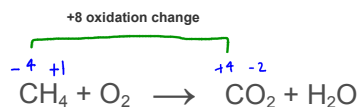


Chapter 22-23 Hydrocarbons

Organic Compounds

All Carbon containing compounds

★ Except carbon oxides, carbides, and carbonates which are inorganic.
CO & CO₂ Na₄C CaCO₃



Hydrocarbons

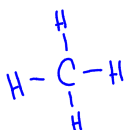
Simple organic compounds

Contain carbon and hydrogen

Carbon forms 4 covalent bonds

Carbon atoms have 4 valence electrons

Hydrogen forms 1 covalent bond

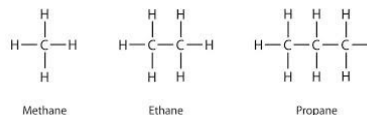


Alkanes

Hydrocarbons that have only single bonds between atoms.

Carbons are saturated with Hydrogen atoms Maximum Hydrogen

★ Nonpolar covalent bonds



Condensed Structural Formula

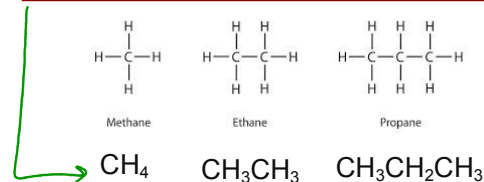


TABLE 21.1 First Ten Members of the Straight-Chain Alkane Series

Molecular Formula	Condensed Structural Formula	Name	Boiling Point (°C)
CH ₄	CH ₄	Methane	-161
C ₂ H ₆	CH ₃ CH ₃	Ethane	-89
C ₃ H ₈	CH ₃ CH ₂ CH ₃	Propane	-44
C ₄ H ₁₀	CH ₃ CH ₂ CH ₂ CH ₃	Butane	-0.5
C ₅ H ₁₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	Pentane	36
C ₆ H ₁₄	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Hexane	68
C ₇ H ₁₆	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Heptane	98
C ₈ H ₁₈	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Octane	125
C ₉ H ₂₀	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Nonane	151
C ₁₀ H ₂₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Decane	174

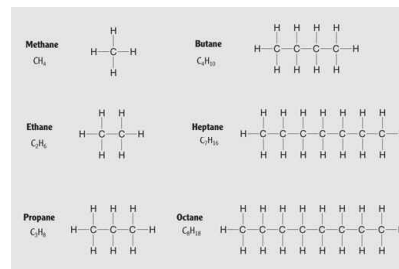
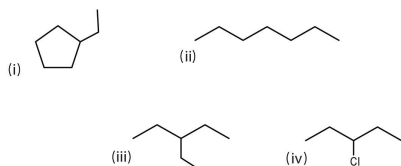
Physical State of Alkanes

- Methane, ethane, propane, & butane are all gases at room temperature. They are only liquids when pressurized.
- They become liquids starting with pentane
- Solid alkanes do not appear until $C_{17}H_{36}$
- Cycloalkanes have higher boiling points than straight chain version
- Branched alkanes have lower boiling points than straight chain

Types of Structural Formulas

Expanded Structural formula			
Condensed Structural formula	CH_4	CH_3-CH_3	$CH_3-CH_2-CH_3$
	Methane	Ethane	Propane

Line Formulas



Straight Chain vs. Branched Chain

Are the carbons lined up in a single line or do carbon atoms branch off of the parent chain?

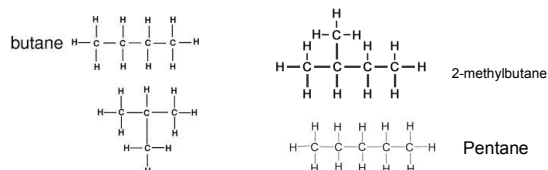


Image by Allopia James Dyer

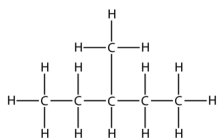
Naming Branched-Chain Alkanes

Parent Chain: The longest continuous chain of carbon atoms in a hydrocarbon

Substituent Groups: a side branch off the parent chain that substitutes for a hydrogen atom.

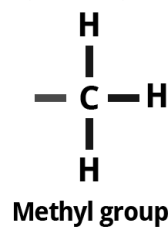
Functional Groups

- They are substituent groups of atoms attached to the carbon backbone of organic molecules.
- The same functional group will undergo the same, or at least similar, chemical reaction regardless of the overall size of the molecule.



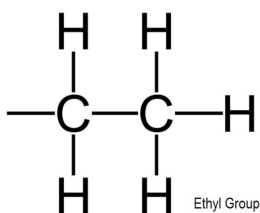
5 carbon pentane chain
a methyl group is attached

Methyl Alkyl Group



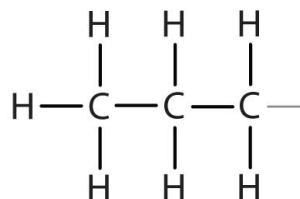
Methyl group

Ethyl Alkyl Group



Ethyl Group

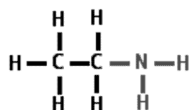
Propyl Alkyl Group



Hydroxyl Functional Group



Amine Functional Group

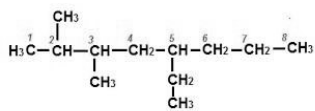


IUPAC Naming Process

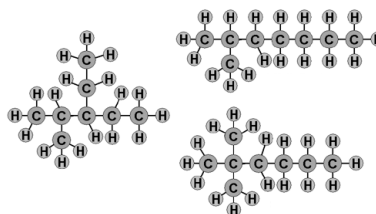
(International Union of Pure and Applied Chemistry)

