organic compounds, of measuring melting points, refractive index, and optical activity. They will learn hands-on how to work with a Gas Chromatograph Mass Spectrometer, a Fourier Transform Infrared Spectrophotometer and Nuclear Magenetic Resonance Spectrometer. Extensive time will be spent on identification of unknown compounds by analyzing their MS, IR and NMR spectra. Through interactive computer programs the students will receive extensive support in thoroughly understanding the concepts taught in the organic chemistry lecture (Chem 28A).

Homework: Students are expected to come to lab well prepared. This means that the steps to be taken to properly complete the experiment are written down in the lab notebook ahead of time. Typically, the theoretical explanations in the lab manual are too brief to fully comprehend the experiment. Therefore preparation reading McMurray's text on the subject is highly recommended and and necessary to answer the lab questions.

Lab Notebooks: Your lab notebook needs to be complete at all times and could be requested by the university you are transferring to. The front page should be an Index of the labs you completed and the dates. The Title, Experiment Number, Overall Reaction Mechanism, Procedure, Safety, Physical Data (melting point, refractive index etc.), Observations, Percent Yield, and Conclusion should all be recorded in your notebook. The title, overall reaction mechanism, procedure and safety should be written in your notebook before class and will be checked at the beginning of lab. The original pages or photocopies need to be included with your lab report and the duplicate pages kept in the notebook. You will be allowed to use these notebooks in the lab quizzes.

Lab Reports: Additional pages in your lab report will contain additional notes and full reaction mechanisms (from the white board and your textbook readings), the theoretical yield and mass percent yield calculations in full and certain questions from your lab manual or McMurray textbook. All these should be completed individually using your textbook. I will give assistance, but not the answers to the questions. Spectra should be fully interpreted and included with your lab report.

Formal Lab Reports: This semester two experiments will be typed up as formal lab reports using the observations and data collected in the experiment. These extensive lab reports are written in the format of a research paper with an abstract ( 1 paragraph summary), additional background information (at least 600 words) and references. The student will need to use resources in the library and the internet to find appropriate background information. An electronic copy of the abstract and background in Microsoft Word (without the diagrams) needs to be e-mailed to the instructor, and a printed copy of the report must be submitted to the instructor or switchboard by 5pm on the due date. Lab reports will be checked for plagiarism using “Turnitin”. The questions do not need to be typed. The reaction mechanism must be drawn using "CHEMDRAW", (or the free "CHEMSKETCH" found on the internet) or a similar professional chemical drawing program. Other reaction mechanisms may be cut and pasted into the report. The formal lab report should also include another similar reaction that is biologically or pharmaceutically interesting. A reaction mechanism for this reaction should also be included, clearly showing how it is similar, as well as what the product is used for.

Lab materials: Expensive grounded glassware and other delicate lab supplies will be made available. Students will be held responsible for their own desk inventory.

Attendance: Attendance at all labs is mandatory. In accordance with Community College policy role will be taken every lab session. Students will only be allowed to miss or drop one laboratory assignment (and not one that is used for a Formal Report). You will be dropped if you miss more than 25% of the classes before the drop date without contacting the instructor.

Cancelled Classes: If the instructor is absent, and official yellow “class cancellation” notice and instructions will be posted on the door of the classroom. We will try and put a timely announcement on Blackboard and the Reedley College website.

Make-up labs If you have to miss a lab you may be able to make arrangements with the instructor or lab technician to complete it (if the chemicals are still available), or complete it the next lab period. 10% will be deducted for the inconvenience of having to do a make-up lab for the student. Only one make-up lab will be allowed per student. If you do not complete an experiment (drying, purifying your product or analyzing it) you may be able to make arrangements with the instructor or lab technician to complete it (with no points deducted).

Grading: To determine the final grade in this class the average of the formal reports will count towards 30%, the average of the two lab quizzes 20%, and the individually graded labs towards 50% of your final grade. For each lab report you will also be graded on the quality and the yield of the product, the working technique and effort, cleaning up, the amount of assistance the student required and the efforts to reach the experimental goal. General grade break-off : A 90% and up; B 80-89%; C 70-79%; D 60-69%; F 59% and lower. Lab reports and formal lab reports may be submitted (to me, Jason or switchboard) **up to one week** after their due date, but 2% will be deducted for each school day it is late. This policy holds even if a student is absent or did a make-up lab.

