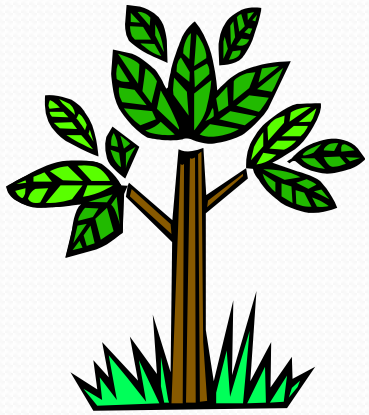
Organic chemistrey

Class; FORM FOUR

Organic Chemistry- The study of carbon & carbon compounds

- Organic compounds are the primary constituents of all living organisms.





What is the organic chemistry ?

Organic chemistry : is a branch of chemistry that involves the study of the structures, composition, and synthesis of carbon-containing compounds.

- Carbon is the spine of the organic compound

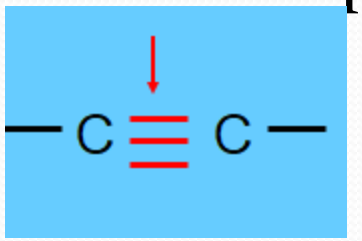
  Whey?

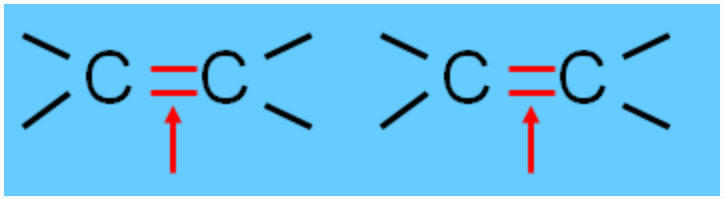
- Because carbon has it's unique property
- And they are;-

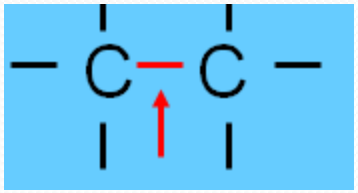
1: Carbon atoms can join to each other to form long chains

Cont..

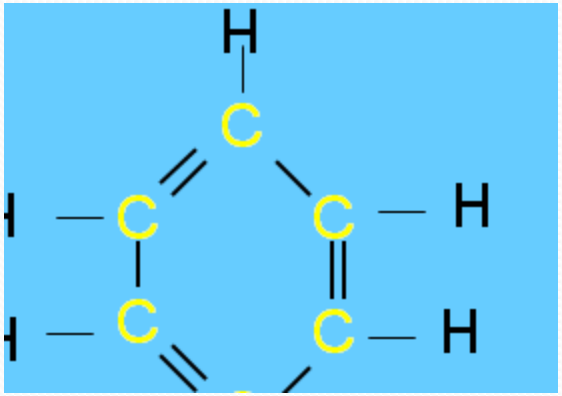
- The carbon atoms in a chain can be linked by single, double or triple covalent bonds



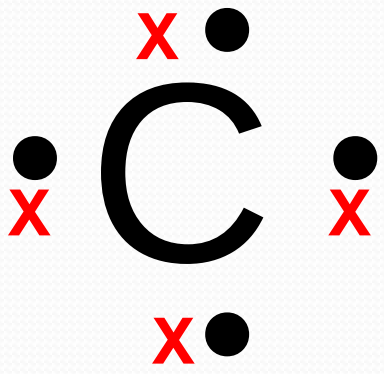




- . Carbon atoms can also arrange themselves in rings.



Draw an electron dot diagram of carbon.



Carbon is able to form 4 covalent bonds (4 valence electrons) with other carbon or other elements.

What is the carbon ?

- Non-metal element
- in Group lV of the Periodic

1. HYDROCARBONS

- A **hydrocarbon** is an organic compound consisting entirely of **hydrogen** and **carbon ONLY**.

1. HYDROCARBON

Aliphatic (R)

