Tutorial 16: An Introduction to Organic Chemistry and Nomenclature of Hydrocarbons

Goals:

- ✓ Understand the definition of organic chemistry.
- ✓ Be able to name and draw straight chained hydrocarbons and branched hydrocarbons with up to 10 carbons in the parent chain.
- ✓ Know the difference in saturated and unsaturated hydrocarbons, and understand the general formulas for alkanes, alkenes and alkynes.
- ✓ Know how to represent organic molecules using line structures.

Organic Chemistry

- Organic chemistry is the branch of chemistry that deals with the study of carbon based compounds.

- Carbon is capable of forming four bonds:
  - Four single bonds = tetrahedral geometry
  - Two single bonds and one double bond = trigonal planar geometry
  - Two double bonds = linear geometry
  - One single bond and one triple bond = linear geometry

- Hydrocarbons are the simplest organic compounds and are made up of C and H only.
  - Saturated: Saturated hydrocarbons contain the maximum number of H atoms possible per C atom. Saturated hydrocarbons are known as alkanes.

  - Unsaturated: Unsaturated hydrocarbons contain less than the maximum number of H atoms possible per C atom because they contain double or triple bonds. Unsaturated hydrocarbons are known as alkenes or alkynes.

Nomenclature of Straight Chained Hydrocarbons

- A prefix tells how many carbons are in the chain:

Meth-
Eth-
Prop-
But-
Pent-
Hex-
Hept-
Oct-
Non-
Dec-

- The suffix tells whether it is an alkane, alkene or alkyne:

-ane
-ene
-yne

- For alkenes and alkynes with over three carbons, you must specify the location of the double or triple bond with a number.

- For alkenes with over three carbons, check for cis-trans isomers.

Isomers

- Iso- means same and –mers means parts.
- Isomers are compounds with the same molecular formula but different chemical structures.
- Structural isomers (constitutional isomers) have the same molecular formula, but a different connectivity of atoms.
- Geometric isomers (cis-trans isomers) have the same molecular formula, same connectivity of atoms, but different 3-D arrangements about the double bond.

NOTE: Some cyclic structures can also exist as a cis and trans isomer, but this will not be covered here. Our discussion of geometric isomers will only focus on alkenes.

Nomenclature of Branched Alkanes

1. Name the longest chain
2. Number the main chain giving the lowest number priority to any branched groups
3. Name the branched groups and identify their position by the number in the chain
4. Write the full name as a single word
   - use hyphens to separate numbers from prefixes
   - use commas to separate numbers from numbers
   - use alphabetical order for branched groups
   - use di-, tri-, or tetra- prefixes if there are multiples of the same branch group

Nomenclature of Branched Alkenes and Alkynes

1. Name the parent chain (the longest chain containing the double or triple bond)
2. Number the chain giving the lowest priority to the double or triple bond
3. Assign a name and number to the branched groups
4. Write the full name as one word
   - use hyphens to separate numbers from prefixes
   - use commas to separate numbers from numbers
   - use alphabetical order for branched groups
   - use di-, tri-, or tetra- prefixes if there are multiples of the same branch group
   - if it is an alkene, determine if cis-trans isomers apply

Condensed and Line Structures

- Condensed structures eliminate the need to draw out all of the single bonds in a molecule. We will still show double and triple bonds, as well as bonds to branched groups.

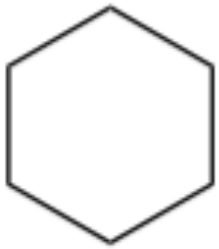
- Line structures are the fasted method for drawing out molecules. In this form, all points represent a carbon and all hydrogen atoms are assumed for octet. Atoms other than carbon and hydrogen are drawn in.

Cyclic Hydrocarbons

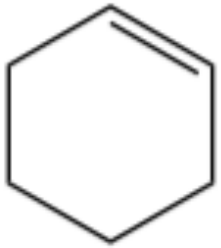
cyclopropane

cyclobutane

cyclopentane



cyclohexane



cyclohexene