# CLASSIFICATION & NOMENCLATURE

## 1. KEKULE'S PRINCIPLE :

- Carbon has four valencies.
- Carbon has a property of catenation. It can make a large chain with addition of other carbons.
- A carbon atom can share 2, 4 or 6 electrons with other carbons & can form single, double or triple bond.
- For a carbon atom, it is not possible to make more than 3 bonds with adjacent carbon atom because a carbon atom complete its octet from overlapping which consists directional property.

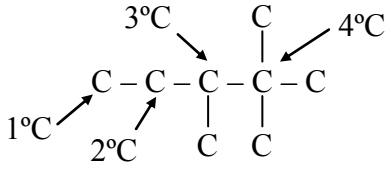
## 2. THE FOUR VALENCIES OF CARBON ATOM CAN BE REPRESENTED BY FOLLOWING WAY :

| Structure | σ bonds | π bonds | Hybridisation | Shape | Bond Angle | No. of Bond angles |
|---|---|---|---|---|---|---|
|  | 4 | 0 | $sp^3$ | Tetrahedral (Non planar) | 109º28' | 6 |
|  | 3 | 1 | $sp^2$ | Planar (Trigonal) | 120º | 3 |
|  | 2 | 2 | sp | Linear | 180º | 1 |
|  | 2 | 2 | sp | Linear | 180º | 1 |

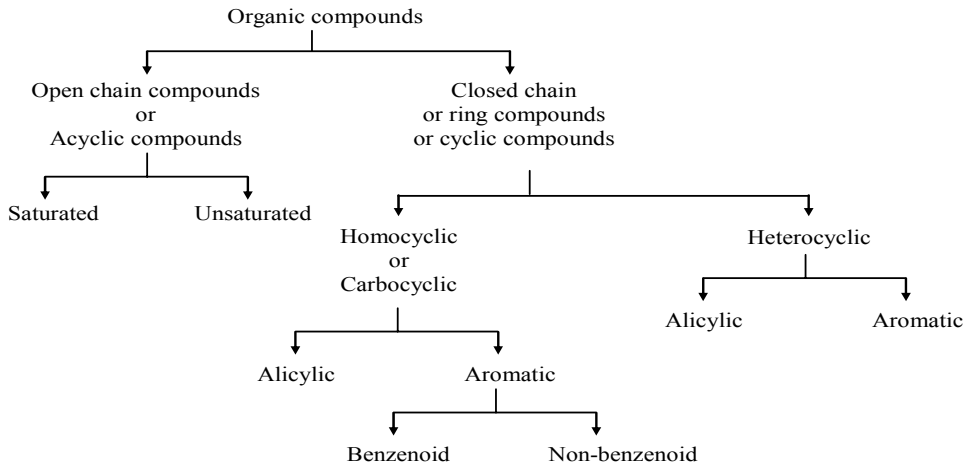
## 3. CLASSIFICATION OF CARBON :

There are four types of carbon present in organic compounds. The carbon which is directly attached with one, two, three and four carbon atoms are known as primary, secondary, tertiary and quarternary carbon atom respectively.

On the basis of carbon atom, hydrogen atoms bonded with 1º, 2º or 3º are named as primary, secondary or tertiary hydrogen atom respectively.




## 4. CLASSIFICATION OF ORGANIC COMPOUNDS :



**SPECIAL POINTS :**

- Saturated compounds having carbon-carbon single bonds.

  e.g. $CH_4$, $CH_3–CH_3$, $CH_3–CH_2–CH_3$

- Unsaturated compounds having atleast one carbon-carbon multiple bond (= or ≡)

  e.g. $CH_2=CH_2$, $HC\equiv CH$, $HC\equiv C–CH_3$, $H_2C=CH–CH_3$, $CH_2=C=CH_2$, $CH_2=CH–C\equiv CH$, $HC\equiv C–C\equiv CH$

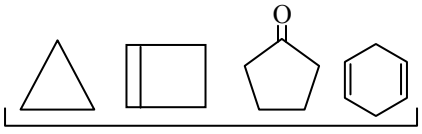
- Homocyclic compounds having similar types of atoms in the complete cycle. Whereas heterocyclic compounds having atleast one different atom (O, S, N) in the cycle.

- Alicyclic = Aliphatic + homo/hetero cyclic

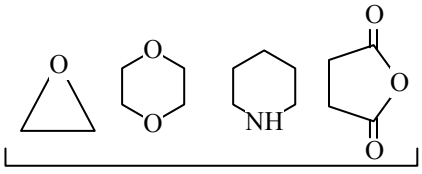
  ⇓

  (Alipher = Fats)

**e.g.**



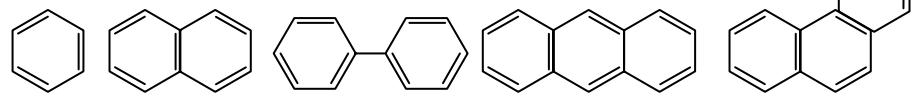

Homocyclic




Heterocyclic

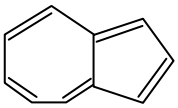
- Aromatic compounds having sweet smell (aroma), cyclic resonance and follow Huckle's rule ($4n + 2 = \pi$ electrons)

  **e.g.** Benzenoid compounds :



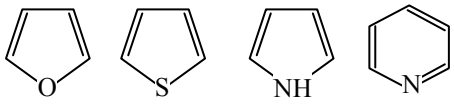
Benzene Naphthalene Biphenyl Anthracene Phenanthrene

**e.g.** Non-Benzenoid compounds :



Azulene

**e.g.** Heterocyclic compounds :




Furan Thiophene Pyrrole Pyridine

## 5. HOMOLOGOUS SERIES :

The organic compounds which are structurally similar having same functional groups, combinedly gives a series known as homologous series and the members as homologues. The homologous series is characterised by :

(i) The two adjacent members are differ by a $– CH_2 –$ group or 14 atomic mass unit.

