

**Chemistry 222 - Introduction to Quantitative Analysis  
Spring 2021**

**I. General Information**

Instructor:

**Dr. Brian Lamp**

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<http://blamp.sites.truman.edu/>

Schedule:

Lecture	MWF	8:30-9:20 AM	MG2007
Laboratory	Th	1:30-5:20 PM	MG1030

Office Hours:

Office hours are posted outside Dr. Lamp's office and on his website. If you are unable to meet during these hours, please arrange a time IN ADVANCE.

Required Text(s):

"*Quantitative Chemical Analysis*", 8<sup>th</sup> Edition, D. C. Harris, Freeman, New York, NY, 2011. **Also required:** One semester access to [Sapling Learning Online Homework](#)

Laboratory Manual:

"*CHEM 222 Laboratory Manual*" is available online at <http://chemlab.truman.edu/quantitative-analysis/>

Laboratory Notebook:

A permanently bound laboratory notebook capable of creating duplicate pages *is required*.

Other Materials:

All students will be required to purchase departmental approved *safety goggles* for use in the laboratory. Students must have a *hand-held scientific calculator* for use on homework problems, labs, and exams. It will be assumed that you have a calculator for all quizzes and exams

Course Objectives:

- Explore fundamentals of chemical analysis.
- Develop problem-solving skills in chemical equilibrium and chemical analysis.
- Develop laboratory skills necessary to produce reliable analytical results.
- Hone data interpretation and analysis skills.

Important Advice:

Your success in this, or any course, is directly related to the effort you put forth as you move through the semester. Procrastination and inefficient study habits are two of the primary reasons students struggle in their courses. *Develop a good study plan and stick with it and you will find yourself a much happier and more successful student!*

Time Expectation:

The minimum investment of time by the average Truman student necessary to achieve the learning goals in this course are typically not less two hours of out of class student work each week per lecture hour. This time is spent working problems, reading and preparing for lecture, and studying for exams and quizzes. An additional four hours per week is typically used for preparing for lab and writing lab notebooks and lab reports. This estimate for an average student may have weekly variations.

Academic Integrity:

Students are expected to abide by the Truman State University Student Conduct Code and complete their coursework, including exams and laboratories using their original words and ideas and properly cite the words and ideas of others.

The General Catalog states:

*Students are expected to do their own academic work. Any student involved in cheating on a paper, an examination or in any other form of academic dishonesty is subject to disciplinary action, including suspension or expulsion from the class, the student's academic program, or the University.*

Serious cases of academic dishonesty are reported by the faculty member to his or her Department Chair and to his or her Dean, who may take additional disciplinary action against the dishonest student, including suspension or expulsion from classes in the School. The Dean reports the dishonesty to the Vice President for Academic Affairs, who may also report it to the Vice President for Student Affairs. The Dean may also report the dishonesty to the School in which the dishonest student is enrolled as a

major; the Dean of this School may suspend or expel the student from the academic program in the major. The Dean of Students may also suspend or expel the student from the University as outlined in the Student Conduct Code for incidents of academic dishonesty.

More information can be found in the General Catalog ([http://catalog.truman.edu/content.php?catoid=19&navoid=1063#Academic Dishonesty](http://catalog.truman.edu/content.php?catoid=19&navoid=1063#Academic_Dishonesty)) and the Student Conduct Code Section 8.050.1 (<http://policies.truman.edu/policylibrary/student-conduct-code/>).

Disability Services:

To obtain disability-related academic accommodations students with documented disabilities must contact the course instructor and the Office of Student Access and Disability Services (OSA) as soon as possible. Truman complies with ADA requirements. For additional information, refer to the Office of Student Access and Disability Services website at <http://disabilityservices.truman.edu/>. You may also contact OSA by phone at (660) 785-4478 or email [studentaccess@truman.edu](mailto:studentaccess@truman.edu)

Mobile Devices:

**Unless you are an emergency responder, all cell phones and electronic devices must be silenced and stored while in lecture.** Failure to do so will result in dismissal from the class session (this includes exams). This policy includes texting.

