2302520 : Environmental Chemistry
Aquatic Chemistry
November 14 – December 4,2003

Instructors: Dr. Mark Nanny
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Text:
A Problem-Solving Approach to Aquatic Chemistry, James N. Jensen, John Wiley & Sons, 2003

Grading: Letter grades are assigned based on your point total at the end of the semester relative to the point totals of your fellow classmates and relative to my expectations. I do not have a strict 90-80-70 scale for assigning letter grades; rather, I try to find the natural breaks between students. Even though I have a sliding scale, I do have a few achievement levels. First, if your weighted average for the semester is above 90%, you will be guaranteed an "A" for the course. Second, if your weighted average for the semester is above 65%, you will be guaranteed of at least a "C" for the course. On the other end, I do have a bottom-line, that is, a minimum acceptable level of performance. If your average is below 50%, you will receive an "F" for the course. Borderline cases will be determined by your attendance record and attitude toward learning.

Distribution of Total Grade:

Homework: (55%)	15 homework assignments
Quizzes: (40%)	6 quizzes
Class Participation (5%)	

Group Problem Solving Methods

Since a primary focus of this course involves learning how to solve aquatic chemistry problems, class sessions will consist of a mixture of lectures and group problem solving activities. You will be assigned to a group that you will work with for the duration of the semester.

Bibliography

Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, Werner Stumm and James J. Morgan, Wiley Interscience, 3rd edition, 1996. (The Bible of Water Chemistry; everything you always wanted to know and a whole-lot more! In-depth coverage; excellent text).

Water Chemistry, Vernon L. Snoeyink and David Jenkins, John Wiley & Sons, 1980. (Not as thick as Stumm & Morgan, more of an "Introductory" text on water chemistry).

Principles and Applications of Aqueous Chemistry, Francois M.M. Morel and Janet G. Hering, Wiley Interscience, 1993. (Intermediate between Stumm & Morgan and Snoeyink & Jenkins; Good coverage, but sometimes a bit difficult to understand because of sparse details. Uses the Tableau method to solve problems, the same method that is used in the MINTEQL computer program).

Water Chemistry, Mark M. Benjamin, McGraw Hill, 2002 (General introductory water chemistry text; solves problems in a rather unique way).

Lecture Outline:

Lecture Number	Lecture Topics	Book Chapters
Thermodynamics and Equilibrium Concepts		
Lecture 1	• Introduction & Concentration Units • Introduction to Thermodynamics • Using Thermodynamics to Predict Equilibrium & Chemical Species Concentrations	Chapters 1 & 2 Chapter 3; 3.1 – 3.10
Lecture 2	• Equilibrium Expressions • Solving Equilibrium Expressions Algebraically	Chapter 6 Chapter 7
Lecture 3	• Solving Equilibrium Expressions Graphically	Chapters 7 & 8
Lecture 4	• Nanoqul Computer Program • Review of Solving Equilibrium Expressions	Chapter 9
Acid & Base Chemistry		
Lecture 5	• Quiz: Thermodynamics & Equilibrium • Introduction to Acids and Base Chemistry • Acid and Base Titrations • Titrations and Buffers	Chapter 11 Chapter 12
Lecture 6	• Alkalinity and Acidity • Review of Acid – Base Chemistry	Chapter 13
Metal Ion Complexation		
Lecture 7	• Quiz: Acids & Bases • Coordination Chemistry and Complexation Reactions • Solving Complexation Equilibrium Calculations: Single Metal Ions and Ligands	Chapter 15: 15.1 – 15. 6
Lecture 8	• Solving Complexation Equilibrium Calculations: Multiple Metal Ions and Ligands • Review of Complexation Reactions and Calculations	Chapter 15: 15.6
Reduction – Oxidation Chemistry		
Lecture 9	• Quiz: Metal Complexation • Balancing Redox Equations & Redox Thermodynamics • Solving Redox Reactions: Algebraically & Graphically	Chapter 16: 16.1 – 16.7
Lecture 10	• Solving Redox Reactions: Computer Modeling & Case Studies • Review of Reduction – Oxidation Chemistry	Chapter 16: 16.8
Heterogeneous Systems: Gas – Liquid Equilibria		
Lecture 11	• Quiz: Reduction-Oxidation Chemistry • Henry's Law, Roult's Law, and Equilibrium • Dissolved CO_2 and Open Systems	Chapter 18

Lecture Number	Lecture Topic	Book Chapters
Heterogeneous Systems: Solid –Liquid Equilibria		
Lecture 12	• Quiz: Heterogeneous Systems – Gas/Liquid • Saturation and Precipitation • Effect of Ligands, Metal Ions, and Carbonate	Chapter 19: 19.1 – 19.5
Lecture 13	• Intro. to Aquatic Chemistry of Surfaces • Aquatic Chemistry of Mineral Surfaces • Review of Solid-Liquid Equilibria	Chapter 19: 19.6 - 19.7
Non-Ideal Systems & Aquatic Chemical Kinetics		
Lecture 14	• Quiz: Heterogeneous Systems – Solid/Liquid • Ionic Strength and Activity Coefficients • Effect of Temperature and Pressure on Activity • Reaction Rates and Expressions	Chapter 21 Chapter 22: 22.1 – 22.3
Lecture 15	• Zero, 1^{st}, and 2^{nd} Order Reactions • Sequential Reactions • Effect of Temperature and Ionic Strength on Reaction Rates • Review of Aquatic Chemical Kinetics	Chapter 22: 22.4 - 22.5