(ii) All the members of a series have same general formula, general methods of preparation and similar chemical properties due to same functional group.

(iii) The homologues shows difference in physical properties due to change in molecular mass and structural arrangement of molecule.

**SOME STANDARD HOMOLOGOUS SERIES ARE :**

| S.No. | Name of Series | General Formula | I-homologue | II-homologue |
|---|---|---|---|---|
| 1. | Alkane | $C_nH_{2n+2}$ | $CH_4$ | $CH_3–CH_3$ |
| 2. | Alkene | $C_nH_{2n}$ | $CH_2=CH_2$ | $CH_2=CH–CH_3$ |
| 3. | Alkyne | $C_nH_{2n-2}$ | $HC\equiv CH$ | $HC\equiv C–CH_3$ |
| 4. | Halo alkane | $C_nH_{2n+1}X$ | $CH_3–X$ | $CH_3–CH_2–X$ |
| 5. | Alcohol | $C_nH_{2n+2}O$ | $CH_3–OH$ | $CH_3–CH_2–OH$ |
| 6. | Ether | $C_nH_{2n+2}O$ | $CH_3–O–CH_3$ | $CH_3–O–CH_2–CH_3$ |
| 7. | Aldehyde | $C_nH_{2n}O$ | H–CHO | $CH_3–CHO$ |
| 8. | Ketone | $C_nH_{2n}O$ | $CH_3–\overset{\overset{O}{\|\|}}{C}–CH_3$ | $CH_3–\overset{\overset{O}{\|\|}}{C}–CH_2–CH_3$ |
| 9. | Carboxylic acid | $C_nH_{2n}O_2$ | H–COOH | $CH_3–COOH$ |
| 10. | Ester | $C_nH_{2n}O_2$ | $H–\overset{\overset{O}{\|\|}}{C}–O–CH_3$ | $H–\overset{\overset{O}{\|\|}}{C}–O–CH_2CH_3$ or $CH_3–\overset{\overset{O}{\|\|}}{C}–O–CH_3$ |
| 11. | Amide | $C_nH_{2n+1}NO$ | $H–CONH_2$ | $CH_3–CONH_2$ |
| 12. | Nitro alkane | $C_nH_{2n+1}NO_2$ | $CH_3–N\overset{O}{\underset{O}{<}}$ | $CH_3–CH_2–N\overset{O}{\underset{O}{<}}$ |
| 13. | Amine | $C_nH_{2n+3}N$ | $CH_3–NH_2$ | $CH_3–CH_2–NH_2$ |

## 6. NOMENCLATURE OF ORGANIC COMPOUNDS :

Mainly three system are adopted for naming of an organic compound :

**(a) Common Name or Trivial Name System**

**(b) Derived Name System**

**(c) IUPAC Name or Jeneva Name System**

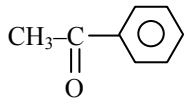
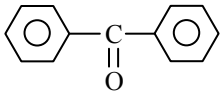
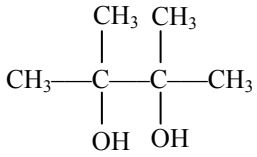
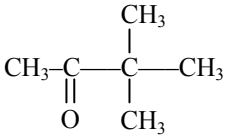
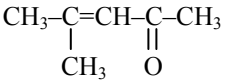
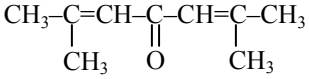
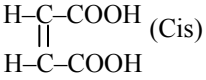
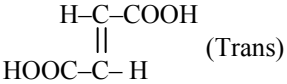
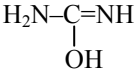
### 6.1 SOME COMMON NAMES BASED ON SOURCE :

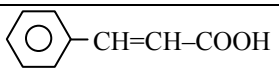
| S.No. | Compound | Common Name | Source |
|---|---|---|---|
| 1. | $CH_4$ | Marsh gas (Fire damp) | Marshy places |
| 2. | $CH_3OH$ | Wood spirit (Carbinol) | Destructive distillation of wood |
| 3. | $CH_3CH_2OH$ | Grain alcohol | Grain |
| 4. | $NH_2–\overset{\overset{O}{\|\|}}{C}–NH_2$ | Urea (Carbamide) | Urine |
| 5. | HCOOH | Formic acid | Formica (Red ants) |

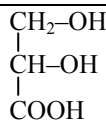
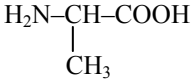
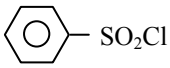
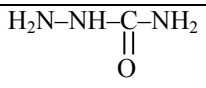
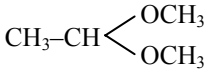
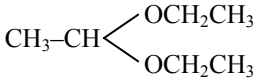
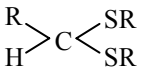
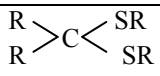
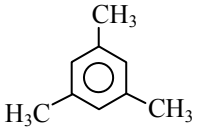
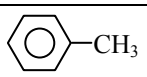
| S.No. | Compound | Common Name | Source |
|---|---|---|---|
| 6. | $CH_3COOH$ | Acetic acid | Acetum (Vinegar) |
| 7. | HOOC–COOH | Oxalic acid | Oxalis plant |
| 8. | $CH_3–\underset{\displaystyle OH}{\underset{\vert}{CH}}–COOH$ | Lactic acid | Lactum (Milk) |
| 9. | $CH_3CH_2CH_2COOH$ | Butyric acid | Butter |
| 10. | $HO–\underset{\displaystyle HO–CH–COOH}{\underset{\vert}{CH}}–COOH$ | Tartaric acid | Tamarind |
| 11. | $HO–\underset{\displaystyle CH_2–COOH}{\underset{\vert}{CH}}–COOH$ | Malic acid | Malum (Apple) |
| 12. | $\begin{array}{l} CH_2–COOH \\ \vert \\ HO–C–COOH \\ \vert \\ CH_2–COOH \end{array}$ | Citric acid | Citron (Lemon) |