Emergency Procedures:

In each classroom on campus, there is a poster of emergency procedures explaining best practices in the event of an active shooter/hostile intruder, fire, severe weather, bomb threat, power outage, and medical emergency. This poster is also available as a PDF at this link: <http://police.truman.edu/files/2015/12/Emergency-Procedures.pdf> .



Students should be aware of the classroom environment and note the exits for the room and building. For more detailed information about emergency procedures, please consult the Emergency Guide for Academic Buildings:

<http://police.truman.edu/emergency-procedures/academic-buildings/>

This six-minute video provides some basic information on how to react in the event there is an active shooter in your location: <http://police.truman.edu/emergency-procedures/active-shooter/active-shooter-preparedness-video/>

Truman students, faculty, and staff can sign up for the TruAlert emergency text messaging service via TruView. TruAlert sends a text message to all enrolled cell phones in the event of an emergency at the University. To register, sign in to TruView and click on the “Truman” tab. Click on the registration link in the lower right of the page under the “Update and View My Personal Information” channel on the “Emergency Text Messaging” or “Update Emergency Text Messaging Information” link. During a campus emergency, information will also be posted on the TruAlert website <http://trualert.truman.edu/>.

Attendance etc.:

It is expected that everyone will attend class and participate. A seating chart will be used and roll will be taken daily to assist in contact tracing. Students with sanctioned absences will not be penalized for being absent, but will be expected to make up any missed work within a reasonable length of time. The professor reserves the right to deem additional absences as unsanctioned once a student has missed 6.67% of class time for sanctioned absences. A list of sanctioned absences can be found in the General Catalog (see link below). For an absence to be sanctioned, students must notify the professor of scheduled absences during the free add/drop period and as soon as possible for any other absences. Students should also provide the faculty member with written notification of the absence. Arrangements for making up work should be made prior to the absence. If the absence is unexpected, the student must arrange to make up the missed work as soon as possible. Students must realize that making up missed laboratory experiments is very challenging and may not be logistically possible in all instances. The complete Truman Attendance Policy can be found in the General Catalog (click on “Attendance Policy”):

[http://catalog.truman.edu/content.php?catoid=19&navoid=1063#Attendance\\_Policy](http://catalog.truman.edu/content.php?catoid=19&navoid=1063#Attendance_Policy)

A special attendance policy for Spring 2021 was approved by Faculty Senate (<https://docs.google.com/document/d/1YV4VhH7qthjIU93p7PX0e7WjJDshjB0PVdcR26ivCVI/edit>) The policy states:

- No student having a sanctioned absence shall be penalized for such absence on account solely of being absent. Nothing in this policy is intended to excuse a student from the responsibility to make up missed work within a reasonable length of time.
- No faculty member will require documentation in support of a health-related absence.
- Nevertheless, students are strongly encouraged to attend required in-person or synchronous online class meetings when they can (i.e., they show no signs of illness and have no other sanctioned reason to be absent). Professors are encouraged to provide a clear mechanism for making up missed classes. The mechanism should work to achieve similar learning outcomes to those intended by class attendance, using activities that could involve make-up sessions, watching a recorded video of the class session, or other alternative assignments, according to the format of the course, the length of the absence and the resources available to the student and faculty member.
- In general, no part of a student's final semester grade should be calculated based on attendance. Courses for which interactions are necessary to achieve the learning outcomes of the course (such as courses with a significant laboratory or performance component) may require attendance at some of those course elements not to exceed 50%. In extreme COVID-related circumstances where a student cannot meet even this expectation, the faculty member is advised to issue a grade of incomplete and require the student to fulfill the unmet requirement in a future semester.
- The course's policy must be in the syllabus and communicated with students by the first day of class.
- Courses with field or clinical placements may defer to the attendance policy of the cooperating agencies.

