

GLOSSARY

1,6-hexanediamine

a monomer that when placed in a condensation reaction forms a polyamide. Hexanediamine has amino groups on either end of a 6-carbon chain.

sp hybrid orbitals

one of a set of two orbitals with a linear arrangement that results from combining one s and one p orbital

*sp*² hybrid orbitals

one of a set of three orbitals with a trigonal planar arrangement that results from combining one s and two p orbitals

*sp*³ hybrid orbitals

one of a set of four orbitals with a tetrahedral arrangement that results from combining one s and three p orbitals

*sp*³*d* hybrid orbitals

one of a set of five orbitals with a trigonal bipyramidal arrangement that results from combining one s, three p, and one d orbital

*sp*³*d*² hybrid orbitals

one of a set of six orbitals with an octahedral arrangement that results from combining one s, three p, and two d orbitals

π^* antibonding molecular orbital

antibonding molecular orbital formed by out of phase side-by-side overlap of atomic orbitals, in which the electron density is found on both sides of the internuclear axis, and there is a node between the nuclei

σ s molecular orbital

molecular orbital in which the electron density is found along the axis of the bond

acyl group

an alkyl group attached to a carbon-oxygen double bond

Acylation

substituting an acyl group into something

addition polymerization

monomer molecules bond to each other without the loss of any other atoms

addition reactions

reactions in which a double carbon-carbon bond forms a single carbon-carbon bond by the addition of a reactant. Typical reaction for an alkene.

Alcohols

organic compound with a hydroxyl group ($-\text{OH}$) bonded to a carbon atom

aldehydes

organic compound containing a carbonyl group bonded to two hydrogen atoms or a hydrogen atom and a carbon substituent

alkaloid

a class of basic, naturally occurring organic compounds that contain at least one nitrogen atom.

Alkanes

molecule consisting of only carbon and hydrogen atoms connected by single (σ) bonds

alkenes

molecule consisting of carbon and hydrogen containing at least one carbon-carbon double bond

alkynes

molecule consisting of carbon and hydrogen containing at least one carbon-carbon triple bond

amidation

the reaction in which an amide group replaces the hydrogen atom on the amino group.

Amides

organic molecule that features a nitrogen atom connected to the carbon atom in a carbonyl group

Amines

organic molecule in which a nitrogen atom is bonded to one or more alkyl group

antibonding orbitals

molecular orbital located outside of the region between two nuclei; electrons in an antibonding orbital destabilize the molecule

aromatic

compounds containing a benzene ring

aromatic hydrocarbons

cyclic molecule consisting of carbon and hydrogen with delocalized alternating carbon-carbon single and double bonds, resulting in enhanced stability

aryl

an group containing an aromatic ring

base peak

the tallest peak in the MS spectrum and set equivalent to 100%

bond order

number of pairs of electrons between two atoms; it can be found by the number of bonds in a Lewis structure or by the difference between the number of bonding and antibonding electrons divided by two bonding orbital

bonding orbitals

molecular orbital located between two nuclei; electrons in a bonding orbital stabilize a molecule

carbonyl group

carbon atom double bonded to an oxygen atom

carboxyl group

a combination of two functional groups attached to a single carbon atom. These two functional groups include; a single bonded hydroxyl (OH) group and a double bonded carbonyl (O) group. Carboxyl is often seen as COOH.

Carboxylic acids

An organic compound that has a carboxyl functional group.

Celluloids

class of compounds created from nitrocellulose (partially nitrated cellulose) and camphor, with added dyes and other agents

Cellulose

major component in the cell walls of plants formed from repeating units of glucose

chain reaction

process of reactions repeating themselves following initiation

chain termination

two radicals react to bring the polymerization to a halt

chemical shift

The position on the NMR plot at which the nuclei absorbs

Chromatography

method by which a mixture is separated by distributing its components between two phases

combustion reaction

occurs when alkanes (hydrocarbons) burn in the presence of oxygen, a highly exothermic oxidation-reduction reaction that produces carbon dioxide and water. A spark or flame are needed to start the reaction.

Compression molding

forming process in which a plastic material is placed directly into a heated metal mold then is softened by the heat and therefore forced to conform to the shape of the mold, as the mold closes

condensation polymerization

two different monomers combine with the loss of a small molecule, usually water

conjugated pi bond

To be considered conjugated, two or more pi bonds must be separated by only one single bond

copolymer

two or more different monomers that form a polymer in a specific ratio

degenerate orbitals

orbitals that have the same energy

Dehydrogenation

elimination reaction where a hydrogen is lost from an alkane to create an alkene under high temperatures

Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA)

polymers, composed of long, three-part chains consisting of phosphate groups, sugars with 5 C atoms (ribose or deoxyribose), and N-containing rings referred to as bases

dextrorotatory

optically active substances that rotate the plane of polarized light to the right (clockwise) from the observer's point of view

diamagnetic

phenomenon in which a material is not magnetic itself but is repelled by a magnetic field; it occurs when there are only paired electrons present

dicarboxylic acids

An organic compound which contains 2 carboxyl groups. These organic molecules show similar chemical behaviour and reactivity to monocarboxylic acids.