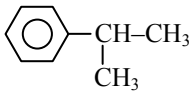
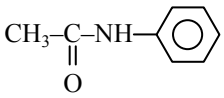
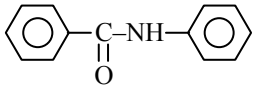
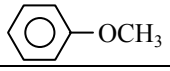
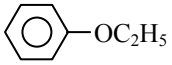
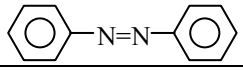
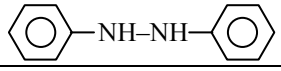
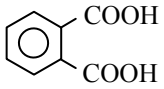
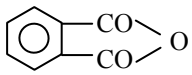
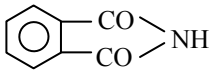
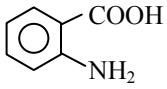
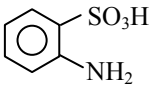
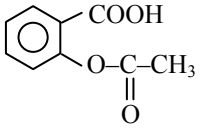
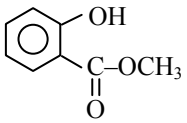
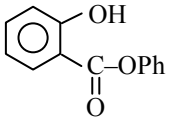
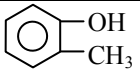
**6.2 SOME STANDARD COMMON NAMES (TO BE REMEMBER) :**

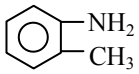
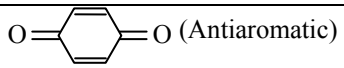
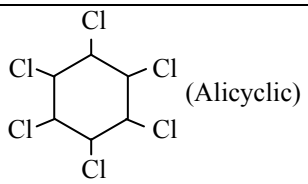
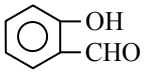
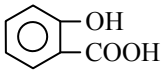
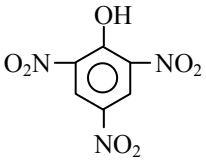
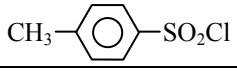
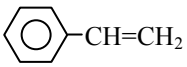
| S.No. | Common Name | Structure Formula |
|---|---|---|
| 1. | Isoheptane or Triptane | $\begin{array}{l} \quad\quad CH_3 \\ \quad\quad\vert \\ CH_3–CH–C–CH_3 \\ \quad\vert\quad\vert \\ \quad CH_3\ CH_3 \end{array}$ |
| 2. | Isooctane | $\begin{array}{l} \quad\quad\quad\quad CH_3 \\ \quad\quad\quad\quad\vert \\ CH_3–CH–CH_2–C–CH_3 \\ \quad\vert\quad\quad\quad\vert \\ \quad CH_3\quad\quad CH_3 \end{array}$ |
| 3. | Ethylene | $H_2C = CH_2$ |
| 4. | Acetylene | $HC \equiv CH$ |
| 5. | Allylene | $HC{\equiv}C–CH_3$ |
| 6. | Crotonylene | $CH_3–C{\equiv}C–CH_3$ |
| 7. | Allene | $CH_2{=}C{=}CH_2$ |
| 8. | Ketene | $CH_2{=}C{=}O$ |
| 9. | Acetone or Dimethyl Ketone | $\begin{array}{l} CH_3–\underset{\displaystyle\Vert}{C}–CH_3 \\ \quad\quad O \end{array}$ |
| 10. | Pavaldehyde | $\begin{array}{l} \quad\quad CH_3 \\ \quad\quad\vert \\ CH_3–C–CHO \\ \quad\quad\vert \\ \quad\quad CH_3 \end{array}$ |
| 11. | Chloral | $Cl_3C–CHO$ |

| S.No. | Common Name | Structure Formula |
|---|---|---|
| 12. | Acrolein or Acryl aldehyde | $CH_2=CH-CHO$ |
| 13. | Acetophenone or Methyl phenyl Ketone |  |
| 14. | Benzophenone or Diphenyl Ketone |  |
| 15. | Pinacol |  |
| 16. | Pinacolone |  |
| 17. | Mesityl oxide (Dimer of acetone) |  |
| 18. | Phorone (Trimer of acetone) |  |
| 19. | Oxalic acid | HOOC–COOH |
| 20 | Malonic acid | $HOOC-CH_2-COOH$ |
| 21. | Succinic acid | $HOOC-(CH_2)_2-COOH$ |
| 22. | Gluteric acid | $HOOC-(CH_2)_3-COOH$ |
| 23. | Adipic acid | $HOOC-(CH_2)_4-COOH$ |
| 24. | Pimelic acid | $HOOC-(CH_2)_5-COOH$ |
| 25. | Maleic acid |  (Cis) |
| 26. | Fumeric acid |  (Trans) |
| 27. | Cyanic acid | HO–C≡N |
| 28. | Isocyanic acid (Tautomer of cyanic acid) | O=C=NH |
| 29. | Isourea (Tautomer of urea) |  |

