Instructor: Dr. David Carter
Office hours: Tu 2:30-4 pm; W 8-9:30, Th 9:30-11:00, or by appointment
Office: CAV 218 Office Phone: 486-6626
email: david.carter@angelo.edu Course web site: Blackboard1
Class times: MWF 11-11:50 A.M. CAV 223 Lab: Thursday 2-4:50 P.M., CAV 206/211

Texts: REQUIRED EBook/Online Homework
These will be available in and accessed through Blackboard.
The cost will be $99.99.
Optional hard copy book options: textbook can be purchased in same edition, but older editions are significantly less expensive and will work well if you have the ebook.
Supplemental Text: “Analytical Chemistry 2.1”2, David Harvey, 2008 (Available online).

Other Materials: The Official Laboratory Research Notebook Safety Goggles

Learning Outcomes
1. Survey fundamental methods of Quantitative Analysis. (1a)*
2. Develop an awareness of the fundamental steps required to perform a quantitative chemical analysis and an understanding of the role that each step plays, its importance and its logical place in the sequence of steps that comprise a chemical analysis. (3a)
3. Develop an understanding of the application of chemical equilibrium to quantitative analysis in order that students may assess the feasibility of a method and be able to troubleshoot analytical methods. Students should understand analytical methods from an equilibrium perspective. (1a,2b,c)
4. Use the principles or stoichiometry and dimensional analysis to do the computations necessary to convert the data of a chemical analysis into meaningful quantitative information. (2b, 3a)
5. Learn how to use statistical methods in data analysis to estimate the precision and accuracy of analytical results. (2a)
6. Develop physical laboratory skills needed to perform precise and accurate quantitative analyses. (3b)
7. Understand the importance of the application of quantitative chemical analysis to other sciences and that the principles learned in this course are essential to the quality of experimental work done in other science disciplines. (4a,2c)
8. Improve student ability to plan, implement, record, and report experimental work effectively. (2a)
9. Train students to use spreadsheets for a wide range of scientific calculations. (2d)
10. Develop insight into the selection of lab equipment required to attain desired levels of precision and accuracy in measurements. Students should be able to select equipment appropriate for a given level of accuracy and precision. (3b)
11. Students should be familiar with methods of standardization and calibration required to achieve required levels of accuracy and will be introduced to the concept and application of quality control in analytical measurements. (3b)
12. Develop working knowledge of acid-base, precipitation, complexation & redox reactions. (2a,3b)
13. Students will be introduced to principles of working safely with chemicals in the laboratory and chemical hygiene. (3b)

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1 http://blackboard.angelo.edu
2 http://dpuadweb.depauw.edu/harvey_web/eTextProject/version_2.1.html
Evaluation of Student Learning Outcomes
Student learning outcomes will be evaluated by test questions and by the grading of lab notebook, reports and other assignments. Number-letter notations in parentheses after each objective refer to the Student Learning Objectives of the Department of Chemistry and Biochemistry. These are available in the Course Information section of Blackboard.

Grading

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>200pts</td>
</tr>
<tr>
<td>Class Participation</td>
<td>50pts</td>
</tr>
<tr>
<td>Exams (3 X 100 pts ea.)</td>
<td>300pts</td>
</tr>
<tr>
<td>Lab</td>
<td>450pts</td>
</tr>
<tr>
<td>Final Exam</td>
<td>200pts</td>
</tr>
<tr>
<td>Total</td>
<td>1200pts</td>
</tr>
</tbody>
</table>

Grace Scale: A = 88 to 100%; B = 76 to 87.9%; C = 64 to 75.9%; D = 54-63.9%; F ≤ 53.9%

