

(...Contd.) ORGANIC CHEMISTRY : BASIC PRINCIPLES AND TECHNIQUES**Kumud Bala****Nomenclature of unsaturated hydrocarbons:**

Open chain hydrocarbons which contain carbon-carbon double or triple bonds in the molecules are called unsaturated hydrocarbons. These are further classified into two types (i) Alkene (ii) Alkyne

ALKENES: Unsaturated aliphatic hydrocarbons containing a carbon-carbon double bond ($>C=C<$) are called alkene. They are also called olefins (Greek-olefiant =oil forming)

General formula= C_nH_{2n} where $n = 2, 3, 4, \dots$ etc.

Primary suffix = ene

Common names: Alkane - ane + ylene = Alkylene

IUPAC name : Alkane - ane + ene = Alkene

The positions of the double bonds are indicated by the Greek letters $\alpha, \beta, \gamma, \dots$ etc. in the common system while Arabic numericals, i.e., 1,2,3,4, etc. are used in the IUPAC system. For example

n	Formula	Common name	IUPAC name
2	$CH_2=CH_2$	Ethylene	Ethene
3	$CH_3CH=CH_2$	Propylene	Propene
4	$CH_3CH_2CH=CH_2$	α -Butylene	But-1-ene
4	$CH_3CH=CHCH_3$	β -Butylene	But-2-ene
5	$CH_3CH_2CH_2CH=CH_2$	α -Pentylene	Pent-1-ene
5	$CH_3CH_2CH=CHCH_3$	β -Pentylene	Pent-2-ene
6	$CH_3CH_2CH_2CH_2CH=CH_2$	α -Hexylene	Hex-1-ene
6	$CH_3CH_2CH_2CH=CHCH_2$	β -Hexylene	Hex-2-ene
6	$CH_3CH_2CH=CHCH_2CH_3$	γ -Hexylene	Hex-3-ene

ALKYNES: Unsaturated aliphatic hydrocarbons containing a carbon-carbon triple bond ($-C\equiv C-$) are called alkyne. In the common system, they are called acetylenes after the name of the first member of this family i.e., acetylene. General formula : C_nH_{2n-2} where $n = 2, 3, 4, \dots$ etc.

Primary suffix : yne

Common name : Acetylene and its alkyl derivatives

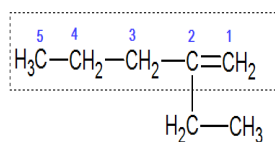
IUPAC name: Alkane - ane + yne =alkyne. The position of the triple bond on the parent chain is designated by lowest possible Arabic numerals. For example:

n	Formula	Common name	IUPAC name
2	$CH\equiv CH$	Acetylene	Ethyne
3	$CH_3-C\equiv CH$	Methyl acetylene or allylene	Propyne
4	$CH_3CH_2-C\equiv CH$	Ethyl acetylene	But -1-yne
4	$CH_3-C\equiv C-CH_3$	Dimethyl acetylene	But-2-yne
5	$CH_3CH_2CH_2-C\equiv CH$	n-propyl acetylene	Pent -1-yne
5	$CH_3CH_2-C\equiv C-CH_3$	Ethyl methyl acetylene	Pent -2-yne
6	$CH_3CH_2CH_2CH_2-C\equiv CH$	n-butyl acetylene	Hex-1-yne
6	$CH_3CH_2CH_2-C\equiv C-CH_3$	Methyl - n-propyl acetylene	Hex -2-yne

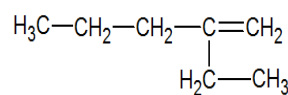
Rule for IUPAC nomenclature of unsaturated hydrocarbons (Alkene and Alkyne)

While naming compounds containing multiple (double and triple) bonds, the following addition rules are followed:

1. The parent chain must contain the multiple bonds regardless of the fact whether it also denotes the longest continuous chain of carbon atoms or not. For example, in structure (1), the parent chain consists of five carbon atoms as indicated. Through the longest chain contain six carbon atoms it is not the parent chain since it does not include the double bond.

