Nomenclature of Organic Compounds
DISCLAIMER

“The content provided herein are created and owned by various authors and licensed to Sorting Hat Technologies Private Limited (“Company”). The Company disclaims all rights and liabilities in relation to the content. The author of the content shall be solely responsible towards, without limitation, any claims, liabilities, damages or suits which may arise with respect to the same.”
Introduction of Organic Compounds

Why is an entire branch of chemistry devoted to the study of carbon-containing compounds?

- We study organic chemistry because just about all of the molecules that make life possible—proteins, enzymes, vitamins, lipids, carbohydrates, and nucleic acids—contain carbon, so the chemical reactions that take place in living systems, including our own bodies, are organic reactions.

- Most of the compounds found in nature—those we rely on for food, medicine, clothing (cotton, wool, silk), and energy (natural gas, petroleum).

Berzelius Vital Force Theory

- According to vitalism, organic compounds were only those that came from living organisms, and only living things could synthesize organic compounds through intervention of a vital force.

- Inorganic compounds were considered those compounds that came from nonliving sources.

- Because chemists could not create life in the laboratory, they assumed they could not create compounds with a vital force. With this mind-set, you can imagine how surprised chemists were in 1828 when Friedrich Wohler produced urea—a compound known to be excreted by mammals—by heating ammonium cyanate, an inorganic mineral.

- Failure of Berzelius vital theory and synthesis of first organic compound.

\[
\text{NH}_2\text{C} \overset{\text{(heating)}}{\longrightarrow} \text{NH}_2\text{C} - \text{NH}_2
\]

Introduction

Organic chemistry and you

- You are already a highly skilled organic chemist. As you read these words, your eyes are using an organic compound (retinal) to convert visible light into nerve impulses.

- When you picked up this book, your muscles were doing chemical reactions on sugars to give you the energy you needed.

Definition

Old definitions of Organic Compounds

- Compounds which we can derive from living organisms (Plants & Animals) are called organic compounds.

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Formic acid</td>
<td>Ant</td>
</tr>
<tr>
<td>2. Sugar</td>
<td>Sugarcane</td>
</tr>
</tbody>
</table>
• Specialized field of chemistry called organic chemistry, which derives its name from the fact that in the 19th century most of the them are known carbon compounds were considered to have originated in living organisms

**Derivatives of Hydrocarbon**

• If we replace one or more than Hydrogen from Hydrocarbon by an atom or group of atoms then compound formed is called derivative of Hydrocarbon.

\[
\text{C}_2\text{H}_6 + \text{OH} \rightarrow \text{C}_2\text{H}_5\text{OH}
\]

Hydrocarbon Hydrocarbon derivative

* Some Properties of Carbon

**Catenation :**

• Due to catenation properties of carbon, it can form long bonded covalent structures. (Chain form)

• Carbon can form single, double or triple bond (covalent).

  Eg.: Alkanes \( \rightarrow \text{C}_n\text{H}_{2n+2} \)
  Alkenes \( \rightarrow \text{C}_n\text{H}_{2n} \)
  Alkynes \( \rightarrow \text{C}_n\text{H}_{2n-2} \)

• Carbon in general shows valency 4.

  (ability to form bond with carbon or other atoms.)

• It is not necessary to show valency 4. It may be variable sometime.

**Definition**

**Modern Definition of Organic Compounds**

• Hydrocarbon and their derivatives are called organic compounds.

• Compounds containing carbon and Hydrogen only are called Hydrocarbons.

**Point to remember**

• Some Compounds may appear as organic compounds but they are actually inorganic e.g., \( \text{CO}_2 \), \( \text{NaHCO}_3 \), \( \text{H}_2\text{CO}_3 \).
Types of Formula

1. **Molecular formula**:
   Example:
   (i) Water $\rightarrow$ $\text{H}_2\text{O}$
   (ii) Sulphuric Acid $\rightarrow$ $\text{H}_2\text{SO}_4$

2. **Empirical formula**:
   Example:
   
<table>
<thead>
<tr>
<th>Molecular formula</th>
<th>Empirical formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Glucose $\text{C}<em>6\text{H}</em>{12}\text{O}_6$</td>
<td>$\text{C}_2\text{H}_2\text{O}_1$</td>
</tr>
<tr>
<td>(ii) Propene $\text{C}_3\text{H}_6$</td>
<td>$\text{C}_1\text{H}_2$</td>
</tr>
</tbody>
</table>

3. **Structural formula**:
   Example: $\text{H}_2\text{SO}_4$

   ![Structural formula](image)

   (Structural Formula)

* **Representation of Organic Compounds**

   Organic chemists use a variety of formats to write structural formulas

   ![Dash formula](image)  
   ![Condensed formula](image)  
   ![Bond-line formula](image)

4. **Dash-formula**:

   Dash structural formulas have lines that show bonding electron pairs, and include elemental symbols for all of the atoms in a molecule.
4. Introduction of Organic Compounds

Q
(i) $\text{C}_2\text{H}_6$
(ii) $\text{C}_4\text{H}_8$
(iii) $\text{C}_3\text{H}_4$

Sol
(i) $\text{C}_2\text{H}_6 \rightarrow \text{H} - \text{C} - \text{C} - \text{H}$

(ii) $\text{C}_4\text{H}_8 \rightarrow \text{H} - \text{C} = \text{C} - \text{C} - \text{H}$ or $\text{H} - \text{C} - \text{C} - \text{H} - \text{H}$

(iii) $\text{C}_3\text{H}_4 \rightarrow \text{H} - \text{C} \equiv \text{C} - \text{C} - \text{H}$

5. Condensed Structural Formulas:

**Definition**
In fully condensed formulas, all of the atoms that are attached to the carbon are usually written immediately after that carbon, listing hydrogens first.

**Examples (Unsolved)**

- (a) $\text{C}_2\text{H}_6$
- (b) $\text{C}_4\text{H}_8$
- (c) $\text{C}_5\text{H}_{10}$
- (d) $\text{C}_4\text{H}_{10}$

**Sol**

(a) $\text{H}_3\text{C} - \text{CH}_3$
(b) $\text{H}_2\text{C} - \text{CH} = \text{CH}_2$ or $\text{H}_2\text{C} - \text{CH} - \text{CH}_2$
(c) $\text{H}_2\text{C} = \text{CH} - \text{CH}_2 - \text{CH}_3$
(d) $\text{H}_2\text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
6. Bond-Line Formulas:

Examples:

\[
\begin{align*}
\text{Terminal points and bends represent C, all other valencies are filled by H. Hydrogen atom attach to carbon is not shown.}
\end{align*}
\]

Bond line notation:

Degree of Carbon:

Degree of a given carbon means number of carbon atoms directly attached to particular carbon atom has to be considered.

1° carbon → Attached to 1C – also known as primary carbon

Note:

* If the compound has any heteroatom it will be shown and any hydrogen atom attached with it will also be shown.
2° carbon → Attached to 2C – also known as secondary carbon
\[ \text{CH}_3-(\text{CH}_2)-\text{CH}_3 \]

3° carbon → Tertiary carbon
\[ \text{CH}_3-\text{CH}-\text{CH}_3 \]

4° carbon → Quaternary carbon
\[ \text{CH}_3-\text{C}-(\text{CH}_3) \]

**Degree of Hydrogen:**
Similarly we define degree of H atom as the degree of carbon atom to which it is attached.

1° H → Attached to 1° C
2° H → Attached to 2° C
3° H → Attached to 3° C
4° H → Not possible

**Example:**

\[ \text{H} \quad \text{H} \quad (1° \text{H}) \]
\[ \text{H} \quad \text{C} \quad (3° \text{H}) \]
\[ \text{H} \quad \text{CH}_3(1° \text{H}) \quad (2° \text{H}) \]

**Q**

<table>
<thead>
<tr>
<th>Compound</th>
<th>1°C</th>
<th>2°C</th>
<th>3°C</th>
<th>4°C</th>
<th>1°H</th>
<th>2°H</th>
<th>3°H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iii)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(iv)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sol**

<table>
<thead>
<tr>
<th>Compound</th>
<th>1°C</th>
<th>2°C</th>
<th>3°C</th>
<th>4°C</th>
<th>1°H</th>
<th>2°H</th>
<th>3°H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Note:
- Alcohols are hydrocarbon that contains –OH (hydroxy) group.
- Degree of alcohol is degree of carbon atom to which –OH group is attached.

Degree of Alcohols:

Example:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Compound</th>
<th>Degree of Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>CH₃–CH₂–OH</td>
<td>1° alcohol</td>
</tr>
<tr>
<td>(ii)</td>
<td>CH₃–CH–OH</td>
<td>2° alcohol</td>
</tr>
<tr>
<td>(iii)</td>
<td>CH₃–C–OH</td>
<td>3° alcohol</td>
</tr>
</tbody>
</table>

Identify the degree of given alcohols

Sol

(i) CH₃–CH₂–OH 1°
(ii) CH₃–CH–OH 2°
(iii) CH₃–C–OH 3°
Degree of Alkyl halide (R–X) :

(i) $\text{H}_3\text{C} - \text{CH}_2 - \text{Cl}$ 1° halide

(ii) $\text{CH}_3 - \text{CH} - \text{Cl}$ 2° halide

(iii) $\text{CH}_3 - \text{C} - \text{Cl}$ 3° halide

Definition

Degree of alkyl halide is the degree of carbon atom directly attached to halogen.

Q Identify the degree of given halides :

(i) $\text{Cl}$ 3°

(ii) $\text{F}$ 2°

(iii) $\text{Br}$ 3°

(iv) $\text{Cl}$ 2°

Sol (i) $\text{Cl}$ 3°

(ii) $\text{F}$ 2°

(iii) $\text{Br}$ 3°

(iv) $\text{Cl}$ 2°

Degree of Amines (R–NH$_2$) :

Degree of amines is numbers of carbon atoms directly attached with nitrogen.

