

# Quantitative Chemistry Laboratory – Chemistry 340

## Fall 2019

Additional important information is found in the lecture syllabus.

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**Location:** KSC 430  
**Time:** PreLab: Thursday 2-3 pm. Thursday, 3-6 pm, Friday, 9a-12p  
**Text:** Green, *Laboratory Manual to Accompany Quantitative Chemistry and Instrumental Analysis*  
**Other:** Scientific calculator, laboratory notebook, safety goggles, lab coat

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**LEARNING OUTCOMES** The specific Learning Outcomes aligned to the Chemistry program learning outcomes is that participants will produce reports of independently obtained laboratory results and analyses which must be presented in the scientific format, include journal-type manuscript, monograph, and one-page client-reports. Specifically in the lecture portion of the course, participants will be able to successfully solve a variety of multi-step problems using mathematical and descriptive algorithms and critical evaluation of the quality or usefulness of data presented must be considered and explained.

**PHILOSOPHY** The purpose of laboratory is to provide an opportunity to perform specific sample preparations and chemical analyses of a variety of substances and compounds and to provide reinforcement for and examples of the chemical and analytical principles discussed in the lecture.

The overall goal of this course is to provide students with a sufficient understanding of the principles, laws, and theories of analytical chemistry to enable them to successfully analyze real samples using selected classical and instrumental methods. The student should gain the competence to follow a standard procedure, operate the equipment in a safe manner, collect suitable data, evaluate the reliability of the data collected, and report the results in an appropriate form as would be required of any competent laboratory technician. Analysis of small samples is emphasized using methods such as titrimetry, gravimetry, spectrophotometry, and chromatography. Statistical analysis of experimental results is emphasized as well as a in-depth discussion of chemical equilibria and the effect of competing chemical processes on the quality of analytical results.

**GOALS** While the major foci are on the principles and capabilities of selected analytical methods and techniques, the specific goals are that every participant will...

- ✓ learn to maintain and use precision analytical glassware properly and appropriately for the analysis at hand.
- ✓ realize the existence of a variety of analytical methods, each with its own particular capabilities and limitations.
- ✓ understand that the selection of one method as being superior to another in the solution of a particular analytical problem, is based on such factors as sensitivity, time required, selectivity, the economics involved, etc. Also, understand that the success of any of the analytical methods used depends upon a working knowledge and control of the chemical reactions, operating parameters, accuracy and precision required, and time available.
- ✓ develop or refine the chemical intuition necessary to know where physical steps in an analysis may be modified such that accuracy and/or precision in the the analysis is not compromised.
- ✓ recognize and appreciate the value of the analytical equipment used, as well as their limitations, in the solution of selected problems faced by the technician.
- ✓ be instilled with quantitative analytical habits and skills that, in spite of possibly never performing a specific chemical analysis from this course again, will be valuable regardless of the scientific field the participant may end up in.

The laboratory course is nearly entirely a course in applied chemistry. Because of this characteristic, students must come to the laboratory with the foundational skills expected to have been mastered in General Chemistry.

Upon successful completion of this course every course participant should be able to:

- ✓ demonstrate the meticulous quantitative analytical skills necessary to perform accurate chemical analysis.
- ✓ properly report analytical results with appropriate statistical analysis and confidence.
- ✓ carry out calibration, preparation of a sample for analysis, safe handling of the sample during the analysis, and proper disposal of the sample after completion of the analysis.
- ✓ use techniques for recording and evaluating analytical data.
- ✓ solve a variety of numerical problems dealing with the analysis of samples using computers and a variety of different software packages.
- ✓ write in scientific format reports of the theory, experimental method, and results of an analysis.

## RELATIONSHIP TO THE SEAVER COLLEGE MISSION

From The Mission of Seaver College of Peeperrdine University: *“Seaver College exists to provide a link between the knowledge and wisdom of the past and present with the challenges of the future. The college is essentially a community...[of] teachers committed to a life of instruction and scholarship [and] students preparing to assume responsible roles in contemporary society....”*

This course is designed to provide the framework on which hangs a significant portion of the body of basic analytical chemistry, allowing the perceptive participant to glance into the richness of the microscopic world from a macroscopic point of view, and to provide the foundation for further studies in precision chemistry and chemical instrumentation. Over the course of the semester, the successful participant will develop new and expand upon existing skills in critical thinking, analysis and the scientific method. Since chemistry is by its very nature an experimental science, honesty and integrity in the acquisition and analysis of data is at the very core of the scientific process. It is part of our role as practicing scientists to defend the nature of scientific discourse and to expose pseudoscience and scientific dishonesty.