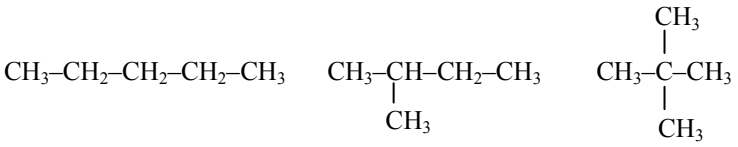
| S.No. | Common Name | Structure Formula |
|---|---|---|
| 30. | Chloroform (Anaesthatic agent) | $CHCl_3$ |
| 31. | Chloropicrin (Nitro Chloroform) | $Cl_3C–NO_2$ |
| 32. | Chloretone<br>(Chloroform + acetone) | $CH_3–\underset{\displaystyle OH}{\overset{\displaystyle CCl_3}{\underset{|}{\overset{|}{C}}}}–CH_3$ |
| 33. | Pyrene (Fire - extinguisher) | $CCl_4$ |
| 34. | Westrosol<br>or Triclene | $\begin{matrix} Cl \\ Cl \end{matrix}\!\!>\!C=C\!<\!\!\begin{matrix} H \\ Cl \end{matrix}$ |
| 35. | Westron | $\begin{matrix} Cl \\ Cl \end{matrix}\!\!>\!CH-CH\!<\!\!\begin{matrix} Cl \\ Cl \end{matrix}$ |
| 36. | Tetraclene<br>or Perclene | $\begin{matrix} Cl & & Cl \\ & C=C & \\ Cl & & Cl \end{matrix}$ |
| 37. | Isoprene | $CH_2=\underset{\displaystyle CH_3}{\overset{\displaystyle }{\underset{|}{\overset{|}{C}}}}–CH=CH_2$ |
| 38. | Chloroprene<br>(Monomer of Neoprene Polymer) | $CH_2=\underset{\displaystyle Cl}{\overset{\displaystyle }{\underset{|}{\overset{|}{C}}}}–CH=CH_2$ |
| 39. | AAE (Aceto acetic ester)<br>or EAA (Ethyl aceto acetate) | $CH_3–\overset{\displaystyle O}{\overset{\|}{C}}–CH_2–\overset{\displaystyle O}{\overset{\|}{C}}–OC_2H_5$ |
| 40. | Acrylic acid | $CH_2=CH–COOH$ |
| 41. | Crotonic acid | $CH_3–CH=CH–COOH$ |
| 42. | Cinnamic acid |  |
| 43. | Glycol | $\underset{\displaystyle CH_2–OH}{\overset{\displaystyle CH_2–OH}{\underset{|}{\overset{|}{}}}}$ |
| 44. | Glycerol | $\underset{\displaystyle CH_2–OH}{\overset{\displaystyle CH–OH}{\underset{|}{\overset{|}{}}}}$ |
| 45. | Phosgene<br>or Carbonyl chloride | $Cl–\overset{\displaystyle O}{\overset{\|}{C}}–Cl$ |
| 46. | Glyceraldehyde | $\underset{\displaystyle CH–OH}{\overset{\displaystyle CH_2–OH}{\underset{|}{\overset{|}{}}}}$ |

| S.No. | Common Name | Structure Formula |
|---|---|---|
| 47. | Glyceric acid |  |
| 48. | Glyoxal |  |
| 49. | Glycine | $H_2N–CH_2–COOH$ |
| 50. | α-Alanine |  |
| 51. | Tilden reagent | Cl–N=O |
| 52. | Grignard reagent | R–MgX |
| 53. | Frankland reagent | R–Zn–R |
| 54. | Hinsberg reagent (used in N-compounds) |  |
| 55. | Mustard Gas<br>(Explosive used in I-world war) | $Cl–CH_2–CH_2–S–CH_2–CH_2–Cl$ |
| 56. | Lewisite (Explosive used in II-world war) | $Cl–CH=CH–AsCl_2$ |
| 57. | Semicarbazide |  |
| 58. | Schiff's Base or Anil | R–CH=N–R |
| 59. | Methylal |  |
| 60. | Ethylal |  |
| 61. | Mercaptal |  |
| 62. | Mercaptol |  |
| 63. | Mercaptan | R–SH |
| 64. | Mercaptide | R–S–R |
| 65 | Mesitylene |  |
| 66. | Toluene |  |

| S.No. | Common Name | Structure Formula |
|---|---|---|
| 67. | Cummene<br>or Isopropyl benzene |  |
| 68. | Acetanilide |  |
| 69. | Benzanilide |  |
| 70. | Anisole |  |
| 71. | Phenetole |  |
| 72. | Azo benzene |  |
| 73. | Hydrazo benzene |  |
| 74. | Phthalic acid |  |
| 75. | Phthalic anhydride |  |
| 76. | Phthalimide |  |
| 77. | Anthranilic acid |  |
| 78. | Sulphanilic acid<br>(Forms zwitter ion) |  |
| 79. | Aspirin<br>(Analgesic) |  |
| 80 | Salol (Antiseptic) |  |
| 81 | Oil of wintergreen |  |
| 82. | o-Cresol |  |
| 83. | o-Toluic acid |  |

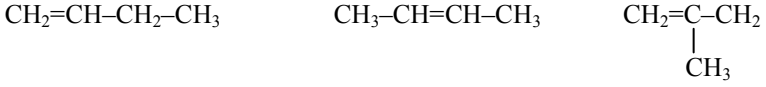
| S.No. | Common Name | Structure Formula |
|---|---|---|
| 84. | o-Toluidene |  |
| 85. | p-Benzoquinone |  (Antiaromatic) |
| 86. | Gammexane<br>or Lindane<br>or BHC (Benzene hexachloride) |  (Alicyclic) |
| 87. | Salicylaldehyde |  |
| 88. | Salicylic acid |  |
| 89. | Picric acid |  |
| 90. | Tosyl chloride |  |
| 91. | Styrene |  |
| 92. | o-Xylene |  |

**6.3 SYSTEMATIC COMMON NAMES OF HYDROCARBON :**



n-Pentane Isopentane Neopentane

n-Butane Isobutane



α-Butylene β-Butylene Isobutylene

**SPECIAL POINTS :**

- prefix **"n"** is used for unbranched carbon chain.
- prefix **"iso"** is used when one methyl group is attached on 2nd carbon from either terminal
- prefix **"neo"** is used when two methyl groups are attached on 2nd carbon from either terminal.
- Prefix **"α/β"** is used to locate the position of double bond.

