

# CHEMISTRY 263 - Section B6

## Lecture Outline 3 & Assignment 3

TR 12:30-13:50  
February 7, 2006  
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### Read:

TWG Solomons and CB Fryhle "Organic Chemistry" 8th Edition (2004):

- Functional Group List on pp 70-71 and (Periodic Table) one page back from Inside Back Cover
- Relative Strength of Acids and Bases on Inside Front Cover - same table page 105
- Chapter 11 – Alcohols and Ethers - review, especially nomenclature and properties
- Chapter 12 – Alcohols from Carbonyl Compounds - review
- Chapter 16 – Aldehydes and Ketones - Carbonyl Reactions
- Chapter 17 – Aldehydes and Ketones – Reactions at alpha-Carbon, Aldol
- Chapter 22 – Carbohydrates – read for overview structure and properties

### Problems:

Do Not turn in, answers available in "Study Guide and Solutions Manual for Organic Chemistry" by Solomons and Fryhle..

#### Chapter 11:

11.6; 11.13; 11.25; 11.26

#### Chapter 12:

12.6; 12.7; 12.11 a to f; 12.12

#### Chapter 16:

16.2; 16.5; 16.7; 16.9; 16.10; 16.17; 16.23; 16.26; 16.37

#### Chapter 17:

17.1; 17.2; 17.7; 17.14; 17.19; 17.35 a and b

#### Chapter 22:

22.1; 22.2; 22.4; 22.11; 22.20; 22.28

## Lecture Outline 3: Review of Stereochemistry, Alcohols and Ethers; Aldehydes & Ketones - Properties of the Carbonyl Group

### 1. Review of Structure, Nomenclature and Physical Properties of Alcohols and Ethers

- A. Aliphatic Alcohols
- B. Aromatic Alcohols (Phenols)
- C. Ethers
- D. Alcohols and Phenols - general properties
  1. MP, BP, solubility, density - hydrogen bonding
  2. Acidity of Aliphatic Alcohols (ROH)
- E. Acidity of Phenols (ArOH) - resonance
- F. Physical Properties of Ethers

### 2. Review of Stereochemistry - "Fixed three dimensional arrangements"

- A. The Concept of Chirality
  1. Identification of chiral objects and molecules - definitions
  2. Types of stereoisomers - enantiomers and diastereomers
  3. Racemic mixtures - 50-50 mixtures of enantiomers
- B. The R and S Nomenclature System
  1. Rules for assignment of R and S configurations
- C. Molecules with more than one chiral center

1. Enantiomers and Diastereomers
2. Meso compounds - chiral centers with plane of symmetry within molecule
3. Recognition of chiral centers in complex molecules

### 3. Structure, Nomenclature, Properties of Aldehydes and Ketones

- A. Nature of the Carbonyl Group - Physical Properties
  1. Polarity and Reactivity
  2. Hybridization and shape ( $sp^2$ , planar)
  3. Physical Properties - BP, MP, solubility, smell
- B. Nomenclature of Aldehydes - RCHO
  1. IUPAC - alkane name, replace "e" with "al"
- C. Nomenclature of Ketones - RCOR
  1. IUPAC - alkane name - replace "e" with "one"

### 4. Preparation of Aldehydes and Ketones

- A. Aldehydes
  1. Oxidation of Primary Alcohol:  $RCH_2OH \rightarrow RCHO$
  2. Reduction of Acyl Halides:  $RCOX \rightarrow RCHO$
- B. Ketones
  1. Friedel-Crafts Acylations
  2. Oxidation of 2° Alcohols:  $R_2CHOH \rightarrow R_2CO$
  3. With Organometals:  $RMgX$ ,  $R_2Cd$ ,  $R_2CuLi$

### 5. Reactions of Aldehydes and Ketones

- A. Nucleophilic Additions at the Carbonyl Carbon Atom
  1. General considerations - strong vs. weak nucleophiles
  2. Cyanohydrin formation
  3. Grignard reagent addition
  4. Reduction (hydride addition)
  5. Hemiacetal and Acetal formation
- B. Nucleophilic Addition - Elimination at the Carbonyl Carbon
  1. Wittig Reaction
  2. Addition of Derivatives of Ammonia: formation of oximes, hydrazones, imines
  3. Cannizzaro Reaction of Aldehydes with no  $\alpha$  hydrogen
- C. Reactions at the  $\alpha$ -carbon
  1. Enolate formations - Keto - enol tautomerism
  2. Halogenation and Haloform Reaction
  3. Alkylation
  4. Aldol Addition
- D. Reactions of  $\alpha,\beta$ -unsaturated aldehydes and ketones
  1. Conjugate Addition vs Simple Addition

### 6. Carbohydrates

- A. Monosaccharides
  1. Classification - aldose, ketose, triose, tetrose, etc.
  2. Stereoisomerism
  3. Anomers and Ring Formation (Hemiacetals, Acetals)
  4. Properties and Sweet Taste
- B. Disaccharides and Polysaccharides
  1. Sucrose
  2. Cellulose, Starch, Glycogen