Examples :

$\text{CH}_3\text{–NH}_2$ (1° amine)

$\text{CH}_3\text{–NH–CH}_3$ (2° amine)

$\text{H}_3\text{C}\text{–N}–\text{CH}_3$ (3° amine)
Identify the degree of given amines (1°, 2°, 3° amine):

(i) \( \text{NH}_2 \)
(ii) \( \text{N} \)
(iii) \( \text{N} \)
(iv) \( \text{N} \)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Compound</th>
<th>1°</th>
<th>2°</th>
<th>3° amine</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td></td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>(ii)</td>
<td></td>
<td>×</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>(iii)</td>
<td></td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>(iv)</td>
<td></td>
<td>×</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>
Functional Groups and Classification

**Functional groups**

**Definition**
Part of the molecules which are responsible for the characteristics chemical reactions of those molecules.

**TYPE OF FUNCTIONAL GROUPS**

<table>
<thead>
<tr>
<th>Functional Group</th>
<th>Structure</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{H}_2\text{C} = \text{CH}_2 )</td>
<td></td>
<td>Alkene</td>
</tr>
<tr>
<td>( \text{CH} = \text{CH} )</td>
<td></td>
<td>Alkene</td>
</tr>
<tr>
<td>( \text{R}–\text{OH} )</td>
<td></td>
<td>Alcohol</td>
</tr>
<tr>
<td>( \text{R}–\text{SH} )</td>
<td></td>
<td>Thio alcohol</td>
</tr>
<tr>
<td>( \text{R}–\text{O}–\text{R} )</td>
<td></td>
<td>Ether</td>
</tr>
<tr>
<td>( \text{R}–\text{S}–\text{R} )</td>
<td></td>
<td>Thio ether</td>
</tr>
<tr>
<td>( \text{R}–\text{CH}=\text{O} )</td>
<td></td>
<td>Aldehyde</td>
</tr>
<tr>
<td>( \text{R}–\text{COOH} )</td>
<td></td>
<td>Carboxylic acid</td>
</tr>
<tr>
<td>( \text{R}–\text{SO}_3\text{H} )</td>
<td></td>
<td>Sulphonic acid</td>
</tr>
<tr>
<td>( \text{R}–\text{C}≡\text{N} )</td>
<td></td>
<td>Cyanide</td>
</tr>
<tr>
<td>( \text{R}–\text{N}=\text{O} )</td>
<td></td>
<td>Nitroso</td>
</tr>
<tr>
<td>( \text{R}–\text{CH}=\text{N}–\text{R} )</td>
<td></td>
<td>Imine</td>
</tr>
<tr>
<td>( \text{R}–\text{C}=\text{O} )</td>
<td></td>
<td>Ketone</td>
</tr>
<tr>
<td>( \text{R}–\text{C}–\text{O}–\text{C}–\text{R} )</td>
<td></td>
<td>Anhydride</td>
</tr>
<tr>
<td>( \text{R}–\text{O–C}–\text{R} )</td>
<td></td>
<td>Phenol</td>
</tr>
<tr>
<td>( \text{R}–\text{N}–\text{C}≡\text{N} )</td>
<td></td>
<td>Isocyanide</td>
</tr>
<tr>
<td>( \text{R}–\text{N}=\text{O} )</td>
<td></td>
<td>Aniline</td>
</tr>
<tr>
<td>( \text{R}–\text{C}–\text{O}–\text{C}–\text{R} )</td>
<td></td>
<td>Esters</td>
</tr>
<tr>
<td>( \text{R}–\text{C}–\text{NH}_2 )</td>
<td></td>
<td>Amides</td>
</tr>
<tr>
<td>( \text{R}–\text{C}–\text{X} )</td>
<td></td>
<td>Acid halides</td>
</tr>
<tr>
<td>( \text{R}–\text{N}=\text{O} )</td>
<td></td>
<td>Nitroso</td>
</tr>
<tr>
<td>( \text{–N}=\text{N}– )</td>
<td></td>
<td>Azo</td>
</tr>
</tbody>
</table>

Type of functional groups:

**Point to remember**
Due to difference in their properties, \( 1^\circ, 2^\circ, 3^\circ \) amine are treated as different functional groups but primary, secondary and tertiary alcohols are considered as same functional groups.
Q Identify the function group present in given molecule and encircle them:

\[
\begin{align*}
&\text{HS} \quad \text{Cl} \\
&\text{OH} \quad \text{O}
\end{align*}
\]

Sol thio alcohol \hspace{1cm} \text{acid chloride} \hspace{1cm} \text{Alcohol}

Q Identify the function group present in given molecule and encircle them:

\[
\begin{align*}
&\text{O} \\
&\text{NC} \quad \text{N} \\
&\text{OH} \quad \text{H}
\end{align*}
\]

Sol ketone \hspace{1cm} 2^\circ \text{amine} \hspace{1cm} \text{Cyanide} \hspace{1cm} \text{Alcohol}

Q Identify the function group present in given molecule and encircle them:

\[
\begin{align*}
&\text{SH} \\
&\text{OHC} \quad \text{O}
\end{align*}
\]
12. Functional Groups and Classification

Number of different functional group present in given compound

Total 5
Penicillin has following structure

Number of π-bonds possible in given structure

3 + 1 + 1 + 1 = 6

**Homologous Series**

**Example-1**
- CH₄ Methane
- CH₃CH₃ Ethane
- CH₃CH₂CH₃ Propane
- CH₃(CH₂)₂CH₃ Butane
- CH₃(CH₂)₃CH₃ Pentane

Homologous series of alkanes (also known as paraffins).
Each consecutive member differ by –CH₂–

**Example-2**
- CH₃OH Methanol
- CH₃CH₂OH Ethanol
- CH₃CH₂CH₂OH Propanol
- CH₃(CH₂)₂CH₂OH Butanol
- CH₃(CH₂)₃CH₂OH Pentanol

Homologous series of alcohol.
Example-3

- H–C–OH
  Methanoic acid
- CH₃–C–OH
  Ethanoic acid
- CH₃–CH₂–C–OH
  Propanoic acid
- CH₃–(CH₂)₂–C–OH
  Butanoic acid
- H₃C–CH₂–CH₂–CH₂–C–OH
  Pentanoic acid

Calculation of number of \( \sigma \) bond and \( \pi \) bonds in the compound

\( \sigma \) bond :

Ex. \( \text{C}_2\text{H}_6 \)

\[ \begin{array}{c}
  \text{H} \\
  \sigma \\
  \text{C} \\
  \sigma \\
  \text{H} \\
  \sigma \\
  \text{H} \\
  \sigma \\
\end{array} \]

\( \Rightarrow 7 \sigma \) bonds

\( \pi \) bond :

Ex. \( \text{C}_2\text{H}_4 \)

\[ \begin{array}{c}
  \text{H} \\
  \sigma \\
  \text{C} \\
  \sigma \\
  \text{H} \\
  \sigma \\
\end{array} \]

\( \Rightarrow 5 \sigma \) bond

Homologous series of carboxylic acid.

Introduction

- The first bond formed by atom is always \( \sigma \) bond. It is formed by axial overlapping. Single bonds are always \( \sigma \) bonds.

- If two atoms forms more than one bond between them except the first bond, rest all are \( \pi \) bonds. They are formed by sideways overlapping.
**Q** Find the number of bonds (σ bond and π bond) in following compounds:

(i) \( H-C≡C-H \)

(ii) \( \text{[Diagram]} \)

(iii) \( N≡C\overset{\cdot}{C}=\overset{\cdot}{C}≡N \)

(iv) \( \text{[Diagram]} \)

<table>
<thead>
<tr>
<th>Compound</th>
<th>σ bond</th>
<th>π bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>(ii)</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>(iii)</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>(iv)</td>
<td>21</td>
<td>3</td>
</tr>
</tbody>
</table>

**Q** Number of π bonds present in given compound is

\( \text{[Diagram]} \)

Number of π bonds present in given compound is:

\[ 3 + 2 + 2 + 1 = 8 \]
Classification of Organic Compounds

- Acyclic (open chain)
  - Saturated
    - Alkane
      - \( \text{C}_n \text{H}_{2n+2} \)
        - \( n = 1, 2, 3, \ldots \)
  - Unsaturated
    - Alkene
      - \( \text{C}_n \text{H}_{2n} \) (\( \text{C} = \text{C} \))
    - Alkyne
      - \( \text{C}_n \text{H}_{2n-2} \) (\( \text{C} = \text{C} \))

- Cyclic (Closed chain)
  - Homocyclic
    - Alicyclic
      - Aromatic
        - Benzenoid
          - Alicyclic
            - Aromatic
        - Non-Benzenoid
          - Alicyclic
            - Aromatic
  - Heterocyclic
**Nomenclature**

Mainly three systems are adopted for naming an organic compound

(i) Common names or Trivial system
(ii) Derived system
(ii) IUPAC system or Jeneva system