Uncyclic / Open Structure

Saturated

No pi bond formation or all are single bonded
Ex. Alkanes

Unsaturated

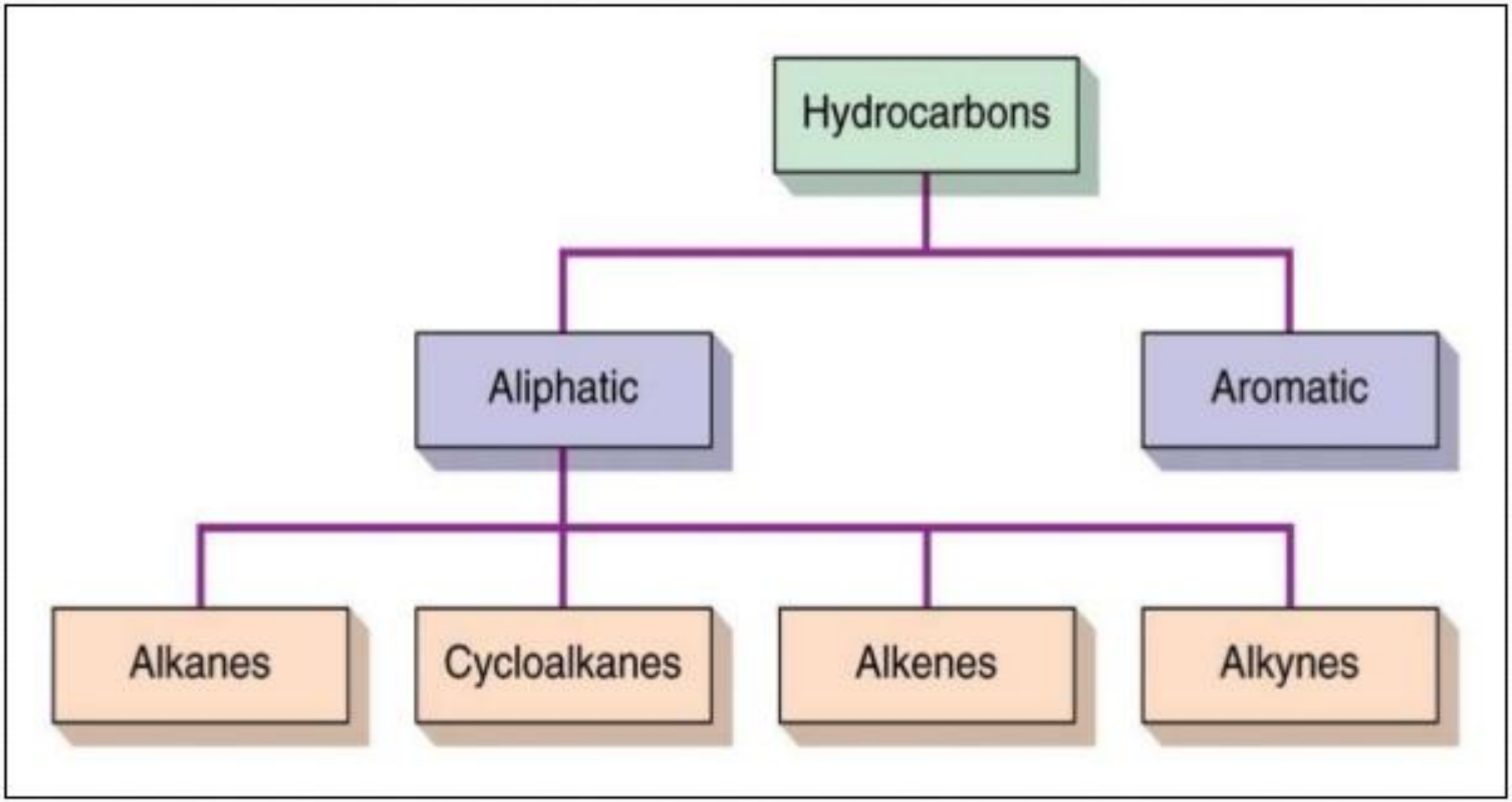
Contain pi bonds / has double or triple bonds
Ex. Alkenes/Alkynes

Aromatic (Ar)

Factors to consider:

1. Should be cyclic (closed structure / no terminal point)
2. Planar (2D structure)
3. Has conjugated double bond (alternating)
4. Follows Huckel's Rule
   #pi e- = 4n + 2

Classification of Hydrocarbons



Cont..

- There are thousands of organic compounds many more than all the inorganic compounds put together.

- In order to make sense they are arranged in families of compounds with similar propefties.

Base names

Prefix	Length of carbon chain
Meth	**1**
Eth	**2**
Prop	**3**
But	**4**
Pent	5
Hex	6
Hept	7
Oct	8
Non	9
Dec	10

Alkanes

Table Q
Homologous Series of Hydrocarbons

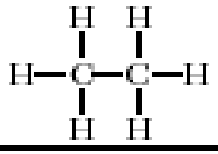
Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	

Table P
Organic Prefixes

Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

- CH_4 = methane
- C_2H_6 = ethane
- C_3H_8 = propane
- C_4H_{10} = butane
- C_5H_{12} = pentane

Alkanes



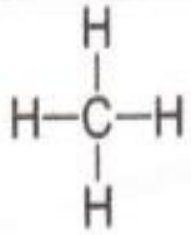
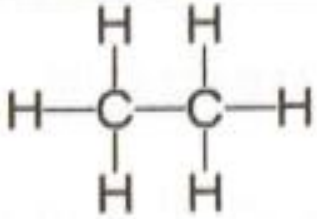
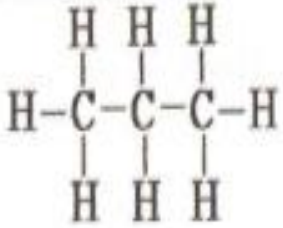
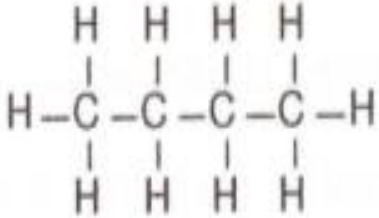
Simplest members of the hydrocarbon family.