CHEM 222 has a significant hands-on laboratory component that cannot be replicated through other activities, thus meeting the criteria of a course where interactions are necessary to achieve the course outcomes. Therefore, sanctioned absences cannot exceed 50% of the scheduled lab meetings. In cases where sanctioned absences do exceed 50% of the scheduled lab meetings, reasonable attempts will be made to make up lab time to reach this threshold. If this is not feasible, a grade of incomplete will be issued.

FERPA:

Education records are protected by the Family Education Right to Privacy Act (FERPA). As a result, course grades, assignments, advising records, etc. cannot be released to third parties without your permission. There are, however, several exceptions about which you should be aware. For example, education records can be disclosed to employees or offices at Truman who have an "educational need to know". These employees and offices may include your academic advisor, the Institutional Compliance Officer, the Registrar's Office, or Student Affairs depending on the type of information. For more information about FERPA, see <http://www.truman.edu/registrar/ferpa/>.

Title IX:

Truman State University, in compliance with applicable laws and recognizing its deeper commitment to equity, diversity and inclusion which enhances accessibility and promotes excellence in all aspects of the Truman Experience, does not discriminate on the basis of age, color, disability, national origin, race, religion, retaliation, sex (including pregnancy), sexual orientation, or protected veteran status in its programs and activities, including employment, admissions, and educational programs and activities. Faculty and staff are considered "mandated reporters" and therefore are required to report potential violations of the University's Anti-Discrimination Policies to the Institutional Compliance Officer. Title IX prohibits sex harassment, sexual assault, intimate partner violence, stalking and retaliation. Truman State University encourages individuals who believe they may have been impacted by sexual or gender-based discrimination to consult with the

Title IX Coordinator who is available to speak in depth about the resources and options. Faculty and staff are considered “mandated reporters” and therefore are required to report potential incidents of sexual misconduct that they become aware of to the Title IX Coordinator.

For more information on discrimination or Title IX, or to file a complaint contact:

**Dr. Lauri Millot**, Institutional Compliance Officer, Title IX and Section 504  
Coordinator  
Office of Institutional Compliance  
Violette Hall, Room 1308  
100 E. Normal Ave  
Kirksville, MO 63501  
Phone: (660) 785-4354  
[titleix@truman.edu](mailto:titleix@truman.edu)

The institution’s complaint procedure can be viewed at <https://wp-internal.truman.edu/provost/files/2020/11/Truman-State-University-Complaint-Reporting-and-Resolution-Procedure9.2020.pdf> and the complaint form is accessible at <http://titleix.truman.edu/make-a-report/>.

## II. Lecture

### Course Coverage:

The lecture portion of the course will cover the following major topics in analytical chemistry. Assigned readings from the text and problems will be given to parallel the main topics. Listed after each topic are the pertinent chapters in the text and approximate number of lectures planned for each.

<u>Topic</u>	<u># Lect.</u>	<u>Chapters</u>
Introductory Tools and Definitions	3	0,1,2
Quality Assurance/Treatment of Analytical Data	4	3,4,5
Introductory Chemical Equilibrium	4	6,7
Gravimetric Analysis	2	26
Acid-Base Equilibrium and Titrations	6	8,9,10
Complexation Chemistry and EDTA Titrations	3	11
Electrochemistry/Redox/Potentiometry	5	13,14
Spectroscopy	3	17-21
Extraction/Chromatography	3	22-25

### Exams:

Five exams worth a total of 400 points will be given. Four of these exams will be in-class with the fifth composed of a series of longer, out-of-class independently worked problems. **Tentative exam dates are Feb. 10 (W), Mar. 3 (W), March 31 (W), and April 28 (W).** A comprehensive final exam (the ACS Standardized Exam) will be given Friday, May 7 from 7:30-9:20 AM. The final exam will be worth 200 points.