**Trivial System:**

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>ORGANIC COMPOUND</th>
<th>TRIVIAL NAME</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH₃OH</td>
<td>Wood spirit or Methyl spirit</td>
<td>Obtained by destructive distillation of wood</td>
</tr>
<tr>
<td>2</td>
<td>NH₂CONH₂</td>
<td>Urea</td>
<td>Obtained from urine</td>
</tr>
<tr>
<td>3</td>
<td>CH₄</td>
<td>Marsh gas (fire damp)</td>
<td>It was produced in marshy places</td>
</tr>
<tr>
<td>4</td>
<td>CH₃COOH</td>
<td>Vinegar</td>
<td>Obtained from Acetum –i.e. Vinegar</td>
</tr>
<tr>
<td>5</td>
<td>COOH</td>
<td>Oxalic acid</td>
<td>Obtained from oxalis plant</td>
</tr>
<tr>
<td>6</td>
<td>HCOOH</td>
<td>Formic acid</td>
<td>Obtained from formicus [Red ant]</td>
</tr>
<tr>
<td>7</td>
<td>H₂C—CH—COOH</td>
<td>Lactic acid</td>
<td>Obtained from sour mild</td>
</tr>
<tr>
<td>8</td>
<td>H₂C—COOH</td>
<td>Malic acid</td>
<td>Obtained from apples</td>
</tr>
<tr>
<td>9</td>
<td>CH₃CH₂CH₂COOH</td>
<td>Butyric acid</td>
<td>Obtained from butter</td>
</tr>
<tr>
<td>10</td>
<td>CH₃(CH₂)₄COOH</td>
<td>Caproic acid</td>
<td>Obtained from goats</td>
</tr>
</tbody>
</table>

**Introduction**

Initially organic compounds are named on the basis of source from which they were obtained for Some typical compounds in which common and trivial names are also differ.
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>ORGANIC COMPOUND</th>
<th>TRIVIAL NAME</th>
<th>SOURCE (COMMON NAME)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH₄</td>
<td>Marsh gas</td>
<td>Methane</td>
</tr>
<tr>
<td>2</td>
<td>CH₃OH</td>
<td>Wood spirit</td>
<td>Methyl alcohol</td>
</tr>
<tr>
<td>3</td>
<td>CH₃COOH</td>
<td>Vinegar</td>
<td>Acetic acid</td>
</tr>
<tr>
<td>4</td>
<td>H₃C—C—CH₃</td>
<td>Acetone</td>
<td>Dimethyl ketone</td>
</tr>
</tbody>
</table>

### Derived System
- This system is reserved for the following nine homologous series.

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>NAME OF HOMOLOGOUS SERIES</th>
<th>DERIVED NAME</th>
<th>STRUCTURE OF GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alkane</td>
<td>Methane</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alkene</td>
<td>Ethylene</td>
<td>&gt; C = C &lt;</td>
</tr>
<tr>
<td>3</td>
<td>Alkyne</td>
<td>Acetylene</td>
<td>− C ≡ C −</td>
</tr>
<tr>
<td>4</td>
<td>Alkanol</td>
<td>Carbinol</td>
<td>− C─OH</td>
</tr>
<tr>
<td>5</td>
<td>Alkanal</td>
<td>Acetaldehyde</td>
<td>−C─OH</td>
</tr>
</tbody>
</table>
IUPAC system of Nomenclature

- International union of pure and applied chemistry.
- IUPAC system for naming is something that is very similar to addressing a person with his complete designation.

Dr. Abdul Kalam

(Prefix) Main name Surname

Systematic IUPAC name follow SPWPS rule

S  P  W  P  S
(Secondary prefix) (Primary prefix) (Word root) (Primary suffix) (Secondary suffix)

Secondary prefix

- It defines substituent & position of substituent.
- IUPAC considers following given groups as substituents:

1. \(-R\) \(\Rightarrow\) alkyl
   
   **Examples**:  
   - \(-\text{CH}_3\) \(\Rightarrow\) methyl  
   - \(-\text{CH}_2\text{CH}_3\) \(\Rightarrow\) ethyl  
   - \(-\text{CH}_2\text{CH}_2\text{CH}_3\) \(\Rightarrow\) propyl  
   - \(-\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3\) \(\Rightarrow\) butyl  
   - \(-\text{Ph}\) \(\Rightarrow\) phenyl

2. \(-\text{OR}\) \(\Rightarrow\) alkoxy
   
   **Examples**:  
   - \(-\text{OCH}_3\) \(\Rightarrow\) methoxy  
   - \(-\text{OC}_2\text{H}_5\) \(\Rightarrow\) ethoxy  
   - \(-\text{OCH}_2\text{CH}_2\text{CH}_3\) \(\Rightarrow\) propoxy  
   - \(-\text{OPh}\) \(\Rightarrow\) phenoxy

3. \(-X\) \(\Rightarrow\) Halo
   
   **Examples**:  
   - \(-\text{F}\) \(\Rightarrow\) Fluoro  
   - \(-\text{Cl}\) \(\Rightarrow\) Chloro  
   - \(-\text{Br}\) \(\Rightarrow\) Bromo  
   - \(-\text{I}\) \(\Rightarrow\) Iodo

4. \(-\text{NO}_2\) \(\Rightarrow\) Nitro
5. \(-\text{NO}\) \(\Rightarrow\) Nitroso
6. \(-\text{N}_3\) \(\Rightarrow\) Azido
**Primary prefix**
- A primary prefix is used simply to distinguish cyclic from acyclic compounds.
- A primary prefix, cyclo is used immediately before the word root.
- It defines nature of parent carbon chain.
  - Open chain (alicyclic) ⇒
  - Closed chain (cyclic) ⇒ Cyclo
  - Bicyclic ⇒ Bicyclo
  - Spirane ⇒ Spiro

**Word Root**
- It is the basic unit of the name. It denotes the number of carbon atoms present in the principal chain (the longest possible continuous chain of carbon atoms including the functional group and based upon the common names of alkanes) of the organic molecules.
  - According to number of carbon’s in parent C–chain.
    - $C_1 \rightarrow$ meth    $C_5 \rightarrow$ pent
    - $C_2 \rightarrow$ eth    $C_{12} \rightarrow$ dodec
    - $C_3 \rightarrow$ prop   $C_{13} \rightarrow$ tridec
    - $C_4 \rightarrow$ but    $C_{20} \rightarrow$ eicos
    - $C_5 \rightarrow$ pent   $C_{20} \rightarrow$ hept
    - $C_6 \rightarrow$ hex    $C_{20} \rightarrow$ oct
    - $C_7 \rightarrow$ hept   $C_{20} \rightarrow$ non
    - $C_8 \rightarrow$ oct    $C_{20} \rightarrow$ dec
    - $C_9 \rightarrow$ non    $C_{100} \rightarrow$ hect

**Primary Suffix**
- A primary suffix is always added to the word root to indicate whether the carbon chain is saturated or unsaturated.
- The three basic primary suffixes are given below:
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>TYPE OF CARBON CHAIN</th>
<th>PRIMARY SUFFIX</th>
<th>GENERAL NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(a) Saturated</td>
<td>-ane</td>
<td>Alkane</td>
</tr>
<tr>
<td>2</td>
<td>(b) Unsaturated with one double bond</td>
<td>-ene</td>
<td>Alkene</td>
</tr>
<tr>
<td>3</td>
<td>(c) Unsaturated with one triple bond</td>
<td>-yne</td>
<td>Alkyne</td>
</tr>
</tbody>
</table>

If the parent carbon chain contain two, three or more double or triple bond, numerical prefix such as di (for two), tri (for three), tetra (for four) etc. are added to the primary suffix.

For example.
### Nomenclature

#### Type of Carbon Chain

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>TYPE OF CARBON CHAIN</th>
<th>PRIMARY SUFFIX</th>
<th>GENERAL NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(a) Unsaturated with one double bond</td>
<td>-diene</td>
<td>Alkadiene</td>
</tr>
<tr>
<td>2</td>
<td>(b) Unsaturated with one triple bond</td>
<td>-diyne</td>
<td>Alkadiyne</td>
</tr>
</tbody>
</table>

#### Secondary Suffix

A secondary suffix is always added to the primary suffix to indicate the nature of the functional group present in the organic compounds. Secondary suffix of some important functional groups are given below:

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>CLASS OF ORGANIC COMPOUNDS</th>
<th>FUNCTIONAL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alcohols</td>
<td>–OH</td>
</tr>
<tr>
<td>2</td>
<td>Aldehydes</td>
<td>–CHO</td>
</tr>
<tr>
<td>3</td>
<td>Ketones</td>
<td>&gt;C=O</td>
</tr>
<tr>
<td>4</td>
<td>Carboxylic acids</td>
<td>–COOH</td>
</tr>
<tr>
<td>5</td>
<td>Acid amides</td>
<td>–CONH₂</td>
</tr>
<tr>
<td>6</td>
<td>Acid chlorides</td>
<td>–COX</td>
</tr>
<tr>
<td>7</td>
<td>Esters</td>
<td>–COOR</td>
</tr>
<tr>
<td>8</td>
<td>Nitriles</td>
<td>–CN</td>
</tr>
<tr>
<td>9</td>
<td>Thioalcohols</td>
<td>–SH</td>
</tr>
<tr>
<td>10</td>
<td>Amines</td>
<td>–NH₂</td>
</tr>
</tbody>
</table>

**Note:**
- We will discuss secondary suffix in detail after mono functional group naming.
**Nomenclature of Alkane**

Steps in IUPAC Naming

(A) Selection of parent chain  (B) Numbering at parent chain

**Rule-1:**
- Select the longest carbon chain containing maximum number of carbon and this longest carbon chain is also called parent carbon chain (PCC).
- Longest carbon chain not always straight.

**Eg.**

**Rule-2:**
- If two or more carbon chain contains same number of carbon then PCC is considered which has more number of substituents.

**Eg.**

**Rule-3:**
- Numbering of parent carbon chain is done by lowest locant rule.

**Lowest Locant Rule:**
- According to this rule numbering is done in such a way so that substituent will get lowest number.

**Eg.**

2-methyl butane
Note:
- In IUPAC naming numbers of substituent will be separated by (,) comma and number & alphabet is separated by (‘–’) hyphen.