- contain only hydrogen and carbon
- only have single bonds

All members have the general formula of

$$C_nH_{2n+2}$$

Twice as many hydrogen as carbon + 2

Name	Formula	Structure formula	N. carbon	b. point
Methane	CH_4		1	-164 ^{0}C
Ethane	C_2H_6		2	-87 ^{0}C
Propane	C_3H_8		3	-42^{0}C
Butane	C_4H_{10}		4	-0.5 ^{0}C

Alkanes

- Alkanes are hydrocarbons (they contain only carbon and hydrogen).
- which have single bonds between all the atoms.
- so alkanes are called saturated hydrocarbons

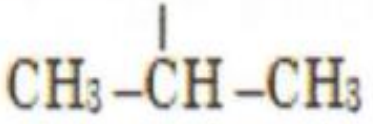
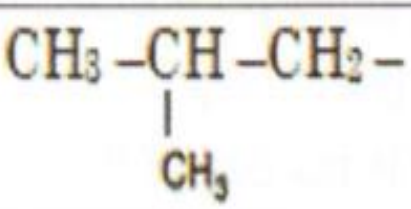
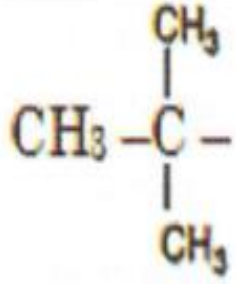
Alkyl Group

- Alkyl group contains one less hydrogen than the corresponding alkane.
- General abbreviation "R" (for Radical, an incomplete species or the "rest" of the molecule)

- In naming this group the "-ane" is dropped and "-yl" is added.
  - CH_3 is "methyl" (from methane)
  - CH_2CH_3 is "ethyl" from ethane

Cont..

- Before we discuss the rules for naming branched alkanes,
- let us see what alkyl groups are.
- Alkyl groups are saturated hydrocarbon radicals having the general formula CnH2n*r,
- where n = 1,2,3.....
- They are derived from alkanes by removing a single hydrogen atom.
- Their names are also derived by changing the suffix -ane of alkanes to -yl.

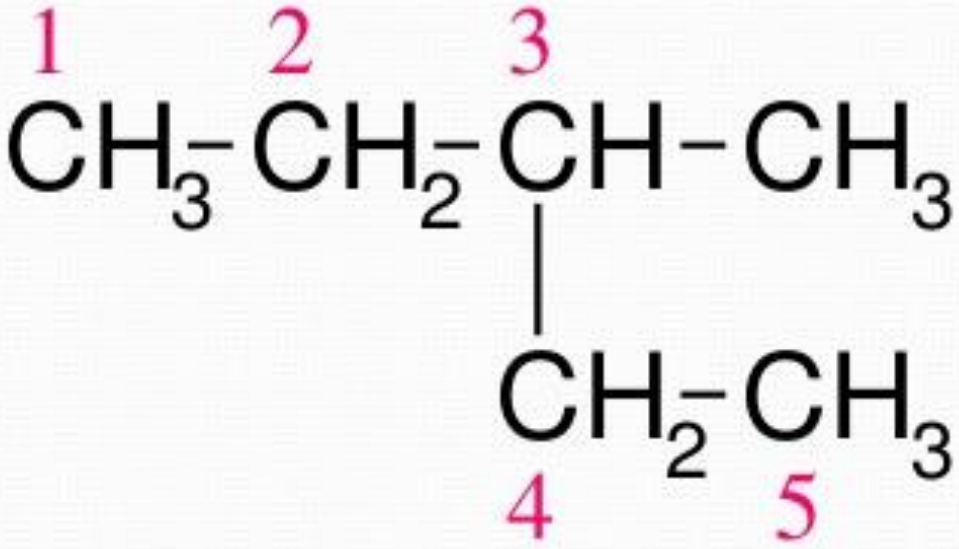
Formula and name of alkane	Formula and name of alkyl radical	Structural formula of alkyl radical
CH_4 (methane)	CH_3 (methyl)	CH_3-
C_2H_6 (ethane)	C_2H_5 (ethyl)	CH_3CH_2-
C_3H_8 (propane)	C_3H_7 (n-propyl)	$CH_3-CH_2-CH_2-$
	C_3H_7 (iso-propyl)	
C_4H_{10} (butane)	C_4H_9- (n-butyl)	$CH_3-CH_2-CH_2-CH_2-$
	C_4H_9- (iso-butyl)	
	C_4H_9- (sec-butyl)	
	C_4H_9- (tert-butyl)	