### Homework:

Regular homework assignments will be given. Homework assignments will be graded so that the total contribution to the final grade is a maximum of 200 points.

- Homework has a *significant* impact on your success in the course, not only in terms of its contribution to the total points in the course, but also in terms of preparation for quizzes and exams. Adequate time and consideration should be given to these assignments.
- Not all assignments will be graded.
- Due dates will be announced in advance and will be strictly enforced.
- Reading and homework assignments will be announced at the beginning of class. *The instructor assumes no responsibility for communicating the assignment again for those who are late or miss class.*
- *Failure to complete homework assignments will have a bearing on the consideration of borderline grades at the end of the semester.*

### Quizzes:

The instructor reserves the right to give lecture or laboratory pop quizzes. Quizzes are likely to result from poor lecture and laboratory preparation, unsafe lab practices, or poor course citizenship.

Lecture: The lecture portion of the course will explore and elaborate upon topics presented in the reading. Since the lectures will most certainly contain additional information not present in the reading, attendance is critical.

Make-up Exams: If you cannot attend a scheduled exam for a **valid, instructor-approved reason**, notify the instructor IN ADVANCE and an arrangement may be made. No credit will be given for missed exams or quizzes without prior instructor approval.

## II. Laboratory

Laboratory: A schedule of experiments that will be performed during the semester is provided on Dr. Lamp's website. **Your lab time must be used efficiently in order to finish the experiments by term's end.** Before coming to lab you must familiarize yourself with the theory, techniques, safety precautions, and instrumentation for the experiment. It is essential to have your experimental procedure outlined thoroughly and data tables set up BEFORE coming to lab. Plan ahead and note what needs to be done to prepare for the next experiment. For example, solid samples may need to be dried prior to use and solutions prepared prior to performing the experiment. Failure to consider these tasks will delay your ability to start the experiment as you had planned.

Lab Grading: Lab performance has a major bearing on your overall course grade. The three areas listed below contribute to your lab grade.

- A. Unknowns: Since a major focus of a quantitative analysis is the precise and accurate determination of a component or components in a sample, a substantial portion of your lab grade will be derived from the quality of your results for several unknowns. A maximum of 350 points will be awarded based on the accuracy of your analyses.  
*Once an experiment is completed, you have one week (7 days) to turn in an unknown report form or be subject to the penalty described below.*
- B. Lab Notebook: It is important that accurate and comprehensive records be kept when performing an analysis. Therefore, you will be required to keep a bound notebook containing procedural outlines, laboratory data, calculations, graphs, results, and error analysis. Laboratory notebook grades will be worth a maximum of 100 points of your lab grade.  
*Once an experiment is completed, you have one week (7 days) to turn in the laboratory notebook or be subject to the penalty described below.*
- C. Discretionary: 100 points of your lab grade are allotted as discretionary points, which may be awarded in a variety of ways. Pre-lab quizzes, use of proper lab techniques, preparation, understanding of procedures, safety practices, independence, and cleanliness will all be considered. These points may also be used for formal reports and group projects.

Lab Progress Monitoring: As you leave the lab at the end of a session, you must complete and initial the lab log, indicating the status of any experiments under way and the plan for the next lab session. Failure to complete the log will result in a loss of lab discretionary points.

Late Hand-ins: A penalty of 20% per **calendar day** will be assessed for turning in unknown results or notebooks later than the assigned date. After 5 days, a grade of zero will be awarded.

**YOU MUST SUCCESSFULLY PASS THE LABORATORY  
IN ORDER TO PASS THE CLASS!**

#### IV. Grading

<u>Grade point breakdown:</u>	<u>Source</u>	<u>Total Points</u>
	Exams and Quizzes	400 pts. maximum
	Homework	200 pts. maximum
	Project	100 pts. maximum
	Final Exam	200 pts. maximum
	Lab Unknowns	350 pts. maximum
	Lab Notebook	100 pts. maximum
	<u>Lab Discretionary</u>	<u>100 pts. maximum</u>
	Total points	1450 pts. maximum

Grading Scale: Awarding of final class grades will be based on the scale below. Percentages will be computed on the basis of total possible points for the semester.