Student Responsibilities
1. Attendance. Class attendance is expected. The student is responsible for making-up any work missed due to absence from class. The student will only be permitted to make up missed work under the following conditions:
   a. Unavoidable emergency absences (illness, death in the immediate family, etc.): you must contact me during or before the class immediately following the absence with a valid, verifiable excuse.
   b. Planned absences: you must get my approval make arrangements to make up missed work prior to the absence. The reason for the absence should warrant missing class to get my approval; participation in University sponsored events falls in this category.
   c. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence.
2. Class Preparation. Read each reading assignment before it is covered in class; come to class prepared to discuss the material. Contribute to in-class discussions of the material.
3. Homework and Quizzes. Do all assigned homework problems whether they are graded or not. During the class that immediately follows the giving of an assignment, you may take the opportunity to ask questions of that assignment at the start of the class. After they are graded or discussed in class, make sure you understand them. Quizzes may not be announced. When they are unannounced, they may be over the two most recent homework assignments or over the last two lectures. Therefore, it is to your advantage to get an early start on each assignment and to review your class notes daily.
4. Exams. Demonstrate your knowledge and understanding of the material covered on exams. All exams are cumulative; however, regular exams will predominantly (> 90% of exam) cover material covered since the last exam. 60% of the Final Exam will be material covered since Exam 3, and 40% will cover material already covered on previous exams.
5. Exams cannot be made-up, except in the following circumstances:
   a. Previous arrangements are made with me
   b. Serious illness (note from a physician, etc. required)
   c. Death in the immediate family
6. Laboratory. Laboratory work is an essential part of a science course. Students should make every effort to participate fully in the laboratory experience. Material from lab experiments may be covered on lecture exams.
7. Show all work when doing mathematical problems on the homework, tests and in lab.
8. All numerical answers must be written with the correct number of significant digits and appropriate units.
Laboratory Assignment Grading

Grading of laboratory assignments will be based on three criteria: lab report (notebook), accuracy and precision. The number of points varies for each of these as a function of the laboratory. For example: some of the methods used should yield accuracies within 1 part per thousand (1 ppt or 0.1%) of the correct value. The number of points given for accuracy in these labs will be higher than other labs. Some labs are more qualitative in nature and more points will then be given for the lab report. The points assigned for each lab are given below.

<table>
<thead>
<tr>
<th>Lab</th>
<th>Accuracy Pts</th>
<th>Precision Pts</th>
<th>Report Pts</th>
<th>Total Pts</th>
</tr>
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<tbody>
<tr>
<td>Excel Intro</td>
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<td>10</td>
<td>10</td>
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<tr>
<td>Buret reading stats</td>
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<td>10</td>
<td>10</td>
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<tr>
<td>Penny mass stats</td>
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<td>10</td>
<td>30</td>
<td>40</td>
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<tr>
<td>Pipet Calibration</td>
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<td>10</td>
<td>20</td>
<td>30</td>
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<tr>
<td>NaOH Standardization</td>
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<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>KHP Unknowns</td>
<td>50</td>
<td>10</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>HCl Standardization</td>
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<td>10</td>
<td>10</td>
<td>20</td>
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<tr>
<td>Water Analysis - Alkalinity</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>20</td>
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<tr>
<td>Experimental Acid-Base Titration Curves</td>
<td>5</td>
<td>5</td>
<td>30</td>
<td>40</td>
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<tr>
<td>Calculated Acid Base Titration Curves</td>
<td>HCl vs NaOH</td>
<td>10</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>KHP vs NaOH</td>
<td>15</td>
<td></td>
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<tr>
<td>Redox Titration</td>
<td>Standarize KMnO₄</td>
<td>0 10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Oxalate Unknown</td>
<td>50</td>
<td>10</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>Mn in steel</td>
<td>10</td>
<td>5</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>Calib. Curve Stats Spreadsheet*</td>
<td>5</td>
<td>15</td>
<td>20</td>
<td></td>
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<tr>
<td>Calc'd Redox Titration Curve</td>
<td>20</td>
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<tr>
<td>Ion Selective Electrodes</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>Instructor Eval:</td>
<td>Technique/ Safety/Notebook,</td>
<td></td>
<td>35</td>
<td></td>
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</tbody>
</table>

TOTAL 160 105 255 530**

Proposed Study/Lab schedules will be updated in class and Blackboard as needed.

** Out of 450 points, actual total depends on time allowed. **
General Policies Related to All Courses
All students are required to follow the policies and procedures presented in these documents:

Angelo State University Student Handbook¹
Angelo State University Catalog²

Academic Integrity
Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject to disciplinary action and possible expulsion from ASU.
The College of Science and Engineering adheres to the university’s Statement of Academic Integrity.³

Accommodations for Students with Disabilities
ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA) and subsequent legislation.