IUPAC System of Nomenclature

For Alkanes

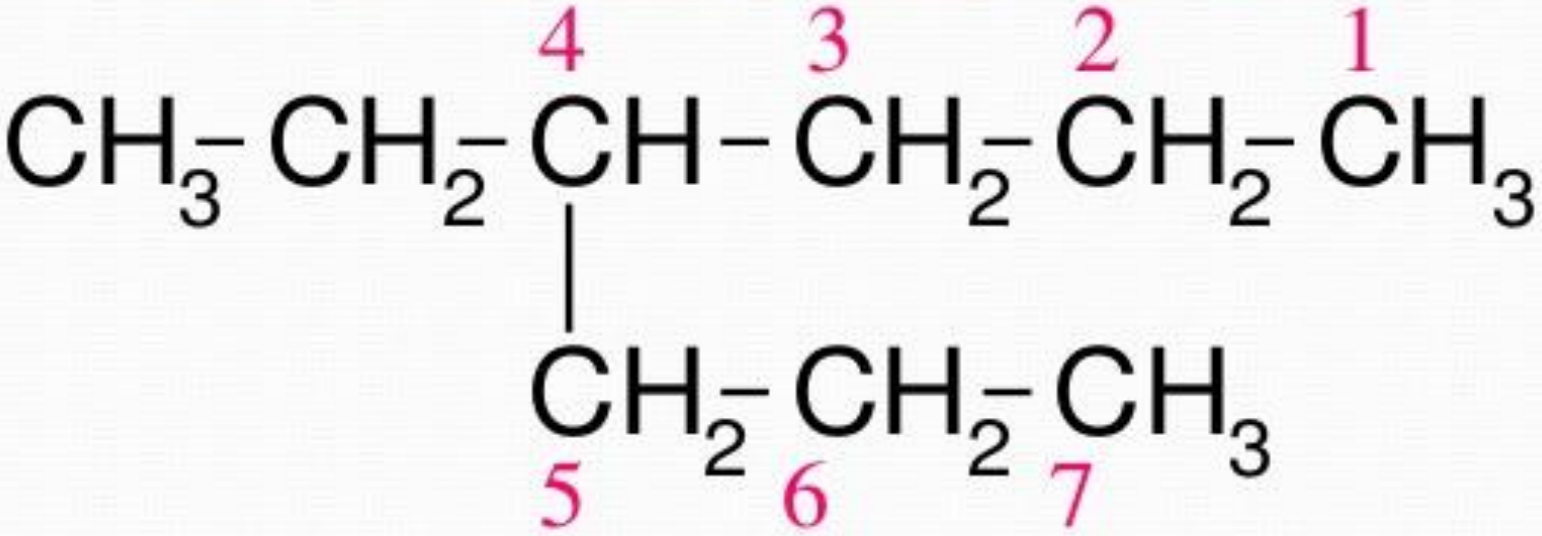
- Identify the longest chain -- parent
- number from the end closest to first branch
- Name the groups attached to the chain, using the carbon number as the locator.
- Alphabetize substituents.
- Use di-, tri-, etc., for multiples of same substituent
- combine number and name of substituent with parent name, separating with hyphen

