

## CHEMISTRY 100.13 – 2015/2016

**Instructor:** Manuel Aquino, Office PSC-3024, Phone 867-5336 (Lab: PSC-3017)

**Text:** Chemistry – The Central Science (13<sup>th</sup> Ed) by T.L. Brown, H.E. Lemay, B.E. Bursten, C.J. Murphy, P.M. Woodward, M.W. Stoltzfus; Prentice Hall 2015.

**Lectures:** P Block

**Labs:** Monday PM and Wednesday AM in PSC 2037

**Evaluation:** 2 major exams and 2 midterm tests comprise 70% of the final mark; the lab component (labs and lab exam) accounts for 20% of the final grade. Assignments account for 10%. The final course mark is normally calculated in the following way:

|                       |      |
|-----------------------|------|
| Assignments:          | 10%  |
| Mid-Term Exams:       | 20%  |
| December Exam:        | 20%  |
| April Exam:           | 30%  |
| Lab (incl. lab exam): | 20%  |
|                       | 100% |

### **\*PLEASE NOTE\***

The lecture component (80%) and the lab component (20%) must **each** be passed **separately** in order to receive a passing grade for the course. **The passing grade for the lab component is 70%.** If a student **fails to complete** more than **3** labs, for whatever reason, a failing grade will be assigned for the course. A complete lab means carrying out the designated procedure and submitting a completed lab module for that procedure. Lab pre-labs and write-ups will account for 15% and a lab exam for the remaining 5%. The lab exam will take place at the end of March.

### ***Testing Schedule (Tentative)***

|                                |                            |
|--------------------------------|----------------------------|
| October Mid-Term:              | Tuesday, October 20, 2015  |
| February Mid-Term:             | Tuesday, February 16, 2016 |
| December Exam (2 hrs):         | TBA, December, 2015        |
| Lab Exam (Full year, 1 hr):    | TBA, March, 2016           |
| April Exam (Full year, 3 hrs): | TBA, April, 2016           |

## **Topics Outline**

The following outline is based on the above text. Those topics designated “**READ**” are part of the course material, but, with a few exceptions, will not be covered in detail during lectures.

### **Chapter 1. INTRODUCTION: MATTER AND MEASUREMENT**

- 1.1. The Study of Chemistry ..... **READ**
- 1.2. Classifications of Matter ..... **READ**
- 1.3. Properties of Matter ..... **READ**
- 1.4. Units of Measurement ..... **READ**
- 1.5. Uncertainty in Measurement
- 1.6. Dimensional Analysis

### **Chapter 2. ATOMS, MOLECULES, AND IONS**

- 2.1. The Atomic Theory of Matter ..... **READ**
- 2.2. The Discovery of Atomic Structure ..... **READ**
- 2.3. The Modern View of Atomic Structure
- 2.4. Atomic Weights
- 2.5. The Periodic Table
- 2.6. Molecules and Molecular Compounds
- 2.7. Ions and Ionic Compounds
- 2.8. Naming Inorganic Compounds
- 2.9. Some Simple Organic Compounds

### **Chapter 3. CHEMICAL REACTIONS AND REACTION STOICHIOMETRY**

- 3.1. Chemical Equations
- 3.2. Some Simple Patterns of Chemical Reactivity
- 3.3. Formula Weights
- 3.4. Avogadro's Number and the Mole
- 3.5. Empirical Formulas from Analyses
- 3.6. Quantitative Information from Balanced Equations
- 3.7. Limiting Reactants

### **Chapter 4. REACTIONS IN AQUEOUS SOLUTION**

- 4.1. General Properties of Aqueous Solutions
- 4.2. Precipitation Reactions
- 4.3. Acids, Bases and Neutralization Reactions
- 4.5. Concentrations of Solutions
- 4.6. Solution Stoichiometry and Chemical Analyses

### **Chapter 4/20 OXIDATION REDUCTION REACTIONS**

- 4.4 Oxidation Reduction Reactions
- 20.1 Oxidation States
- 20.2 Balancing Redox Equations

**Chapter 5**    ***THERMOCHEMISTRY***

- 5.3. Enthalpy
- 5.4. Enthalpies of Reaction
- 5.6. Hess's Law

**Chapter 10**    ***GASES***

- 10.1. Characteristics of Gases
- 10.2. Pressure
- 10.3. The Gas Laws
- 10.4. The Ideal-Gas Equation
- 10.5. Further Applications of the Ideal Gas Equation
- 10.6. Gas Mixtures and Partial Pressures
- 10.7. Kinetic-Molecular Theory of Gases
- 10.8. Molecular Effusion and Diffusion
- 10.9. Real Gases: Deviations from Ideal Behavior

**Chapter 15**    ***CHEMICAL EQUILIBRIUM***

- 15.1. The Concept of Equilibrium
- 15.2. The Equilibrium Constant
- 15.3. Understanding and Working with Equilibrium Constants
- 15.4. Heterogeneous Equilibria
- 15.5. Calculating Equilibrium Constants
- 15.6. Applications of Equilibrium Constants
- 15.7. Le Châtelier's Principle

