

# CHEM 230 - CHEMICAL QUANTITATIVE ANALYSIS

## SUMMER TERM, 2009

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Office Hours: One hour before class each week or by appointment

### A. COURSE OBJECTIVE

This is a three-credit course whose primary objective is to introduce the classical "wet" methods of analytical chemistry; instrumental methods of analysis are covered in a different course. The entire quarter will be devoted to statistical treatment of experimental data, gravimetric, volumetric, and titrimetric methods of analysis. Specific applications to acid/base systems and redox systems will be addressed as well as industrial applications of each principle where applicable. A schedule is attached which details the topics to be covered throughout the quarter along with assigned homework problems for each topic.

**B. CLASS MEETING TIME** Monday evenings from 6:00 to 8:45 in Room 135, LeBow Building

**C. PREREQUISITES** CHEM 102 or (CHEM 162 and CHEM 164)

### D. REQUIRED COURSE MATERIALS

Text: Quantitative Chemical Analysis, Seventh Edition by Daniel C. Harris, published by W.H. Freeman and Company (2007)  
Lecture Notes for CHEM 230 by E. Thorne

### E. COURSE LEARNER OBJECTIVES

Upon completion of this course the student should be able to:

- Apply statistical methods to experimental data and be able to determine confidence intervals, reject "bad" data, determine uncertainties via propagation of errors methodology, and perform linear regression analyses
- Understand the principles of gravimetric analysis and the optimal conditions for a successful analysis
- Utilize the various types of volumetric analysis as a tool for determining the amount of analyte in an unknown sample
- Apply the principle of chemical equilibrium to various chemical systems for purposes of determining the composition of a system at equilibrium
- Understand the effect of applied stress to a system at equilibrium and how it affects the overall system
- Use activity coefficients to correct equilibrium calculations for non-ideal conditions
- Understand the distinction between strong vs. weak acids and bases

- Be able to apply equilibrium calculations to weak acid/base systems and determine pH
- Understand the distinction between monoprotic vs. polyprotic acids/bases and how each impacts on the equilibrium condition
- Prepare a buffer system to meet a specific pH requirement
- Construct titration curves for acid/base systems and extract information such as equilibrium constants from them
- Select an appropriate indicator for an acid-base titration
- Understand the principles of oxidation and reduction
- Balance redox equations
- Understand the similarities and differences between voltaic and electrolytic cells.
- Determine standard state potentials for electrochemical cells
- Apply the Nernst equation to non-standard conditions or electrochemical cells
- Construct redox titration curves and select an appropriate indicator for a redox analysis

## **F. HOMEWORK ASSIGNMENTS**

This handout contains a table indicating the chapters in the textbook to be studied and the assigned homework problems for each chapter. In general, homework problems will not be covered in class unless specific requests are made pertaining to certain problems. Unless you come to class prepared to ask questions about those problems that gave you some difficulty, it is assumed that you were able to successfully complete the assignments. The schedule supplied is tentative and is subject to revision as the quarter progresses. Any deviations from the schedule will be announced in class. The problem assignments listed are the minimum number of problems that should be attempted to adequately understand the material. Those topics that provide difficulty to the student should be supplemented by additional problems of the same type, either from the course textbook or any of the supplementary references listed in the lecture notes. All of the assigned problems on the list are problems of the type requiring a calculation of some sort. In addition, you should look at the non-mathematical questions included with the problems at the end of each chapter to insure that you understand the theoretical principles not requiring any type of calculation.

## **G. PROBLEM SETS**

There will be a separate problem set corresponding to each of the exams given in this course. The problem sets are primarily the more time-consuming problems that are less appropriate for an in-class exam having a time limit. For example, some of them will involve problems which are better suited for treatment by using a spreadsheet application such as Excel to complete repetitive calculations and/or construction of a graph and evaluating the equation of the best straight line using linear regression. Successfully completing these problem sets provides an excellent preparation for the in-class exam. The problem set for each exam is due at the beginning of that exam. Once the answers to the problem set have been posted, no problem set will be accepted for credit and you will have forfeited that portion of your course grade. Large discrepancies between an in-class exam and the problem set grade will likely require you having to support/explain your problem set answers and could lead to a reduction of the problem set grade.