Student Disability Services is located in the Office of Student Affairs, and is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability. It is the student’s responsibility to initiate such a request by contacting an employee of the Office of Student Affairs, in the Houston Harte University Center, Room 112, or contacting the department via email at ADA@angelo.edu. For more information about the application process and requirements, visit the Student Disability Services website.⁴ The employee charged with the responsibility of reviewing and authorizing accommodation requests is:

Dallas Swafford
Director of Student Disability Services
Office of Student Affairs
325-942-2047 dallas.swafford@angelo.edu
Houston Harte University Center, Room 112

Virtual communication
Office hours and/or advising may be done with the assistance of the telephone, Collaborate, Skype, etc.

Incomplete Grade Policy
It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 Grading Procedures⁵ for more information.

Plagiarism
Plagiarism is a serious topic covered in ASU’s Academic Integrity policy⁶ in the Student Handbook. Plagiarism is the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality. Resources to help you understand this policy better are available at the ASU Writing Center.⁷
Student Absence for Observance of Religious Holy Days
A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day for more information.

Title IX Statement
Angelo State University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from sex discrimination of any kind. In accordance with Title VII, Title IX, the Violence Against Women Act (VAWA), the Campus Sexual Violence Elimination Act (SaVE), and other federal and state laws, the University prohibits discrimination based on sex, which includes pregnancy, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination and unwelcome behavior of a sexual nature. The term includes sexual harassment, nonconsensual sexual contact, nonconsensual sexual intercourse, sexual assault, sexual exploitation, stalking, public indecency, interpersonal violence (domestic violence or dating violence), sexual violence, and any other misconduct based on sex.

You are encouraged to report any incidents involving sexual misconduct to the Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator, Michelle Boone, J.D. You may submit reports in the following manner:
Online: [www.angelo.edu/incident-form](http://www.angelo.edu/incident-form)
Face to Face: Mayer Administration Building, Room 210
Phone: 325-942-2022
Email: michelle.boone@angelo.edu

Note, as a faculty member at Angelo State, I am a mandatory reporter and must report incidents involving sexual misconduct to the Title IX Coordinator. Should you wish to speak to someone in confidence about an issue, you may contact the University Counseling Center (325-942-2371), the 24-Hour Crisis Helpline (325-486-6345), or the University Health Clinic (325-942-2171).

For more information about resources related to sexual misconduct, Title IX, or Angelo State's policy please visit: [www.angelo.edu/title-ix](http://www.angelo.edu/title-ix).

Required Use of Masks/Facial Coverings
As a member of the Texas Tech University System, Angelo State University has adopted the mandatory Facial Covering Policy to ensure a safe and healthy classroom experience. Current research on the COVID-19 virus suggests there is a significant reduction in the potential for transmission of the virus from person to person by wearing a mask/facial covering that covers the nose and mouth areas. Therefore, in compliance with the university policy students in this class are required to wear a mask/facial covering before, during, and after class. Faculty members may also ask you to display your daily screening badge as a prerequisite to enter the classroom. You are also asked to maintain safe distancing practices to the best of your ability. For the safety of everyone, any student not appropriately wearing a mask/facial covering will be asked to leave the classroom immediately. The student will be responsible to make up any missed class content or work. Continued non-compliance with the Texas Tech University System Policy may result in disciplinary action through the Office of Student Conduct.

Modifications to the Syllabus
This syllabus, including grade evaluation and course schedule, is subject to modification. In particular, the COVID-19 pandemic may require significant changes in course delivery and content on potentially short notice.

Last Day to Drop course with grade of "W": is Tues, Nov.10, 2020.
### Proposed Study Schedule