Rule-4:
- If two or more different substituents are present at parent carbon chain then numbering is done according to lowest locant rule while writing IUPAC name follow alphabetical order.

**Eg.**:

Rule-5:
If two or more similar substituents are present on parent carbon chain then use di, tri, tetra etc. before 2° prefix while writing IUPAC name but di, tri, tetra, etc. are not considered alphabetically.

**Eg.**:

Rule-6:
- If two or more substituents are present on parent carbon chain and they get same number from either side during numbering then numbering is done by alphabetical order.

**Eg.**:

2-bromo-3-chlorobutane
Sol 1. 2,2-dimethylpropane

2. 3,3-diethylpentane

3. 2,2,4-trimethylhexane

4. 4-ethyl-3,3-dimethylhexane

5. 5-bromo-2,3-dichlorohexane

6. 3-chloro-4-ethylhexane

7. 3,4-dimethylhexane

8. 3-bromo-1-chloro-2-iodopentane
Nomenclature of cyclic alkane

Rule:

- The cyclic structure or ring is considered as P.C.C. till the number of carbon in the ring is same or greater than number of carbon in chain.
- Rest all rules are similar as nomenclature of alkane.

Examples:

1. ![Structure 1](image) → 1-methylcyclohexane

2. ![Structure 2](image) → 1-ethylcyclopropane 'or' ethylcyclopropane

3. ![Structure 3](image) → Propylcyclopropane

4. ![Structure 4](image) → 1-cyclopropylbutane

5. ![Structure 5](image) → 1-ethyl-1,2-dimethylhexane
**Nomenclature of Alkene & Alkyne**

**Rule-1:**
**Parent carbon chain selection:**
- Select the longest carbon chain containing maximum number of multiple bonds.
- If two chains having same number of multiple bonds then check maximum number of carbons to select parent carbon chain.
- If multiple bonds & carbon both are same then see maximum number of substituent to select parent carbon chain.
- Number of multiple bond > Number of carbon > Number of substituent (priority order)

**EXAMPLE-1:**

```
\[ \begin{array}{c}
\text{C} = \text{C} \\
\text{C} = \text{C} - \text{C} - \text{C} - \text{C} - \text{C} \\
\text{C} - \text{C} - \text{C} \\
\text{C} = \text{C} \\
\end{array} \]
```

**EXAMPLE-2:**

```
\[ \begin{array}{c}
\text{C} = \text{C} - \text{C} - \text{C} - \text{C} - \text{C} - \text{C} \\
\text{C} - \text{C} = \text{C} \\
\end{array} \]
```

**EXAMPLE-3:**

```
\[ \begin{array}{c}
\text{C} = \text{C} - \text{C} - \text{C} = \text{C} \\
\text{C} = \text{C} \\
\end{array} \]
```

**Rule-2:**
**Numbering of parent carbon chain:**
- While doing numbering in alkene and alkyne minimum number should be given to multiple bond.
- If multiple bond getting same number from either side then give minimum number to substituent.
- For numbering multiple bond priority is high compare to substituent.
Examples:

1. \[ \begin{array}{c}
    1 & 2 & 3 & 4 & 5 \\
    \text{4-methylpent-1-ene}
\end{array} \]

2. \[ \begin{array}{c}
    3 & 2 & 1 \\
    \text{1-bromoprop-1-ene}
\end{array} \]

3. \[ \begin{array}{c}
    3 & 2 & 1 \\
    \text{3-bromoprop-1-ene}
\end{array} \]

4. \[ \begin{array}{c}
    3 & 2 & 1 \\
    \text{1-bromo-3-chloroprop-1-ene}
\end{array} \]

5. \[ \begin{array}{c}
    3 & 2 & 1 \\
    \text{3-bromo-1-chloroprop-1-ene}
\end{array} \]

6. \[ \begin{array}{c}
    2 & 3 & 4 \\
    \text{1-bromobut-2-ene}
\end{array} \]

Rule–3:
If two or more similar multiple bonds are present on PCC then use di, tri, tetra etc. before 1° suffix and before this di, tri, tetra etc. ‘a’ should be written.

Examples:

1. \[ \begin{array}{c}
    1 & 2 & 3 & 4 & 5 \\
    \text{Hepta-1,3-diene}
\end{array} \]

2. \[ \begin{array}{c}
    1 & 2 & 3 & 4 & 5 \\
    \text{Penta-1,4-diene}
\end{array} \]

Rule–4:
If in parent carbon chain alkene and alkyne both are present and they are getting same number from either side i.e. in between alkene and alkyne) then numbering is done from alkene side because alphabetically ene > yne.
Examples:

1. \(\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{C} \equiv \text{CH}\)  
   Pent-1-en-4-yne

2. \(\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{C} \equiv \text{C} - \text{CH}_3\)  
   Hept-2-en-5-yne

Q

1. \[
\begin{array}{c}
\text{CH}_2 = \text{CH} = \text{CH} = \text{CH} \end{array}
\]

2. \[
\begin{array}{c}
\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} \end{array}
\]

3. \[
\begin{array}{c}
\text{CH}_2 = \text{CH} \end{array}
\]

4. \[
\begin{array}{c}
\text{CH}_2 = \text{CH} - \text{Cl} \end{array}
\]

5. \[
\begin{array}{c}
\text{CH}_2 \end{array}
\]

6. \[
\begin{array}{c}
\text{Br} - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH}_3 \end{array}
\]

7. \[
\begin{array}{c}
\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_2 - \text{CH} = \text{CH}_2 \end{array}
\]

Sol

1. 3-ethylhex-1-ene

2. 4-ethylhept-1-ene

3. 4-chlorobut-1-yne

4. Buta-1,3-diyne

5. 1-cyclopropyleth-1-ene

6. 1-bromobut-1-yne

7. Hex-1-en-4-yne

Nomenclature of cyclic alkene

Rule:
All rules are similar to alkene & alkyne but during numbering 1 number is always given to alkene.

3-methylcyclohex-1-ene
Q
1. 
2. 
3. 
4. 
5. 
6. 

Sol
1. 3,4-dimethylcyclobut-1-ene
2. 1,4-dimethylcyclobut-1-ene
3. 1-bromo-2-chlorocyclobut-1-ene
4. 3-bromo-6-chlorocyclohex-1-ene
5. 1-bromo-4-chlorocyclopenta-1,3-diene
6. 6-bromo-3-ethyl-3-methylcyclohex-1-ene
# Nomenclature of Complex Locant

Complex locant is defined as which consist of substituent in substituent.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>COMPLEX LOCANT</th>
<th>COMMON NAME</th>
<th>IUPAC NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(-\text{C}-\text{C}) (\text{C})</td>
<td>Iso propyl</td>
<td>1-methyl ethyl</td>
</tr>
<tr>
<td>2</td>
<td>(-\text{C}-\text{C}-\text{C}) (\text{C})</td>
<td>Sec-butyl</td>
<td>1-methyl propyl</td>
</tr>
<tr>
<td>3</td>
<td>(-\text{C}-\text{C}-\text{C}) (\text{C})</td>
<td>Iso-butyl</td>
<td>2-methyl propyl</td>
</tr>
<tr>
<td>4</td>
<td>(-\text{C}-\text{C}-\text{C}-\text{C}) (\text{C})</td>
<td>Iso-pentyl</td>
<td>3-methyl butyl</td>
</tr>
<tr>
<td>5</td>
<td>(\text{C}) (-\text{C}-\text{C}) (\text{C})</td>
<td>Tert-butyl</td>
<td>1,1-dimethyl ethyl</td>
</tr>
<tr>
<td>6</td>
<td>(\text{C}) (-\text{C}-\text{C}-\text{C}) (\text{C})</td>
<td>Neo pentyl</td>
<td>2,2-dimethyl propyl</td>
</tr>
</tbody>
</table>
NOTE:

- Complex locant are written in square brackets \([\quad]\).
- In complex locant di, tri, tetra etc. should be considered in alphabetical order. iso, neo, sec. are also considered in alphabetic order.
- IUPAC name will be preferred over common name.
- If two similar complex locant are present then use bis, tris, tetrakis etc.

\([\text{di = bis, tri = tris, tetra = tetrakis}]\)

**Examples:**

5-\([1,1\text{-dimethylethyl}]\)undecane

4,5-bis \([1,1\text{-dimethylethyl}]\)nonane

**Questions:**

1. 2. 3.
4. 5. 6.
7. 8. 9.
10. 11. 12.
1. 5-[1-methylpropyl]nonane
2. 3,4-diethyl-2-methylhexane
3. 3-ethyl-2,2 dimethylhexane
4. 1-[1,1-dimethylethyl]cyclohexane
5. 1-[1-methylethyl]cyclohexane
6. 1-ethylcyclohexane
7. 1-ethyl-1-methylcyclohexane
8. 1-ethyl-3-methylcyclohexane
9. 1-ethylcyclohexane
10. 1-[1-methylcyclopropyl]cyclohexane
11. 1-cyclopropyl-3[1-methylethyl]cyclohexane
12. 3-methyl-5-[1-methylethyl]-4-propyl-octane
13. 2,2,3-trimethyl-6[1-methylethyl]nonane
14. 2,2,3,7,8,8-hexamethylnonane

Substituent Consist of Multiple Bond
1. If substituent having double bond:
   2° prefix / secondary prefix  alkenyl

   Examples:
   (i) – \(\text{CH} = \text{CH}\_2\) ethenyl
   (ii) – \(\text{CH} = \text{CH} – \text{CH}_3\) prop-1-enyl
   (iii) – \(\text{CH}_2 – \text{CH} = \text{CH}\_2\) prop-2-enyl
   (iv) \(4\)-ethylhepta-1,6-diene
   (v) cyclobut-1-enyl
   (vi) \(4\)-ethylhepta-1,6-diene

