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

**V. Cornel, Reedley College, Fall 2014, #59744**

**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: 10-11am MWF**

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

**Course corequisite: Chem 28A Course prerequisite: CHEM1B**

Textbooks:

* 1. Svoronos/Sarlo, Organic Chemistry Laboratory Manual, 2nd edition
  2. Klein, Organic Chemistry, 2nd Ed. or equivalent CHEM28A organic chemistry textbook to supplement the lab manual

Required Materials:

1. A lab research notebook (duplicate pages not needed).
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. The students will receive extensive support in thoroughly understanding the concepts taught in the organic chemistry lecture (Chem 28A).

Additional reading: Typically, the theoretical explanations in the lab manual are too brief to fully comprehend the experiment and answer the questions. Therefore preparation reading Klein's texbook (or alternative CHEM28A textbook) on the subject is highly recommended.

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, and Safety must be written into your lab notebook before coming to each lab. This will be checked at the beginning of lab. Copies of these pages need to be included with your lab report. During lab the Physical Data (melting point, refractive index etc.), Observations, Percent Yield, and Conclusion should all be recorded in your notebook. You will be allowed to use your handwritten lab notebook in the lab quizzes and any of this information could be asked.

Lab Reports: Photocopy the pages from your lab notebook (no carbon copy pages). Add to these any additional notes and full reaction mechanisms that were written on the white board, your full theoretical yield and mass percent yield calculations and certain questions from your lab manual. All these should be completed individually using your textbook. Points will be deducted from both parties if identical calculations or answers are given. 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. Use at least your lab manual, textbook, another book and an internet source. 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. I 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, photocopied or typed 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. No answers to questions are allowed in the lab notebook.

Drop date: The drop date is Friday October 10, 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 August 29, 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:**

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 two 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 2014 T/Th*** | | |
| 1 | Aug 12 | Read Preface and pages 1-3. Lab safety quiz. MSDS sheets. |
|  | Aug 14 | Practice Lewis Structures, molecular modeling and chemical bonds |
| 2 | Aug 19 | Molecular Orbital lab (handout). Read McMurray Chapter 1. |
|  | Aug 21 | **Exp 3.1 C** Melting Point Determination. *Due today*  **Exp. 3.3** Refractive Index (using digital RI). *Due today* |
| 3 | Aug 26 | **Exp. 4.1 parts I and II**. Simple Distillations. *Due 8/28 together with Exp 4.2* |
|  | Aug 28 | **Exp. 4.2** Fractional Distillation. *Due today* |
| 4 | Sep 2 | **Exp. 6.2** Extraction. *Due 9/9. No questions* ***(Lecture E1)*** |
|  | Sep 4 | **Exp. 6.3** Re-crystallization. *Due 9/11 Q1 and 3* |
| 5 | Sep 9 | **Exp. 6.5** **Isolation of Caffeine from Tea**. *Due 9/16* Q1. ***Formal Report 1 to be done on this lab*** |
|  | Sep 11 | **CHEMDRAW exercises** –to be used for Formal reports. *Due today*. **Bring USB drive to save work** |
| 6 | Sep 16 | **Exp 2.1 and 2.2** Stereochemistry and Molecular models. *Due 9/25* |
|  | Sep 18 | **Exp 2.3-2.5:** Stereochemistry in more depth: the R/S designation, E/Z designation, Fischer projection formulas and meso-compounds. *Due 9/25* |
| 7 | Sep 23 | **Exp. 7** Equilibrium constant. *Due 9/30 All Q* ***(Lecture E2)*** |
|  | Sep 25 | **Exp. 8.1-8.4** Sodium Fusion Test. Tests for S, halogens and N *Due 10/2 Q 1a,b and 2* |
| 8 | Sept 30 | **Exp. 10.1** Synthesis of Cyclohexene. *Due 10/7 All Q except 2b* |
|  | Oct 2 | ***Lab Quiz 1*** |
| 9 | **Oct 7** | **Exp. 10.2** Synthesis of 1,2-Cyclohexanedial from Cyclohexane *Due 10/14 Q 2a,b, 4, 5(2a,b)* |
|  | Oct 9 | **Exp. 11** Reactions of Acetylene and the Qualitative Tests of Hydrocarbons and Alkyl Halides. Acetylene will be synthesized for you. *Due 11/21 Q1a,b,c,d, 4* |
|  | **Oct 10** | **Drop Date. Last day to drop to get a "W"** |
| 10 | Oct 14 | **Exp. 13.1** The Synthesis of t-Butyl Chloride. *Due 10/21 Q 2, 3* |
|  | Oct 16 | **Exp. 13.2** The Solvolysis of t-Butyl Chloride. *Due 10/23*Dry glassware for **14.1** all Q ***(Lecture E3)*** |
| 11 | Oct 21 | **Exp 14.1** Alcohols. The Grignard Reaction. |
|  | Oct 23 | **Finish 14.1** *Due 10/30 Q1,2a,b,e (and acid)* |
| 12 | Oct 28 | **Exp. 14.2** Qualitative tests for Alcohols. *Due 11/4 Q 1(a,b), 2(b,d), 3(a,b,c)* |
|  | Oct 30 | **Exp. 14.3** **Preparation of Phenacetin from Acetaminophen.** *Due 10/6*  *All Q except 2.* ***Do Formal Report 2 on this lab***. |
| 13 | Nov 4 | Introduction to Mass Spectroscopy (handout). *Due today Q4, 6* |
|  | Nov 6 | **Exp 9.1** Introduction to Infrared Spectroscopy. Analysing samples using the Infrared Spectrometer. *Due today* |
| 14 | Nov 11 | **Veteran's Day. No classes** |
|  | Nov 13 | Analyzing samples using the Gas Chromatography Mass Spectrometer *Due 11/20* ***(Lecture E4)*** |
| 15 | Nov 18 | **Exp 9.2** Introduction to NMR. ***Q1,2,9*** *Due today* |
|  | Nov 20 | Analysis of unknown compounds by MS, IR and NMR. *Due today* |
| 16 | Nov 25 | Analysis of unknown compounds by MS, IR and NMR. *Due today* |
|  | Nov 27 | **Thanksgiving Holiday** |
| 17 | Dec 2 | **Lab Quiz 2** |
|  | Dec 4 | Nomenclature and Functional Group worksheet *Due today* |
|  | Dec 9 | ***(Lecture E5)*** |