<table>
<thead>
<tr>
<th>Wk #</th>
<th>Lecture Topics</th>
<th>Sapling</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mon 8/17:</td>
<td>Syllabus Review - Grading Policies</td>
<td>Practice Assignment * Due 8/18</td>
<td>Pre-Lab Watch Videos on Measurement and Sig Figs</td>
</tr>
<tr>
<td></td>
<td>Technology: Sapling</td>
<td>Ch 0 Learning Curve 8/19</td>
<td>• Harris 10e Sec’s 3-1 to 3-2; Harvey pp. 16-18</td>
</tr>
<tr>
<td></td>
<td>Intro to Analytical Chemistry Handout</td>
<td>HW 0 Analyt Chem Intro 8/20</td>
<td>Lab 8/20</td>
</tr>
<tr>
<td>Wed 8/19:</td>
<td>Accuracy and Precision - Harvey pp. 45-46</td>
<td>HW2A Sig Figs 8/24</td>
<td>• Safety Review</td>
</tr>
<tr>
<td></td>
<td>Detecting/Discarding Bad Data - Harris Sec 4-6; Harvey pp. 112-15</td>
<td>HW 2B Std Dev/Conf Int’s†† Due 8/26</td>
<td>• Buret Measurements</td>
</tr>
<tr>
<td></td>
<td>o Q-test (faster) - Harvey only.</td>
<td>Metric . . . Review * 8/24</td>
<td>Basic Sample Statistics</td>
</tr>
<tr>
<td></td>
<td>o Grubbs Test (statistically more reliable)</td>
<td>Gen Chem Review * (hard) 8/28</td>
<td>Excel Basics</td>
</tr>
<tr>
<td></td>
<td>Introduction to Data Analysis: Uncertainty, Standard Deviation and Confidence Intervals: Harris Sec’s 4-1 &amp; 4-3</td>
<td></td>
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<tr>
<td>Fri 8/21:</td>
<td>Nomenclature Review - handout</td>
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<tr>
<td></td>
<td>Sec’s 1-1 to 1-3: Dimensional Analysis</td>
<td></td>
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</tr>
<tr>
<td>Mon 8/24:</td>
<td>Interpretation of mean, standard deviation and confidence interval</td>
<td>HW 4B Stat Compar†† Due 8/27</td>
<td>Lab 8/27</td>
</tr>
<tr>
<td></td>
<td>Contrast x̄ , s and t to μ, σ and Z - Harris Sec. 4-3</td>
<td>Penny Prelab</td>
<td>Penny Mass Lab - Comparative Statistics</td>
</tr>
<tr>
<td>Wed 8/26:</td>
<td>t-test and F-test - Sec. 4-2 &amp; 4-4</td>
<td>HW4C Stat Comp XCred Due 9/2</td>
<td></td>
</tr>
<tr>
<td>Fri 9/28:</td>
<td>Stoichiometry Review - Harvey Sec. 2C</td>
<td>HW 3A Grav. Stoich. Due 9/1</td>
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</tr>
<tr>
<td></td>
<td>Stoichiometry, Gravimetric - Handout, Harris Ch. 27</td>
<td>HW 1 B Conc Prelecture†† Due 8/311</td>
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<tr>
<td>Mon 8/31</td>
<td>Finish Gravimetric</td>
<td>HW 5A Vol Stoich Due 9/7</td>
<td>Lab 9/3</td>
</tr>
<tr>
<td></td>
<td>Solution Concentration</td>
<td>HW 4A Vol Pipet Prelab 9/3 noon</td>
<td>Calibrate 25 mL pipet - Harris, pp. 28, 32-35, 38-39</td>
</tr>
<tr>
<td>Wed 9/2</td>
<td>Volumetric Stoichiometry</td>
<td></td>
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<tr>
<td>Fri 9/4:</td>
<td>Finish stoichiometry</td>
<td></td>
<td></td>
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<tr>
<td>Wk #</td>
<td>Lecture Topics</td>
<td>Sapling Extra Credit indicated by * Late up to 3 days accepted</td>
<td>Lab</td>
</tr>
<tr>
<td>------</td>
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<td>---------------------------------------------------------------</td>
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<tr>
<td>4</td>
<td>Mon 9/7: Holiday - No Class</td>
<td>HW 6A Sys/Rand Err'' Due 9/11 HW 6B Propagation Err'' Due 9/14</td>
<td>Lab 9/10</td>
</tr>
<tr>
<td>5</td>
<td>Mon 9/14: Equilibrium Review - Sec. 6-1 to 6-2</td>
<td>HW 7A Equil Review Due 9/16</td>
<td>Lab 9/17</td>
</tr>
<tr>
<td>6</td>
<td>Mon 9/14: Equilibrium Review - Sec. 6-1 to 6-2</td>
<td>HW 7A Equil Review Due 9/16</td>
<td>Lab 9/17</td>
</tr>
<tr>
<td>7</td>
<td>Mon 9/28: Advanced Monoprotic Acid-Base Concepts</td>
<td>HW 9C Making Buffers'' Due 9/30 HW 8D Activity Coeff's'' Due 10/2</td>
