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Fall 9-1-2020

### CHMY 311.00: Analytical Chemistry - Quantitative Analysis

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## Chemistry 311: Analytical Chemistry - Quantitative Analysis

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**Professor:** Chris Palmer Office: Chem. 203A.

Office hours Mon. 1:00-2:00; Tuesday 11:00-12:00 or by appointment (phone: 406 272 5637 or e-mail christopher.palmer@umontana.edu).

**Learning Outcomes:** Quantitative laboratory skills include sample and standard preparation, gravimetric and volumetric measurements, instrumental methods (e.g. potentiometry, absorbance, and fluorescence spectrophotometry, liquid chromatography), data analysis with spreadsheet programs, and concise clear presentation and discussion of results. This course has several significant learning outcomes:

1. Prepare the student to perform careful, reproducible and accurate laboratory work: Important practical skills that the student will ultimately need in order to perform well in any laboratory environment.
2. Develop skills to analyze and evaluate experimental data.
3. Develop a deeper understanding of the principles underlying quantitative chemical analysis:
  - a. solution thermodynamics and equilibria
  - b. solubility calculations
  - c. acid/base and buffer calculations
  - d. metal complexation chemistry and calculations
  - e. gravimetric procedures and analysis
  - f. titrations and quantitative volumetric procedures and calculations
  - g. spectroscopy applications, procedures and calculations
  - h. chromatography applications, procedures and calculations

**Text:** David Harvey, *Analytical Chemistry 2.1*, Online edition  
[http://dpuadweb.depauw.edu/harvey\\_web/eTextProject/version\\_2.1.html](http://dpuadweb.depauw.edu/harvey_web/eTextProject/version_2.1.html)

**Homework:** Sapling Learning online

**Grading:** Labs (8), 800 pts (100 pts each)  
Lab Notebook, 100 pts  
Homework, 174 pts  
Exams (3), 300 pts (100 pts each)  
Final (ACS standardized exam), 150pts

Total: 1524 pts

Your overall course grade will depend strongly upon your laboratory work and your ability to calculate and clearly report results. However, the exams and final are challenging and can impact your grade. The homework, exams and final will focus on the more fundamental material presented in the lecture. We cover about 11 Chapters

in Harvey, so keep up on the reading and do relevant homework problems or your exam/final grades will suffer. Grades will be curved but grade cutoffs are usually close to the traditional ranges. The plus/minus system of grading will be used.

**Laboratory notebook and reports:** A bound laboratory notebook with page numbers is required. **You MUST have *and use your lab notebook for all labs*.** Separate laboratory reports will be submitted for each lab. A detailed description of the laboratory notebook and report format is provided elsewhere. All laboratory reports are to be submitted on Moodle and are due on the Wednesday following the final day of the experiment. Lab report grades will be reduced by 10%/day if they are late and will only be accepted up to 5 days after the due date (except in cases of illness or family emergency, explained prior to the deadline if possible).

**Other:** Safety goggles are required for this course and must be worn at all times. You will be working with strong acids and bases which can cause irreversible loss of eyesight and significant scarring. A lab coat is also recommended for those who wish to keep their clothing from mysteriously acquiring holes. Students are expected to adhere to the lab schedule. Lab make-ups will not be possible due to the limited availability of the lab. There is more than enough time devoted to each experiment and we are not responsible for poor time usage on your part.

**Academic misconduct** is subject to an academic penalty by the course instructor and/or disciplinary sanction by the University. Academic misconduct is defined as all forms of academic dishonesty. All of the academic policies found in the Student Conduct Code ([http://life.umt.edu/vpsa/student\\_conduct.php](http://life.umt.edu/vpsa/student_conduct.php)) apply to this course.

Of particular relevance to this course, it is considered academic misconduct to represent another person's words, ideas, data, or materials as one's own. It is also considered academic misconduct to copy from another student's paper, consult unauthorized material, give information to another student or collaborate with one or more students without authorization during an examination or academic exercise without the instructor's permission.

