






**HOUSTON COMMUNITY COLLEGE SOUTHWEST**  
**COURSE OUTLINE FOR CHEM 2425 – ORGANIC CHEMISTRY II**  
**Spring 2017 *Second Start 12 Week Section***  
**Class Number 15964**

<b>Discipline/Program</b>	CHEMISTRY
<b>Course Level</b>	Second Year (Sophomore)
<b>Course Title</b>	Organic Chemistry II
<b>Course Rubric and Number</b>	CHEM 2425
<b>Semester with Course Reference Number (CRN)</b>	Spring 2017, 12 Weeks CRN 15964
<b>Course Location/Times</b>	Stafford Scarcella Center, 10141 Cash Road Tuesday Room S109 (lab) 2:00 – 6:00 PM Thursday Room W121 (lecture) 2:00 – 6:00 PM
<b>Course Semester Credit Hours (SCH) (lecture, lab)</b>	4 (3 lecture, 3 lab)
<b>Total Course Contact Hours</b>	96
<b>Course Length (number of weeks)</b>	12
<b>Type of Instruction</b>	In-person
<b>Instructor contact information (phone number and email address)</b>	Dr. Steven E. Dessens Office Phone: 713-718-6710 E-mail: <a href="mailto:steven.dessens@hccs.edu">steven.dessens@hccs.edu</a> Learning Web: <a href="http://learning.hccs.edu/faculty/steven.dessens">http://learning.hccs.edu/faculty/steven.dessens</a>
<b>Office Location and Hours</b>	Room S107 Stafford Scarcella building, Friday 1:00-4:00 PM.
<b>Course Description: ACGM or WECM</b>	Study of the properties and behavior of hydrocarbon compounds and their derivatives. Designed for students in science or pre-professional programs.
<b>Course Description: HCC Catalog Description</b>	Continuation of CHEM 2423. Topics include aromaticity, benzene and EAS reactions, aldehydes, ketones, carboxylic acids and their derivatives, condensation reactions, amines, phenols, and infrared and NMR spectroscopy. Core Curriculum Course.
<b>Course Prerequisite(s)</b>	CHEM 2423, Must be placed into college-level reading and be placed into MATH 1314 (or higher) and be placed into college-level writing.
<b>Academic Discipline Program Learning Outcomes</b>	<ol style="list-style-type: none"> <li>1. Demonstrate a basic mastery of chemistry by writing formulas and equations for chemical reactions, performing chemical calculations, and recognizing the application of chemistry in our daily lives.</li> <li>2. Demonstrate a mastery of introductory and intermediate level chemistry to promote success in higher level chemistry and other science programs at four-year universities.</li> <li>3. Demonstrate a mastery of General and Organic Chemistry in preparation for professional programs such as Medicine, Dentistry, and Pharmacy.</li> <li>4. Conduct laboratory experiments by making measurements, performing chemical reactions, and analyzing the results in a group or individual setting.</li> </ol>
<b>Course Student Learning Outcomes (SLO)</b>	<ol style="list-style-type: none"> <li>1. Compare and contrast the structures, properties, and reactions of aromatic compounds, carbonyl compounds (aldehydes, ketones, carboxylic acids, acyl halides, anhydrides, esters, amides), and amines.</li> <li>2. Design syntheses for organic compounds and write mechanisms for the reactions.</li> <li>3. Perform laboratory synthesis, purification, and characterization of organic compounds studied in the course.</li> </ol>
<b>Learning Objectives (Numbering system linked to SLO)</b>	<ol style="list-style-type: none"> <li>1.1. Determine the aromaticity of aromatic hydrocarbons and benzene derivatives using Hückel <math>4n + 2</math> Rule. Explain Electrophilic Aromatic Substitution (EAS) reactions of aromatic rings such as benzene and its derivatives.</li> <li>1.2. Identify conjugation in organic compounds and the reactions of conjugated dienes using Diels alder reaction.</li> </ol>