**Chapter 16**    ***ACID-BASE EQUILIBRIA***

- 16.1. Acids and Bases – A Brief Review
- 16.2. Brønsted-Lowry Acids and Bases
- 16.3. The Autoionization of Water
- 16.4. The pH Scale
- 16.5. Strong Acids and Bases
- 16.6. Weak Acids
- 16.7. Weak Bases
- 16.8. Relation Between  $K_a$  and  $K_b$
- 16.9. Acid-Base Properties of Salt Solutions
- 16.10. Acid-Base Behavior and Chemical Structure ..... **READ**
- 16.11. Lewis Acids and Bases ..... **READ**

**Chapter 17**    ***ADDITIONAL ASPECTS OF AQUEOUS EQUILIBRIA***

- 17.1. The Common-Ion Effect
- 17.2. Buffers
- 17.3. Acid-Base Titrations
- 17.4. Solubility Equilibria
- 17.5. Factors that Affect Solubility
- 17.6. Precipitation and Separation of Ions
- 17.7. Qualitative Analyses for Metallic Elements ..... **READ**

**Chapter 14**    ***CHEMICAL KINETICS***

- 14.1. Factors that Affect Reaction Rates
- 14.2. Reaction Rates
- 14.3. Concentration and Rate Laws
- 14.4. The Change of Concentration with Time
- 14.5. Temperature and Rate
- 14.6. Reaction Mechanisms ..... **READ**
- 14.7. Catalysis

**Chapter 5**    ***THERMOCHEMISTRY (CONT.)***

- 5.1. Energy
- 5.2. The First Law of Thermodynamics
- 5.4. Enthalpies of Reaction
- 5.5. Calorimetry
- 5.7. Enthalpies of Formation
- 5.8. Foods and Fuels

**Chapter 19**    ***CHEMICAL THERMODYNAMICS***

- 19.1. Spontaneous Processes
- 19.2. Entropy and the Second Law of Thermodynamics
- 19.3. The Molecular Interpretation of Entropy and the Third Law of Thermodynamics
- 19.4. Entropy Changes in Chemical Reactions
- 19.5. Gibbs Free Energy
- 19.6. Free Energy and Temperature
- 19.7. Free Energy and the Equilibrium Constant

**Chapter 6**    ***ELECTRONIC STRUCTURE OF ATOMS***

- 6.1. The Wave Nature of Light ..... **READ**
- 6.2. Quantized Energy and Photons ..... **READ**
- 6.3. Line Spectra and the Bohr Model ..... **READ**
- 6.4. The Wave Behaviour of Matter ..... **READ**
- 6.5. Quantum Mechanics and Atomic Orbitals
- 6.6. Representations of Orbitals
- 6.7. Many-Electron Atoms
- 6.8. Electron Configurations
- 6.9. Electron Configurations and the Periodic Table

**Chapter 7**    ***PERIODIC PROPERTIES OF THE ELEMENTS***

- 7.1. Development of the Periodic Table ..... **READ**
- 7.2. Effective Nuclear Charge
- 7.3. Sizes of Atoms and Ions
- 7.4. Ionization Energy
- 7.5. Electron Affinity
- 7.6. Metals, Nonmetals, and Metalloids
- 7.7. Trends for Group 1A and Group 2A Metals ..... **READ**
- 7.8. Trends for Selected Nonmetals ..... **READ**

**Chapter 8    *BASIC CONCEPTS OF CHEMICAL BONDING***

- 8.1. Lewis Symbols and the Octet Rule
- 8.2. Ionic Bonding
- 8.3. Covalent Bonding
- 8.4. Bond Polarity and Electronegativity
- 8.5. Drawing Lewis Structures
- 8.6. Resonance Structures
- 8.7. Exceptions to the Octet Rule
- 8.8. Strengths and Lengths of Covalent Bonds

**Chapter 9    *MOLECULAR GEOMETRY AND BONDING THEORIES***

- 9.1. Molecular Shapes
- 9.2. The VSEPR Model
- 9.3. Molecular Shape and Molecular Polarity
- 9.4. Covalent Bonding and Orbital Overlap
- 9.5. Hybrid Orbitals
- 9.6. Multiple Bonds
- 9.7. Molecular Orbitals.....**READ**
- 9.8. Period 2 Diatomic Molecules.....**READ**

**Chapter 24    *THE CHEMISTRY OF LIFE: ORGANIC AND BIOLOGICAL CHEMISTRY***

- 24.1. General Characteristics of Organic Molecules
- 24.2. Introduction to Hydrocarbons
- 24.3. Alkenes, Alkynes and Aromatic Hydrocarbons
- 24.4. Organic Functional Groups
- 24.5. Chirality in Organic Chemistry
- 24.6. Introduction to Biochemistry
- 24.7. Proteins
- 24.8. Carbohydrates
- 24.9. Lipids
- 24.10. Nucleic Acids

**Chapter 11    *LIQUIDS AND INTERMOLECULAR FORCES (Note: Some sections of this chapter may be covered earlier in the term)***

- 11.1. A Molecular Comparison of Gases, Liquids, and Solids
- 11.2. Intermolecular Forces
- 11.3. Select Properties of Liquids
- 11.4. Phase Changes
- 11.5. Vapor Pressure
- 11.6. Phase Diagrams
- 11.7. Liquid Crystals.....**READ**

**Chapter 13    *PROPERTIES OF SOLUTIONS (Time Permitting)***

- 13.1. The Solution Process
- 13.2. Saturated Solutions and Solubility
- 13.3. Factors Affecting Solubility
- 13.4. Expressing Solution Concentrations
- 13.5. Colligative Properties
- 13.6. Colloids..... **READ**