Lab Quizzes: You will be allowed to use your lab notebooks for the lab quizzes, but no additional pages. The lab notebooks will be checked during the quiz. Typically the questions will be on reaction mechanisms, procedure e.g. what mass of a reactant was used, your data (melting points, mass of product, % yield etc.), names of lab equipment and interpretation of spectra.

Drop date: The drop date is Friday March 14, 2014. After this date a letter grade A-F will have to appear on your transcripts. If you are dropped from the class before Friday January 17, 2014 you avoid receiving a "W".

Lab rules: It is MANDATORY to use a lab coat and safety glasses at any time that you are in the lab and somebody is working with chemicals. You are required to have read each experiment, including the Safety Tips before you enter the lab. You will receive corrections, additional safety and waste instructions and these should be recorded in your notebook. It is imperative that you not be late in lab, you would be a hazard to others if you miss the instructions. Coming in late means you loose 10% for that lab. You need to go over the instructions with the instructor before you may start the lab. End lab time is set: 10:50 am sharp. Copying of experimental data and answers to questions in lab reports is considered fraudulent behavior and will result in a zero grade for the copier and the originator. **Students work in pairs, but your lab reports must be done individually or both students will loose points.**

**Student Learning Outcomes**: In the process of completing this course, students will:

A. learn how to synthesize aromatic organic compounds using the Friedel-Crafts reaction

B. learn how to synthesize simple organic cyclic compounds using the Diels-Alder process.

C. gain an understanding how to set up a variety of reactions to make carboxylic acids, such as hydrolysis of benzonitrile, side chain oxidations of alkyl benzenes.

D. set up the formation of an ester followed by its basic hydrolysis, its saponification.

E. learn how to do qualitative tests for aldehydes and ketones.

F. gain an understanding how to make a simple di-peptide from amino acids.

G. prepare a soap and learn how detergents work.

H. learn how to determine the degree of unsaturation in lipids and its meaning for the structure and physical behavior of lipid molecules.

**Lab Content:**

Each of the following experiments will take 4-6 hours. Alternative experiments may be substituted.

A. Aromatic Reactions

* nitration of bromobenzene
* Friedel-Crafts alkylation: synthesis of 2,5-di-t-butyl-1,4-dimethoxybenzene
* nucleophilic aromatic substitution: synthesis of 2,5-dinitrophenylaniline
* oxidation of the side chain of an arene: synthesis of 2-chlorobenzoic acid from 2-chlorotoluene
* benzyne intermediate: synthesis of tripycene

B. Carboxylic acids and derivatives

* hydrolysis of benzonitrile
* synthesis of aspirin
* synthesis of isoamyl acetate
* imides: synthesis of N-phenylphthalimide
* saponification of an ester.

C. Aldehydes and Ketones

* qualitative tests
* oxidation of cyclohexanol to cyclohexanone
* reduction of cyclohexanone to cyclohexanol
* acetal formation: synthesis of 4,5-dimethyldioxolane

D. Carbanions and α,β-unsaturated carbonyls

* Aldol Condensations, synthesis of dibenzalacetone

E. Amines

* synthesis of acetanilide
* coupling of aromatic diazonium compounds: azo-dye formation

F. Synthesis of cyclic compounds

* Diels-Alder reaction: cycloalkenes from conjugated dienes

G. Polynuclear aromatics and heterocycles

* oxidation of 2-methylnaphthalene

H. Biomolecules and Green Chemistry

* Synthesis of ethanol from corn

I. Carbohydrates

* qualitative tests
* acid catalyzed hydrolysis of sucrose: a kinetic study.

