

**Chemistry 222 - Introduction to Quantitative Analysis
Spring 2016**

I. General Information

Instructor:

Dr. Brian Lamp

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

Schedule:

| | | | |
|-----------------------|-----|---------------|--------|
| Lecture | MWF | 8:30-9:20 AM | MG1098 |
| Laboratory Section 01 | T | 8:30-12:20 AM | MG1030 |
| Laboratory Section 02 | T | 1:30-5:20 PM | MG1030 |

Required
Text(s):

"*Quantitative Chemical Analysis*", Eighth Edition, D. C. Harris, Freeman, New York, NY, 2011. Text website: <http://bcs.whfreeman.com/gca8e/>

Also required: One semester access to [Sapling Learning Online Homework](#)

Laboratory
Manual:

"*CHEM 222 Laboratory Manual*" is available online at <http://chemlab.truman.edu/CHEM222manual/contents.asp>

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. The instructor will not loan calculators to students who have none.

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.

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.

Special
Needs:

Any student who has a disability that may prevent him/her from fully participating in the class activities must contact the Student Disability Services Office immediately to ensure that your needs are properly met. If no contact is made, no concessions will be considered.

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. Students caught committing an act of academic misconduct will be subject to the full range of penalties, including failing the course. In every case, the Dean of Student Affairs office and the Provost and Vice President for Academic Affairs will be notified.

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.

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. 2 (W), Mar. 30 (W), and Apr. 27 (W).** A comprehensive final exam (the American Chemical Society Standardized Exam) will be given Friday, May 6 from 7:30-9:20 AM. The final exam will be worth 200 points.

Homework:

Regular homework assignments will be given. These assignments will be graded so that the total contribution to the final grade is a maximum of 250 points. A special project announced early in the semester will also count toward the homework grade.

- 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.
- Late assignments will not be accepted. 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 turn in 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. *As a result, lecture attendance will play a role in borderline grade assignments.*

Make-up Exams:

No make-up exams or quizzes will be given. If you cannot attend a scheduled exam for a **valid, instructor-approved reason**, notify the instructor IN ADVANCE and an arrangement may be made. **Any exams missed due to illness must be verified with a doctor's or health center note prior to scheduling any make-up.** 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 accuracy and precision of your results for several unknowns. A total 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 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 | 250 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 | 1400 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/Notebook_Files/LabNotebook.asp. 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 1/5th 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.

Other important considerations:

- **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 is a reasonable reflection of the number of significant digits in the number. You may 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 |
|---|-----------------|---------------|
| Submitted on Time, Legible and Complete. | | |
| <u>General Format and Content</u> Title: Statement of Purpose: <ul style="list-style-type: none"> -Clearly and concisely described the purpose of the experiment. -Used complete sentences. Background: <ul style="list-style-type: none"> -Included balanced chemical reactions. -Included hazard information for reagents and procedure. -Included reference(s) to the source for the experimental procedure. Procedural Outline: <ul style="list-style-type: none"> -Included working OUTLINE of the procedure for the experiment. -Written in your own words. -Left room for modifications. Data: <ul style="list-style-type: none"> -All pertinent data recorded, tables used when appropriate. -Section is separate from Procedural Outline. -Documents instruments, reagents, etc. Calculations: <ul style="list-style-type: none"> -An example of each calculation performed is shown. -A propagation of error analysis is shown. -Appropriate units are used. All graphs are annotated appropriately -Spreadsheet calculations are documented, including filenames. -All printouts affixed to notebook pages. | | |
| Discussion of Conclusions and Error Analysis: <ul style="list-style-type: none"> -Discusses numerical results, including confidence limits. -Presents an analysis of results and discussion of error sources. -Compares experimentally determined uncertainty to expected propagated error. -Suggests specific sources of error, and potential solutions. -Written well, uses complete sentences, minimal spelling and grammar errors. -Includes Summary Table. | | |
| Total | | |

General Comments