

Chapter: Carbon and Hydrocarbons

Section 3: Saturated Hydrocarbons

Saturated hydrocarbons: hydrocarbons in which each carbon atom in the molecule forms four single covalent bonds with other atoms

Alkane: hydrocarbons that contain only single bonds

- each member differs from the next by one carbon and two hydrogens (-CH₂-)
- ethane vs. propane
- general structure for alkanes = C_nH_{2n+2}

Cycloalkanes: alkanes in which the carbon atoms are arranged in a ring, or cyclic, structure

- general structure for cycloalkanes = C_nH_{2n}

Draw butane and cyclobutane

IUPAC: International Union of Pure and Applied Chemistry

- developed the systematic method for naming compounds
- the basic part of the name is the longest carbon chain, or parent hydrocarbon

Prefixes:

Number of Carbons:

1

2

3

Prefix

meth-

eth-

prop-

4	but-
5	pent-
6	hex-
7	hept-
8	oct-
9	non-
10	dec-

Naming:

- Unbranched Chain Alkane Nomenclature
 - Count the number of carbon atoms
 - Find the prefix
 - Add the suffix –ane
 - Example on white board
- Branched Chain Alkane Nomenclature
 - **Alkyl groups:** groups of atoms that are formed when one hydrogen atom is removed from an alkane molecule
 - Methyl (-CH₃)
 - Ethyl (-CH₂-CH₃)
 - Propyl (-CH₂-CH₂-CH₃)
 - Butyl (-CH₂-CH₂-CH₂-CH₃)
 - Name the parent hydrocarbon (longest chain)
 - Add the name of the alkyl groups
 - Use numerical prefixes if there is more than one alkyl group
 1. di-, tri-, tetra-
 - Number the carbon atoms in the parent chain

- Insert position numbers
- Punctuate the name

- Cycloalkane nomenclature
 - Name the parent hydrocarbon
 - i. Add the prefix *cyclo-* after adding the number of carbons in the ring
 - Add the name of the alkyl groups
 - Number the carbon atoms in the parent hydrocarbon
 - i. Assign position numbers to the alkyl group that comes first in alphabetical order
 - ii. Number in the direction that gives the rest of the alkyl groups the lowest numbers
 - Insert position numbers
 - Punctuate the name

Natural Gas: a fossil fuel composed primarily of alkanes containing one to four carbon atoms

- Butane and propane
 - Lower molecular mass (low number of carbons) are primarily gases
 - Higher molecular mass (high number of carbons) are primarily liquids and solids

Fractional distillation: components of a mixture (different molecular mass) are separated on the basis of boiling points, by condensation of vapor in a fractionating column

Engines are powered by gasoline (mix of hydrocarbons) combustion

- (hydrocarbon) + $O_2 \rightarrow CO_2 + H_2O$
- Fuel ignites spontaneously before the flame front therefore there is a decrease in the amount of power causing knocking in the engine
 - Straight chain hydrocarbons are more likely to cause the knocking than branched hydrocarbons
 - **Octane rating:** a fuel is measure of its burning efficiency and its antiknock properties
 - Mixture of 2,2,4-trimethylpentane (called *isooctane*) and heptane
 - Pure 2,2,4-trimethylpentane is very resistant to knocking and has a rating of 100
 - Pure heptane has an octane rating of 0 and burns with a lot of knocking
 - Octane rating of 87 (common unleaded fuel) has 87% isooctane and 13% heptane

HEET: gets rid of water in gasoline

- Methanol – polar solvent – CH_3OH
 - CH_3 is nonpolar and OH is polar
 - Gas is nonpolar while water is polar so you get a two-layer is gas line
 - Gas + water \rightarrow immiscible
 - Gas + alcohol \rightarrow miscible
 - Gas + water + alcohol \rightarrow miscible
- Think of oil on your hands?