Find the longest continuous carbon chain



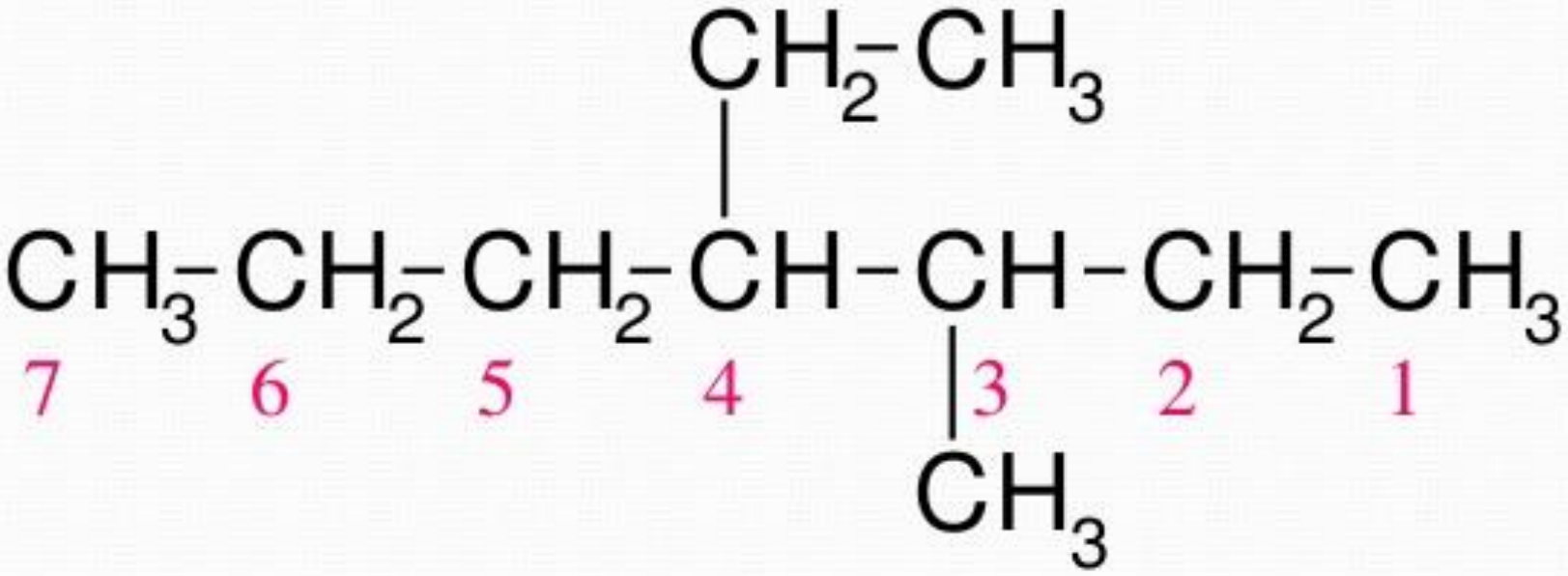
3-methylpentane

You must choose the longest continuous carbon chain



4-ethylheptane

Number from the end nearest the first substituent



4-ethyl-3-methylheptane

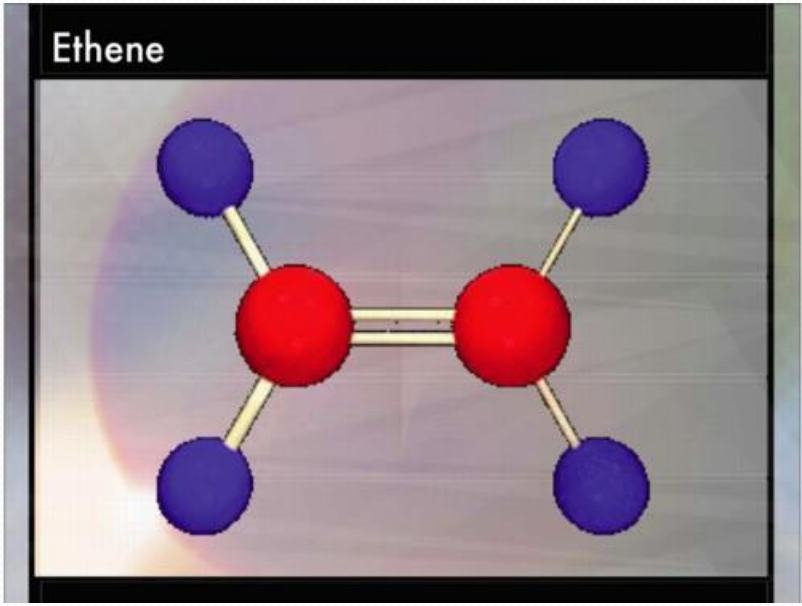
Substituents in Organic Compounds

Formula of Substituent	Name of Substituent
Br—	Bromo
Cl—	Chloro
F—	Fluoro
I—	Iodo
CH_3—	Methyl
CH_3CH_2—	Ethyl

Alk*enes* – C_nH_{2n}

series of unsaturated hydrocarbons having one double bond (C=C)

- Also called ethylenes series (IUPAC name is ethene)
- General formula C_nH_{2n}

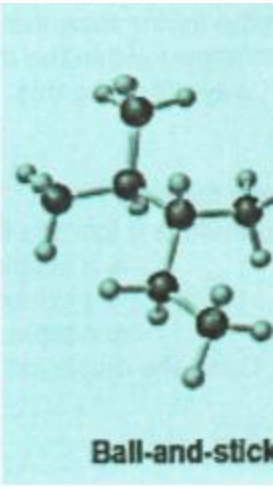


Models

- There are two ways of representing organic :-

1 : A ball-and-stick model : which shows atoms as and bonds as sticks

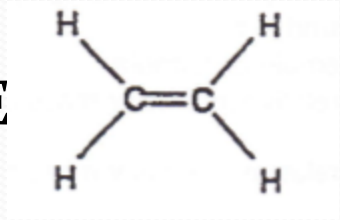
Good example are water

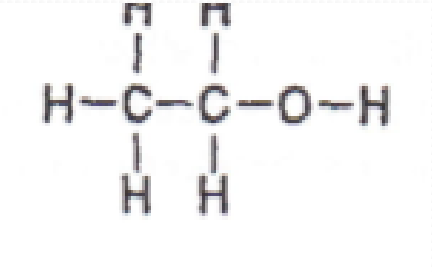


2: Space-filling models : which are an accurately scaled-up image of the molecule, but bonds are no shown, and it can be difficult to see each atom in a complex molecule

