

15: Carbonyl Compounds: Esters, Amides, and Related Molecules

15.1 Carbonyl Compounds with the Structure $R-C(=O)-Z$

The $C(=O)-Z$ Functional Group (15.1A)

The Z Group

α -H Acidity and Enol Content

$R-C(=O)-Z$ Compounds are Interconvertible (15.1B)

Acid Chloride Interconversions

Nucleophilic Acyl Substitution

Oxidation States of $R-C(=O)-Z$ Compounds (15.1C)

$R-C\equiv N$ versus $R-C(=O)-Z$ (15.1D)

Comments about Nomenclature (15.1E)

15.2 Acid Halides ($R-C(=O)-X$)

Preparation, Reactivity, and Properties (15.2A)

Preparation

Reactivity and Properties

Nomenclature (15.2B)

15.3 Esters ($R-C(=O)-OR'$)

Preparation, Reactivity, and Properties (15.3A)

Preparation

Reactivity

Properties

Electron Delocalization

Nomenclature (15.3B)

The R' Part

The $RC(=O)O$ Part

Systematic or Common

15.4 Amides ($R-C(=O)-NR'_2$)

Preparation and Reactivity (15.4A)

Structure of Amides (15.4B)

Amides are Planar

C-N Rotation is Restricted

cis and trans Isomers of Amides

Properties of Amides (15.4C)

Amide Basicity

Amide Hydrogen Bonding

Amides as Solvents

Nomenclature (15.4D)

15.5 Anhydrides ($R-C(=O)-O-C(=O)-R$)

Preparation, Reactivity, and Properties (15.5A)

Preparation of Symmetrical Anhydrides.

Preparation of Mixed Anhydrides

Reactivity of Anhydrides

Nomenclature (15.5B)

(continued)

15.6 Nitriles (R-C≡N)

Preparation and Properties (15.6A)

Alkyl Nitriles

Aryl Nitriles

Properties of Nitriles

Nomenclature (15.6B)

15.7 Lactones, Lactams, and Cyclic Anhydrides

Structure (15.7A)

Cyclic Anhydrides

Lactones and Lactams

Nomenclature (15.7B)

Lactones

Lactams

15.8 Biologically Important Molecules with R-C(=O)-Z Groups

Esters (15.8A)

Waxes

Fats and Oils

Amides (15.8B)

Proteins

Peptides

Lactams (15.8C)

15.9 Spectrometric Properties of R-C(=O)-Z and R-C≡N

Ultraviolet-Visible Spectrometry (15.9A)

Infrared Spectrometry (15.9B)

C=O Stretch

C-O Stretch

N-H Stretch and N-H Bend

C≡N Stretch

NMR Spectrometry (15.9C)

¹³C NMR

¹H NMR

Determination of C-N Rotational Barriers in Amides