2. If substituent having triple bond:
   2° prefix alkynyl

   Examples:
   (i) – \(\text{C} – \text{CH}\) ethynyl
   (ii) – \(\text{C} – \text{CH} – \text{CH}_3\) prop-1-ynyl
   (iii) – \(\text{CH}_2 – \text{C} – \text{CH}\) prop-2-ynyl
   (iv) \(4\)-ethylhepta-1,6-diene

3. If substituent attached to parent carbon chain by multiple bond:
   2° prefix \(\Rightarrow\) alkylidene
Examples:

(i) \( = \text{CH}_2 \) Methylene or methylidene only for this

(ii) \( = \text{CH–CH}_3 \) Ethylidene

(iii) \( = \text{CH–CH}_2–\text{CH}_3 \) Propylidene

(iv) \( \text{Cyclopropylidene} \)

(v) \( \text{Cyclobutylidene} \)

Example:

4-methylenehepta-1,6-diene

‘or’

4-methylidenehepta-1,6-diene

Note:

1. \( \text{CH}_2=\text{CH}_2 \) vinyl \( \text{CH}_3 = \text{CH}– \) (vinyllic carbon)

2. \( \text{CH}_3–\text{CH=CH}_2 \) allyl \( \text{CH}_2=\text{CH–CH}=– \) (allylic carbon)

3. \( \text{CH}_3–\text{CH} < \text{Cl} \) geminal carbon

4. \( \text{CH}_3–\text{CH}_2 < \text{Cl} \) vicinal (vic)

Example:

\( \text{CH}_3–\text{CH} < \text{Cl} \) gem-dichloride

\( \text{CH}_3–\text{CH}–\text{CH}–\text{CH}_3 \) vicinal dichloride

Q \( \text{C}_3\text{H}_4\text{Br}_2 \), How many gem dibromide are possible and how many vicinal dibromide are possible?

Sol

Geminal

Geminal

Vicinal
Nomenclature of Epoxy

2° prefix - epoxy

1. 1, 2-epoxyethane
2. 1, 2-epoxypropane
3. 2,3-epoxybutane
4. 2,4-epoxypentane
5. (2,3), (4,5)-diepoxyhexane
IUPAC Naming of Functional Groups

1. Carboxylic Acid
2. Sulphonic Acid
3. Acid Anhydride
4. Ester

1. Nomenclature of Carboxylic Acid
   2° suffix oic acid

![Structural formulas for carboxylic acids and derivatives]

**Q**

1.  \(\text{H-C-OH}\)
2.  \(\text{H}_3\text{C-C-OH}\)
3.  \(\text{C} = \text{COOH}\)
4.  \(\text{C}-\text{C}-\text{H}\)
5.  \(\text{C} = \text{COOH}\)
6.  \(\text{Cl}_3\text{C-C-OH}\)
7.  \(\text{C}-\text{C}-\text{OH}\)

**Sol**

1.  \(\text{H-C-OH}\)  
   Methanoic acid
2.  \(\text{CH}_2\text{C-OH}\)  
   Ethanoic acid
3.  \(\text{C} = \text{COOH}\)  
   2-methylbut-2-en-oic acid
4.  \(\text{C} = \text{COOH}\)  
   3[cycloprop-2-enyl]butanoic acid
5. \[\text{Penta-2,4-dienoic acid}\]

6. \[\text{2,2,2-trichloroethanoic acid}\]

7. \[\text{2-[cyclohexa-1,3 dienyl]ethanoic acid}\]

**Nomenclature of Dicarboxylic Acid**

**General molecular formula:**

\[
\begin{align*}
\text{COOH} \\
\text{(CH}_2\text{)_n} \quad \text{COOH}
\end{align*}
\]

<table>
<thead>
<tr>
<th>N</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>M</td>
<td>S</td>
<td>G</td>
<td>A</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>Oxalic acid</td>
<td>Malonic acid</td>
<td>Succinic acid</td>
<td>Glutaric acid</td>
<td>Adipic acid</td>
<td>Pimelic acid</td>
<td>Suberic acid</td>
</tr>
</tbody>
</table>

**Questions**

1. \[\text{HO-C-C-C-OH}\]

2. \[\text{HO-C-CH}_2\text{-CH}_2\text{-C-OH}\]

3. \[\text{HO-C-CH}_2\text{-CH}_2\text{-CH}_2\text{-C-OH}\]

4. \[\text{HO-C-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-C-OH}\]

5. \[\text{HO-C-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-C-OH}\]
1. \[
\begin{align*}
&\text{Common name: Oxalic acid} \\
&\text{IUPAC name: Ethane-1,2-dioic acid}
\end{align*}
\]

2. \[
\begin{align*}
&\text{Common name: Succinic acid} \\
&\text{IUPAC name: Butane-1,4-dioic acid}
\end{align*}
\]

3. \[
\begin{align*}
&\text{Common name: Glutaric acid} \\
&\text{IUPAC name: Pentane-1,5-dioic acid}
\end{align*}
\]

4. \[
\begin{align*}
&\text{Common name: Pimelic acid} \\
&\text{IUPAC name: Heptane-1,7-dioic acid}
\end{align*}
\]

5. \[
\begin{align*}
&\text{Common name: Suberic acid} \\
&\text{IUPAC name: Octane-1,8-dioic acid}
\end{align*}
\]

2. **Nomenclature of Sulphonic Acid**

   2° suffix Sulphonic acid

\[
\begin{align*}
&1. \quad \text{Propane-1-sulphonic acid} \\
&2. \quad \text{Butane-2-sulphonic acid} \\
&3. \quad \text{3-bromobutane-2-sulphonic acid}
\end{align*}
\]
4. But-3-ene-1-sulphonic acid

5. Pent-1-en-4-yne-3-sulphonic acid

3. **Nomenclature of Anhydride**

2° suffix oic anhydride

\[
\begin{array}{c}
\text{H/R} - \text{C} - \text{O} - \text{C} - \text{R/H} \\
\text{O} & \text{O}
\end{array}
\]

**Examples:**

1. \(\text{CH}_3 - \text{C} - \text{O} - \text{H} \rightarrow \text{CH}_3 - \text{C} - \text{O} - \text{C} - \text{CH}_3\)
   ethanoic anhydride

2. \(\text{H}_2\text{C} - \text{C} - \text{O} - \text{H} \rightarrow \text{H} - \text{C} - \text{O} - \text{C} - \text{CH}_3\)
   ethanoic methanoic anhydride

**Questions:**

1. \(\text{H} - \text{C} - \text{O} - \text{C} - \text{H}\)
2. \(\text{H}_3\text{C} - \text{C} - \text{O} - \text{C} - \text{CH}_2 - \text{CH}_3\)
3. \(\text{C} = \text{O} - \text{O} - \text{C} - \text{CH}_2 - \text{CH}_3\)
4. \(\text{Br} - \text{C} - \text{O} - \text{C} - \text{Cl}\)
5. \(\text{C}_8\text{H}_8\text{O}_4\)
**IUPAC Naming of Functional Groups**

**Sol**

1. \( \text{H} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{H}} \) Methanoic anhydride

2. \( \text{H}_2\overset{2}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{2}{\text{H}}_2\overset{3}{\text{C}}_3 \) Ethanoicpropanoic anhydride

3. \( \overset{2}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{2}{\text{H}}_3 \) 2-methylpropanoic-prop-2-enoic anhydride

4. \( \overset{2}{\text{Br}}\overset{2}{\text{Cl}}\overset{2}{\text{C}} - \overset{1}{\text{O}} - \overset{2}{\text{H}}_2\overset{3}{\text{C}}_3 \) 2-bromoethanoic-2-chloroethanoic anhydride

5. Cyclohexane-1,2-dicarboxylic anhydride

**Nomenclature of Ester**

2° suffix oate

\[
\begin{array}{c}
\text{R} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{R}} \\
\text{PCC}
\end{array}
\]

IUPAC name: alkylalkanoate

**Q**

1. \( \text{H}_2\overset{3}{\text{C}} - \overset{1}{\text{C}} - \overset{2}{\text{O}} - \overset{3}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{H}} \)

3. \( \text{H} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{H}} \)

5. \( \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{Cl}} \)

7. \( \text{Cl} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{Br}} \)

2. \( \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{Br}} - \overset{1}{\text{O}} - \overset{2}{\text{H}}_2\overset{3}{\text{C}}_3 \)

4. \( \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{Br}} - \overset{1}{\text{O}} - \overset{1}{\text{Cl}} \)

6. \( \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{C}} - \overset{1}{\text{O}} - \overset{1}{\text{Cl}} - \overset{1}{\text{Br}} \)
Sol:

1. \(\text{CH}_3 - \text{C} - \text{C} \quad \text{O} \quad \text{CH}_2 - \text{CH}_2\) Ethylpropanoate

2. \(\text{CH}_3 - \text{C} - \text{C} \quad \text{O} \quad \text{CH}_2 - \text{CH}_2\) Ethyl-2-bromopropanoate

3. \(\text{H} \quad \text{C} \quad \text{O} \quad \text{CH}_3\) Methylmethanoate

4. \(\text{CH}_3 - \text{C} - \text{C} \quad \text{O} \quad \text{Cl}\) [1-chloroethenyl]-2-bromobutanoate

5. \(\text{C}_5\) Cyclopropylpentanoate

6. \(\text{CH}_3 - \text{C} - \text{O} \quad \text{Cl}\) Pent-3-enylethanoate

7. \(\text{CH}_3 - \text{C} - \text{C} \quad \text{O} \quad \text{Cl}\) 2-bromo-1-methyleth-1-yl-2-chlorobutanoate