Molecular formula

- uses element symbols and, often, numerical subscripts to give the actual number of atoms of each element in a molecule of the compound.
- 1. Displayed formula : **Displayed formula is a formula that shows every atom and every bond in a molecule**
- **E**





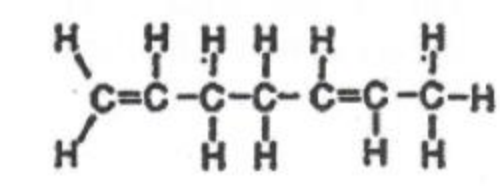
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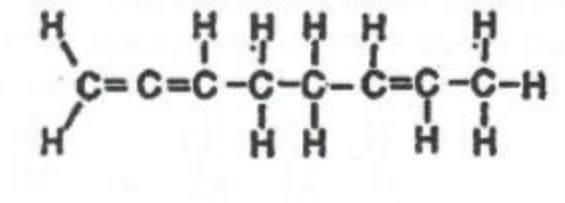
- , Structural formula: Each carbon is written separately, with the atoms or groups that are attached to it.
- The structural formula of hexane is written as: CHsCHzCHzCHzCHzCHs
- or it can be shortened as CHs (CHz)+CHs (in this case it known as the condensed formula).

Naming alkenes

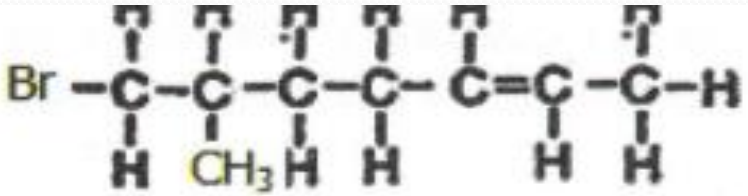
- . Find the longest chain
- chain is numbered from the end closer to the C=C bond
- Write the position number of the double bond
- Example

- what is the name of this compounds

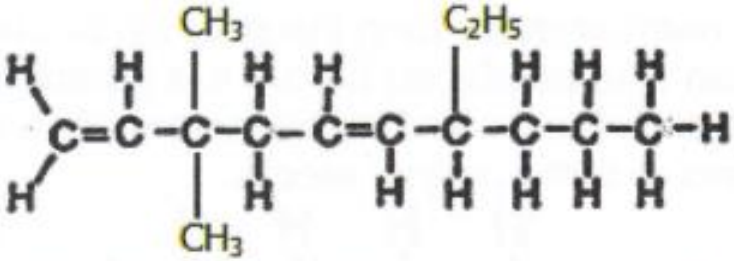




Case 3: branched chain alkenes



7-bromo-6-methylhept-2-ene



7-ethyl-3,3-dimethyldec-1,5-diene

Alkynes:

- Hydrocarbons with Triple Bonds
- Hydrocarbons that contain at least one C :tC bond are called alkynes

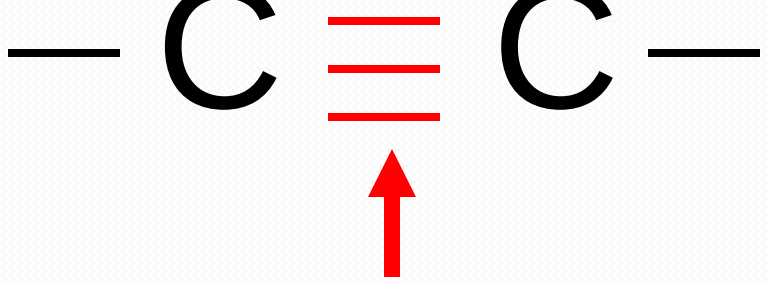
- Alkynes are named in the same way as alkenes, except that the suffix is -yne.

Alk*ynes* –

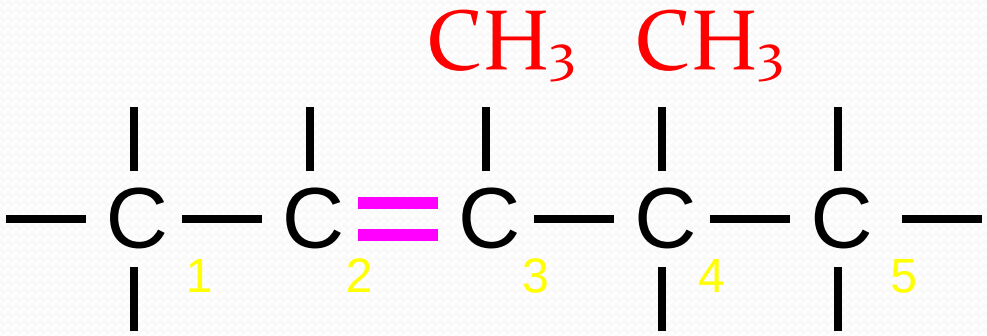
a series of unsaturated hydrocarbons that contain 1 triple bond.