**Students with Disabilities:** If you are a student with a disability and wish to discuss reasonable modifications for this course, contact me privately to discuss the specific modifications you wish to request. Please be advised I may request that you provide a letter from Disability Services for Students verifying your right to reasonable modifications. If you have not yet contacted Disability Services, located in Lommasson Center 154, please do so in order to verify your disability and to coordinate your reasonable modifications. For more information, visit the Disability Services website at <http://www.umt.edu/disability>.

**Important Dates:** Deadlines regarding registration, adding or dropping courses, or changing grading options for courses can be obtained from the Registrar on the following website:

<http://www.umt.edu/registrar/students/dropadd.php>

### **Important COVID -19 Information:**

- Mask use is required within the classroom
- The expectation is that you will use your cleaning kit supplies to clean your personal work space when you arrive for class, and before you leave the classroom
- Classrooms may have one-way entrances / exits to minimize crowding
- Please do not congregate outside the classroom before and after class
- Specific seating arrangements will be used to ensure social distancing and support contact tracing efforts
- Class attendance will be recorded to support contact tracing efforts
- Drinking liquids and eating food is discouraged within the classroom (which requires mask removal)
- The lectures in this class will be recorded to facilitate remote learning
- Stay home if you feel sick and/or if exhibiting COVID-19 symptoms
- If you or someone else is sick or displaying symptoms, please contact the Curry Health Center at (406) 243-4330
- Up-to-Date COVID-19 Information from the University of Montana
  - UM Coronavirus Website: <https://www.umt.edu/coronavirus>
  - UM COVID-19 Fall 2020 website:  
<https://www.umt.edu/coronavirus/fall2020.php>
- You are strongly encouraged to remain vigilant in mitigating the spread of COVID-19 outside the classroom

<b>Chemistry 311 Lecture Schedule (LA 103b) Fall Semester 2018</b>		<b>Reading</b>	
<b>Date</b>	<b>lecture subject</b>	<b>Harvey 2.0</b>	<b>Harris 8<sup>th</sup> Ed.</b>
Wed. Aug. 19	Course overview and orientation, The Analytical Process	Ch. 1	Ch 0
Mon. Aug. 24	The Analytical Process, Measurements and Units	Ch. 2	Ch. 0,1
Wed. Aug. 26	Experimental Error and Significant Figures	Ch. 3,4,5,7A,B	Ch. 3
Mon Aug. 31	Statistics and Calibration	Ch. 3,4,5,7A,B	Ch. 4,5
Wed Sept. 2	Statistics and Calibration	Ch. 3,4,5,7A,B	Ch. 4,5
Mon Sept. 7	<b>Holiday – Labor Day</b>		
Wed Sept. 9	<b>Exam 1 (Chs. 1, 2, 3,4,5,7A,B)</b>		
Mon Sept. 14	Spectroscopy	Ch. 10A,B,C	Ch. 17-19
Wed Sept. 16	Spectroscopy	Ch. 10A,B,C	Ch. 17-19
Mon Sept. 21	Solution Equilibria	Ch. 6	Ch. 6
Wed Sept. 23	Equilibria, Activity and Activity Coefficients	Ch. 6	Ch. 6,7
Mon Sept. 28	Activity and Activity Coefficients	Ch. 6I	Ch. 7
Wed Sept. 30	Systematic Treatment of Equilibria	Ch. 6G	Ch. 7
Mon Oct. 5	Systematic Treatment of Equilibria	Ch. 6G	Ch. 7
Wed Oct. 7	Systematic Treatment of Equilibria	Ch. 6G,H	Ch. 7
Mon Oct. 12	<b>EXAM #2 (Chs 6, 10A,B,C)</b>		
Wed Oct 14	Acid/base equilibria and Titrations	Ch. 6, 9A,B	Ch. 7-10
Mon Oct 19	Acid/base equilibria and Titrations	Ch. 6, 9A,B	Ch. 7-10
Wed. Oct. 21	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Mon Oct. 26	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Wed Oct. 28	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Mon. Nov 2.	Electrochemistry/Redox Titrations	Ch. 11, 9D	Ch. 13-15
Wed Nov. 4	Electrochemistry/Redox Titrations	Ch. 11, 9D	Ch. 13-15
Mon Nov. 9	<b>EXAM #3 (Chs 6, 9, 11)</b>		
Wed Nov. 11	Veteran's Day		
Mon Nov. 16	Separations	Ch. 12A, B	Ch. 22
Wed. Nov. 18	Separations/Liquid Chromatography	Ch. 12A,B,E,F	Ch. 22, 24
Online Segment Available 10/1	Fluorescence Spectroscopy	Ch. 10F	Ch. 18
Tue. Nov. 24	<b>Final Exam 1:10-3:10 PM</b>		