J. Amino Acids and Proteins

* qualitative tests
* synthesis of a peptide

K. Lipids: fats, oils and steroids

* preparation and properties of a soap

**Important: If you have a verified need for an academic accommodation or materials in alternate media (i.e., Braille, large print, electronic text, etc.) per the Americans with Disabilities Act (ADA) or Section 504 of the Rehabilitation Act, please contact the Disabled Student Services as soon as possible.**

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| Date | Lab |
| 1/14 | Syllabus, check-in to lockers and sign the safety agreement. |
| 1/16 | Lab 12. Diels-Alder reaction. Q2(a-d), 3(a-e). Leave for 2 weeks for crystals to form. |
| 1/21 and 1/23 | Lab 17.1 Oxidation of cyclohexanol to cyclohexanone. Q 1,2(a,b),3 Due 1/30 Dry glassware for lab 17.2 |
| 1/28 and 1/30 | Lab 17.2 Reduction of cyclohexanone to cyclohexanol. Q1 (a,b,d,e,f) Due 2/11 |
| 2/4 and 2/6 **(E1)** | Lab 17.4 The Pinacol-Pinacolone rearrangement. Q 1 Due 3/13 |
| 2/11 | Finish Lab 12: The Diels-Alder reaction. Q 2(a-d) and 3(a-e). Due 2/18 |
| 2/13 | Lab 17.5 Qualitative tests for aldehydes and ketones. Q 5,8. Due 2/20 |
| 2/18 | Lab 15.3 Synthesis of 2,4-dinitrophenylaniline. Q1-4. Due Tuesday 2/25. |
| 2/20 and 2/25 | Lab 15.4. Oxidation of the side chain of an arene: Synthesis of 2-chlorobenzoic acid from 2-chlorotoluene. **Do Formal Report 1 on this reaction.** Q1(a), 3, 5. Due 3/4 |
| 2/27 | **Lab Quiz 1** |
| 3/4 | Work on Formal Report 1 (CHEMDRAW, books available in lab) |
| 3/6 **(E2)** | Lab 15.5 Benzyne, the synthesis of triptycene. Q1,2 and 3(b,c). Due 3/13 |
| 3/11 | Lab 16.2. The hydrolysis of benzonitrile. All questions. Due 3/18 |
| 3/13 | Lab 16.3 Synthesis of aspirin. Q 1(not f), Due 3/20 |
| **Friday 3/14** | **Last day to drop a course in person to receive a “W”** |
| **Sunday 3/16** | **Last day to drop a course on Webadvisor to receive a "W"** |
| 3/18 and 3/20 | Lab 16.4 Synthesis of isoamylacetate. Q 1,2,4. Due 4/1 |
| 3/25 | Lab 16.5 Imides: synthesis of N-phenylphthalimide. Q 1,2. Due 4/1 |
| 3/27 **(E3)** | Lab 16.6 The saponification of an ester Q 2,3,5 Due 4/3 |
| 4/1 | Lab 18.1 The aldolcondensation: synthesis of dibenzalacetone. **Do Formal Report 2 on this reaction**. Q 2(a,b),3. Due 4/8 |
| 4/3 | Work on Fromal Report 2 (CHEMDRAW, books) |
| 4/8 | Lab 19.1 Reduction of a nitro compound to an amine. Q 3,4,5. Due 4/22 |
| 4/10 | Lab 19.2 Synthesis of acetanilide. Q 1,2,4,5. Due 4/24 |
| **4/15 and 4/17** | **Spring Recess. No labs** |
| 4/22 | Lab 19.3 The coupling of diazonium compounds, azo dye formation. Bring a T-shirt to dye. Q1. Due 4/29 |
| 4/24 | Lab 20.1 Oxidation of 2-methylnaphthalene. Q1, 2c, 3a. Due 5/6 |
| 4/29 | Lab 20.2 Synthesis of benzimidazole Q 3a. Due 5/8 |
| 5/1 **(E4)** | Synthesis of Ethanol from Corn. Due 5/8 |
| 5/6 | Lab 21.2 Qualitative tests for carbohydrates. New Q1. Due 5/13 |
| 5/8 | Lab 23.1 Preparation and properties of a soap. Q1(a,d),2(a,b),3(a,b). Due today |
| 5/13 | Lab 22.2 Qualitative tests for amino acids and proteins. Q 1,3(a,b,d,e,g),4 Due 5/15 |
| 5/15 | **Lab Quiz 2** |
| **Tues May 20** | Final Lecture Exam 2:00-3:50 in PHY77 |