Chemistry 3LA3 – Strategies for Chemical Discovery
Fall 2016
Department of Chemistry and Chemical Biology, McMaster University

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Course Web Page
on McMaster’s Avenue to Learn System

Lectures
Mondays, 2:30 pm; HH 305

Laboratories
Thursdays and Fridays at 1:30 pm-5:30 pm; ABB-402

Required Course Materials

Texts: same text as in 2nd year – TCD and The Organic Chem Lab Survival Manual (OCLSM), By James W. Zubrick

Hardbound “Physics Notes” laboratory notebook (a Blue or a Black notebook is OK, although the black notebooks are slightly better since they have more lines per page).

Safety goggles
Lab coat
An account with an online file storage service (i.e., Dropbox, Google Drive, etc.)

CHEM 3LA3 Projects

PROJECT 1: An integrated study of the heterohalogenation of 1-hexene and styrene with potassium dichloroiodate.


PROJECT 3: Synthesis of Grubbs’ Catalyst for Use in Ring-Opening and Ring-Closing Metathesis Reactions.
PROJECT 4: Diels-Alder Reaction of 2,4-Hexadien-1-ol with maleic anhydride followed by characterization with NMR and X-ray diffraction, and then further elaboration into a more complex structure.

PROJECT 5: Synthesis and characterization of liquid crystals.

Course Philosophy

The Level III laboratory program is designed as preparation for the research course that most students will take in Level IV (4G09). CHEM 3LA3 will provide the opportunity for you, the student, to not only perform independent work in the fume hood, but also to independently interpret your results and combine data from different experiments in forming an overall picture of a chemical phenomenon. This course will build upon the skills that you have learned in the Level II laboratory courses, and will now focus on developing problem solving skills and chemical “intuition”, rather than just expanding on the set of skills you have already acquired. Emphasis will be placed on instilling a broader perspective of laboratory work, where you must consider how each step accomplished within a given laboratory period fits into the context of the overall project, where each step builds upon the previous.

Integration of sub-disciplines will naturally be part of each project as you will be required to perform all aspects of synthesis (organic/inorganic), characterization (structural analysis and determination of physical properties), and utilization/application of your products in chemistry and device constructs. We will strive to expose you to advanced techniques in synthesis (Schlenk line chemistry, applications of catalysts, synthesis of nanocrystals, etc.) and characterization/analysis (high-resolution electron microscopy, X-ray diffraction, mass spectrometry, atomic absorption spectroscopy, etc.), and the preparation/use of valuable compounds (not things you want to pour into the waste container at the end of the period).

A conscious effort has been made to not pack as many different physical skills as possible into each lab period, but instead to provide lab time that will be spent on data interpretation. An emphasis has been placed on interdisciplinary problems that combine synthetic skills with physical analysis/interpretation of results, where the products are ones that have an impact on society. Advanced training in techniques applicable to specific sub-sets of chemistry is left to the 4G09 course, where you will have already identified your interests and will be motivated to learn the advanced techniques that are required of the sub-discipline you choose to “specialize” in.

Note on Scenarios: While the scenarios are designed to provide context and purpose to the laboratory exercise, the details of these scenarios are purely fictitious. Although the situations and concepts described in the scenarios may reflect real possibilities, students should not expect that the molecules handled in the lab correspond to the phenomena described in the scenarios. When writing up your lab results in CHEM 3LA3, please do not mention the scenarios or place the results in this context – it does not fit with the idea of writing up the experiments in the format of a JACS paper!

Chemistry 3LA3 Course Structure

A team composed of the instructor and the graduate teaching assistants will carry out day-to-day instruction and supervision, and weekly evaluation of laboratory notebooks, with technical support provided by undergraduate laboratory staff members. Both the primary faculty course instructors and the teaching assistants will contribute to student evaluation in the courses. Each laboratory project will span two weeks (4 lab periods), and all tasks will contain aspects of
compound preparation, structural characterization/analysis, data interpretation, and product utilization. Five separate projects will be carried out during the semester. Each project (not each lab!) is self-contained, but some overlap between different experiments will be attempted (i.e., a catalyst prepared in one project may be useful for another).

**Evaluation**

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<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Pre-lab preparation</td>
<td>15%</td>
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<tr>
<td>Laboratory notebook</td>
<td>20%</td>
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<tr>
<td>Skills Assessment</td>
<td>25%</td>
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<tr>
<td>Laboratory Reports</td>
<td>40%</td>
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Grades for *pre-lab preparation, lab notebook maintenance, and skills assessment* will be assigned continuously throughout the course on a day-to-day basis. Each project in the laboratory manual provides specific instructions with respect to pre-lab preparation, which will involve two separate aspects:

**Readings.** The description of the project itself must be read from start to finish before entering the laboratory. Chapters in the 3LA3/3LB3 course textbooks ("TCD" and "OCLSM") that constitute essential reading in advance of the experiment will be indicated in **boldface** under the heading “Techniques”.

**Notebook preparation.** The “Pre-lab” section of each project lists specific things that are to be entered into the notebook prior to entering the laboratory.