**Chemistry 311**  
**Lab Schedule (CHCB 213)**  
**Fall Semester 2018**

Date*	Lab Description	Reading	
Aug. 19-26	no lab	Harvey, 2.0	Harris 8 <sup>th</sup> Ed.
Aug. 27 – 28	Lab overview, tools of analytical chemistry, check-in.	Ch. 2	Ch. 2
Sept. 1-2	Lab #1 – Statistics, data analysis, and spreadsheet programs	Ch. 1-5	Ch. 0-4
Sept. 3-4	Lab #1 – Volumetric and gravimetric measurements	Ch. 1-5	Ch. 0-4
Sept. 8-9	Lab #1 – Spectrophotometric verification of pipettor performance	Ch. 1-5, 8	Ch. 0-5
Sept. 10-11	Lab #2 – Gravimetric determination of chloride	Ch. 6,8	Ch. 6,7,8,26
Sept. 15-16	Lab #2 – Gravimetric determination of chloride	Ch. 6,8	Ch. 6,7,8,26
Sept. 17-18	Lab #2 – Gravimetric determination of chloride	Ch. 6,8	Ch. 6,7,8,26
Sept. 22-23	Lab #2 – Gravimetric determination of chloride	Ch. 6,8	Ch. 6,7,8,26
Sept. 22-23	Lab #3 – Spectrophotometric determination of Fe	Ch. 10	Ch. 4,5,17-19
Sept. 24-25	Lab #3 – Spectrophotometric determination of Fe	Ch. 10	Ch. 4,5,17-19
Sept. 29-30	Lab #3 – Spectrophotometric determination of Fe	Ch. 10	Ch. 4,5,17-19
Oct. 1-2	Lab #4 – Spectrophotometric determination of Mn in steel	Ch. 10	Ch. 5,17-19
Oct. 6-7	Lab #4 – Spectrophotometric determination of Mn in steel	Ch. 10	Ch. 5,17-19
Oct. 8-9	Lab #4 – Spectrophotometric determination of Mn in steel	Ch. 10	Ch. 5,17-19
Oct. 13-14	Lab #5 – Acid-base analysis: the Gran plot	Ch. 9	Ch. 6,7,8,10,14
Oct. 15-16	Lab #5 – Acid-base analysis: the Gran plot	Ch. 9	Ch. 6,7,8,10,14
Oct. 20-21	Lab #5 – Acid-base analysis: the Gran plot	Ch. 9	Ch. 6,7,8,10,14
Oct. 22-23	Lab #6 – EDTA titration of Ca and Mg in natural waters	Ch. 9	Ch. 12
Oct. 27-28	Lab #6 - EDTA titration of Ca and Mg in natural waters	Ch. 9	Ch. 12
Oct. 29-30	Lab #6 – EDTA titration of Ca and Mg in natural waters	Ch. 9	Ch. 12
Nov. 4-13	Lab #7 - Fluorimetry /Lab #8 HPLC	Ch. 10/12	Ch. 17-19/22,24
Nov. 17-18	check-out		