## 6.4 RADICALS :

### COMMON NAMES OF HYDROCARBON RADICALS

n-Propyl $CH_3–CH_2–CH_2–$

Iso propyl $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–$

n-butyl $CH_3–CH_2–CH_2–CH_2–$

Isobutyl $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–$

s-butyl $CH_3–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_3$

t-Butyl $\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{CH_3–C–}}}}$

n-Pentyl $CH_3–CH_2–CH_2–CH_2–CH_2–$

s-Pentyl $CH_3–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$

Active s-pentyl $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_2–CH_3$

Isopentyl $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_2–$

Active isopentyl $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_3$

Neopentyl $\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{CH_3–C–CH_2–}}}}$

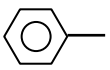
t-Pentyl $\underset{\displaystyle CH_3}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{CH_3–C–CH_2–CH_3}}}}$

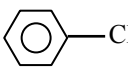
Active pentyl $–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$

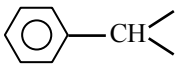
Vinyl $CH_2=CH–$

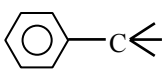
Allyl $CH_2=CH–CH_2–$

Propargyl $HC\equiv C–CH_2–$

Phenyl  or Ph–

Benzyl 

Benzal or Benzylidene 

Benzo or Benzylidyne 

## 6.5 COMMON NAMES OF HYDROCARBON DERIVATIVES :

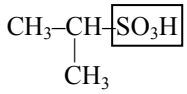
For systematic common names of these compounds we are dividing whole functional groups in following two systems :

### 6.5.1 SYSTEM - I :

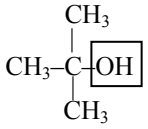
In this system prefix is decided by hydrocarbon radical (as discussed above) and suffix is given by following table:

| S. No. | Functional Group | Suffix |
|---|---|---|
| 1 | $-SO_3H$ | sulphonic acid |
| 2 | –OH | alcohol |
| 3 | –SH | thioalcohol |
| 4 | $-NH_2$ /–NH– / $-\overset{|}{N}-$ | amine |
| 5 | –O– | ether |
| 6 | –S– | thioether |
| 7 | –X | halide |
| 8 | $-\overset{\overset{O}{\|\|}}{C}-$ | ketone |
| 9 | – C≡N | cyanide |
| 10 | – N⇇C | isocyanide |

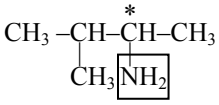
**e.g.**



Isopropyl sulphonic acid

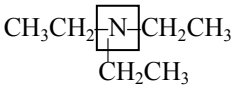


t-Butyl alcohol

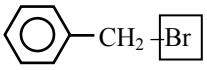


Active isopentyl amine
or
Active isoamyl amine

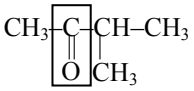
Ethyl methyl ether



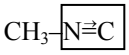
Triethyl amine



Benzyl bromide

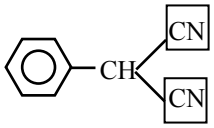


Isopropyl methyl ketone



Methyl isocyanide

Propargyl vinyl thioether



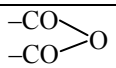
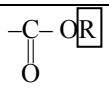
Benzal (di) cyanide

### 6.5.2 SYSTEM II :

In this system prefix is decided by total number of carbon atoms in the compound

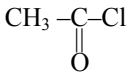
| If total carbon ⇒ | One | Two | Three | Four | Five |
|---|---|---|---|---|---|
| Prefix ⇒ | Form | Acet | Propion | Butyr | Valer |

And suffix is given by following table :

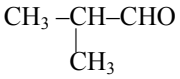
| S. No. | Functional Group | Suffix |
|---|---|---|
| 1 | —COOH | ic acid |
| 2 |  | ic anhydride |
| 3 |  | Alkyl …… oate |
| 4 | –COX | yl halide |
| 5 | $-CONH_2$ | amide |
| 6 | –CHO | aldehyde |
| 7 | – C≡N | onitrile |
| 8 | – N⇉C | oisonitrile |

**e.g.**

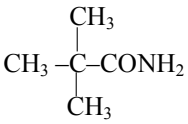
Formic acid



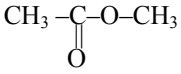
Acetyl chloride



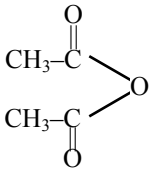
Isobutyraldehyd



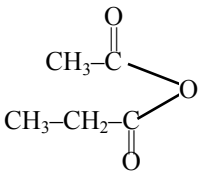
Neovaleramide



Methyl acetate



Acetic anhydride



Acetic propionic anhydride

**SPECIAL POINTS :**

- Prefix **"Acryl"** is used for the compounds which have total three carbon atoms and double bond is on 2nd carbon. (only for system II groups)

  e.g $CH_2 = CH–COOH$ Acrylic acid

  $CH_2 = CH–CHO$ Acryl aldehyde

  $CH_2=CH–CONH_2$ Acrylamide

- Prefix **"Croton"** is used for the compounds which have total four carbon atoms and double bond is on 2nd carbon (only for system II groups)

  e.g $CH_3–CH = CH–COOH$ Crotonic acid

  $CH_3–CH = CH – CHO$ Croton aldehyde

  $CH_3–CH = CH – COCl$ Crotonyl chloride

☛ Prefix **"Pyruv"** is used when $CH_3-\overset{\overset{O}{\|}}{C}-$ is directly attached with (system II) functional groups.

**e.g.** $CH_3-\overset{\overset{O}{\|}}{C}-COOH$ Pyruvic acid; $CH_3-\overset{\overset{O}{\|}}{C}-CHO$ Pyruvaldehyde; $CH_3-\overset{\overset{O}{\|}}{C}-CONH_2$ Pyruvamide; $CH_3-\overset{\overset{O}{\|}}{C}-COBr$ Pyruvyl bromide

☛ –CN and –NC groups are considered in both systems.

