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### 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. 2:00-3:00; Tuesday 11:00-12:00 or by appointment (phone: 243-4079 or e-mail at 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 2.0*, Online edition

**Homework:** Sapling Learning online

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

Total: 1500 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://www.umt.edu/vpsa/policies/student\\_conduct.php](http://www.umt.edu/vpsa/policies/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>

<b>Chemistry 311 Lecture Schedule (CHEM 102) Fall Semester 2014</b>		<b>Reading</b>	
<b>Date</b>	<b>lecture subject</b>	<b>Harvey 2.0</b>	<b>Harris 8<sup>th</sup> Ed.</b>
Mon. Aug. 31	Course overview and orientation, The Analytical Process	Ch. 1	Ch 0
Wed. Sep. 2	The Analytical Process, Measurements and Units	Ch. 2	Ch. 0,1
Mon. Sept. 7	Holiday (No lecture)		
Wed. Sept. 9	Experimental Error and Significant Figures	Ch. 3,4,5,7A,B	Ch. 3
Mon. Sept. 14	Statistics and Calibration	Ch. 3,4,5,7A,B	Ch. 4,5
Wed. Sept. 16	Solution Equilibria	Ch. 6	Ch. 6
Mon. Sept. 21	Solution Equilibria and Activity	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	<b>EXAM #1 (Chs 1-5, 6, 7A,B)</b>		
Mon. Oct. 5	Spectroscopy	Ch. 10A,B,C	Ch. 17-19
Wed. Oct. 7	Spectroscopy	Ch. 10A,B,C	Ch. 17-19
Mon. Oct. 12	Systematic Treatment of Equilibria	Ch 6G	Ch 7
Wed. Oct. 14	Systematic Treatment of Equilibria	Ch 6G	Ch 7
Mon. Oct. 19	Systematic Treatment of Equilibria	Ch. 6G,H	Ch. 7
Wed. Oct. 21	Acid/base equilibria and Titrations	Ch. 6, 9A,B	Ch. 7-10
Mon. Oct. 26	Acid/base equilibria and Titrations	Ch. 6, 9A,B	Ch. 7-10
Wed. Oct. 28	<b>EXAM #2 (Chs 6, 10A,B,C)</b>		
Mon. Nov. 2	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Wed. Nov. 4	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Mon. Nov. 9	Metal Complexation equilibria/EDTA titrations	Ch. 6, 9C	Ch. 11
Wed. Nov. 11	Veteran's Day – No class		
Mon. Nov. 16	Electrochemistry/Redox Titrations	Ch. 11, 9D	Ch. 13-15
Wed. Nov. 18	Electrochemistry/Redox Titrations	Ch. 11, 9D	Ch. 13-15
Mon. Nov. 23	<b>EXAM #3 (Chs 6, 9, 11)</b>		
Wed. Nov. 25	Thanksgiving	Ch. 10F	Ch. 18
Mon. Nov. 30	Fluorescence Spectroscopy	Ch. 12A,B	Ch. 22
Wed. Dec. 2	Separations		
Mon. Dec. 7	Separations/Liquid Chromatography	Ch. 12A,B,E,F	Ch. 22, 24
Wed. Dec. 9	Liquid Chromatography	Ch. 12E,F	Ch. 24
Mon. Dec. 14	<b>Final Exam 1:10-3:10 pm</b>		

**Chemistry 311**  
**Lab Schedule (CHCB 213)**  
**Fall Semester 2015**

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