Priority List of Functional Group

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>FUNCTIONAL GROUP</th>
<th>2° PREFIX</th>
<th>2° SUFFIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>– COOH</td>
<td>carboxylic acid</td>
<td>oic acid</td>
</tr>
<tr>
<td>2</td>
<td>– SO(_3)H</td>
<td>sulpho</td>
<td>sulphonic acid</td>
</tr>
<tr>
<td>Number</td>
<td>Functional Group</td>
<td>Description</td>
<td>Name</td>
</tr>
<tr>
<td>--------</td>
<td>------------------</td>
<td>-------------</td>
<td>------</td>
</tr>
<tr>
<td>3</td>
<td>(-C\equiv-O\equiv-C)</td>
<td>-</td>
<td>oic anhydride</td>
</tr>
<tr>
<td>4</td>
<td>(-C\equiv-O\equiv-R)</td>
<td>Alkanoyl oxy or alkoxy carbonyl</td>
<td>oate</td>
</tr>
<tr>
<td>5</td>
<td>(-C\equiv-X)</td>
<td>halo formyl</td>
<td>oylhalide</td>
</tr>
<tr>
<td>6</td>
<td>(-C\equiv-NH\equiv)</td>
<td>carbamoyl</td>
<td>amide</td>
</tr>
<tr>
<td>7</td>
<td>(-C\equiv-N)</td>
<td>cyano</td>
<td>nitrile</td>
</tr>
<tr>
<td>8</td>
<td>(-N\equiv-C)</td>
<td>isocyanate</td>
<td>isonitrile</td>
</tr>
<tr>
<td>9</td>
<td>(-CHO)</td>
<td>3 or 4</td>
<td>al</td>
</tr>
<tr>
<td>10</td>
<td>(-C\equiv-O\equiv)</td>
<td>keto/oxo</td>
<td>one</td>
</tr>
<tr>
<td>11</td>
<td>(-OH)</td>
<td>hydroxy</td>
<td>ol</td>
</tr>
<tr>
<td>12</td>
<td>(-SH)</td>
<td>sulphonyl/mercapto</td>
<td>thiol</td>
</tr>
<tr>
<td>13</td>
<td>(-NH\equiv)</td>
<td>amino</td>
<td>amine</td>
</tr>
<tr>
<td>14</td>
<td>epoxy</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
IUPAC Naming of Functional Groups

**Nomenclature of Acid Halide**

2° suffix : oyl halide

\[
\begin{array}{c}
R - C - X \\
\bigg/ \bigg/ \\
\big/ \big/ \\
\big/ \big/ \\
O
\end{array}
\]

**Let's understand**

1. Acid Halide
2. Amide
3. Cyanide
4. Aldehyde
5. Ketone

**Q**

1. \( \text{H} - \text{C} - \text{Cl} \)
2. \( \text{CH}_3 - \text{C} - \text{Cl} \)
3. \( \text{Cl} \)
4. \( \text{Cl} \)
5. \( \text{Cl} \)
6. \( \text{Cl} \)

**Sol**

1. H – C – Cl
   - Methanoylchloride
2. CH₃ – C – Cl
   - Ethanoylchloride
3. \( \text{Cl} \)
   - Prop-2-en-1-oylchloride
4. \( \text{Cl} \)
   - Prop-2-yn-1-oylchloride
5. \( \text{Cl} \)
   - Penta-2,4-dien-1-oylchloride
6. \( \text{Cl} \)
   - 2-methylpropan-1-oylchloride
7. \( \text{Cl} \)
   - 2,2-dimethylpropan-1-oylchloride
IUPAC Naming of Functional Groups

8. \( \begin{array}{c}
4 & 3 & 2 & 1 \\
5 & & & \text{Cl}
\end{array} \) 3-cyclopropylpentan-1-oylchloride

Nomenclature of Amide

2° suffix: amide

\[ \begin{array}{c}
\text{O} \\
\text{H/R - C - N - R} \\
\text{N,N-dialkylalkanamide}
\end{array} \]

Q

1. \( \begin{array}{c}
\text{Br} \\
\text{O} \\
\text{CH}_2 - \text{CH} - \text{C} - \text{N} - \text{CH}_3
\end{array} \)

2. \( \begin{array}{c}
\text{O} \\
\text{CH}_3 - \text{C} - \text{NH}_2
\end{array} \)

3. \( \begin{array}{c}
\text{O} \\
\text{NH} - \text{Et}
\end{array} \)

4. \( \begin{array}{c}
\text{Br} \\
\text{NH} - \text{Br}
\end{array} \)

5. \( \begin{array}{c}
\text{O} \\
\text{N} - \text{Br}
\end{array} \)

Sol

1. \( \begin{array}{c}
\text{Br} \\
\text{O} \\
\text{CH}_2 - \text{CH} - \text{C} - \text{N} - \text{CH}_3
\end{array} \) 2-bromo-N,N-dimethylpropanamide

2. \( \begin{array}{c}
\text{O} \\
\text{CH}_3 - \text{C} - \text{NH}_2
\end{array} \) Ethanamide

3. \( \begin{array}{c}
\text{NH} - \text{Et}
\end{array} \) N-ethylthamamide

4. \( \begin{array}{c}
\text{Br} \\
\text{O} \\
\text{NH} - \text{Br}
\end{array} \) N, 2-dibromopropanamide

5. \( \begin{array}{c}
\text{O} \\
\text{N} - \text{Cl}
\end{array} \) N-bromo-N-chloropropanamide

Nomenclature of Cyanide (R–CN)

2° suffix: nitrile
### IUPAC Naming of Functional Groups

<table>
<thead>
<tr>
<th>Q</th>
<th>1. ( \text{CH}_3 - \text{C} \equiv \text{N} )</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{CH}_2=\text{CH-CN} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>( \text{CH}_2=\text{CH-CN} )</td>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>( \text{Br} ) ( \text{Cl} ) ( \text{C} \equiv \text{N} )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sol</th>
<th>1. ( \text{CH}_3 - \text{C} \equiv \text{N} )</th>
<th>Ethanenitrile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Pentanenitrile</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>2-ethylhexanenitrile</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>2-ethylbut-3-ene-1-nitrile</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>( \text{CH}_2=\text{CH-C} \equiv \text{C} - \text{C} \equiv \text{N} )</td>
<td>Pent-4-en-2-yne-1-nitrile</td>
</tr>
<tr>
<td>6.</td>
<td>3-cyclopropylpentanenitrile</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>3-bromo-2-[1-chloroethenyl]-but-3-enenitrile</td>
<td></td>
</tr>
</tbody>
</table>

### Nomenclature of Aldehyde

2° suffix al

\[
\begin{array}{c}
R - \text{C-H} \\
\| \\
\text{O}
\end{array}
\]
IUPAC Naming of Functional Groups

**Q**

1. \( \text{CH}_3 - \text{C} - \text{H} \)
2. \( \text{H} - \text{C} - \text{H} \)
3. \( \text{C}_3 \text{H}_6 \text{O} \)
4. \( \text{C}_4 \text{H}_8 \text{O} \)
5. \( \text{C}_5 \text{H}_{10} \text{O} \)
6. \( \text{C}_6 \text{H}_{14} \text{O} \)
7. \( \text{C}_7 \text{H}_{14} \text{O} \)

**Sol**

1. \( \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \)
   - Ethanal
2. \( \text{H} - \text{C} - \text{H} \)
   - Methanal
3. \( \text{C}_3 \text{H}_5 \text{O} \)
   - Prop-2-en-1-al
4. \( \text{C}_4 \text{H}_6 \text{O} \)
   - But-2-en-1-al
5. \( \text{C}_5 \text{H}_{10} \text{O} \)
   - 2-ethylpent-1-al
6. \( \text{C}_7 \text{H}_{14} \text{O} \)
   - 4-[cyclopent-2-enyl]pentan-1-al
7. \( \text{C}_7 \text{H}_{14} \text{O} \)
   - Pent-4-en-1-al
IUPAC Naming of Functional Groups

8. \(
\text{\begin{tikzpicture}
  \tikzstyle{every node}=[font=\footnotesize]
  \tikzstyle{vertex}=[circle,fill,inner sep=1.5pt]
  \tikzstyle{edge}=[thick]

  \node[vertex] (1) at (0,0) {H};
  \node[vertex] (2) at (1,0) {\text{CH}_2};
  \node[vertex] (3) at (2,0) {\text{CH}_2};
  \node[vertex] (4) at (4,0) {\text{C}};
  \node[vertex] (5) at (4,1) {\text{C}};
  \node[vertex] (6) at (5,1) {\text{CH}_2};
  \node[vertex] (7) at (5,0) {\text{O}};

  \draw[edge] (1) -- (2);
  \draw[edge] (2) -- (3);
  \draw[edge] (4) -- (5);
  \draw[edge] (5) -- (6);
  \draw[edge] (6) -- (7);
\end{tikzpicture}}\)

2-cyclopentylethan-1-al

9. \(\text{H} - \text{C} - \text{CH}_2 - \text{O} - \text{C} - \text{H}\)

Propan-1,3-dial

**Nomenclature of Ketone**

\(2^o\) suffix one

**Q**

1. \(\text{CH}_3 - \text{C} - \text{CH}_3\)
2. \(\text{CH}_3\text{CH}_2\text{CO}\)
3. \(\text{CH}_3\text{CH}_2\text{CO}_2\text{H}\)
4. \(\text{CH}_3\text{CCH}_2\text{CO}\)
5. \(\text{CH}_3\text{CO}\)
6. \(\text{C}_5\text{H}_4\text{O}\)
7. \(\text{CH}_3 - \text{C} - \text{C} - \text{C} - \text{CH}_3\)
8. \(\text{O} - \text{CH}_2\text{CH} = \text{CH} = \text{CH}_2\)