<u>Grade</u>	<u>Percentage</u>
A	90.0-100
B	80.0-89.9
C	70.0-79.9
D	60.0-69.9
F	<60.0

*The instructor reserves the right to lower the grading scale, but it will never be raised.*  
**REMEMBER:** *You must earn a passing percentage from the laboratory in order to pass the class.*

#### V. Other Information

- Do not procrastinate!!! It will not be possible to complete and understand many of the homework assignments if work on them is delayed until the night before they are due. Your understanding of lecture material, and grades on homework and exams will be adversely affected by this approach. *It is strongly recommended that you work ahead on reading and homework and participate fully in classroom discussions and problem solving sessions.*
- *Above all, remember that the quantitative analysis laboratory is quite different from past chemistry labs you have taken. Cleanliness, time efficiency, attention to detail, and advanced preparation are **critical** in achieving good results in the lab. Sloppy, unprepared, and disorganized work habits will adversely affect your success.*
- Trim the edges of any spiral notebook paper and **staple multiple sheets** prior to submission. Failure to do so will result in a 20% penalty on the assignment.
- All assignments in lab and lecture *must be written legibly and in a well-organized fashion*. If an answer or work cannot easily be interpreted, no credit will be given.
- All mathematical work and assumptions used when solving a problem, whether on homework or exams, *must be shown in order to receive credit for the problem*. Please mark your answers clearly.
- Homework, exam keys, assignments, announcements and various other information can be found on Blackboard or on Dr. Lamp's CHEM 222 web page at <http://blamp.sites.truman.edu/>.

**"One important key to success is self-confidence. An important key to self-confidence is preparation." -Arthur Ashe**

## Lab Notebook Guidelines

Lab notebooks will follow the format described on the Truman ChemLab website at <http://chemlab.truman.edu/the-laboratory-notebook/>. The following modifications and points of emphasis supplement the format described there.

The notebook must be arranged in the following order:

1. **Title:** A brief, descriptive title for the experiment.
2. **Statement of Purpose:** One or two sentences describing the analytical goal(s) for the experiment.
3. **Background:** At a minimum, this section must contain the following:
  - a. A complete reference(s) to the procedure that you are using (website, book, article) following the American Chemical Society formatting guidelines. Examples are below, more examples can be found online:  
**Journal Article:**  
Author, A. A.; Author, B. B.; Author, C. C. Title of Article. *Journal Abbreviation (italics)* **Year (boldface)**, *Volume (italics)*, Pages.  
**Book:**  
Author, A. A.; Author, B. B. *Book Title (italics)*, Edition (if any); Publisher: Place of Publication, Year; Pages.  
**Website:**  
Author, A. A. (if any). Title of Site. Complete URL (accessed date), other identifying information.
  - b. Balanced chemical equations for any chemical reactions.
  - c. Any hazardous properties (flammability, toxicity, etc.) of the substances that you will encounter in the exercise or any potential procedural hazards.
4. **Procedural Outline:** Be sure to leave the right 1/5<sup>th</sup> of the page for procedural modifications. **You do not record your results on the right-hand side!** Results are recorded in the *Results* section.
5. **Data/Results:** Aside from experimental results, this section should include the following:
  - a. The first item in this section **must** be a table providing identifying information for all reagents and instruments used in the lab. It is not necessary to document glassware (pipets, flasks...). For a chemical, include the name of its manufacturer, its purity, catalog number and the lot number, if available. For an instrument (including a balance), include serial number or Truman tag number, model, and manufacturer.
  - b. All filenames for data collected and stored electronically must be recorded.
6. **Calculations:** An example of each calculation performed to reach the final reported answers should be shown with the units clearly shown at each step. Also, a propagation of error calculation must be done to provide an estimate of the precision expected for your experiment. Include the output from any programs used to perform these calculations, and the filename under which the data were saved.
7. **Discussion of Conclusions and Error Analysis:** The key purpose for the discussion section is to present your results and discuss their quality. Are your data reliable? How do you know? What aspects of the experiment contribute to uncertainty in your results? How could you improve your confidence in your data? The discussion should be written in third-person, passive voice with no personal pronouns. *This section must be typed and properly affixed to your notebook pages.*
8. **Summary of Results:** Your summary table must contain the same information that is included on the unknown report form.
  - **Record everything directly in your lab notebook, not on other paper! Students writing on something other than their lab notebook will lose lab discretionary points and may be penalized on their lab notebook grade!!**
  - Don't copy directly from the lab manual, the procedure should be an outline.
  - Avoid blank space. Cross out and initial any large blank spaces.
  - Write your name and a running title for the experiment on the top of each page. Sign and date the bottom of each page as it is completed.
  - Document your calculations in Excel in the event that you or I need to reproduce them.

