CHM1022

ORGANIC CHEMISTRY (Lectures 1-12)

Lecture 1 – Functional Groups

Functional Groups

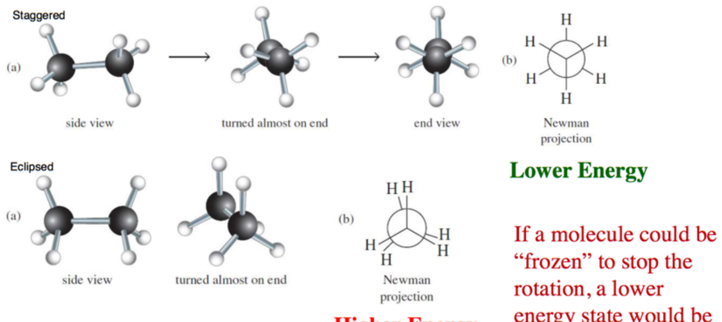
- Alkanes: Single C-C bonds (saturated) -ane-
- Alkenes: Double C-C bonds (unsaturated) -en-
- Alkynes: Triple C-C bonds (unsaturated) -yn-
- Arenes: Benzene-like rings (unsaturated)
- Alcohols: R-O-H -ol
- Carboxylic Acid: R-C-O-O-H -oic acid
- Esters: R-(C=O)-O -ol -oic acid
- Ethers: R-O-R'
- Alkyl Halides: R-X
- Amines: R-NH_2 -amine
- Aldehydes: R-C-H-O -al
- Ketones: R-(C=O)-R -one
- Amides: R-C-O-N-H-R'

Isomers

- Same compounds with the same molecular formula but a different connectivity of atoms
- Possess different physical and chemical properties

Free Rotation

- Staggered (opposite ends) → Lower energy
- Eclipsed (same ends) → Higher energy



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Nomenclature of Compounds

- The longest chain closest to a functional group is '1' (-OH takes priority)
- Name down the chain with the smallest number of carbons in the chain
- Include functional groups with suffixes and infixes (prop-1-ol)

Alcohols

- Polar
- High boiling point
- Soluble in water

Amines

- Both 1° and 2° amines form intermolecular hydrogen bonds
- N-H----N hydrogen bonds are not as strong as O-H----O due to electronegativity
- Solubility is also determined by the length of the carbon chain
- More C = less soluble

Lecture 2 – Stereochemistry

Terminology

- Constitutional Isomers: Isomers with a different connectivity
- Stereoisomers: Isomers with the same molecular formula and the same connectivity but a different orientation in space
    - Enantiomers: Mirror images
    - Diastereoisomers: Not mirror images
- Geometric Isomers: Broken into two orientations
    - Cis: Same side
    - Trans: Different side

Chirality

- Chiral: A molecule that is not superposable on its mirror image
- Achiral: A molecule that is superposable on its mirror image
    - Has a plane of symmetry
- Many chiral molecules contain an asymmetric carbon center, called a stereogenic center
- Drawn on paper with dashed and bold lines

Enantiomers

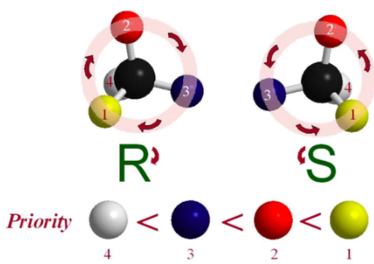
- Have identical physical and chemical properties in an achiral environment
- Human body is a chiral environment
- Labelled "R" or "S" enantiomers

Optical Activity

- If a sample is optically inactive (achiral), the plane is unchanged and no rotation is detected
- If a sample is optically active (chiral), the plane of polarisation is rotated. The polarimeter is used to determine both the direction and magnitude of the rotation
- Enantiomers can be distinguished by how they interact with a plane of polarised light; they are optical isomers
- Dextrorotatory (d) or (+): Rotation of the plane clockwise
- Levorotatory (l) or (-): Rotation of the plane anticlockwise
- Racemic Mixture (±): Equal amount of the enantiomers (1:1 ratio of R:S)

Naming Enantiomers

- Used to designate configuration at a stereocentre
- The labels R and S are use to differentiate
    1. Locate the stereogenic centre
    2. Assign a priority (1 → 4) to each substituent
    3. Orient the lowest priority substituent away from you (usually H atom)
    4. The remaining three groups then project towards you



Naming Enantiomers II

- (+) and (-) do not denote R and S
- The higher the atomic number, the higher the priority
- The atoms directly attached to the stereocentre are examined first
- In the case of double bonds, the atoms are treated as two atoms attached by single bonds
- For a pair of enantiomers, the value of the specific rotation is the same but opposite in sign

Stereoisomers

- For a molecule with 1 stereocentre, 2^1 = 2 stereoisomers are possible
- For a molecule with 2 stereocentres, 2^2 = 4 stereoisomers are possible
- For a molecule with n stereocentres, n = 2^n stereoisomers are possible

Meso Forms