**Sol**

1. \(\text{CH}_3 - \text{C} - \text{C} - \text{CH}_3\)
   Propan-2-one
2. \(\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}\)
   Butan-2-one
3. \(\text{CH}_3\text{CCH} = \text{CH}_2\text{CO}\)
   But-3-en-2-one
4. \(\text{CH}_3\text{CH} = \text{CHCH} = \text{CH}_2\text{CO}\)
   Pent-3-en-2-one
5. \(\text{CH}_3\text{COCH} - \text{Cl}\)
   2-bromo-4-chloropentan-3-one
6. \(\text{C}_5\text{H}_5\text{O}\)
   Cyclopenta-2,4-dien-1-one
IUPAC Naming of Functional Groups

Subjective Problems

Q1 Write down the correct IUPAC name of given compound:

\[
\text{\begin{array}{c}
\text{NO}_2 \\
\text{CONH}_2 \\
\text{F} \\
\text{C} = \text{O} \\
\text{Cl}
\end{array}}
\]

Sol 3-carbamoyl-4-fluoro-2-methyl-5-nitrohex-5-enoylchloride

Q2 Write down the correct IUPAC name of given compound:

\[
\text{\begin{array}{c}
\text{C} = \text{N} \\
\text{C} = \text{N} \\
\text{C} = \text{N} \\
\text{C} = \text{N}
\end{array}}
\]

Sol 1-[4'-isocyanocyclohexene]methanenitrile
Q3  Write down the correct IUPAC name of given compound:

\[
\text{Br} \quad \text{OCH}_3 \quad \text{C} = \text{O} \quad \text{NH}_2
\]

\[
\begin{array}{c}
\text{C} \\
\text{Br} \\
\text{Br} \\
\text{OCH}_3 \\
\text{C} = \text{O} \\
\text{NH}_2 \\
\end{array}
\]

\text{Sol}  \quad 5\text{-bromo-3-methoxy-2-methylhepta-3,5-dienamide}

Q4  Write down the correct IUPAC name of given compound:

\[
\begin{array}{c}
\text{Cl} \\
\text{C} = \text{O} \\
\text{CONH}_2 \\
\end{array}
\]

\[
\begin{array}{c}
\text{CONH}_2 \\
\text{CONH}_2 \\
\text{CONH}_2 \\
\end{array}
\]

\text{Sol}  \quad 3'\text{-carbamoyl-2-cyclobutenyl-4'-isocyanocyclohexanoylchloride}

Q5  Write down the correct IUPAC name of given compound:

\[
\text{CN} \quad \text{CN} \quad \text{CN}
\]

\[
\begin{array}{c}
\text{CN} \\
\text{CN} \\
\end{array}
\]

\text{Sol}  \quad 2\text{-[2'-isocyaenoethyl]pent-2-en-4-yenitrile}
Q6  Write down the correct IUPAC name of given compound:

Sol 2-[2’-bromo-1’-cyano-3’-fluorocycloprop-2-enyl] ethanamide
IUPAC Naming of Alcohol and Amine

Nomenclature of Alcohol (R–OH)
Secondary suffix – ‘ol’

Rule-1:
Select longest carbon chain containing
1. Functional group
2. Multiple bond
3. Locant / substituent
Priority: (i) > (ii) > (iii)

Rule-2:
While numbering, functional group is given more preference over multiple bonds.
Priority:
Functional group > Multiple bond > Substituents

Let’s understand
IUPAC Naming of
1. Alcohol
2. Amine

Q
1. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} \)
2. \( \text{CH}_3\text{CH}_2\text{CH}=(\text{CH}=(\text{CH})\text{OH} \)
3. \( \text{CH}=(\text{CH})\text{CH}=\text{CH}\text{OH} \)
4. \( \text{CH}_3\text{CH}=(\text{CH})\text{CH}_2\text{OH} \)
5. \( \text{CH}_3\text{CH}=(\text{CH}=\text{CH})\text{Br} \)
6. \( \text{C}_2\text{H}_4\text{OH} \)
7. \( \text{CH}=(\text{CH}=(\text{CH})\text{CH}=(\text{CH})\text{OH} \)
8. \( \text{CH}=(\text{CH})\text{CH}=(\text{CH})\text{OH} \)
9. \( \text{HOCH}=(\text{CH}=(\text{CH})\text{CH}=(\text{CH})\text{CH}=(\text{CH})\text{OH} \)
10. \( \text{CH}_3\text{CH}=(\text{CH})\text{CH}=(\text{CH})\text{Br} \)

Sol
1. \( \text{(5 4 3 2 1)}\) \( \text{OH} \)
   4-methylpentan-1-ol
2. \( \text{(5 4 3 2 1)}\) \( \text{OH} \)
   4-methylpentan-2-ol
3. \( \text{(3 2 1)}\) \( \text{OH} \)
   Prop-2-ene-1-ol
4. 4,3,2-1 OH 3,3-dimethylbutan-1-ol

5. OH 1 6 2 3 4 5 Br 5-bromocyclohex-2-en-1-ol

6. OH 1 2 2 OH Ethan-1,2-diol

7. 5,4,3,2,1 OH 4,4-dimethylpent-2-en-1-ol

8. OH 1 2 3 4 4 But-2-en-2-ol

9. OH 1 2 3 4 5 4-cyclopropylpentan-2-ol

10. OH 1 2 3 4 5 Br 4-bromopentan-2-ol

11. Cyclohexa-2,5-dien-1-ol
### Nomenclature of Amine \([R – \text{NH}_2]\)

2° suffix amine

<table>
<thead>
<tr>
<th>Q</th>
<th>1. ( \text{CH}_3 – \text{NH}_2 )</th>
<th>2. ( \text{NH}_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3. ( \text{CH}_3 – \text{NH} – \text{CH}_2 – \text{CH}_3 )</td>
<td>4. ( \text{H}_3\text{C} – \text{N} – \text{CH}_2 – \text{CH}_2 – \text{CH}_3 )</td>
</tr>
<tr>
<td></td>
<td>5. ( \text{NH}_2 )</td>
<td>6. ( \text{NH} – \text{CH}_2 – \text{CH}_3 )</td>
</tr>
<tr>
<td></td>
<td>7. ( \text{NH} – \text{CH} – \text{CH}_3 )</td>
<td>8. ( \text{N} – \text{CH} – \text{CH}_3 )</td>
</tr>
<tr>
<td></td>
<td>9. ( \text{NH}_2 )</td>
<td>10. ( \text{NH}_2 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sol</th>
<th>1. ( \text{CH}_3 – \text{NH}_2 )</th>
<th>Methanamine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. ( \text{NH}_2 )</td>
<td>Butan-2-amine</td>
</tr>
<tr>
<td></td>
<td>3. ( \text{CH}_3 – \text{NH} – \text{CH}_2 – \text{CH}_3 )</td>
<td>N-methylethanamine</td>
</tr>
<tr>
<td></td>
<td>4. ( \text{H}_3\text{C} – \text{N} – \text{CH}_2 – \text{CH}_2 – \text{CH}_3 )</td>
<td>N-ethyl-N-methylpropan-1-amine</td>
</tr>
<tr>
<td></td>
<td>5. ( \text{NH}_2 )</td>
<td>But-3-en-2-amine</td>
</tr>
<tr>
<td></td>
<td>6. ( \text{NH} – \text{CH}_2 – \text{CH}_3 )</td>
<td>N-ethylbutan-2-amine</td>
</tr>
<tr>
<td></td>
<td>7. ( \text{NH} – \text{CH} – \text{CH}_3 )</td>
<td>N-ethyl-2-methylpropan-2-amine</td>
</tr>
</tbody>
</table>

53.
IUPAC Naming of Alcohol and Amine

8.  \[
\begin{array}{c}
\text{N-ethyl-N-methylbutan-2-amine}
\end{array}
\]

9.  \[
\begin{array}{c}
2-\text{methylpropan-2-amine}
\end{array}
\]

10. \[
\begin{array}{c}
\text{Prop-2-en-1-amine}
\end{array}
\]

Q

1. 3-chloro-5-cyano-4-oxoheptanoic acid

2. 2-hydroxypropanoic acid

3. Ethyl-3-oxobutanoate

Sol

1. 3-chloro-5-cyano-4-oxoheptanoic acid

2. 2-hydroxypropanoic acid

3. Ethyl-3-oxobutanoate
4. 5-hydroxycyclohex-2-en-1-one

5. 6-amino-5-carbamoylheptane-2-sulphonic acid

6. 4-methoxycarbonylbut-2-en-1-oic acid

7. 4-ethanoyloxybutanoic acid

8. 4-ethanoyloxy-2-methylbutanoic acid

9. 3-chloroformyl-2-methyl-4-[N-methylamino]pentanoic acid

10. 2-cyanoethanoic acid
Subjective Problems

Q1  Write the IUPAC name of given compound:

![Image of compound](image1)

**Sol**

3-amino-1-hydroxypent-3-en-2-one

Q2  IUPAC name of given compound is a-bromo-b-chlorocyclohex-p-en-1,4-dione

![Image of compound](image2)

*Find a + b + p =*

**Sol**

5-bromo-2-chlorocyclohex-2-en-1,4-dione

a = 5, b = 2, p = 2

\[a + b + p = 5 + 2 + 2 = 9\]

Q  Write down the correct IUPAC name of following compounds:

(I) \[\text{CH}_3 - \text{C} - \text{C} - \text{H} \]

(II) \[\text{NH} - \text{CH}_3\]

(III) \[\text{HO} - \text{C} - \text{Br}\]

**Sol**

(I) \[\text{CH}_3 - \text{C} - \text{C} - \text{H} \]

2-oxopropanal
Identify the principle functional group according to IUPAC priority table for following given compound.

