

Organic Chemistry

What is organic chemistry?

- The name implies that it is the chemistry of living things
- That is partially true
- Organic chemistry- the study of carbon containing compounds (*with a few exceptions-like CO₂)
- All living things are carbon based.
- However, carbon is not only involved in living things.

Why does carbon get its own class of chemistry?

- Since carbon can form 4 covalent bonds it has a large number of possibilities for structures.
- It also readily bonds with other carbon atoms forming chains or rings, which gives it billions of stable structures.
- Also, living things continuously do "experiments" making new carbon compounds.

...because there are so many useful carbon compounds

- Chemistry is basically split into organic and inorganic.
- Carbon chemistry and everything else, and the everything else didn't really become important until recently.
- Since living things naturally make all of these carbon compounds, man found several uses for them without having to manufacture them.

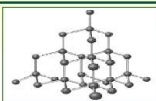
Just a small sampling

- Some carbon compounds include
- DNA, diamonds, natural gas, aspirin, octane, polyester, freon, asphalt...
- Caffeine, carbohydrates, plastics, rubber, acrylic, vinyl, graphite, proteins, propane...
- Vinegar, citric acid, leather, TNT, alcohol, ibuprofen, soot, cellulose, butane etc.
- There are more known compounds of carbon than there are for all other elements combined!

Allotropes of pure carbon

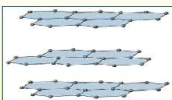
- Allotrope- Different molecular structure of molecules containing the same atom
- Diamonds- dense tetrahedral network
- Graphite- layers laying on top of each other
- Buckminsterfullerene or buckyball ~ found in soot (a sphere)

Allotropes of Carbon



Diamond
sp³-hybridized
carbon

Graphite
sp²-hybridized
carbon



Fullerenes: C₆₀, C₇₀

Simplest organic compounds

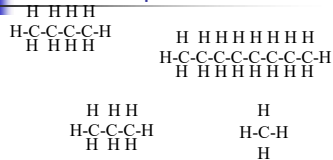
- Hydrocarbons- compounds containing
- carbon and hydrogen
- Alkanes- straight chain hydrocarbons with all single bonds
- Organic molecules follow their own system of nomenclature (naming)
- Alkanes get the suffix "-ane"

Naming and drawing organic compounds

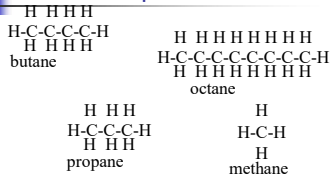
Root words

	# of C atoms		# of C atoms
Meth	1	Hex	6
Eth	2	Hept	7
Prop	3	Oct	8
But	4	Non	9
Pent	5	Dec	10

So for example

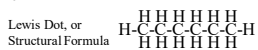


So for example



Molecular Formulas

- Alkanes always have the molecular formula of:
 - C_nH_{2n+2}
 - 2 H on every C except the end, they get 3
 - Hexane-
 - C_6H_{14} ← molecular formula

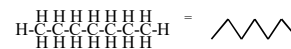


Skeleton Formulas

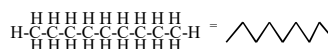
- Drawing Lewis Dot structural formulas for long organic compounds can get rather tedious.
- So organic has shortened it
- They don't write the C's or the H's
- You draw a jagged line, at each corner there is a Carbon
- Assume all extra spaces are filled with H

For Example

Heptane, C_7H_{16}

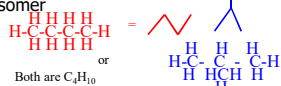


Nonane, C_9H_{20}



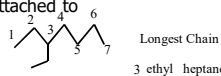
Isomers

- Isomers- compounds with the same molecular formula but different structural formulas
- Different structural formulas mean it has different properties
- Butane is the first alkane with a possible isomer



Naming Isomers

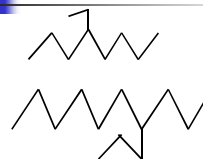
- Name the longest chain possible.
- As a prefix, name the chain attached with -yl on the end and give the number of the carbon atom it is attached to




It could also be 5 ethyl heptane if you started numbering from the other side, when given an option always go with the **Lower number!!!**


Name this molecule

And give its molecular formula



Name this molecule
And give its molecular formula


 4 ethyl octane
 $C_{10}H_{22}$

 4 propyl decane
 $C_{13}H_{28}$



Cyclic Hydrocarbons



A hydrocarbon that is a ring instead of a chain. To name it, give it the prefix "cyclo-"

- Molecular Formula
- Subtract 2 H from C_xH_{2x+2}
- C_xH_{2x}
- cyclobutane


 C_4H_8


Name the following compounds and give their formula


 


 

Name the following compounds and give their formula

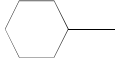
 cyclohexane
 C_6H_{12}

 cycloheptane
 C_7H_{14}

 cyclooctane
 C_8H_{16}

 cyclodecane
 $C_{10}H_{20}$

Name and give the formula

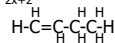



Methyl cyclohexane
 C_7H_{14}

Alkenes

- Contain a double bond
- They get the suffix "-ene" and the number of the carbon atom the double bond is on (lowest number)
- Molecular formula
- Subtract 2 H for each double bond from skeleton formula

C_xH_{2x+2} 1 butene C_4H_8

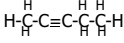

 

Alkynes



- Contain a triple bond
- They get the suffix "-yne" and the number of the carbon atom the triple bond is on. Molecular formula
- subtract 4 H for each triple bond from C_xH_{2x+2}



Skeleton formula


2 pentyne C_5H_8


Name and give the formula for these compounds


 


 





Name and give the formula for these compounds

 2 hexene C_6H_{12}

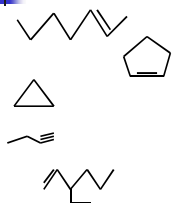
 Cyclopentane
 C_5H_{10}

 3 methyl nonane $C_{10}H_{22}$

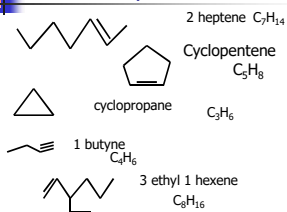
 ethyne (commonly known as acetylene)
 C_2H_2

 3 methyl 1 pentene
 C_6H_{12}

Name and give the formula for these compounds



Name and give the formula for these compounds



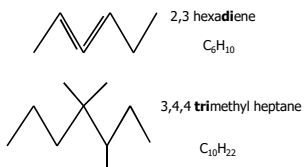
Doubles and triples

- If you have two of the same thing put "di" in front of it
- If you have three of the same thing put "tri" in front of it

Examples

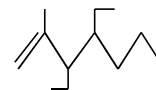


Examples



Multiple groups on a chain

- Name each and put the prefixes in alphabetical order



Multiple groups on a chain

- Name each and put the prefixes in alphabetical order