**e.g.**

$CH_3-\underset{CH_3}{\underset{|}{CH}}-N\rightleftharpoons C$ → System (I): Isopropyl isocyanide; System (II): Isobutyroisonitrile

$CH_3-\underset{CH_3}{\underset{|}{CH}}-C\equiv N$ → System (I): Isopropyl cyanide; System (II): Isobutyronitrile

$CH_2=CH-C\equiv N$ → System (I): Vinyl cyanide; System (II): Acrylonitrile

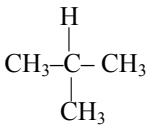
$CH_2=CH-N\rightleftharpoons C$ → System (I): Vinyl isocyanide; System (II): Acryloisonitrile

## 7. DERIVED NAME SYSTEM :

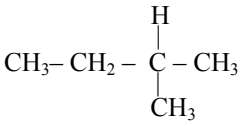
According to this system name of any compound is given according to the representative compound of the homologous series. This system is reserved for following homologous series :

| Series | Name of Homologous series | Name of Representative compound | Structure of group |
|---|---|---|---|
| 1 | Alkane | Methane | $-\overset{|}{\underset{|}{C}}-$ |
| 2 | Alkene | Ethylene | >C=C< |
| 3 | Alkyne | Acetylene | –C≡C– |
| 4 | Alkanol | Carbinol | $-\overset{|}{\underset{|}{C}}-OH$ |
| 5. | Alkanal | Acetaldehyde | $-\overset{|}{\underset{|}{C}}-CHO$ |
| 6. | Alkanoic acid | Acetic acid | $-\overset{|}{\underset{|}{C}}-COOH$ |
| 7. | Alkanoyl halide | Acetyl halide | $-\overset{|}{\underset{|}{C}}-COX$ |
| 8. | Alkanamide | Acetamide | $-\overset{|}{\underset{|}{C}}-CONH_2$ |
| 9. | Alkanone | Acetone | $-\overset{|}{\underset{|}{C}}-\overset{\overset{O}{\|}}{C}-\overset{|}{\underset{|}{C}}-$ |

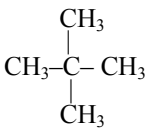
**e.g.**



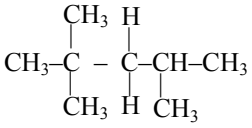
Trimethyl methane



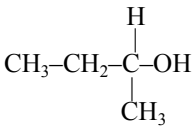
Ethyl dimethyl methane



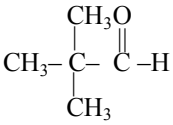
Tetramethyl methane



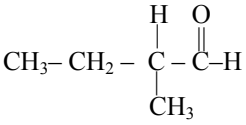
Tertiarybutyl Isopropyl methane



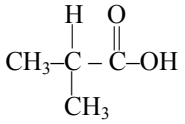
Ethylmethyl carbinol



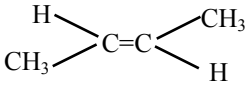
Trimethyl acetaldehyde



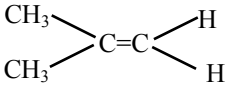
Ethylmethyl acetaldehyde



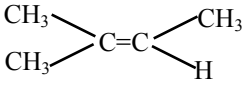
Dimethyl acetic acid



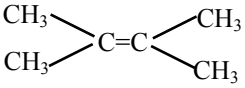
Symmetrical dimethyl ethylene



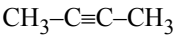
Unsymmetrical dimethyl ethylene



Trimethyl ethylene



Tetramethyl ethylene

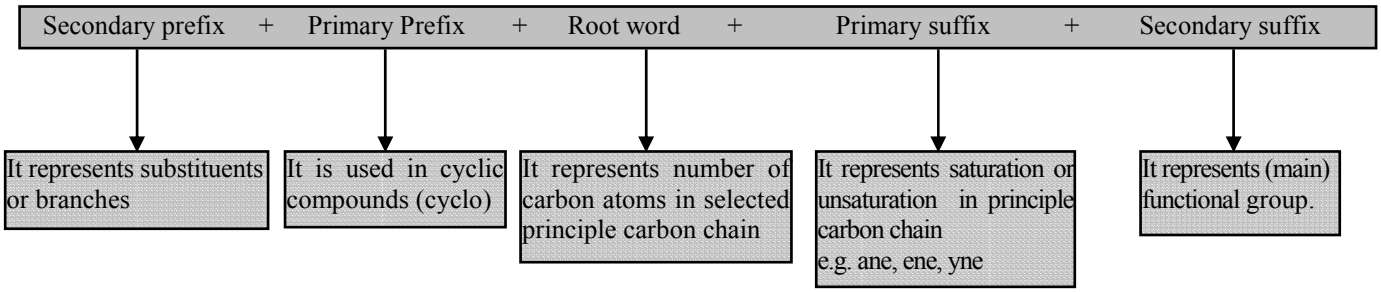


Dimethyl acetylene

## 8. IUPAC NAME SYSTEM OR GENEVA NAME SYSTEM :

(International union of pure and applied chemistry)

### 8.1 Parts and format of IUPAC name :




### 8.2 Rules for IUPAC nomenclature :

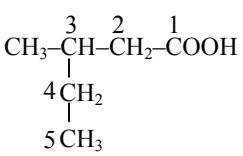
**Rule – 1 :** Select the longest continuous chain of carbon atoms which have maximum number of substituents, multiple bonds and functional groups.

Priority order : Functional group > Multiple bond (= or ≡) > Substituent

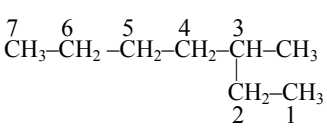
**Rule – 2 :** Selected principle carbon chain is numbered from the side where substituent or multiple bond or functional group is nearer (lowest possible number):

Priority order : Functional group > Double bond > Triple bond > Substituent

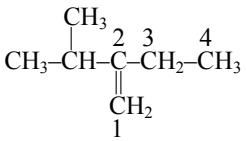
e.g.