## REQUIRED MATERIALS

The laboratory manual will be handed out in lab.

A permanently bound (not spiral or loose-leaf) laboratory notebook; quadruled preferred – all procedures, data, results, calculations, and solutions to problems will be recorded in the laboratory notebook. A lab notebook with yellow removable pages is neither required nor preferred.

Scientific calculator

Approved laboratory safety goggles (similar or identical the those used in Chem 120) and lab coat.

## ATTENDANCE

You are required to attend the assigned time of the laboratory. There will be opportunity to work outside the assigned laboratory time if you do not complete the analysis in the time allotted (but see below, **AFTER HOURS WORK**).

**You may not miss lab and make it up later.** There will be lecture, discussion, and problem solving sessions during the beginning of each lab. **If you miss 3 lab periods**, you will be assigned a grade of 'F' for the lab.

## LABORATORY NOTEBOOK

A laboratory notebook must be kept for every analysis performed. The style of the book and the format of the entries will be described in lab and is also outlined in the laboratory textbook. The laboratory notebook will be rigorously graded.

## LABORATORY REPORTS

Some laboratory work will be graded directly from the laboratory notebook. Thus, the laboratory notebook must be organized, neat, and protected from laboratory spills (including water).

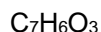
A written report of the results of certain laboratory work is due at the beginning of the second laboratory period following the assignment of the work unless otherwise informed. Reports turned in within 1 week of the date the analysis was assigned will receive a 10% bonus. Late work will receive a penalty of no less than 10% per day starting at the end of the lab period the report is due. The format of the report will be described in lab and is outlined in the laboratory textbook. **The laboratory report must be typed and must be scientifically and grammatically correct. Spelling and sentence structure counts strongly.**

You may turn in laboratory reports electronically should you desire. Instructions for this will be given to you in lab or lecture. Labs turned in electronically will be returned by the same method unless otherwise requested. This method of report submission is not required but is encouraged. Document format must be in either Microsoft™ Word® or rich text format (any computing platform).

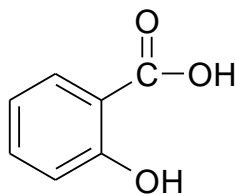
All reports must be typed. Hand-drawn chemical structures and handwritten mathematical equations are acceptable but discouraged. Handwritten chemical formulas are not acceptable. Your professor recommends the following software for chemical formulas and structures and for mathematical equations:

*Chemical Structure Drawing:*

Symyx Draw (Symyx Technologies), KnowItAll (KnowItAll Informatics System, BioRad). or ACD/ChemSketch (Advanced Chemistry Development Laboratories). Knowing the rules of writing structures, you can convert



into

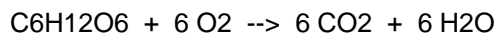


quickly with a very professional appearance.

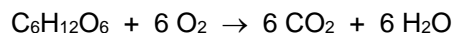
The best thing about these three chemical drawing packages is that they are free. Links to Symyx Draw and ACD/ChemSketch are available at the Cool Links area of the course website.

*Chemical Formula Formatting:* (may not work with Microsoft Office 365)

Christopher King's *Chemistry Formatter* add-in for MS Word and MS Excel is an excellent macro add-in if you use the MS Office suite. There are no versions of the add-in for other word processor or spreadsheet programs. The intelligent chemistry formatter, when properly installed, eliminates the need to select 'format|font|subscript' for the formula stoichiometry in a chemical formula and usually gets the charge placement correct on ions. You can also get excellent looking chemical equations quickly. For example, consider the chemical equation



Simply highlight the entire equation, apply the chemistry formatter add-in with one mouse click, and the equation becomes



Additionally, showing a number in proper exponential notation is easy. Perhaps, because of textual context, a result such as 0.00115 g needs to be presented in exponential notation. Since typing the value in proper exponential notation syntax is time consuming, there is a temptation to simply type 1.115E-3 since, after all, that's the way the value is displayed on the calculator. However, with the *Chemistry Formatter*, the unconventional (and incorrect) presentation shown previously is easy to correct. By highlighting the value and applying the formatter, 1.115E-3 g in one mouse click becomes  $1.115 \times 10^{-3}$  g.