- Also called the acetylene series

- General formula C_nH_{2n-2}

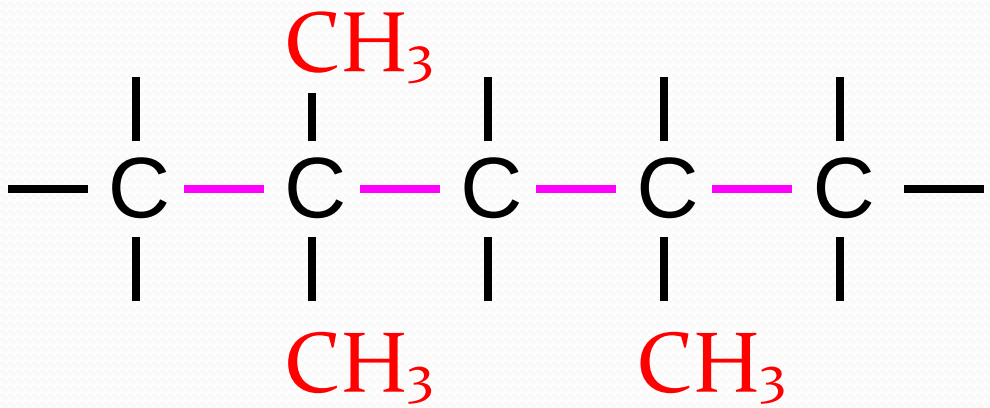


When naming with a double/triple bond- start # carbons closest to the bond.



3,4 dimethyl, 2-pentene

- **2,2,4-trimethylpentane**



Other Organic Compounds

Functional Groups – specific groupings of atoms that give characteristic properties to organic compounds.

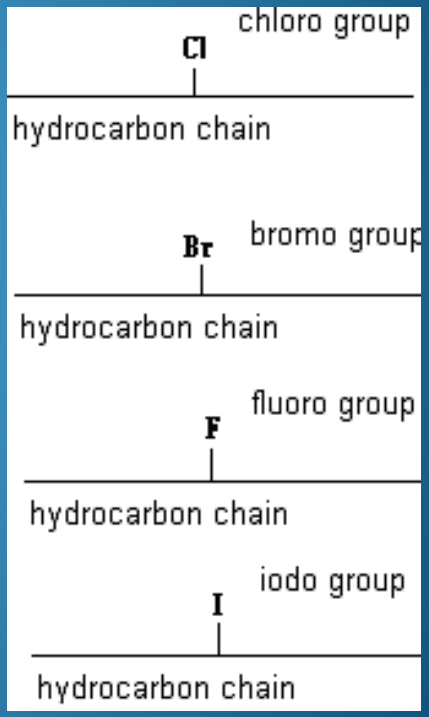
⇨ halides

F (fluoro-)

Cl (chloro-)

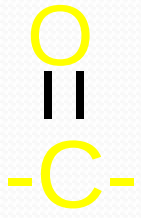
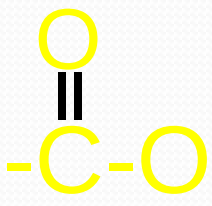
Br (bromo-)

I (iodo-)



What group do these belong to?

Halogens

- Alcohols -OH hydroxyl
- Organic acids -COOH carboxyl
- Aldehydes -CHO carbonyl
- Ketones 
- Ethers -O-
- Esters 
- Amines
- Amides

Alcohols

- functional group consists of a carbon bonded to an -OH, and the general formula of an alcohol is R -OH (or CnHzn*rOH).

Alcohols

- Are organic cmpds in which one or more of the hydrogens is replaced with an – OH group.