Drawing

uses the tensile strength of the material to pull it through the die

elastomers

polymers with elastic properties

electromagnetic spectrum

The full range of electromagnetic radiation wavelengths

electrophilic addition reactions

Reactions involving alkenes and electrophiles. Alkenes are the nucleophiles and the electrophile is a carbon bonded to an electronegative atom such as oxygen, nitrogen, sulfur or a halogen.

Elimination reactions

The opposite of addition reactions. They occur when a single reactant splits into two products, often with the formation of a small molecule such as water or HBr

enantiomers

Molecules that are nonsuperimposable (nonidentical) mirror images of each other

esterification

The process of combining an organic acid with an alcohol to form an ester and water.

esters

organic compound containing a carbonyl group with an attached oxygen atom that is bonded to a carbon substituent

ether

organic compound with an oxygen atom that is bonded to two carbon atoms

Extrusion

process used to create objects of a fixed cross-sectional profile

fingerprint region

complex region of infrared spectra in the 1450 to 600 cm^{-1} region

Fischer projections

the aldehyde group is written at the top, and the hydrogen atoms and OH groups that are attached to each chiral carbon are written to the right or left. (If the monosaccharide is a ketose, the ketone functional group is the second carbon atom.) Vertical lines represent bonds pointing away from you, while horizontal lines represent bonds coming toward you.

free radical

a neutral chemical species that contains an odd number of electrons and thus has a single, unpaired electron in one of its orbitals

functional groups

The structural components differentiating different organic families involve specific arrangements of atoms or bonds. This is the part of a molecule that imparts a specific chemical reactivity.

glass transition temperature

Temperature where the thermal kinetic energy becomes high enough to allow internal rotation to occur within the bonds and to allow the individual molecules to slide independently of their neighbors

HDPE (High density polyethylene)

HDPE (High density polyethylene) is defined by a density of greater or equal to 0.941 g/cm^3 .

heterocyclic compounds

cyclic or ring shaped compounds containing carbon and other elements such as oxygen, nitrogen or sulfur.

homonuclear diatomic molecules

molecule consisting of two identical atoms

hybrid orbitals

orbital created by combining atomic orbitals on a central atom

hybridization

model that describes the changes in the atomic orbitals of an atom when it forms a covalent compound

initiator

chemically active molecule

Injection molding

manufacturing process for producing parts by injecting molten material into a mold

Isomerization

rearrangement of the molecular structure under heat, pressure and exposure to a catalyst

isomers

Compounds with the same molecular formula but different spatial arrangements of the atoms in their molecules

ketones

organic compound containing a carbonyl group with two carbon substituents attached to it

LDPE (Low density polyethylene)

LDPE (Low density polyethylene) is defined by a density range of 0.910–0.940 g/cm³.

levorotatory

optically active substances rotate the plane of polarized light to the left (counterclockwise) from the observer's point of view

line structure formula

The formula where carbon atoms are not symbolized with a C, but represented by each end of a line or bend in a line. Hydrogen atoms are not drawn if they are attached to a carbon

linear combination of atomic orbitals (LCAO).

technique for combining atomic orbitals to create molecular orbitals

LLDPE (Linear low density polyethylene)

LLDPE (Linear low density polyethylene) is defined by a density range of 0.915–0.925 g/cm³. LLDPE is a substantially linear polymer with significant numbers of short branches.

macromolecule

a very large molecule containing thousands of atoms covalently bonded together in a specific structure

Matter

anything that occupies space and has mass

Microfiber

synthetic fiber finer than one denier or decitex/thread, having a diameter of less than ten micrometers

Molding

process of manufacturing by shaping liquid or pliable raw material using a rigid frame called a mold or matrix

molecular formula

The formula that shows only the kinds and numbers of atoms in a molecule

molecular ion peak, or parent peak

the peak that corresponds to the molecular weight of the compound

molecular orbital (ψ^2).

region of space in which an electron has a high probability of being found in a molecule

molecular orbital diagram

visual representation of the relative energy levels of molecular orbitals

Molecular orbital theory

model that describes the behavior of electrons delocalized throughout a molecule in terms of the combination of atomic wave functions

monomers

smallest repeating unit that links together to form a polymer

natural

found in nature

Neoprene

family of synthetic rubbers that are produced by polymerization of chloroprene

Nitrile

An organic compound containing a cyano group (carbon triple bonded to nitrogen) is attached to a carbon atom. These compounds are colourless solids or liquids with distinctive odours.

node

plane separating different lobes of orbitals, where the probability of finding an electron is zero

Organic compounds

natural or synthetic compound that contains carbon

overlap

coexistence of orbitals from two different atoms sharing the same region of space, leading to the formation of a covalent bond

oxidation–reduction reactions

identified by changes in the number of oxygen atoms at a particular position in the hydrocarbon skeleton or in the number of bonds between carbon and oxygen at that position. An increase in either corresponds to an oxidation, whereas a decrease corresponds to a reduction. Conversely, an increase in the number of hydrogen atoms in a hydrocarbon is often an indication of a reduction.