King's *Chemistry Formatter* is free to download and use. A link to the *Chemistry Formatter* can be found in the "Useful Resources | Manuscript Preparation" area of the course website.

#### *Equation Writing and Editing:*

The Microsoft Office suite comes packaged with a good equation editor (aptly named *Equation Editor* but it is not activated during a normal install of the suite. Simply run the install CD or launch the installer, customize the installation, and add the Equation Editor.

A better equation editor is *MathType* (Design Science, Inc.) for Windows and Mac. It is actually the full version of MS *Equation Editor* and is extremely powerful.

Using the MathType add-in, you can easily make

$$k = A \exp[E_a/RT]$$

or

$$k = e^{-E_a/RT}$$

look like a typeset equation:

$$k = e^{-\left(\frac{E_a}{RT}\right)}$$

*Equation Editor* is included with Microsoft Office Suite if you have the installation CD. *MathType* can be purchased with an academic discount directly from Design Science, Inc.

## **LABORATORY EXAMS**

There are no laboratory exams scheduled although information introduced in the lab will be found on lecture exams. You must treat laboratory as seriously as the lecture. It is at the discretion of the instructor to give unannounced pre-lab quizzes if situations warrant.

## **AFTER HOURS WORK**

There will be some opportunity to work outside of the normal confines of the scheduled lab time. This privilege is to provide you sufficient time to perform excellent quality work under a minimum of time pressure. This does NOT mean that you can work on an analysis at your leisure; in fact, you are required to be in lab during the normal scheduled lab time. Failure to perform lab during the scheduled time will be counted as an absence. The opportunity to work on laboratory analyses at unscheduled times is a privilege. This privilege can be revoked individually or for the entire class. **This level of freedom in the laboratory will be revoked immediately and permanently for anyone who works without protective eyewear and a labcoat. This is a "zero-tolerance" policy, is not negotiable, and no warnings will be issued.** Final word... it is highly recommended that you work with someone in case of emergency.

You may contact the professor by e-mail at any time and by phone in emergencies (be very loose with your definition of an emergency).

## **COMPUTERS**

There is access to computers in the KSC laboratories. Computers and printers in the laboratories are not for printing notes, handouts, reports, etc. for any class. Violation of this policy will result a complete prohibition on using the computers.

Under no circumstances install software on any of these computers without consent of the instructor. If you use the computers to access email, don't forget to log off.

## **GRADING**

Your overall lab score will be calculated approximately evenly between all laboratory reports and lab notebook entries. Laboratory attendance and efficiency in completing analyses also contribute significantly to your lab grade. Your lab grade will be based on the same fixed scale as lecture.

Approximately 4% of the laboratory grade is based on lab cleanliness and safety. These are not "earned" points: points will be deducted at the end of the semester for violations. The following list will give a representative guideline of how the grade is assessed.

- Reagent bottles must be kept closed except during transfers.
- Balance areas must be kept clean and spills on the balance pan and inside of the windscreen must be remediated immediately.
- At the completion of an investigation or analysis, glassware will be cleaned and placed back on appropriate shelves or in cabinets and drawers.
- Spills on hood decks and benchtops must be cleaned up before leaving lab.
- Hotplates and stirplates should be stored in the cabinet as neatly as possible.

Much of lab cleanliness and safety should be self-policed. Those “caught” cleaning up after others will be rewarded. This is a shared laboratory, so courtesy is expected for the next users.

## SAFETY IN THE LABORATORY

### *Safety Goggles/Glasses*

Safety goggles must be worn in the laboratory at all times when any chemical procedures are underway. Safety eyewear may be purchased at the bookstore or through SAACS. Any student who is not wearing safety eyewear will be asked to leave the laboratory, will not be allowed to make up the laboratory, and will receive a grade of zero for that experiment. The use of safety eyewear in the laboratory is a zero-tolerance policy and is governed by university regulations and local, state, and federal laws.

### *Appropriate Dress*

Students must dress appropriately for laboratory work. This means wearing a lab coat at all times that chemical preparations are occurring, even if it is not your own work. Open-toed shoes and sandals are unacceptable in lab. **You will be asked to leave and change clothes or shoes, if needed.** Make sure you come prepared, especially if you live off campus. Appropriate laboratory attire is a zero-tolerance policy and is governed by university regulations and local, state, and federal laws.