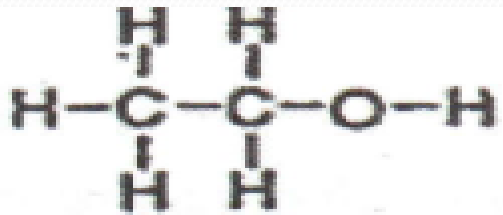
- OH group is called the hydroxyl group

Table R
Organic Functional Groups

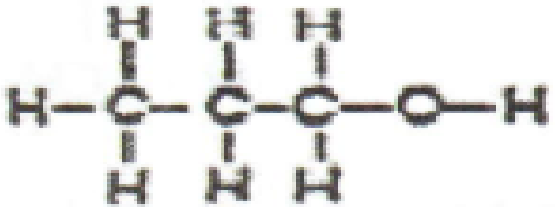
Class of Compound	Functional Group	General Formula	Example
alcohol	—OH	*R*—OH	$CH_3CH_2CH_2OH$ 1-propanol

Glassification of alcohols

- Depending on the number of hydroxyl groups they contain
- alcohols are generally classified into monohydric and polyhydric alcohols.
- Monohydric alcohols: contain only one hydroxyl group



ethanol



propanol

- Polyhydric alcohols: contain two or more hydroxyl groups and are
- further subdivided into dihydric, trihydric,
- Alcohols cannot have two hydroxyl groups bonded to the same carbon.
- b) Trihydric alcohols: contain three hydroxyl groups per molecule and they are named as

Example

C – C – C – C – O – H

Base contains 4 carbon

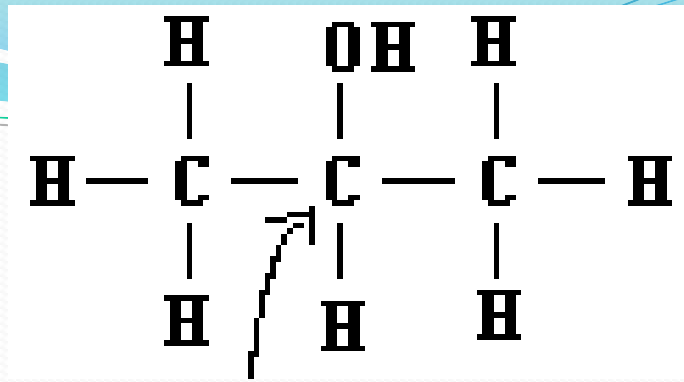
alkane name is butane

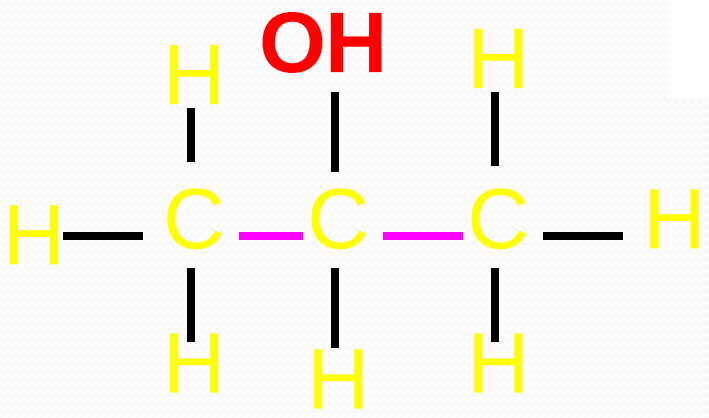
remove –e and add –ol

alcohol name – butanol

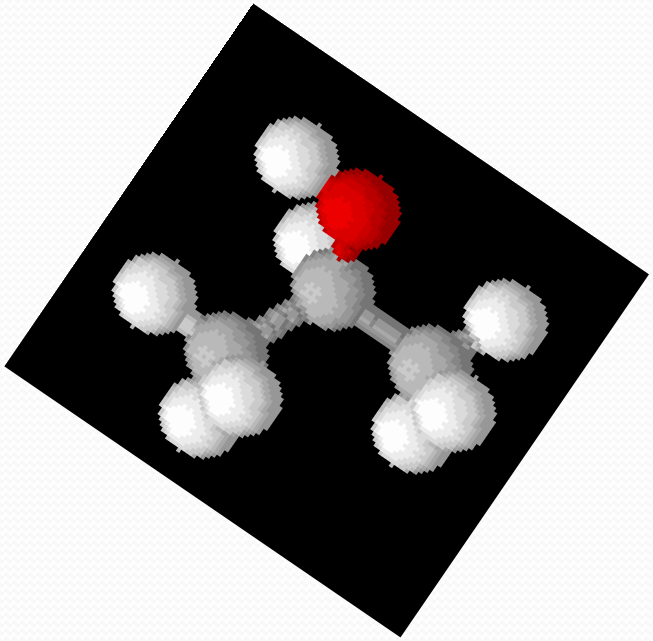
OH is on the first carbon so – 1–butanol

Ex. 2-propanol





1 2 3





Organic acids – have the functional group -COOH

- R-COOH

Carboxyl group

Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
organic acid	$-\overset{\overset{O}{\|\|}}{C}-OH$	$R-\overset{\overset{O}{\|\|}}{C}-OH$	$CH_3CH_2\overset{\overset{O}{\|\|}}{C}-OH$ propanoic acid

IUPAC naming of Organic Acids

- Replace the final "**e**" with "-**oic** "acid

Methanoic acid - HCOOH