3-Methyl pentanoic acid



3-Methyl heptane

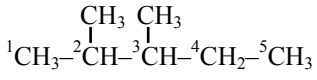


2-Isopropy but-1-ene
or
2-Methyl ethyl but-1-ene

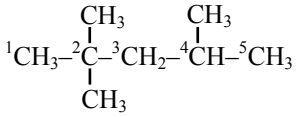
**SPECIAL POINTS :**

- If the compound contain more than one similar alkyl groups, their positions are indicated separately and an appropriate numerical prefix di, tri, tetra....., is attached to the name of the substituent. The positions of the substituents are separated by commas

**e.g.**

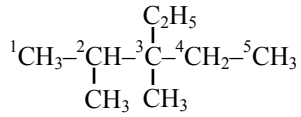


2,3 – Dimethyl pentane



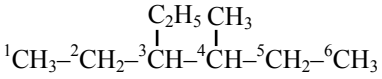
2,2,4- Trimethyl pentane

- If there is different alkyl subsitituents present in the compound, their names are written in the alphabetical order. However, the numerical prefixes such as di, tri etc, are not considered for the alphabetical order. For example ,



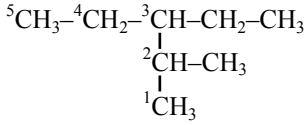
3 –Ethyl-2,3-dimethyl pentane

- If two different alkyl groups are located at the equivalent positions, then numbering in the carbon chain is done in such a way that the alkyl group which comes first in alphabetic order gets the lower position.



3 –Ethyl-4-methylhexane

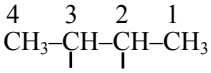
- If a compound has two or more chain of the same length, then principle chain is selected in such a way that greater number of substituent works as prefix.



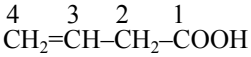
3 –Ethyl -2- methyl pentane

- In case some functional group (other than C=C and C ≡ C) is present in molecule, it is indicated by adding secondary suffix after the primary suffix. The terminal 'e' of the primary suffix is generally removed before adding the secondary suffix. The terminal 'e' of the primary suffix is removed if it is followed by a suffix begining with 'a', 'i', 'o', 'u' or 'y' .

**e.g.**



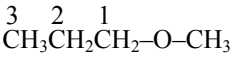
3-Methyl butan-2-ol



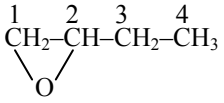
But-3-enoic acid

- **Some of functional group always works as prefix**

| Functional group | Prefix name |
|---|---|
| – X | Halo |
| – OR | Alkoxy |
|  | Epoxy |
| $-NO_2$ | Nitro |
| – NO | Nitroso |



1-Methoxy propane

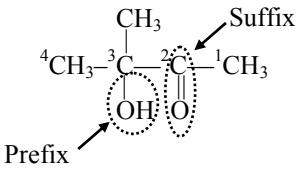


1, 2-Epoxy butane

☛ If the molecule contains more than one dissimilar functional groups, the numbering of the parent chain is done in such a way that the functional group of higher priority gets the lower number. **The order of priority** of various groups for the sake of numbering is given in following table :

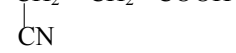
| S.No. | Functional group | Prefix | Suffix |
|---|---|---|---|
| 1 | –C(=O)–OH | carboxy | oic acid |
| 2 | $-SO_3H$ | sulpho | sulphonic acid |
| 3 | –C(=O)–O–C(=O)– | × | oic anhydride |
| 4 | –C(=O)–O–R | alkoxy carbonyl or carbaloxy | alkyl ..... oate |
| 5 | –C(=O)–X | halo formyl or halo carbonyl | oyl halide |
| 6 | –C(=O)–$NH_2$ | carbamoyl or amido | amide |
| 7 | C ≡ N | cyano | nitrile |
| 8 | – N ⩲ C | carbyl amino or isocyano | isonitrile |
| 9 | –C(=O)–H | formyl or oxo | al |
| 10 | –C(=O)– | keto or oxo | one |
| 11 | – OH | hydroxy | ol |
| 12 | – SH | mercapto | thiol |
| 13 | $-NH_2$ | amino | amine |
| 14 | – O – | alkoxy | × |
| 15 | C = C | × | ene |
| 16 | C ≡ C | × | yne |
| 17 | – X | halo | × |
| 18 | $-NO_2$ | nitro | × |

**e.g.**




3-Hydroxy-3-methylbutan -2- one


2-keto propanal



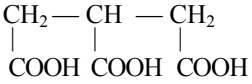

3-cyano propanoic acid

**8.3 Sometimes a special suffix is used for given functional groups :**

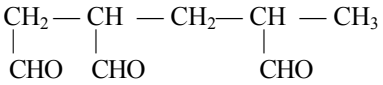
| S.No. | Functional group | Suffix |
|---|---|---|
| 1 | –COOH | Carboxylic acid |
| 2 | –COOR | Alkyl …. carboxylate |
| 3 | –COX | Carbonyl chloride |
| 4 | $–CONH_2$ | Corboxamide |
| 5. | –CN | Carbonitrile |
| 6. | –NC | Carbo isonitile |
| 7. | –CHO | Carbaldehyde |

☛ It is used in acylic compounds when 3 or more functional groups are presents.

