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

**V. Cornel, Reedley College, Fall 2013, #50183 and #50184**

**Lab TTh 8:00-10:50 am or 2:00-4:50pm 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: 10-11am 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. (Duplicate pages or photocopies need to be turned in with each lab report)
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 questions from McMurray will be assigned.

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. Copies of these pages need to be included with your lab report. Spectra should be pasted into your notebooks and a copy of them submitted with your lab report. The spectra need to be fully interpreted.

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.

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 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 October 11, 2013. After this date a letter grade A-F will have to appear on your transcripts. If you are dropped from the class before Friday August 30, 2013 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 and 4:50p.m. 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:**

1. read and follow instructions in an organic laboratory manual, safely handling organic chemicals and glassware with ground-glass joints.  
 2. determine physical properties of organic compounds such as melting point and refractive index.  
 3. synthesize simple organic compounds such as but not limited to cyclohexene, t-butylchloride, alcohols and acids.  
 4. analyze organic molecules using a gas chromatograph and infrared spectrometer and interpret the spectra.

5. write three formal laboratory reports in the form of research papers.

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**Lab Content:**

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

* MSDS sheets
* ground glass equipment

B. Physical Properties

* determination of melting points
* determination of refractive indexes.

C. Distillation

* simple distillation
* fractional distillation

D. Extraction and recrystallization

* extraction of a mixture of benzoic acid, p-dichlorobenzene and methylene chloride
* extraction of myristicin from nutmeg or
* isolation of caffeine from tea
* separation of a mixture of acetanilide, sodium chloride and charcoal using filtration and recrystallization

E. Alkenes and alkynes

* synthesis of cyclohexene
* synthesis of *cis*-1,2–cyclohexanediol from cyclohexene
* synthesis and reactions of acetylene

F. The sodium fusion test

* tests for sulfur, halogens and nitrogen

G. Alkyl halides and the nucleophilic aliphatic substitution

* qualitative tests of alkylhalides using acetylene
* synthesis of t-butylchloride
* solvolysis of t-butyl chloride: a kinetic experiment

H. Equilibrium constant

* reaction of a carboxylic acid and an alcohol

I. Alcohols

* Grignard reaction: synthesis of 2-methyl-2–hexanol
* qualitative tests for alcohols
* Williamson Ether synthesis: preparation of phenacetin from acetaminophen

J. Spectroscopy

* GC and IR experiments
* Analysis of MS and NMR spectra

K. Stereochemistry

* using the molecular model box
* using a variety of computer programs

**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 me as soon as possible.**

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| ***CHEM29A Fall 2013 T/Th*** | | |
| 1 | Aug 13 | Read Preface and pages 1-3. Lab safety quiz. MSDS sheets. |
|  | Aug 15 | Practice Lewis Structures, molecular modeling and chemical bonds |
| 2 | Aug 20 | Molecular Orbital lab (handout). Read McMurray Chapter 1. |
|  | Aug 22 | **Exp 3.1 C** Melting Point Determination. *Due today*  **Exp. 3.3** Refractive Index (using digital RI). *Due today* |
| 3 | Aug 27 | **Exp. 4.1 parts I and II**. Simple Distillations. *Due 8/29 together with Exp 4.2* |
|  | Aug 29 | **Exp. 4.2** Fractional Distillation. *Due today* ***(Lecture Q1)*** |
| 4 | Sep 3 | **Exp. 6.2** Extraction. *Due 9/10. No questions* |
|  | Sep 5 | **Exp. 6.3** Re-crystallization. *Due 9/12* |
| 5 | Sep 10 | **Exp. 6.5** Isolation of **Caffeine** from Tea.***Formal Report 1 to be done on this lab.*** *Due 9/17* |
|  | Sep 12 | **CHEMDRAW exercises** –to be used for Formal reports. *Due today*. **Bring USB drive to save work** |
| 6 | Sep 17 | **Chapter 2.1 and 2.2** Stereochemistry and Molecular models. *Due 9/24* |
|  | Sep 19 | **Chapter 2:** Stereochemistry in more depth: the R/S designation, Fischer projection formulas and meso-compounds. *Due 9/26* ***(Lecture E1)*** |
| 7 | Sep 24 | **Exp. 7** Equilibrium constant. *Due 10/1* |
|  | Sep 26 | **Exp. 14.3** Preparation of Phenacetin from Acetaminophen. *Due 10/3* |
| 8 | Oct 1 | **Exp. 8** Sodium Fusion Test. *Due 10/8 Q 1a,b and 2* |
|  | Oct 3 | **Exp. 10.1** Synthesis of Cyclohexane. *Due 10/10 All Q except 2b* |
| 9 | **Oct 8** | ***Lab Quiz 1*** |
|  | Oct 10 | **Exp. 10.4 Oxidation of Cyclohexene to Adipic Acid** *Due 10/15 Q 2a,b, 4, 5(2a,b)* ***(Lecture Q2)*** |
|  | **Oct 11** | **Drop Date. Last day to drop to get a "W"** |
| 10 | Oct 15 | **Exp. 11** Reactions of Acetylene and the Qualitative Tests of Hydrocarbons and Alkyl Halides. Acetylene will be synthesized for you. *Due 10/22 Q1, 2(a,b,c) and 4* |
|  | Oct 17 | **Exp. 13.1** The Synthesis of t-Butyl Chloride. *Due 10/24 Q 2, 3* |
| 11 | Oct 22 | **Exp. 13.2** The Solvolysis of t-Butyl Chloride. *Due 10/29* Dry glassware for **14.1** |
|  | Oct 24 | **Exp 14.1** Alcohols. **The Grignard Reaction. *Do Formal Report 2 on this lab***. *Due 11/5 Q1,2a,b,e (and acid)* |
| 12 | Oct 29 | **Finish 14.1** andIntroduction to Infrared Spectroscopy. Read **Chapter 9.1** **in lab book.** pgs 89-92. Analysing samples using the Infrared Spectrometer. *Due today* |
|  | Oct 31 | **Exp. 14.2** Qualitative tests for Alcohols. *Due 10/31 Q 1(a,b), 2(b,d), 3(a,b,c)* ***E2*** |
| 13 | Nov 5 | **Nomenclature worksheet.** *Worksheet due today.* |
|  | Nov 7 | **Exp. 15.2** Friedel-Crafts Alkylation: A Microscale Synthesis**.** *Due 10/14 Q1,2* |
| 14 | Nov 12 | Introduction to Mass Spectroscopy (handout). *Due today Q4,6* |
|  | Nov 14 | Analysing samples using the Gas Chromatography Mass Spectrometer *Due today* |
| 15 | Nov 19 | Introduction to NMR. Read McMurray **chapter 12**.1-3, 8-11 ***Lab 9: Q1,2,9*** *Due today* |
|  | Nov 21 | Analysis of unknown compounds by MS, IR and NMR. *Due today* ***(Lec Q3)*** |
| 16 | Nov 26 | Analysis of unknown compounds by MS, IR and NMR. *Due today* |
|  | Nov 28 | **Thanksgiving Holiday** |
| 17 | Dec 3 | **Lab Quiz 2** |
|  | Dec 5 | Nomenclature and Functional Group worksheet *Due today* |

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