

Chemistry 506: Allied Health Chemistry 2

Chapter 14: Carboxylic Acids and Esters

Functional Groups with Single & Double Bonds to Oxygen

Introduction to General, Organic & Biochemistry, 5th Edition by
Bettelheim and March: Chapter 12, Pages 451-482

Outline Notes by Dr. Allen D. Hunter, YSU Department of
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14A Section(s) 14.1/2/3 Introduction, Nomenclature, and Properties

❖ Generic Structure of **Carboxylic Acid** and Carboxylic Acid **Derivatives**

❖ Members of this Class

❖ **Carboxylic Acids**

❖ **Esters**

❖ Acid Chlorides

❖ Anhydrides

❖ Amides (Chapter 15)

- ❖ Physical Properties
 - ❖ Mp and Bp
 - ❖ taste and “feel”
 - ❖ Hydrogen Bonding
 - ❖ H-bond Donors
 - ❖ O-H and N-H
 - ❖ H-bond Acceptors
 - ❖ Lone pairs of O, N, and S

- ❖ Directionally Specific
 - ❖ Hydrogen Bonds and Covalent Bonds

❖ **Relative Strengths of Intermolecular Bonds**

❖ **Van der Waals <**

❖ **Dipole - Dipole <**

❖ **Hydrogen Bonds <**

❖ **Covalent Bonds \approx Ionic Bonds**

❖ **Hydrogen Bonded Dimers of Carboxylic Acids**

❖ Apparent **Doubling of MW**

❖ Cf. **DNA**

❖ **IUPAC Nomenclature of Carboxylic Acids**

❖ anoic acid (two words)

❖ Examples

14B Section(s) 14.4 Important Carboxylic Acids

❖ Formic Acid (Methanoic Acid)

❖ Ants

❖ Acetic Acid (Ethanoic Acid)

❖ Vinegar

❖ Oxalic Acid (dicarboxylic acid)

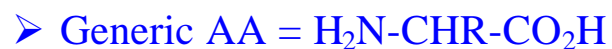
❖ Rhubarb, Spinach, etc.

❖ Benzoic Acid

14C Section(s) 18.2 Amino Acids having Carboxylic Acid

Containing Side Chains

➤ Amino Acids (Building Blocks of Proteins)



➤ Aspartic Acid (acidic)



➤ Glutamic Acid (acidic)



➤ Fatty Acids

➤ R-CO₂H

14E Section(s) 14.5 Preparation of Carboxylic Acids

❖ Oxidation Reactions

❖ Oxidation of Aldehydes (Strong)

❖ Oxidation of 1° Alcohols (Strong)

14F Section(s) 14.6/7 Acid/Base Chemistry

❖ Equilibrium of Carboxylic Acids and Water

❖ Effects of the Electronegativity of R

❖ Carboxylic Acids plus Bases

❖ Base = OH^- , CO_3^{2-} , HCO_3^- , NR_3 , Pyridine, etc.

- ❖ Nomenclature of Carboxylate Salts

- ❖ Metal Alkanoate

- ❖ Examples

- ❖ Carboxylate Salts plus Acids

- ❖ HCl, H₂SO₄, etc.

14G Section(s) 14.8/9 Esters

- ❖ Generic Structure

- ❖ Partial Charges on Carbon (δ^+) and Oxygen (δ^-)
- ❖ No Hydrogen-bonding with self
- ❖ H-bonding acceptor

- ❖ Physical Properties

 - ❖ Mp and Bp

 - ❖ Cf. Carboxylic Acids

 - ❖ odor

❖ Ethyl Acetate (Ethyl Ethanoate)

❖ IUPAC Nomenclature

❖ Alkyl Alkanoate

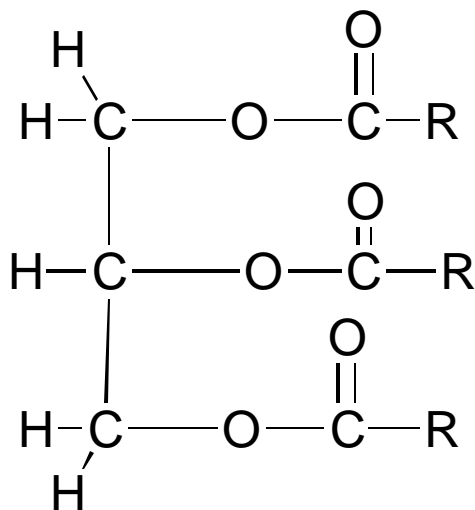
❖ Examples

14H Section(s) 17.2

Biological Esters

➤ Triglycerides

➤ Glycerol and Fatty Acids



- ❖ Indirect Esterification (easier)
 - ❖ Via Acid Chlorides (Thionyl Chloride, SOCl_2)
and Alcohols

- ❖ Alkanoyl Chlorides

- ❖ Anhydride Routes to Esters
- ❖ Acetic Anhydride (only anhydride name for 506)

- ❖ Preparation via Acid Chloride plus Carboxylic Acid

- ❖ Anhydride plus Alcohol (easy)

- ❖ Synthesis of “Polyester”
 - ❖ Condensation Polymers
 - ❖ Dacron, etc. Used in Fibers, Pop bottles, etc.

 - ❖ PET, Poly(ethylene terephthalate)

- ❖ Terephthalic Acid plus Ethylene Glycol

- ❖ Ester Hydrolysis
 - ❖ Hydrolysis by H_3O^+
 - ❖ Hydrolysis by OH^-
 - ❖ Saponification
 - ❖ Hydrolysis by lipase

14J Section(s) 14.12 Phosphorous Acids and Esters

- ❖ H_3PO_4 neutralization
- ❖ Stepwise addition of OH^-

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