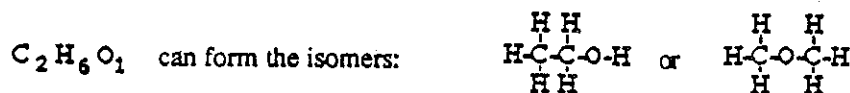


8.1 Alkanes, Alkenes, and Alkynes

Organic chemistry is the study of carbon compounds. The clothes you wear, the food you eat, parts of the home you live in, and the fuels you use to heat your home and drive your car are all made up of carbon compounds.

Carbon bonds in a variety of ways. For example, carbons can form carbon-carbon single, double, and triple bonds. There are also a great number of structural isomers for carbon compounds. Structural isomers have the same molecular formula but different structures.



Hydrocarbons are organic compounds, which are made up of carbons and hydrogens. Alkyl groups, which contain carbons bonded to hydrogens, are named according to the number of carbons in the group. Alkyl groups are bonded to a hydrogen or a carbon chain in order to make hydrocarbons.

Alkyl Groups

methyl: CH_3-
butyl: C_4H_9-
heptyl: $C_7H_{15}-$
decyl: $C_{10}H_{21}-$

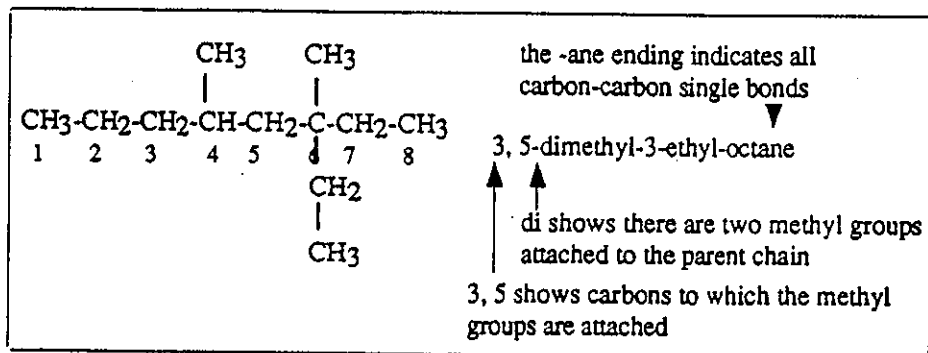
ethyl: C_2H_5-
pentyl: $C_5H_{11}-$
octyl: $C_8H_{17}-$

propyl: C_3H_7-
hexyl: $C_6H_{13}-$
nonyl: $C_9H_{19}-$

One group of hydrocarbons is called alkanes. They have the general formula C_nH_{2n+2} . Alkanes have all carbon-carbon single bonds. The geometry around the carbon atoms is tetrahedral with 109.5° bond angles.

To name alkanes, follow these rules:

- Number the longest, continuous chain of carbon atoms starting at the end closest to the branching.
- Name the longest chain by using the alkyl prefix that corresponds to the number of carbons in the chain, drop the -yl ending on the alkyl group, and end in -ane. For example, CH_4 is called methane. CH_3CH_3 is called ethane. $CH_3CH_2CH_3$ is called propane.
- Name the alkyl groups attached to the longest chain indicating their positions by the number of the carbon on the longest chain to which they are attached. The positions and names of the alkyl groups are written first in the over-all name of the compound.
- If there is more than one of the same alkyl group attached to the parent chain, number each, and add the prefixes di, tri, tetra, etc. to indicate the number of groups.

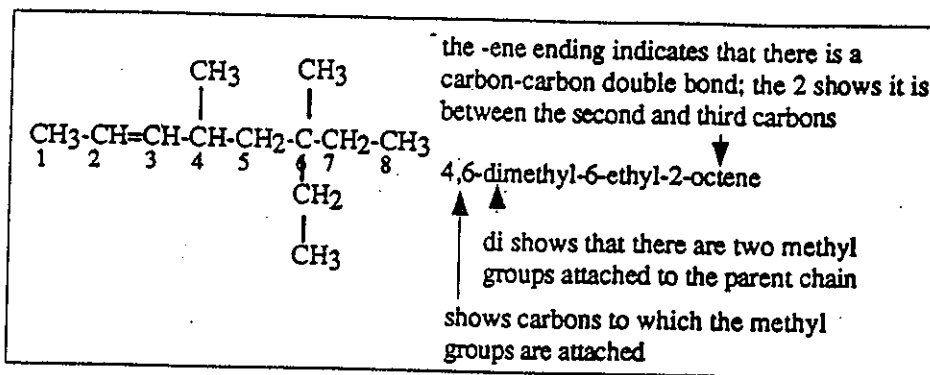


Alkenes are hydrocarbons made up of carbons and hydrogens with one carbon-carbon double bond somewhere in the longest chain. They have the general formula C_nH_{2n} . Alkenes are called unsaturated hydrocarbons because of the double-bond. The geometry around the double bond is trigonal planar with a 120° bond angle.