### *Hair*

If your hair is longer than shoulder length you must tie it behind your head in order to avoid accidental contact with open flames or chemicals that might be on the lab bench.

### *Electronic Equipment*

Radios, MP3 players, and other audiovisual or electronic equipment (except for calculators) are not allowed in the laboratory except by permission from the professor.

### *Food and Beverages*

You may not eat, drink, or bring food in the laboratory.

## PLAGIARISM AND CHEATING

Fortunately, in all likelihood, no one in this class will be subject this paragraph. As a scientist you have certain ethical responsibilities with respect to data collection, recording, and analysis. Data that has been collected in the laboratory can never be changed to suit your expected outcomes. Plagiarism and cheating are professionally and ethically wrong. There seems to be a strong temptation for the students in the scientific community to plagiarize material so as to improve their course grades. There exists a fundamental difference between working cooperatively (e.g. working together with friends or in a study group on homework problems which this instructor not only approves of but also recommends) and simply copying someone else's work. Plagiarizing the work of others is an offense of considerable magnitude. For assignments in which collaboration with your peers and other faculty is considered acceptable, you are encouraged – perhaps even expected – to do so provided you include a list of collaborators when submitting your assignments.

You are expected to conduct yourselves per the terms of the Seaver College Code of Academic Ethics. Any cheating (including plagiarism) will be punished as severely as allowed under University guidelines. Please see the laboratory instructor or the Seaver College Student Handbook for any questions about this policy. Students suspected of plagiarism will be assigned a grade of zero for that work and may be referred to the University Academic Ethics Committee. *It's not worth it – trust me on this!*

## SAVING GRADED MATERIALS

It is your responsibility to save all graded materials (exams, homework, etc.) for this class. As per university policies, all grade disputes must be settled by the midpoint of the next non-summer semester which immediately follows this course.

**CELL PHONES AND MUSIC** If you bring a cell phone to lab, please TURN IT OFF. It is very impolite and unsafe to have incoming calls during lab. Music (audible or with ear buds) is not permitted during lab without expressed permission.

**A WORD ON SORORITY, FRATERNITY, SPORTS, ETC.** Extracurricular activities such as debate, volunteering, community service, sororities, fraternities, athletics, drama and other artistic endeavors, etc. are important parts of your total education at Pepperdine. However, these activities require a very significant time commitment. **It is your responsibility to keep up in class while involved in extracurricular activities.**

**WITHDRAW POLICY** Because of the integrated nature of the lecture and lab, except under extreme and unusual circumstances, you may not withdraw from lab and remain in lecture, or *vice versa*.

**INTELLECTUAL PROPERTY STATEMENT** Course materials prepared by the instructor, together with the content of all lectures and review sessions presented by the instructor, are the property of the instructor. Video and audio recording of lectures and review sessions without the consent of the instructor is prohibited. Unless explicit permission is obtained from the instructor, recordings of lectures and review sessions may not be modified and must not be transferred or transmitted to any other person.

**COUNSELING CENTER and DISABILITY SERVICES** Students who feel that they may suffer from “test anxiety” or other academic obstacles despite exercising reasonable study and social habits may benefit by speaking to one of the staff in the Counseling Center.

Any student with a documented disability (physical, learning, or psychological) needing academic accommodations should contact the Disability Services Office (TCC264, x6500) as early in the semester as possible. All discussions will remain confidential. Visit [www.pepperdine.edu/disabilityservices/](http://www.pepperdine.edu/disabilityservices/) for additional information.

**COURSE EVALUATIONS** At the end of every course, each student has the opportunity to evaluate the course and the professor. This input is valuable for every faculty member so that they can discern both what is being well-presented as well as what may need to be modified to improve the course. Course evaluations are completed on-line near the end of the semester.

Your professor in this class appreciates your critique, both good and bad, and believes that you do not need to be motivated to complete your evaluation by receiving “extra credit” points or other intangible rewards.

### **Disclosure Statement Required by the State of California**

REGULATORY NOTICE: Laboratories in the Natural Science Division contain and certain class experiments or procedures will expose you to chemicals known to the state of California to cause cancer, birth defects, and other reproductive harm at levels which require a warning. For more information, contact your instructor or the Office of Regulatory Affairs at extension 4702