- Affix printouts to notebook pages with glue or tape (not staples). Do NOT staple printouts to the notebook pages! Adjust print settings and/or trim printouts so that they fit within the constraints of a single page and allow the pre-printed page number to show. **Paper must not hang out over the notebook page!**
- Excel knows nothing about sig figs! Be sure the number of digits displayed in your Excel files or plots is a reasonable reflection of the number of significant digits in the number. You generally have to do this manually.

### Example Lab Notebook Grading Rubric

Notebooks will be graded based on the guide below. Point breakdown will vary, but in all cases, at least 1/3 of the possible points will be allocated to the "Discussion of Conclusions and Error Analysis" section.

Deficiencies are either marked below or noted under the General Comments at the bottom of the page. Additional comments may also appear on the notebook pages.	Possible Points	Earned points
<b>Submitted on Time, Legible and Complete.</b>		
<p><b><u>General Format and Content</u></b></p> <p><b>Title:</b></p> <p><b>Statement of Purpose:</b></p> <ul style="list-style-type: none"> <li>-Clearly and concisely described the purpose of the experiment.</li> <li>-Used complete sentences.</li> </ul> <p><b>Background:</b></p> <ul style="list-style-type: none"> <li>-Included balanced chemical reactions.</li> <li>-Included hazard information for reagents and procedure.</li> <li>-Included reference(s) to the source for the experimental procedure.</li> </ul> <p><b>Procedural Outline:</b></p> <ul style="list-style-type: none"> <li>-Included working OUTLINE of the procedure for the experiment.</li> <li>-Written in your own words.</li> <li>-Left room for modifications.</li> </ul> <p><b>Data:</b></p> <ul style="list-style-type: none"> <li>-All pertinent data recorded, tables used when appropriate.</li> <li>-Section is separate from Procedural Outline.</li> <li>-Documents instruments, reagents, etc.</li> </ul> <p><b>Calculations:</b></p> <ul style="list-style-type: none"> <li>-An example of each calculation performed is shown.</li> <li>-A propagation of error analysis is shown.</li> <li>-Appropriate units are used. All graphs are annotated appropriately</li> <li>-Spreadsheet calculations are documented, including filenames.</li> <li>-All printouts affixed to notebook pages.</li> </ul>		
<p><b>Discussion of Conclusions and Error Analysis:</b></p> <ul style="list-style-type: none"> <li>-Discusses numerical results, including confidence limits.</li> <li>-Presents an analysis of results and discussion of error sources.</li> <li>-Compares experimentally determined uncertainty to expected propagated error.</li> <li>-Suggests specific sources of error, and potential solutions.</li> <li>-Written in third-person, passive voice with no personal pronouns.</li> <li>-Written well, uses complete sentences, minimal spelling and grammar errors.</li> <li>-Includes Summary Table.</li> </ul>		
<b>Total</b>		