	<p>1.3. Review nomenclature of alcohols and phenols and reactions based on acidity and basicity properties.</p> <p>1.4. Review nomenclature of ether, thiols, and sulfides and reactions based on acidity cleavage and Claisen rearrangement.</p> <p>1.5. Explain nomenclature, preparations, and nucleophilic addition reactions of ketones and aldehydes by the method of Grignard, Witting, and Wolff-Krishner reactions.</p> <p>1.6. Explain nomenclature, preparations, and properties of carboxylic acids and derivatives including alpha substitutions.</p> <p>1.7. Explain Aldol condensation, Claisen condensation reaction, and mixed Claisen condensations reactions and mechanisms.</p> <p>1.8. Review nomenclature of amines and their derivatives and reactions based on basicity properties. Contrast the reactivity of arylamines and aliphatic amines.</p> <p>2.1. Students should be able write mechanisms of electrophilic addition reactions to alkenes and conjugated dienes, EAS, conversion of alcohols to alkyl halides and alkenes, cleavage reactions of ethers, nucleophilic addition reactions of aldehydes and ketones, reactions of carboxylic acid derivatives, carbonyl alpha substitution and condensation reactions, and reactions of amines with carbonyl compounds.</p> <p>3.1. Determine the molecular structure of organic compounds using interpretation of spectral data such as GC-MS, IR, UV-VIS, and NMR (proton and carbon) or with actual instrumentation at campuses with analytical equipment.</p> <p>3.2. Perform laboratory synthesis and characterization of a the product of a Diels-Alder reaction, perform an EAS reaction such as nitration of methyl benzoate, perform reactions of alcohols and identify an unknown alcohol as primary, secondary, or tertiary, perform similar tests to identify an unknown aldehyde or ketone, perform chemical tests on carboxylic acids and amines to study their properties and classify an unknown amine as primary, secondary, or tertiary.</p>
<b>SCANS and/or Core Curriculum Competencies</b>	Critical Thinking, Communication Skills, Empirical & Quantitative Reasoning, and Teamwork
<b>Course Calendar</b>	<p style="text-align: center;"><b>Weekly Schedule</b></p> <p>Feb 14 Chapter 12 – Structure Determination: Infrared (IR) Spectroscopy Chapter 13 – Structure Determination: Nuclear Magnetic Resonance (NMR) Spectroscopy</p> <p>Feb 16 <b>EXPERIMENT 1 – IR and NMR Spectroscopy. Exercises in Molecular Spectroscopy</b></p> <p>Feb 21 Chapter 14 – Conjugated Compounds and Ultraviolet Spectroscopy</p> <p>Feb 23 Chapter 15 – Benzene and Aromaticity</p> <p>Feb 28 <b>EXPERIMENT 2 – The Diels-Alder Reaction. Preparation of <i>Endo</i>-Norbornene-5,6 <i>cis</i>-Dicarboxylic Anhydride</b></p> <p>Mar 2 Chapter 16 – Chemistry of Benzene: Electrophilic Aromatic Substitution (EAS)</p> <p>Mar 7 <b>EXPERIMENT 3 – Nitration of Aromatic Compounds. Preparation of Methyl <i>m</i>-Nitrobenzoate</b></p> <p><b><u>Mar 9 EXAM 1 – Chapters 12–16</u></b></p> <p>Mar 14 ☞ Spring Break, No Classes ☞</p> <p>Mar 16 ☞ Spring Break, No Classes ☞</p>

	<p>Mar 21 Chapter 17 – Alcohols and Phenols</p> <p>Mar 23 Chapter 18 – Ethers and Epoxides; Thiols and Sulfides</p> <p>Mar 28 <b>EXPERIMENT 4 – Properties of Alcohols</b></p> <p>Mar 30 Chapter 19 – Aldehydes and Ketones: Nucleophilic Addition Reactions</p> <p>Apr 4 <b>EXPERIMENT 6 – Identification of Aldehydes and Ketones</b></p> <p><b><u>Apr 6 EXAM 2 – Chapters 17–18</u></b></p> <p>Apr 11 Chapter 20 – Carboxylic Acids and Nitriles Chapter 21 – Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution Reactions ☞ <b>Last Day for Withdrawals (for a grade of W)</b> ☞</p> <p>Apr 13 Chapter 21</p> <p>Apr 18 Chapter 22 – Carbonyl Alpha-Substitution Reactions</p> <p><b>Apr 20</b> Chapter 23 – Carbonyl Condensation Reactions</p> <p>Apr 25 <b>EXPERIMENT 7 – Aldol Condensation. Synthesis of Dibenzalacetone</b> <b>EXPERIMENT 8 – Carboxylic Acid Reactions and Derivatives</b></p> <p><b><u>Apr 27 EXAM 3 – Chapters 19–23</u></b></p> <p>May 2 Begin Chapter 24 – Amines and Heterocycles</p> <p>May 4 Chapter 24</p> <p>May 9 Finals Week – No Class</p> <p><b><u>May 11 FINAL EXAM, Chapters 12–24, 2:00– 4:00 PM</u></b></p> 
<b>Instructional Methods</b>	Standard class lectures using the whiteboard with occasional use of PowerPoints.
<b>Student Assignments</b>	Outside of laboratory reports, special assignments are not given. I will recommend practice problems but these are not graded. Practice problems, such as those at the end of the chapters, are highly beneficial to learning chemistry. The McMurry organic textbook has “in text” problems within the chapters with answers provided at the end of the textbook. Answers to the end of chapter problems are in the study guide. Practice problems can also be found on my Learning Web site. It is helpful to have a spiral leaf notebook just for working chemistry problems. That will keep your work more organized and you (or I) can more easily review your work.
<b>Student Assessment(s)</b>	<p>The overall score is based on the following:</p> <ul style="list-style-type: none"> <li>• Three regular exams 60%</li> <li>• Laboratory 20%</li> <li>• Final Exam 20%</li> </ul> <p>Overall Score = 0.60(Average of three regular exams) + 0.20(Laboratory grade) + 0.20(Final Exam)</p>
<b>Instructor's Requirements</b>	<b><u>Laboratory Policy</u></b>