1. Find the parent chain and name it based on the carbon atoms.
2. Number the carbons in the parent chain. The carbon closest to the substituent group is always carbon 1.
3. Name each alkyl group substituent.
4. Use prefixes to indicate how many times the substituent group appears. (di-, tri-, tetra-)
5. If there are different alkyl groups on the same parent chain, they should be listed in alphabetical order.
6. Hyphens separate numbers from words and commas separate numbers.

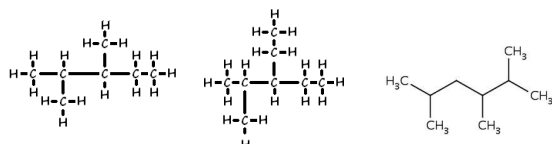
IUPAC Naming Process



Name the Following using IUPAC



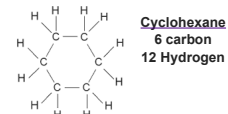
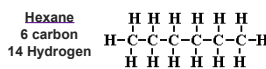
Name the Following using IUPAC



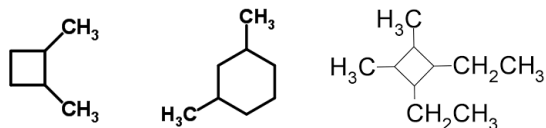
Cyclic Alkanes

Cycloalkanes are when 3 or more carbons are in a ring structure held together by single bonds.

Cycloalkanes have 2 fewer hydrogen atoms than straight chained alkanes due to the carbon's on the end forming C-C bonds.

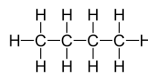


Naming Cycloalkanes

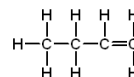


Saturated vs. Unsaturated Hydrocarbons

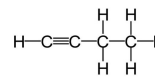
- Determined by the number of hydrogen atoms present in a hydrocarbon.
- The number of double and triple bonds between the carbon atoms changes the number of hydrogen atoms present



10 - H



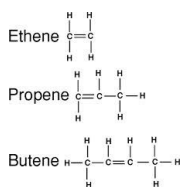
8 - H



6 - H

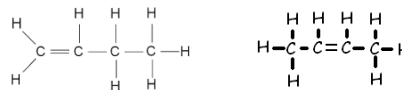
Alkenes

- Unsaturated Hydrocarbons that have one or more **double bonds** between carbon atoms.
- Carbons are unsaturated with Hydrogen atoms



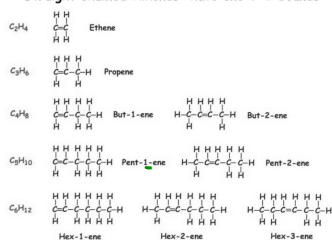
Naming Alkenes

It is very similar to naming alkanes, however, you must identify the location of the double bond. The location of double bond is priority.

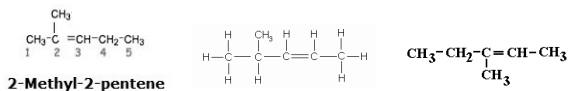


Is 3-butene possible?

Straight chained Alkenes: have one C=C bonds

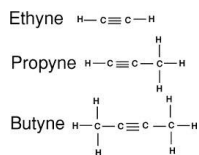


Name the Following using IUPAC

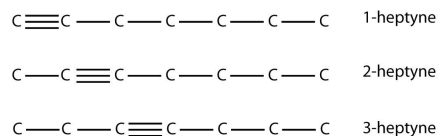


Alkynes

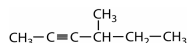
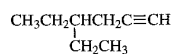
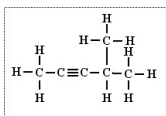
- Unsaturated Hydrocarbons that have one or more **triple bonds** between carbon atoms.
- Carbons are unsaturated with Hydrogen atoms



Name the Following using IUPAC



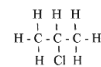
Name the Following using IUPAC



72

Isomers

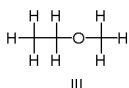
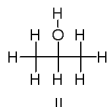
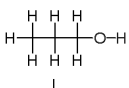
Two or more compounds that have the same molecular formula but different molecular structure.



Both have the same formula, $\text{C}_3\text{H}_7\text{Cl}$
but different structures

Structural Isomers

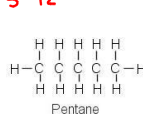
Two or more compounds that have the same molecular formula but are bonded in a completely different order, therefore changing its properties.



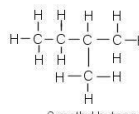
$\text{C}_4\text{H}_{10}\text{O}$

Structural Isomers of Pentane

C_5H_{12}

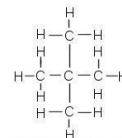


Pentane



2 methyl butane

- methyl group hangs off 2nd C atom
- longest chain is 4 C's long = butane



2,2 dimethyl propane

- 2 methyl groups both hang off 2nd C atom
- longest unbroken chain is 3 C's = propane