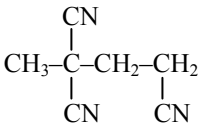
**e.g.**



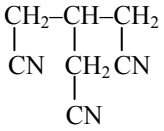
Propane –1,2,3,-tricarboxylic acid



Pentane –1,2,4,-tricarbaldehyde

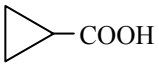


Butane-1,3,3-tricarbonitrile

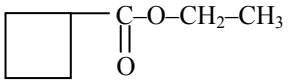


3-Cyanomethyl pentane-1,5-dinitrile

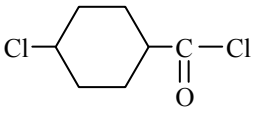
☛ It is used in cyclic compound when functional group is directly attached to the cycle.

**e.g.** 

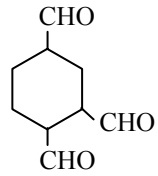
Cyclopropane carboxylic acid



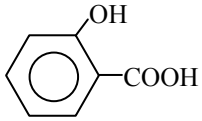
Ethyl cyclobutane carboxylate



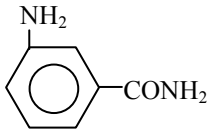
4-Chloro cyclohexane carbonyl chloride



Cyclohexane-1,2,4-tricarbaldehyde



2-Hydroxy benzene carboxylic acid
or
2-Hydroxy benzoic acid



3-Amino benzene carboxamide
or
3-Amino benzamide

**8.4 IUPAC NOMENCLATURE ALICYCLIC COMPOUNDS :**

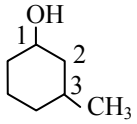
☛ Names of alicyclic compounds are given by putting another prefix ‘cyclo’ before the root word which depends upon the number of carbon atoms in the ring. The suffixes ane, ene or yne are written depending upon saturation or unsaturation in the ring.

☛ If some substituent or functional group is present, it is indicated by some appropriate prefix or suffix and its position is indicated by numbering the carbon atoms of the ring. The numbering is done in such a way so as to assign least possible number to the functional group or substituent in accordance with the rules already discussed.

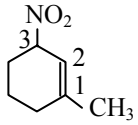
**e.g.**

Cyclohexane

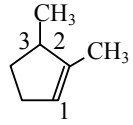
Cyclopentene



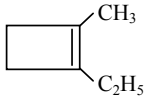

3-Methylcyclo-hexanol



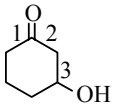

1-Methyl-3-Nitrocyclohexene



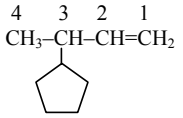

2,3-Dimethylcyclopentene




1-Ethy-2-Methylcyclobutene




3-Hydroxycyclohexanone

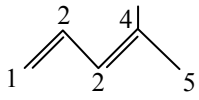



3-Cyclopentyl-1-butene

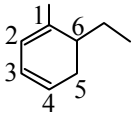
## 8.5. IUPAC NOMENCLATURE OF COMPOUNDS WITH BOND LINE FORMULA

In this representation of organic molecules, carbon and hydrogen atoms are not shown and the lines representing carbon – carbon bonds are drawn in zig-zag manner. A single line (–) represents a single bond, two parallel lines (=) represents a double bond and three parallel lines (≡) represent a triple bond. The only atoms specitically written are those that are neither carbon nor hydrogen bound to carbon. The intersection of lines represent carbon atoms carrying appropriate number of hydrogen atoms.

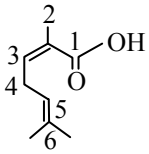
**e.g.**



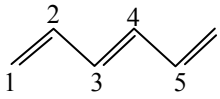

Methylpenta-1,3-diene



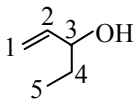

6-Ethyl-1-methylcyclohexa-1,3-diene



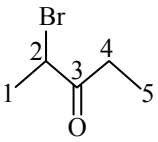

2,6-Dimethylhept-2,5-dien-oic acid




Hexa-1,3,5-triene




Pent-1-en-3-ol



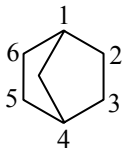

2-Bromopentan-3-one

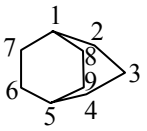
## 8.6 IUPAC NOMENCLATUERE OF BRIDGED BICYCLIC HYDROCARBONS

☛ Saturated bicyclic systems having two or more atoms in common are named by prefixing 'bicyclo' to the name of the cyclic parent hydrocarbon system containing the same total number of carbon atoms in the skeleton. The number of carbon atoms in each of the three bridges, connecting the two tertiary carbon atoms is indicated in parentheses, in descending order and arabic numerals are used to indicate the number of carbon atoms and the numbers are separated by full stops.

☛ The bicyclic system is numbered starting with one of the tertiary bridging cabon and proceeding through longest bridge to the second bridging carbon continuing back to the first bridging carbon through the second longest chain. Numbering is completed by numbering the shortest bridge beginning with the atom next to the first bridging carbon.

**e.g.**



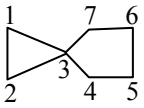

Bicyclo [2,2,1] heptane Bicyclo [3,2,2] Nonane

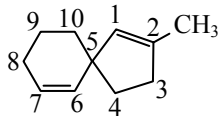
## 8.7. IUPAC NOMENCLATURE OF SPIRO BICYCLIC HYDROCARBONS

☛ Spiro bicyclic hydrocarbons contain two rings consisting of carbon atoms only and the two rings are linked by a common carbon. These compounds are named by placing prefix 'spiro' before the name of the acyclic parent hydrocarbon with same number of skeletal carbon atoms. The numbers of skeletal atoms linked to the spiro atom are indicated by arabic numbers, separately by a fullstop. The numbers are written in ascending order and enclosed in square brackets.

☛ Numbering of a spiro bicyclic hydrocarbon starts with a ring carbon next to the spiro atom and proceeds first through the smaller ring and then through the spiro atom and around the second ring. For example :

e.g.




Spiro [2,4] 2-Methylspiro [4, 5] deca-1, 6-diene