	<p><b>Lab safety</b> will be reviewed before the first lab. Each student will then sign a statement affirming his or her commitment to following safe procedures in the laboratory, and turn the form in to the instructor. Be especially aware of the need for adequate <b>eye protection</b> and <b>proper dress</b> in the laboratory.</p> <ul style="list-style-type: none"> <li>• <b>Safety glasses or goggles must be worn at all times during the laboratory period.</b></li> <li>• <b>No food or drinks are allowed in the lab.</b></li> <li>• <b>Open-toed shoes and/or shorts should not be worn in the lab.</b></li> <li>• <b>Admission to the lab may be denied for violation of any of these rules.</b></li> </ul> <p>Normally, experiments will be performed in groups of two to three students. You should arrive at the lab <i>on time</i> with your lab handout. After you have finished the experiment, show me your results for me to examine briefly, and I will <b>initial</b> ("S.D.") your lab report before you leave. <i>Laboratory reports are due on the next lab day.</i></p> <p>Each report must be done <u>individually</u>; "group reports" and lab reports from different individuals with identical wording are <u>not</u> acceptable! <b>See the directions of the lab report format at the end of this syllabus.</b> Each report will be graded on a 20 point basis. You should come to lab <u>prepared</u>. Read through the experiment and answer the pre-lab questions beforehand. Keep a bound laboratory notebook (clothbound is standard; spiral is acceptable). This is for you to record your "on the spot" observations, changes to procedure, etc., and general data. The actual report is done separately. Makeup policy for missed labs: None!</p> <p><b><u>Exams and Make-up Policy</u></b></p> <p>Examinations will consist of three non-cumulative regular exams plus a comprehensive final. Make-up exams will not normally be given, so make every effort to take the exams on their scheduled dates. In the event that you <i>must</i> miss a regular exam, I will count the grade made on the final exam as the grade for the missed exam (for one missed exam only), and calculate the final course grade accordingly. If you do not miss any of the regular exams, I will replace your lowest exam score with your final exam score if the final exam grade is higher. This is intended to provide you a "second chance" if you do not do well on a particular exam. Remember that the final exam will be <i>comprehensive</i> (meaning that it will cover <i>all</i> of the material from the whole semester, not just the last part). Please note that all students are required to take the final (no student can be exempted).</p>
<b>Program/Discipline Requirements</b>	At the program level, the Chemistry Discipline strives to accomplish the Program Learning Outcomes, Student Learning Outcomes, and Learning Objectives as described above. We desire that you receive a challenging and rewarding experience in your chemistry classes at HCC which will prepare you well for future chemistry and related science courses that you may take in the future.
<b>HCC Grading Scale</b>	<p>A = 100 – 90: .....4 points per semester hour  B = 89 – 80: .....3 points per semester hour  C = 79 – 70: .....2 points per semester hour  D = 69 – 60: .....1 point per semester hour  59 and below = F .....0 points per semester hour  IP (In Progress) .....0 points per semester hour  W(Withdrawn).....0 points per semester hour  I (Incomplete).....0 points per semester hour  AUD (Audit) .....0 points per semester hour</p> <p>IP (In Progress) is given only in certain developmental courses. The student must re-enroll to receive credit. COM (Completed) is given in non-credit and continuing education courses. To compute grade point average (GPA), divide the total grade points by the total number of semester hours attempted. The grades "IP," "COM" and "I" do not affect GPA.</p>
<b>Instructor Grading Criteria</b>	See the above descriptions of the lab, exams, and final. The course grade is based on these four criteria according to the Assessment section above.

