Chemistry 202L – Organic Chemistry II Lab  
Summer II 2006  
Dr. Allen Clabo

- **Co-requisite:** CHEM 202L must be taken in the same semester as CHEM 202.

- **Class times:** MW or TTh, 1:00 – 4:30 p.m., LSF L302

- **Office:** LSF L303E; **Office Hours:** MTWTh 9:00 – 10:00 a.m., 12:00 – 1:00 p.m.

- **Office Telephone:** 661-1457; **E-mail:** dclabo@fmarion.edu

- **Web page:** [http://swampfox.fmarion.edu/web/chem/aclabo/index.htm](http://swampfox.fmarion.edu/web/chem/aclabo/index.htm)

- **Required Materials:**
  - *Student Lab Notebook*, Hayden-McNeil
  - *Splash-resistant chemical safety goggles*

- **Course objectives:**
  - to learn and demonstrate laboratory skills and techniques for the preparation, purification, and identification of organic compounds
  - to use computational chemistry methods to understand the structures, energies, and reactivities of organic molecules
  - to learn and utilize spectroscopic techniques for determining the structures of compounds
  - to demonstrate the use and understanding of organic chemistry literature
  - to learn and practice scientific writing skills
  - to demonstrate critical thinking as applied to laboratory reactions and procedures

- **Writing:** This course involves writing as a part of the lab. Each lab will require correct use of a laboratory notebook before and during lab. Students will be required to write lab reports that model a professional format and standard. Lab will include discussions and instruction about writing in Chemistry. There will be a chemical literature research project assigned for which oral (~5-8 minutes) and written (~1-2 pages) reports will be required. Lab exercises using molecular modeling and spectroscopic techniques will require reasoning and written explanations. Lab quizzes will be given occasionally and will include questions that require critical thinking, problem solving, and written answers.

- **Grading Policy:** The lab grade will be determined from the lab notebook (graded before and during lab), lab reports, and lab quizzes. The final lab grade will be included as a portion of the overall course grade.

- **Attendance** is required at all scheduled lab times. No absences are permitted, and no make-up labs will be scheduled. Any combination of absences and/or lab reports not turned in that totals 3 or more will result in a grade of F for the course.
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- **Safety:** Safety goggles must be worn at all times in the laboratory. Students failing to wear goggles in the lab will be first reminded. The second time students will be asked to leave lab, and an absence from lab will be counted. If you do not have goggles, they are available to purchase. Goggles are not available to rent or borrow. Proper clothing, including long pants and closed toe shoes, must be worn. Other safety equipment (face shield, apron, gloves) must be worn as directed.

- **Lab Schedule**

<table>
<thead>
<tr>
<th>Title</th>
<th>MW</th>
<th>TTh</th>
<th>Lab Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check-in/NMR Spectroscopy I/Photochemistry I</td>
<td>7/12</td>
<td>7/13</td>
<td>pp. 6-7, 28-46;</td>
</tr>
<tr>
<td>Photochemistry II/ Pinacol Rearrangement</td>
<td>7/17</td>
<td>7/18</td>
<td>Handout</td>
</tr>
<tr>
<td>Nitration of Methyl Benzoate/ Molecular Modeling: Electrophilic Aromatic Substitution</td>
<td>7/19</td>
<td>7/20</td>
<td>pp. 11-16, 17-23</td>
</tr>
<tr>
<td>Reduction of Benzil/ Optical Activity of Sugars</td>
<td>7/24</td>
<td>7/25</td>
<td>pp. 24-27; Handouts</td>
</tr>
<tr>
<td>NMR Spectroscopy II/ Oxidation of Cyclohexene/ Literature Assignment</td>
<td>7/26</td>
<td>7/27</td>
<td>pp. 47-51, 52-60</td>
</tr>
<tr>
<td>Saponification/ Mass Spectrometry</td>
<td>7/31</td>
<td>8/1</td>
<td>pp. ??-??</td>
</tr>
<tr>
<td>Investigation of a Reaction</td>
<td>8/2</td>
<td>8/3</td>
<td>pp. 61-64</td>
</tr>
<tr>
<td>Aldol Condensation</td>
<td>8/7</td>
<td>8/8</td>
<td>Handout</td>
</tr>
<tr>
<td>Literature/Check-out</td>
<td>8/9</td>
<td>8/9 (W)</td>
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- **Lab Notebook and Lab Report**

  - Purpose of the Notebook: To learn and to demonstrate the correct preparation and use of an experimental procedure; to record the actual procedure, experimental data, and observations; to demonstrate understanding of the purpose and results of an experiment

  - Parts of the Notebook:

    1. Purpose – What are you trying to learn or to show by the experiment? **Use your own words!**

    2. MSDS Information – What are the hazards associated with the chemicals in the experiment? Make a table of all the chemicals involved (solvents, reagents, etc.) and the CERCLA, NFPA, or other ratings for each. For any ratings of ”2” or higher, describe the hazard specifically and list the appropriate response to exposure. **Never** write “not available,” “not published,” “unknown,” etc.! Every compound has published safety data. (**Note:** MSDS information will always be posted before lab on the board outside L309.) See the lab manual for an
appropriate format for hazard information. **You must have this information recorded for all chemicals before you come to lab.**

3. Reactions – Structures, balanced equations (all), molecular weights, masses, moles, theoretical yields (grams and moles). Use the following format, also shown in the lab manual.

\[
\begin{align*}
\text{Formula} & : \quad C_{14}H_{10}O_2 + \text{NaBH}_4 \\
\text{Molar Mass} & : \quad 210.22 \text{ g/mol} + 37.83 \\
\text{Grams} & : \quad 0.500 \text{ g} + 0.200 \text{ g} \\
\text{Moles} & : \quad 0.00238 \text{ mol (limiting reagent)} + 0.00529 \text{ mol (excess reagent)} \\
\end{align*}
\]

\[
\begin{align*}
\text{Formula} & : \quad C_{14}H_{14}O_2 + \text{Inorganic products} \\
\text{Molar Mass} & : \quad 214.25 \\
\end{align*}
\]

4. Procedure – a) An outline of the procedure, **not** copied from the lab manual, but detailed enough to follow the procedure from the notebook, without referring to the lab manual. b) Notes and comments about the actual course of **your** experiment – actual weights, observations, deviations from the procedure, repeated steps, etc.

5. Results – data (melting points, mass of product, etc.), graphs, chromatograms, spectra, observations about the experiment in general, etc.

**Grading:**

Parts 1 – 4a constitute the Pre-lab assignment for most labs. (Some labs, like modeling or spectroscopy, may have no written pre-lab or another pre-lab assignment.) These parts must be completed **before** lab and will be collected before you begin the experiment. If the pre-lab is not completed before coming to lab, you will not be permitted to attend lab. Part of the purpose of lab is to help you to learn to prepare before attempting experimental procedures.

Parts 4b – 5 are completed during lab. These parts will be checked as you proceed during the lab.

- **The largest portion of the lab grade is derived from lab reports.** Each lab report consists of Purpose, Reactions, Experimental Procedure (brief), Results/Data, and Discussion/Conclusion. The first 4 parts of the report are **similar to** (not identical to!) the corresponding sections of the lab notebook. However, the report must include actual amounts of reagents used, recalculation of theoretical yield of products, individual details of the
procedure actually followed, and actual amounts of products collected and yield obtained. The report must conclude with a thoughtful discussion of the results and conclusions, including whether the purpose of the experiment has been accomplished. This report should be no more than 2-3 pages (plus attachments). The purpose of this final report is not to re-copy the notebook, but to report formally and exactly your experimental work.

The lab report must be produced using a word processing program. Data should be presented in tables. Spectra, graphs, etc. must be attached to the report. Molecular structures and reactions must be drawn with a molecular drawing program like ISIS/Draw or CAChe. These programs are available on all the Windows-based PC's in the Chemistry Department. They are also distributed free on CD for installation elsewhere.

Topics for the discussion should include:
♦ Is the data what you expected? What does the data mean?
♦ Calculate yield (from experimental weights and volumes).
♦ Describe graphs or spectra. What spectral absorptions describe the functional groups of a molecule?
♦ Describe the theory of new techniques used.
♦ Are there errors in the data? (It's o.k.!) Why? What other sources of error are there? (Be reasonable!)
♦ **Did you accomplish the purpose of the experiment? What did you learn?**

Writing skills should be emphasized in the lab report. You should attempt for your writing to have the following characteristics:
♦ Complete but not wordy
♦ Concise but not abbreviated
♦ Original (not copied! Plagiarism, of the lab manual, another student’s work, or any other source, is a violation of the FMU Academic Honesty Policy and is subject to the appropriate penalty, including, first, the loss of credit for the assignment.)
♦ Accurate (actual procedures!)
♦ Thoughtful, demonstrating understanding
♦ Grammatically correct (subject-verb agreement, spelling (use the spell checker!), complete sentences, etc.)

The ultimate example of the desired writing style (format, concise wording, preferred phrasing, etc.) is that found in the chemical literature, for example, the *Journal of Organic Chemistry*.

“If we ask for something more than simplicity, it is silly then to complain that the something more is not simple.” C. S. Lewis