paramagnetism

phenomenon in which a material is not magnetic itself but is attracted to a magnetic field; it occurs when there are unpaired electrons present

Phenolics

polymers made from phenol (hydroxybenzene)

phenols

Compounds in which an OH group is attached directly to an aromatic ring are designated ArOH (where Ar stands for aromatic)

photons

particles of light

pi (π) bonding molecular orbital

molecular orbital formed by side-by-side overlap of atomic orbitals, in which the electron density is found on opposite sides of the internuclear axis

pi bond (π bond)

covalent bond formed by side-by-side overlap of atomic orbitals; the electron density is found on opposite sides of the internuclear axis

Plasticizers

additives that increase the plasticity or decrease the viscosity of a material

plastics

polymers that are capable of being molded (formed into a shape) or are pliable

Polybutadiene

polymer formed from the polymerization of the monomer 1,3-butadiene

Polycarbonates

group of thermoplastic polymers containing carbonate groups in their chemical structures

Polyesters

arise from the reaction of carboxylic acid and an alcohol.

Polyethylene

The most common plastic formed from ethene (ethylene) monomer. Also called polyethene.

Polyethylene terephthalate

commonly abbreviated PET, PETE, or Dacron

polymer

large molecule, or macromolecule, composed of many repeated subunits

polymerization

Process of monomers bonding together to form a polymer

Polypropylene (PP)

also called polypropene; made from the monomer propylene (propene)

Polytetrafluoroethylene (PTFE)

synthetic fluoropolymer of tetrafluoroethylene

Polyurethane

polymer composed of organic units joined by carbamate (urethane) links

Polyvinyl chloride (PVC)

polymer produced from vinyl chloride monomer

primary (1°) alcohol

alcohol in which the carbon atom with the OH group is attached to one other carbon atom

primary (1°) amine

an amine containing one alkyl group on the central nitrogen atom.

Proteins

polymers of amino acids, which are monomers that have an amine functional group and a carboxylic acid functional group

Rearrangement reactions

occur when a single reactant undergoes a reorganization of bonds and atoms to yield an isomeric product

s-p mixing

change that causes σ_p orbitals to be less stable than π_p orbitals due to the mixing of s and p-based molecular orbitals of similar energies.

saponification

hydrolysis of esters into carboxylate salts and alcohols in a basic solution.

saturated hydrocarbons

molecule containing carbon and hydrogen that has only single bonds between carbon atoms

secondary (2°) alcohol

alcohol in which the carbon atom with the OH group is attached to two other carbon atoms

secondary (2°) amine

has two alkyl groups on the central nitrogen.

sigma bonds (σ bonds)

covalent bond formed by overlap of atomic orbitals along the internuclear axis

Spectroscopy

use of electromagnetic radiation (energy) to determine the structure of a compound

spectrum

the pattern in which matter absorbs or emits radiation

starch

important source of energy in the human diet formed from repeating glucose units

stereoisomers

isomers having the same structural formula but differing in the arrangement of atoms or groups of atoms in three-dimensional space

structural formulas

The formula that shows the elements and their arrangements within the molecular structure

styrene-butadiene rubber (SBR)

families of synthetic rubbers derived from styrene and butadiene

substituents

branch or functional group that replaces hydrogen atoms in a larger hydrocarbon chain

Substitution reactions

occur when two reactants exchange parts to give two new products

Sulfur vulcanization

chemical process for converting natural rubber or related polymers into more durable materials by heating them with sulfur or other equivalent curatives or accelerators

synthetic

man-made

tertiary (3°) alcohol

alcohol in which the carbon atom with the OH group is attached to three other carbon atoms

tertiary (3°) amine

has three alkyl groups on the central nitrogen atom.

Thermoplastics

plastics that soften when heated and become firm again when cooled

Thermosetting polymers

plastics that soften when heated and can be molded, but harden permanently

Thiols

sulfur analogs of alcohols, have the general formula RSH. also called mercaptans

Transfer molding

manufacturing process where casting material is forced into a mold

Valence bond theory

description of bonding that involves atomic orbitals overlapping to form σ or π bonds, within which pairs of electrons are shared

ANCILLARY RESOURCES FOR FACULTY

Suggested Additional Resources

If you are faculty looking for additional resources to support your course delivery using this textbook, there are several options:

- Image PowerPoint Banks (created as part of this project; available below)
- OpenStax Instructor resources for *Organic Chemistry: A Tenth Edition* – OpenStax [New tab] (<https://openstax.org/details/books/organic-chemistry?Instructor%20resources>)
- Homework System: LibreADAPT for organic chemistry sources [New tab] (<https://adapt.libretexts.org/open-courses/commons>)
 - Organic Chemistry with a Biological Emphasis (Soderberg)
 - General, Organic, and Biological Chemistry (Ball)
 - Organic Chemistry (LibreTexts)
 - Numerous others

Image PowerPoint Banks

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UPDATE & CHANGE LOG

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