<b>Instructional Materials</b>	<p><b><u>Textbook</u></b></p>  <p><b>Organic Chemistry, 9<sup>th</sup> Edition, by John E. McMurry</b>  Cengage Learning 2015  Custom HCC Softcover 9<sup>th</sup> Edition, Volume II, Chapters 12-24  ISBN-13: 978-1-305-76519-1</p> <p><b><u>Laboratory Manual</u></b>  Provided as handouts at <a href="http://swc2.hccs.edu/pahlavan">http://swc2.hccs.edu/pahlavan</a>.</p> <p><b><u>Optional Study Guide and Solutions Manual</u></b></p>  <p><b>Study Guide with Student Solutions Manual, by John E. McMurry</b>  Cengage Learning 2015  Custom HCC Softcover 9<sup>th</sup> Edition, Volume II, Chapters 12-24  ISBN-13: 978-1-13306-729-0</p>
<b>HCC Policy Statement:  ADA  Academic Honesty  Student attendance  3-peaters  Withdrawal deadline</b>	<p>Access Student Services and other information at:  <a href="http://www.hccs.edu/district/students/">http://www.hccs.edu/district/students/</a></p> <p><b><u>Disability Support Services (DSS)</u></b>  “Any student with a documented disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact the Disability Services Office at the respective college at the beginning of each semester. Faculty are authorized to provide only the accommodations requested by the Disability Support Services Office.”  If you have any special needs or disabilities which may affect your ability to succeed in college classes or participate in any college programs or activities, please contact the DSS office for assistance. At Southwest College, contact Dr. Becky Hauri, 713-718-7909. More information is posted at the Southwest College Counseling webpage at <a href="http://learning.hccs.edu/programs/counseling/southwest">http://learning.hccs.edu/programs/counseling/southwest</a>.</p> <p><b><u>Academic Honesty</u></b>  “Students are responsible for conducting themselves with honor and integrity in fulfilling course requirements. Disciplinary proceedings may be initiated by the college system against a student accused of scholastic dishonesty. Penalties can include a grade of "0" or "F" on the particular assignment, failure in the course, academic probation, or even dismissal from the college. Scholastic dishonesty includes, but is not limited to, cheating on a test, plagiarism, and collusion.”  <b>Use of cell phones are not allowed during exams. Students are not permitted to leave the room during their exam.</b></p> <p><b><u>Attendance Policy</u></b>  The HCCS attendance policy is stated as follows: “Students are expected to attend classes regularly. Students are responsible for materials covered during their absences, and it is the student's responsibility to consult with instructors for make-up assignments. Class attendance is checked daily by instructors. <i>Although it is the responsibility of the student to drop a course for non-attendance, the instructor has full authority to drop a student for excessive absences. A student may be dropped from a course for excessive absences after the student has accumulated absences in excess of 12.5% of the hours of instruction (including lecture and laboratory time).</i>”</p> <p>If circumstances significantly prevent you from attending classes, please inform me. I realize that sometimes outside circumstances can interfere with school, and I will try to be as accommodating as possible, but please be aware of the attendance policy.</p> <p><b><u>Policy Regarding Multiple Repeats of a Course</u></b>  “NOTICE: Students who repeat a course three or more times may soon face significant</p>