To name alkenes, follow these rules:

- Number the longest continuous chain of carbon atoms that contains the double bond. Start numbering on the end closest to the double bond.
- Name the longest chain using the alkyl prefix that corresponds to the number of carbons in the chain, drop the -yl ending on the alkyl group, and end in -ene (instead of -ane). The -ene ending indicates the presence of one double bond in the longest chain. Indicate the position of the carbon-carbon double bond by writing the number of the first carbon to which the double bond is connected just before the name of the longest chain. For example, $\text{CH}_3\text{-CH}=\text{CH-CH}_2\text{-CH}_2\text{-CH}_3$ is named 2-hexene.
- Name the alkyl groups attached to the longest chain indicating their positions by the number of the carbon on the longest chain to which they are attached. The positions and names of the alkyl groups are written first in the over-all name of the compound.
- If there is more than one of the same alkyl group attached to the parent chain, number each, and add the prefixes di, tri, tetra, etc. to indicate the number of groups.



Alkynes are unsaturated, triple bonded substances with the general formula, $\text{C}_n\text{H}_{2n-2}$. The geometry around the triple bond is linear with a 180° bond angle.



The IUPAC nomenclature for alkynes is identical to that of alkenes except the ending is -yne to indicate a triple bond.

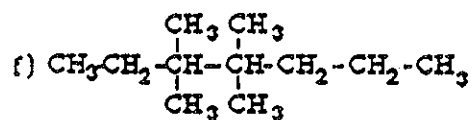
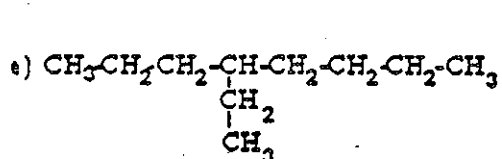
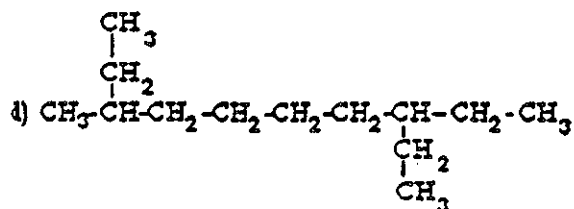
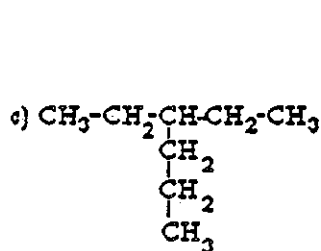
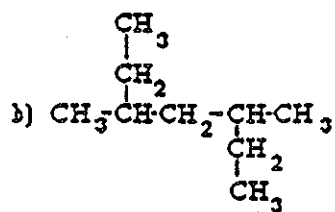
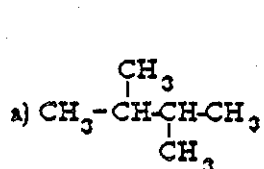
Cooperative Learning

Arrange yourselves into cooperative groups. You will be given 6 black and 14 yellow organic-model balls. The black balls represent carbon atoms and the yellow represent hydrogen atoms. You will also be given pegs for bonding. Using the stick balls, make and then draw the five isomers of hexane, and name them according to the IUPAC rules:

Self Test 8.1

1. Draw the structural isomers of butane and name them according to the IUPAC rules:

2. Name the following according to the IUPAC rules:

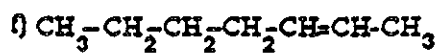
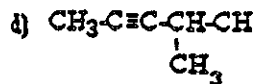
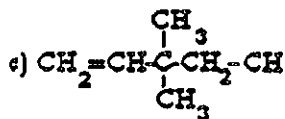
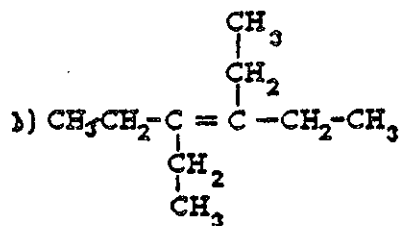
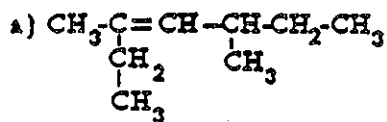


3. Draw the structural formula for the following:

a) 2,2,3,3-tetramethylpentane

b) 2,4-dimethyl-4-ethylheptane

4. Name the following according to IUPAC rules:



5. Draw the structural formula for the following:

a) 2-methyl-3-heptene

b) 3,4-dimethyl-3-hexene

6. Classify the following as alkanes, alkenes, or alkynes:

a) C_4H_{10}

b) C_6H_{12}

c) C_4H_6

d) C_4H_8