<td>Lab 10/1</td>
</tr>
<tr>
<td>8</td>
<td>Mon 10/5: Advanced Systematic Treatment of Equilibrium</td>
<td>HW 9C Making Buffers'' Due 9/30 HW 8D Activity Coeff's'' Due 10/2</td>
<td>Lab 10/8</td>
</tr>
</tbody>
</table>
| Wk # | Lecture Topics | Sapling | Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) | Lab | Unless otherwise noted, all labs due 5 PM following Monday |
|-----|----------------|---------|--------------------------------|-----|-------------------------------------------------|
| 9   | Mon 10/12: Catch Up  
Wed 10/14: Exam 2  
Fri 10/16: Work pH of \( \text{H}_2\text{SO}_4 \) soln two ways  
- Successive approximations  
- Systematic equilibrium  
Polyprotic Acid-Base Titration Curves  
- HW 10F Polyprot Titr Curve* Due 10/22  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) |   | Lab 10/15:  
High Precision/Accuracy Titration II - Standardization  
Prepare and calibrate 0.05 M KMnO4 solution  
Lab 10/15:  
High Precision/Accuracy Titration II - Standardization  
Prepare and calibrate 0.05 M KMnO4 solution  |
| 10  | Mon 10/19: Polyprotic Acid-Base Titration Curves (cont.)  
Wed 10/21: Spectrophotometry: EM Radiation Sec. - 18.1 to 18.2  
Fri 10/23: Spectrophotometry: Beer's Law - Sec. 18.1 to 18.3  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) | HW 18A Rev EM Radiation Due 10/23  
HW 18B Beer's Law* Due 10/26 | Lab 10/22:  
High Precision/Accuracy Titration II - Unknown  
Oxalate unknown  
Lab 10/22:  
High Precision/Accuracy Titration II - Unknown  
Oxalate unknown |
| 11  | Mon 10/26: Applications of Beer's Law - Sec. 18.3 to 18.5  
Fri 10/30: Electrochemical Cells (Examples Part I) - Sec. 14.3 to 14.6  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) | HW 18C Beer's Law Applied Due 10/29  
HW 14A Intro EChem Due 10/30 | Lab 10/29:  
Mn in Steel  
HW: Advanced Calibration Curve Calcs & Method Validation  
Lab 10/29:  
Mn in Steel  
HW: Advanced Calibration Curve Calcs & Method Validation |
| 12  | Mon 11/2: Electrochemical Cells (Examples Part II)  
Wed 11/4: Catch Up  
Fri 11/6: Electrodes and Potentiometry - Sec. 15-1 to 15.6  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) | HW 14B Intro EChem Cells Due 11/6  
HW 14C Advanced EC Cells Due 11/15  
HW 15A Ref Electrodes* Due 11/18 | Lab 11/5:  
Ion selective electrodes  
Clean Up and Check Out  
Lab 11/5:  
Ion selective electrodes  
Clean Up and Check Out |
| 13  | Mon 11/9: Potentiometry continued Advanced sensors  
*** Tues. Nov. 10 - LAST DAY TO DROP ***  
Wed 11/11: Advanced sensors  
Fri 11/13: Advanced Equilibrium - Chap. 13  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) | HW 15B Ion Selective Elecs Due 11/25  
HW 8E Advanced Sys Equil Due 11/19 | Lab 11/12:  
Advanced titration curve calculations: Redox - Chap. 16  
Lab 11/12:  
Advanced titration curve calculations: Redox - Chap. 16 |
| 14  | Mon 11/16: Exam 3  
Wed 11/18: Party Time!  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) |   | Lab 11/19:  
Advanced titration curve calcs: Compleximetric - Chap 12  
Lab 11/19:  
Advanced titration curve calcs: Compleximetric - Chap 12 |
| 15  | Final Exam  
Mon, Nov 23, 10:30 AM–12:30 PM  
Extra Credit indicated by *  
Late up to 3 days accepted  
\( \downarrow \) |   |   |
1 https://www.angelo.edu/student-handbook/
2 https://www.angelo.edu/catalogs/
3 https://www.angelo.edu/student-handbook/community-policies/academic-integrity.php
4 https://www.angelo.edu/services/disability-services/
5 https://www.angelo.edu/content/files/14197-op-1011-grading-procedures
6 https://www.angelo.edu/student-handbook/community-policies/academic-integrity.php
7 https://www.angelo.edu/dept/writing_center/academic_honesty.php
8 https://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of