	<p>tuition/fee increases at HCC and other Texas public colleges and universities. If you are considering course withdrawal because you are not earning passing grades, confer with your instructor/counselor as early as possible about your study habits, reading and writing homework, test-taking skills, attendance, course participation, and opportunities for tutoring or other assistance that might be available.”</p> <p><b><u>Last Day for Administrative and Student Withdrawals</u></b></p> <p>For 12-week Spring 2017 classes, this date is <u>April 11</u>. I urge any student who is contemplating withdrawing from the class to see me first! You may be doing better than you think. Either way, I want to be accessible and supportive. I do not believe in "weed out" classes, and I consider you to be much more than just a name or number! Note my office hours above; if you need assistance, I'm here to help.</p> <p>☛ <b><u>Policy Regarding Withdrawals</u></b> ☛</p> <p>Students desiring to withdraw from a class must do so by the above withdrawal date by filling out a <b>withdrawal form</b> at the registrar's office. <i>After this date, instructors can no longer enter a grade of "W" for the course for any reason.</i></p>
<b>Distance Education and/or Continuing Education Policies</b>	<p>Access DE Policies on their Web site:  <a href="http://de.hccs.edu/student-services/">http://de.hccs.edu/student-services/</a></p> <p>Access CE information on their Web site:  <a href="http://www.hccs.edu/continuing-education/">http://www.hccs.edu/continuing-education/</a></p>
<b>Test Bank</b>	<p>Extra practice problems by chapter, sample exams, and sample finals may be found at the following web sites:  <a href="http://learning.hccs.edu/faculty/steven.dessens">http://learning.hccs.edu/faculty/steven.dessens</a>  <a href="http://swc2.hccs.edu/pahlavan">http://swc2.hccs.edu/pahlavan</a>  <a href="#">McMurry Companion Website</a> (6<sup>th</sup> Edition)</p>
<b>Scoring Rubrics</b>	<p>Regular exams and the final will consist of multiple-choice and show-work questions. These are graded in the standard manner. The regular exams will include extra questions for extra credit, for a total possible score of about 105 to 110 points.</p> <p>The lab reports are graded on the basis of completeness, neatness, and the correctness of the calculations tied to the experimental result. The pre- and post-lab questions are also checked. Each report is graded on a 20 point basis.</p>
<b>Sample Assignments</b>	N/A
<b>Sample Instructional Methods/Activities</b>	<p>See the PowerPoints at my Learning Web site for an overview of the content of each chapter:  <a href="http://learning.hccs.edu/faculty/steven.dessens">http://learning.hccs.edu/faculty/steven.dessens</a></p>

### 🔔 Important Dates 🔔

Feb	14	Tuesday	Class Begins
Apr	11	Monday	Last Day for Administrative/ Student Withdrawals with a grade of "W"
			<b>After the withdrawal date no W can be given, you <u>must</u> receive a regular grade (A-F) in the course.</b>
May	7	Sunday	Instruction Ends
May	11	Thursday	<b>Final Exam</b> (No deviation from the printed schedule is permitted.)
May	14	Sunday	Semester Ends

### Other Information

Free chemistry tutoring is available. A tutoring schedule will be posted in the classroom and lab and will also be placed on my web site at [http://learning.hccs.edu/faculty/steven.dessens/chemistry\\_resources/tutoring-schedules](http://learning.hccs.edu/faculty/steven.dessens/chemistry_resources/tutoring-schedules).

**Upswing** In addition to "face to face" tutoring, HCC also offers online tutoring from Upswing. It is also free and is available for chemistry and many other subjects. The login page is at <https://hccs.upswing.io>.

There are also many interesting chemistry resources on the Internet which can be found by using keyword searches. But your best immediate source of information is your *textbook* - make thorough use of it!

The publisher of the McMurry 6<sup>th</sup> Edition textbook has a useful online companion site with chapter practice quizzes [here](#). The 7<sup>th</sup> Edition companion site is [here](#) but now requires a paid account in order to access it.

If you purchase a new textbook from an HCC bookstore, it will contain an OWL (Online Web Learning) passcode from Cengage, the publisher of your textbook.

- OWL Version 2 home page: <http://www.cengage.com/owlv2/>
- OWL login page: On my Learning Web home page or at the above link.

**eMail Communication** should generally be done via your HCC email account. This is especially important to ensure privacy in communications about your grade or other personal matters related to the class.

### **Evaluation for Greater Learning Student Survey System (EGLS<sub>3</sub>)**

"At Houston Community College, professors believe that thoughtful student feedback is necessary to improve teaching and learning. During a designated time, you will be asked to answer a short online survey of research-based questions related to instruction. The anonymous results of the survey will be made available to your professors and division chairs for continual improvement of instruction. Look for the survey as part of the Houston Community College Student System online near the end of the term." <http://www.hccs.edu/EGLS3>

### **Office of Institutional Equity Statement**

"Title IX of the Education Amendments of 1972 requires that institutions have policies and procedures that protect students' rights with regard to sex/gender discrimination. Information regarding these rights are on the HCC website under Students-Anti-discrimination. Students who are pregnant and require accommodations should contact any of the ADA Counselors for assistance.

It is important that every student understands and conforms to respectful behavior while at HCC. Sexual misconduct is not condoned and will be addressed promptly. Know your rights and how to avoid these difficult situations.

Log in to [www.edurisksolutions.org](http://www.edurisksolutions.org). Sign in using your HCC student email account, then go to the button at the top right that says **Login** and enter your student number."