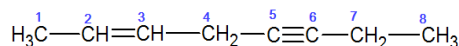


[parent chain contains five carbon atoms (correct)]

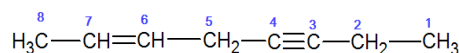


[parent chain contains six carbon atoms without double bond (wrong)]

2. If both double and triple bonds are present, the numbering of the parent chain should always be done from that end which is nearer to the double or the triple bond i.e., the lowest set of locants rule for the multiple bonds must be followed. For example:

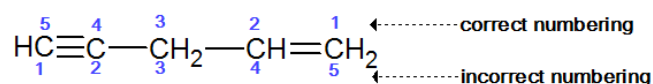


Set of locants = (2, 5)
(correct)

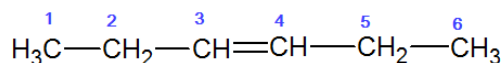


Set of locants = (3, 6)
(incorrect)

3. If the multiple bonds are at similar position, there is a choice in numbering. The double bond is always given preference over the triple bond, for example

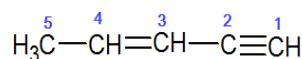


1. If the organic compound contains only one double or the triple bond, its locant or the positional number is always placed before its suffix, for example.



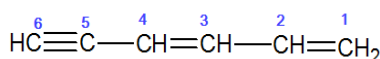
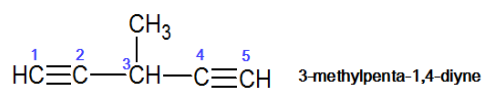
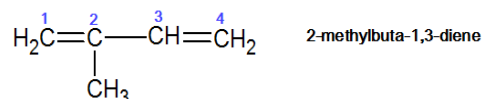
Hex + 3 - ene → Hex-3-ene

If, however, both double and triple bonds are present, their locants are written before their respective suffixes, the terminal 'e' from the suffix 'ene' is dropped while writing the complete name of the organic compound. It may be emphasized here that the organic compound is named as derivative of alkyne rather than alkene, for example



pent - 3 - en(e) + 1 - yne → pent-3-en-1-yne

5. If more than one double bond and triple bond are present, the prefixes like di, tri, etc. are used before the primary suffix for the bond. For example, if 2 double bonds are present the word 'diene' is used. For 2 triple bonds, the word 'diyne' is used.

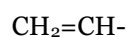


Hexa-1,3-dien-5-yne

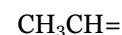
In some cases all the double or triple bonds present in the molecule cannot be included in the longest chain. In such cases the following prefixes are used for double and triple bonded groups.



Methylene



Vinyl or ethenyl

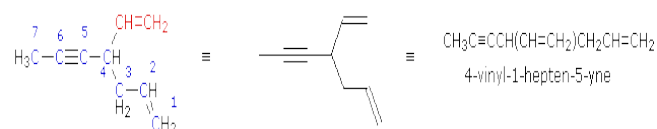
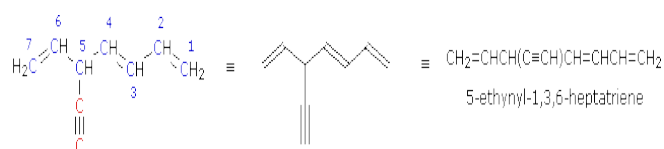


Ethylidene



Ethynyl

For example:



Assignment:

1. The IUPAC name of the compound:



[A] 4,4-Dimethyl-2-butyne

[B] 4-Methyl-2-pentyne

[C] Methylisopropyl acetylene

[D] 2-methyl-4- **pentyl**

2. The IUPAC name of the compound: $(\text{CH}_3)_3\text{C}-\text{CH}=\text{CH}_2$ is

[A] 2,2-Dimethylbut-2-ene

[B] 2,2-Dimethylpent-3-ene

[C] 3,3-Dimethylbut-1-ene

[D] Hex-1-ene

3 The IUPAC name of the compound: $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}=\text{CH}_2$

[A] Penta-1,4-diene

[B] Penta-1,5-diene

[C] 3-Ethylpenta-1,3-diene

[D] Pent-2-en-4-ene

4 Which one is correct structural formula of the following : Pent-1-en-4-yne

[A] $\text{CH}\equiv\text{C}-\text{CH}_2-\text{CH}=\text{CH}_2$

[B] $\text{CH}_3-\text{CH}=\text{CH}-\text{C}\equiv\text{CH}$

[C] $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}-\text{CH}=\text{CH}_2$

[D] $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}=\text{CH}_2$

5 Which of the following is an vinyl group

[A] $\text{CH}_2=$ [B] $\text{CH}_3\text{CH}=\text{$ [C] $\text{CH}_2=\text{CH}-$ [D] $\text{HC}\equiv\text{C}-$

Answer 1. [B] 2. [C] 3. [A] 4. [A] 5. [C]



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