A grade out of 5 for pre-lab preparation will be assigned by the TAs during the first hour of every laboratory session, based primarily on inspection of the lab notebook. The grade will be derived using the following guidelines:

- **5/5** – student has read the experiment and essential readings, the notebook has been prepared as instructed, and the student is clearly well organized.
- **4/5** – student has read and understands the experiment and the essential readings and prepared the notebook as instructed, but there are minor deficiencies.
- **(2-3)/5** – student has read the experiment and the essential readings and prepared the notebook as instructed, but there are major deficiencies in the notebook preparation.
- **1/5** – student has read the experiment, but has recorded nothing in the notebook beyond the title and purpose of the experiment.
- **0/5** – student is completely unprepared – there are no notebook entries and it is clear that the student hasn’t even read the experiment.

Students who receive a grade of 1/5 or less will be required to withdraw from the laboratory, and meet with one of the course instructors, who will decide whether the circumstances warrant allowing the lab to be made up on an alternate date. If a make-up is permitted, it will be the student’s responsibility to arrange a date and time that is acceptable to the technical staff and a TA. If a make-up is not permitted, the student will receive a grade of zero for the project.

Students compelled to be absent from a scheduled laboratory session for any reason are to inform one of the instructors by 1 pm on the Wednesday preceding the session (whenever
possible), and an alternative date for completing the laboratory activities of that day will be arranged. Laboratory sessions missed for medical reasons will require documentation and should be handled through the Associate Dean’s office.

**Lectures**
Lecture periods will be used to provide background information about the projects being carried out throughout the semester, and instruction on improving report-writing skills. This information will be of both a theoretical nature, and a practical guide to carrying out the operations required in the laboratory. Attendance at the lectures is highly recommended.

**Lab Reports**
The *lab reports* will each consist of a written report of minimal length following each project of the course, in which students will interpret the results of the project in detail. These exercises will provide students with experience in preparing reports based on their experimental work, allowing them to consolidate experimental results into a short, cohesive summary. Each report will be due 10 days after completion of the project, by 4 pm on the corresponding Monday, to the Undergraduate Secretary in the main Chemistry office (ABB 156). LATE REPORTS WILL NOT BE ACCEPTED FOR GRADING. Note that completion and submission of all lab reports is required for a passing grade in the course.

**Skills Assessment**
The *skills assessment* will be carried out by the course TAs, in consultation with the instructors, throughout the course. Grades will be assigned based on the following guidelines:

- <10/20 (Insufficient) - Student required continuous assistance while ignoring safety hazards
- 14/20 (Reasonable) - Student performed work competently with some assistance
- 16/20 (Good) - Student showed good skills at performing experiments
- >18/20 (Excellent) - Student showed excellent skill, performed work independently, and had an excellent understanding of the basic principles involved.

Additional categories for assessment will include the students’ ability to identify relevant information, critically assess information, process acquired data, make appropriate conclusions based on experimental evidence, and ability to communicate findings.

A guideline of how each student will be assessed based on level of preparation, daily progress, ability to follow procedures, work cleanliness, and level of understanding is provided below.
Missed Laboratory Experiments

Failure to hand in a laboratory report or complete a laboratory experiment will result in a zero grade unless a valid reason has been filed with and accepted by the Associate Dean’s office. It is the responsibility of the student to ensure that medical slips etc. are filed with the Associate Dean, and that the appropriate Permission Slip is issued and filed with the Course Instructor. There will be no exemptions to these rules.

The Laboratory Notebook is the permanent record of the experiments a chemist carries out. The required laboratory notebook (“Physics Notes”) is available in Titles Bookstore. It is to be purchased new, and not used for any purpose other than Chemistry 3LA3 and (if space permits) 3LB3.

The first two pages of the notebook are to be reserved for a Table of Contents that will contain the title of the experiment and the page number on which it starts. Note that you will have to number the pages in the notebook yourself; please do this prior to the first lab (the first 100 pages should be plenty).
The remainder of the book will contain your lab notebook entries for each of the experiments you do. The right-hand pages are to be used for the text associated with the write-up (purpose, procedure, conclusions, etc.), tables, and hand-entered data that you acquire, while the left-hand pages are to be used for rough calculations, sketches of apparatus, original hard-copies of spectra or any other instrumental data that are acquired during the experiment (stapled or taped in place). Your TAs and course instructors will provide you with additional instructions as time goes on in the course – the basic rule, however, is that everything goes in the lab book, and never on loose scraps of paper that can be misplaced.

Use a pen for all entries in the lab book, and cross out (with a single line) any errors that are made. Tearing out or otherwise removing pages from a laboratory notebook is not permitted, and is punishable by the loss of 2% of the course grade per page removed.

The format to be used in recording the details of an experiment will vary somewhat depending on whether the experiment is primarily synthetic or focuses on analytical or physical measurements. You should emulate the guidelines on keeping a notebook described in chapter 2 of Zubrick, J.W., The Organic Chem Lab Survival Manual, 6th Ed., John Wiley and Sons, 2008.

Course Changes. The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Copyright. In this course you will have access to material that is subject to copyright laws. This includes (but is not limited to) the textbook and all resources developed by the instructor. You are not allowed under any circumstance to share or redistribute these materials in any printed or electronic form without the explicit written consent of the copyright holder (publisher, instructor, etc.). This includes posting any course material on Internet bulletin boards, course repositories, social networks, etc.
Academic Dishonesty

“Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained. *Transcribing passages from other sources in assignments is an example.*
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., Google search, etc.).

Approved by McMaster University Senate: May 12, 2003
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