### **Meningitis Vaccination Requirement**

Texas Senate Bill 1107 passed in May 2011, requires that new HCC students and former HCC students returning after an absence of at least one fall or spring semester who are under the age of 30 are required to present a physician-signed certificate showing they have been vaccinated against bacterial meningitis. The immunization must be administered at least 10 calendar days before the start date of your classes and must have been received within the last five years.

<http://www.hccs.edu/continuing-education/students/apply/meningitis/>

**Title IX of the Education Amendments of 1972 ("Title IX")**, is a Federal civil rights law that prohibits discrimination on the basis of sex — including pregnancy and parental status — in educational programs and activities.

All public and private schools, school districts, colleges, and universities receiving any Federal funds ("schools") must comply with Title IX.\*

For details about this law and your rights, please visit:

<http://www.hccs.edu/district/departments/institutionalequity/title-ix-know-your-rights/>

### **Additional Comments...**

Mastering organic chemistry takes time! In my experience, the number one hindrance to doing well is lack of adequate and quality time to study outside of the classroom. Of course, you must also have a reasonable grasp of the principles you learned in General Chemistry. Remember the old adage, "For every hour of classroom time you should allow for two hours of study time at home," for it is true. A heavy class and/or work load does not leave much quality study time! By "quality" time I mean periods in which you can study undisturbed, when you are still wide-awake and alert. Pace yourself - *overloading yourself trying to meet an application deadline is a recipe for disaster!* Always feel free to ask me anything about the material, no matter how trivial the question may seem. Trying (!) to answer those "simple" questions often leads to a much greater understanding (or to at least a greater appreciation!) of the subject.

*Take care of the little things, and the big things will take care of themselves.* -- C. S. Lewis

*If you can't simplify it, you don't know what the !\$#\* you're talking about!!* -- A. Einstein (so I was told)

Organic chemistry is a vast field. Practically all of the substances we take for granted around us (and in us!), are composed of compounds of carbon. We continue our exploration of this very large subject in this class. I look forward to working with you this semester!



Steve Dessens  
February 2017



# Format of Laboratory Report

Your laboratory report should be divided into the following sections:

**I. Introduction**

A brief statement of the purpose of the experiment. This is also a good place to show relevant structures and chemical equations.

**II. Experimental Procedure**

A statement of the experimental procedure. Be particular about reporting the amounts of materials used and any modifications made to the original procedure.

**III. Results and Discussion**

This section is the most important. Include observations such as appearance of the reaction, color of product, etc. If the experiment was a preparative one, you should also report your percent yield:

$$\frac{\text{actual yield (in grams)}}{\text{theoretical yield (in grams)}} \times 100\% = \text{percent yield}$$

**Show all of your calculations!** Graphs should be done **on graph paper**.

**Note:** The lab handouts contain a "Data Report Sheet" for each experiment. You should record your results here and include this sheet with your report. The discussion part comes from you! Were your results what you expected? If, not, can you suggest reasons why not? If you took a melting point of a compound you synthesized, what is the true, or "literature" melting point? How well does your melting point compare? What does your melting point indicate about the purity of your compound? Assume that your reader is not entirely familiar with the experiment, so you need to explain clearly.

**IV. Conclusions**

The Conclusion section consists of your overall evaluation of your results. This is a good place to mention any modifications to the procedure which you feel would improve the outcome of the experiment.

**V. Answers to Exercises**

Exercises appear at the end of each experiment in the laboratory handouts. They consist of "pre-lab" questions, which should be done before the laboratory period, and "post-lab" questions to be answered after the experiment.

You should write your report **in ink**, or type it, using **one side** of the paper only. If you write your report by hand (which is perfectly OK as long as it is neat and legible), use lined paper (not torn out of a spiral notebook!). **Always** use **complete sentences**. Try your best to avoid spelling and grammatical errors. Write your report in **impersonal form**. The words "I" or "we" should **not** appear in your report. The following examples show some incorrect phrases and how they can be revised to avoid the personal form:

☹ **INCORRECT:** I added 10 g of NaCl to ...

☺ **CORRECT:** Ten grams of NaCl were added to ...

☹ **INCORRECT:** You told me that ...

☺ **CORRECT:** The instructor indicated that ...

☹ **INCORRECT:** We determined that ...

☺ **CORRECT:** It was determined that ...

This style of writing may seem awkward sometimes, but this is the proper form for writing reports. You will find it used extensively in articles and research papers in the scientific literature.