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Chemistry S1404x

**Syllabus**  
**Columbia University**  
**Professor James J. Valentini**

Summer 2011

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**COURSE STRUCTURE**

**Course Instructor**

Professor James J. Valentini  
Office: 528 Havemeyer  
Email: jjv1@columbia.edu  
Office Hours: TR 4:30-6:00 p.m.

**Course Meeting Times**

Lecture, TR 6:10-7:35 p.m., May 24 to August 11, 309 Havemeyer.  
Recitations, four sections, T 5:10-6:00 p.m., T 7:45-8:35 p.m., R 5:10-6:00 p.m., R 7:45-8:35 p.m., 320 Havemeyer. Recitations meet each week, except for the first week of classes and the weeks in which an exam occurs.

**Course Text**

*Chemical Principles*, Sixth Edition, Steven S. Zumdahl, Houghton Mifflin, 2009.

**Course Grading**

Three Exams	25	points each, 75 points total
Five Quizzes	5	points each, 25 points total
Course Total	100	points

**Homework**

Assigned each week on Tuesday. Not graded or collected.

**Quizzes**

Given in recitation sections in the weeks of June 7 and 14, July 5, 12, and 26, August 2. Six quizzes total, five points each; five highest quiz scores counted.

**Exams**

Three, 25 points each, multiple-choice, based on lectures, homework, in-class problems, and demonstrations. Given in lecture period on June 21, July 19, and August 11.

**COURSE MATERIAL**

**Part I. Phases of Matter**

**(Zumdahl: Chapter 5, Chapter 16, Sections 16.1-16.3, 16.10, 16.11)**

- Operational Definitions and Characteristics of Phases
- The Influence of Pressure and Temperature
- The Equation of State
- Gases
  - The Kinetic Molecular Theory
  - The Ideal Gas Law
  - Non-Ideal Gas Behavior
- Intermolecular Interactions

Solids and Liquids  
Phase Diagrams and Transitions

**Part II. Chemical Equilibrium**

**(Zumdahl: Chapter 6)**

Equilibrium Calculations  
Le Chatelier's Principle

**Part III. Solution Chemistry**

**(Zumdahl: Chapters 7, 8, 17)**

Aqueous Solutions  
Practical Solution Chemistry  
Acids and Bases  
    Acid-Base Equilibrium  
    Weak Acids and Bases  
    Polyprotic Acids  
    Buffers  
Solubility Equilibria  
Chemistry in Your Pool  
The Common Ion Effect  
Complex Ions  
Lewis Acids and Bases  
Carbon Dioxide and Water

**Part IV. Thermodynamics and Thermochemistry**

**(Zumdahl: Chapters 9 and 10)**

Energy  
    Energy and its Forms  
    Energy Units  
Work  
Temperature and Thermodynamics  
Heat  
The Relation of Heat and Work  
The First Law of Thermodynamics  
PV Work  
Calculation of q  
State Functions  
Chemical Thermodynamics  
    Calorimetry  
    Thermochemistry  
Spontaneity  
The Conversion of Heat to Work  
Heat Engines  
Entropy  
The Second Law of Thermodynamics  
Statistical Basis of the Second Law  
Practical Examples of the Second Law  
The Third Law of Thermodynamics  
Calculating Entropy  
The Gibbs Energy and Chemical Equilibrium

**Part V. Electrochemistry**  
**(Zumdahl: Chapter 11)**

Chemistry with Electrons  
Reduction and Oxidation  
Redox Reactions  
Half-Cell Reactions  
Electrochemical Cells  
Electrical Work  
Half-Cell Potentials  
Thermodynamics of Electrochemical Cells  
Electrochemistry in Your Basement  
Non-Standard-State Cells  
Batteries

**Part VI. Kinetics**  
**(Zumdahl: Chapter 15)**

The Reaction Rate  
Rate Laws  
First-Order Reaction  
Second-Order Reaction  
Complex Reactions  
Elementary Reactions  
Reaction Mechanisms  
Temperature and Rates