## **H. MAKING UP MISSED EXAMS**

A single make-up exam will be given to replace either Exam I or Exam II. This exam will be given after the second exam and will cover material from both exams. This means that regardless of whether you miss either Exam I or Exam II, the make-up exam you take will cover material from both exams. The make-up exam will replace one exam only, so that if you miss both exams you will forfeit 20% of your grade. To do this, you first have to make an appointment with Marge Fritsche (215-895-2164) at the College of Evening and Professional Studies, located at One Drexel Plaza at 30th and Market Streets. All make-up exams will be administered through the College of Evening and

Professional Studies. **If you do not complete the make-up exam by Friday August 14, your grade for the missed exam will be zero. No make-up exams will be permitted after August 14. THE MAKE-UP EXAM IS TO REPLACE A MISSED EXAM, NOT TO REPLACE A POOR GRADE. THERE IS A TWO-HOUR TIME LIMIT ON THE MAKE-UP EXAM SO YOU WILL HAVE TO ARRIVE EARLY ENOUGH TO RECEIVE THE FULL TIME ALLOWED. THE OFFICE WILL NOT REMAIN OPEN PAST THEIR REGULAR HOURS FOR YOU TO COMPLETE THE EXAM IF YOU ARRIVE LATE. IT IS YOUR RESPONSIBILITY TO MAKE A SUITABLE APPOINTMENT TO TAKE THE EXAM.**

### **I. GRADE BREAKDOWN**

Your grade in the course will be derived from the following sources: two exams during the quarter, a two-hour final exam, and three problem sets, which must be submitted at the exams. The overall contribution of these factors to your course grade will be as follows:

Exam I on Monday July 20, 2009	20% of the course grade
Exam II on Monday August 10, 2009	20% of the course grade
Final Exam on Monday August 31, 2009	30% of the course grade
Problems Sets (three at 10% each)	30% of the course grade

**NOTE: Exam dates are tentative and subject to change**

### **SUPPLEMENTARY PROBLEM**

1. A mixture containing only AgCl and AgBr weighs 2.000 grams. It is quantitatively reduced to silver metal, which weighs 1.300 grams. Calculate the mass of each AgCl and AgBr in the original mixture.

## CHEM 230 - COURSE SCHEDULE

<u>WEEK</u>	<u>DATE</u>	<u>LECTURE TOPICS</u>	<u>CHAPTERS</u>	<u>HOMEWORK ASSIGNMENTS</u>
1	6-22	Data Treatment Statistics	3,4	Introduction To Course
2	6-29	Solubility Product Gravimetric Analysis	6 27	3-1, 3-5a-d, 3-15a,d, 4-3, 4-11, 4-22, 4-32
3	7-6	Volumetric Analysis Chemical Equilibrium Activity Effects	7 6 8	6-14, 6-17, 6-21, 27-10, 27-11, 27-14, 27-15, 27-26, Supplementary Problem #1 (on page 3 of this handout)
4	7-13	Acid-Base Equilibria	9	7-7, 7-9, 7-10, 6-6, 6-12, 8-3
5	7-20	<b>EXAM I</b>		8-4, 8-9, 6-37a-c, 6-38, 6-44, 6-45, 6-49
6	7-27	Acid-Base Equilibria	10	9-6, 9-8, 9-19, 9-20, 9-23
7	8-3	Acid-Base Titrations	11	9-32, 9-33, 9-39, 10-4, 10-11, 10-18, 10-22, 10-26
8	8-10	<b>EXAM II</b>		NO HOMEWORK PROBLEMS FOR TONIGHT
9	8-17	Reduction/Oxidation Redox Titrations	14 16	11-2, 11-6, 11-8 (also select an indicator), 11-19, 11-34, 11-35, 11-40
10	8-24	EDTA Titrations	12	14-6, 14-12, 14-16, 14-25a, 14-26, 14-29, 16-1, 16-6, 16-15, 16-18

**THIS SCHEDULE IS TENTATIVE AND SUBJECT TO CHANGE AS THE TERM PROGRESSES**

EXAM I WILL BE MONDAY JULY 20 AND WILL COVER THE FIRST  
THREE WEEKS LECTURES  
EXAM II WILL BE ON MONDAY AUGUST 10 AND WILL COVER ACID/BASE  
EQUILIBRIA  
THE FINAL EXAM WILL BE COMPREHENSIVE