**Sol**

(I) Aldehyde  
(II) Carboxylic acid  
(III) Ketone  
(IV) Alcohol
Which of the following compounds have main functional group alcohol?

(I) \[ \text{IUPAC Name: } \]

(II) \[ \text{IUPAC Name: } \]

(III) \[ \text{IUPAC Name: } \]

(IV) \[ \text{IUPAC Name: } \]

(V) \[ \text{IUPAC Name: } \]

**Sol**

Priority: 

\[ \text{COOH} > \text{C-H} > \text{C} > \text{OH} > \text{SH} > \text{NH}_2 \]

∴ III, V have main functional group alcohol.
Specific Rule and Aromatic Compound Naming

Introduction

Specific Rule of 1993
In an unbranched alkane 3 or more than 3 carbon containing functional group are attached then alkane is considered as parent carbon chain.

Q
1. \[\text{propane-1,2,3-tricarboxylic acid}\]
2. \[\text{propane-1,2,3-tricarbonitrile}\]
3. \[\text{propane-1,2,3-tricarbaldehyde}\]
4. \[\text{triethylpropane-1,2,3-tricarboxylate}\]

Sol
1. \[\text{propane-1,2,3-tricarboxylic acid}\]
2. \[\text{propane-1,2,3-tricarbonitrile}\]
3. \[\text{propane-1,2,3-tricarbaldehyde}\]
4. \[\text{triethylpropane-1,2,3-tricarboxylate}\]
Specific Rule and Aromatic Compound Naming

1. Aldehyde
2. Carboxylic acid
3. Acid Chloride
4. Amide
5. Cyanide
6. Ester

Special Note
1. Carbaldehyde
2. Carboxylic acid
3. Carbonyl chloride
4. Carboxamide
5. Carbonitrile
6. Carboxylate

Point to remember
If carbon containing terminal functional group is present on cyclic ring then ring is considered as parent carbon chain and carbo word is introduced for that functional group.

Q
1. \(\text{Cyclohexanecarbaldehyde}\)
2. \(\text{Cyclohexanecarboxylic acid}\)
3. \(\text{Cyclohexanecarbonyl chloride}\)
4. \(\text{Cyclohexanecarbonyl amide}\)
5. \(\text{Cyclohexanecarbonitrile}\)
6. \(\text{Cyclohexanecarboxylate}\)
7. \(\text{Cyclohexanecarboxylic acid}\)

Sol
1. \(\text{Cyclohexanecarbaldehyde}\)
2. \(\text{Cyclohexanecarboxylic acid}\)
3. \(\text{Cyclohexanecarbonyl chloride}\)
4. cyclohexanecarboxamide

5. cyclohexanecarbonitrile

6. methylcyclohexanecarboxylate

7. 2-cyclopentylethal

NOMENCLATURE OF AROMATIC COMPOUND

1. Simple Naming
   Rule-1:
   Ethylbenzene

   Rule-2:
   1-phenylethene

Point to remember
If pure alkane directly attached with benzene then consider benzene as parent chain and write as benzene only.

Point to remember
If attached group on benzene is not pure alkane then benzene will be considered as substituent and 2° prefix phenyl is used for it.
### Specific Rule and Aromatic Compound Naming

<table>
<thead>
<tr>
<th>Q</th>
<th>Sol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
<td>5.</td>
</tr>
<tr>
<td>6.</td>
<td>6.</td>
</tr>
</tbody>
</table>
NOMENCLATURE OF AROMATIC COMPOUND
(Considered as parent carbon chain by IUPAC)

1. CH₃NO₂
2. CH₃Cl
3. OHNO₂
4. OHNO₂
5. OHCO₂H
6. COOH

Sol 1. 2, 4, 6-trinitrotoluene
or 1-methyl-2,4,6-trinitro benzene
Specific Rule and Aromatic Compound Naming

2. 4-chlorotoluene or 1-chloro-4-methylbenzene

3. 3-nitrophenol

4. 4-nitrophenol

5. 2-hydroxybenzoic acid

6. 4-hydroxybenzoic acid

Subjective Questions:

1. 4-chlorobenzoic acid
2. Ethyl benzoate
3. Phenol
4. Benzyl cyanide
5. Benzyl acetate
6. 2-Hydroxyacetophenone
Specific Rule and Aromatic Compound Naming

7. Vinyl benzoate
8. Phenyl ethyl alcohol
9. Benzophenone
10. 4-Bromo-2-cyanophenol
11. Nitrobenzene
12. 4-Bromo-2-nitrophenol
13. 2,3-Dichlorophenol
14. Phenethylamine
15. 2-Phenylethanol
16. Chlorobenzoic acid
17. 2-Hydroxycyclohexanol
18. 4-Hydroxybenzyl alcohol
19. 2,4-Dihydroxybenzene
20. Phthalic acid
21. Isophthalic acid
22. Terephthalic acid
Specific Rule and Aromatic Compound Naming

1. ethyl-2-chlorocarbonylbenzene carboxylate
2. ethyl-3-aminobenzoate
3. 3-chlorophenol
4. 2-phenylethanenitrile
5. 1-phenylethanone
6. 1-phenylpropan-2-one
7. 4-phenylbut-3-en-2-one
8. 4-phenylbutan-2-ol
9. 1,1-diphenylmethane
10. 2-bromo-4-hydroxybenzonitrile
Specific Rule and Aromatic Compound Naming

11. 1-nitrobenzene
12. 2-bromo-1-chloro-4-nitrobenzene
13. 1,2-dichlorobenzene
14. 2-ethylaniline
15. 1,2-dimethylbenzene
16. 3-ethoxybenzoylchloride
17. benzene-1,2-diol
18. benzene-1,3-diol
19. benzene-1,4-diol
20. Phthalic acid
   benzene-1,2-dicarboxylic acid
21. isophthalic acid
   benzene-1,3-dicarboxylic acid
22. Benzene-1,4-dicarboxylic acid
Naming of Bicyclo Compounds

Definition

Compound with two fused cycloalkane rings are called bicyclo compounds. They are cyclo alkanes having two or more atoms in common.

Naming of Bicyclo Compounds

- The prefix bicyclo is followed by the name of the alkane whose number of C atoms is equal to the number of C atoms in the two rings.
- The bracketed numbers show the number of C atoms (except bridge-head position C atoms) in each bridge and they are written in decreasing order.

Examples:

1. Bicyclo[3.2.0]heptane
   (i) Number of C atoms in ring A = 3
   (ii) Number of C atoms in ring B = 2
   (iii) Number of C atoms between bridge-head position = 0

2. Bicyclo[2.2.2]octane
   If substituents are present, number of the bridge-head proceeding first along the longest bridge-head (i.e., the larger right), then along the next longest bridge-head, and back to the first bridge-head. The shortest bridge is numbered last.

Example:

IUPAC name: 7-methylbicyclo[4.3.0]nonane

Numbering from the longest bridge-head (i.e., from the larger ring) to the next longest bridge-head (i.e., to the smaller ring).

Point to remember

Out of the two bridge-head C atoms, start numbering from that bridge-head C atom from where the position of the substituent is lowest.

Wrong numbering since the position of the substituent is at C-9

Correct numbering since the position of the substituent is at the lowest number, i.e., at C-7
Example:

8-Methyl bicyclo [3.2.1] octane

Q Give the IUPAC names of the following compounds:

1.  
2.  
3.  
4.  

Sol 1. Bicyclo [5.1.0] octane  
2. Bicyclo [1.1.1] pentane  
3. 7-chloro-2-ethyl bicyclo [2.2.1] heptane  
4. 3-bromo-6-methyl bicyclo [3.2.0] heptane

NAMING OF SPIRANES / SPIRO

• In substituted spiranes, the numbering is started next to the fused C atom in the lower-membered ring.

Definition

Spiranes are poly cyclics that share only one C atom.
### Naming of Bicyclo Compounds

**Example:**

![Spiro[3,4]octane](image)

**Example:**

1. Spiro[2,5]octane
2. 5-bromo-1-ethyl spiro[2,5]octane
3. 1-ethyl-4-methyl spiro[2,5]oct-5-ene

### COMMON & IUPAC NAMES OF SOME HALIDES

<table>
<thead>
<tr>
<th>1. CH₃CH₂CH(Cl)CH₃</th>
<th>2. (CH₃)₂CCH₂Br</th>
<th>3. (CH₃)₂CBr</th>
<th>4. CH₂ = CHCl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common name: sec-butyl chloride</td>
<td>Common name: neo-pentyl bromide</td>
<td>Common name: tert-butyl bromide</td>
<td>Common name: Vinyl chloride</td>
</tr>
<tr>
<td>IUPAC name: 2-chlorobutane</td>
<td>IUPAC name: 1-bromo-2,2-dimethyl propane</td>
<td>IUPAC name: 2-bromo-2-methyl propane</td>
<td>IUPAC name: 1-chloroethene</td>
</tr>
<tr>
<td>5. CH₂ = CHCH₂Br</td>
<td>6. Cl (\text{C}_6\text{H}_4\text{CH}_3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common name: Allyl bromide</td>
<td>Common name: o-chlorotoluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUPAC name: 2-bromoprop-1-ene</td>
<td>IUPAC name: 1-chloro-2-methylbenzene or 2-chlorotoluene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. (\text{C}_6\text{H}_5\text{CH}_2\text{Cl})</td>
<td>8. CH₂Cl₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common name: Benzyl chloride</td>
<td>Common name: Methylene chloride</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUPAC name: chlorophenylmethane</td>
<td>IUPAC name: Dichloromethane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. $\text{CHCl}_3$
   - Common name: Chloroform
   - IUPAC name: Trichloromethane

10. $\text{CHBr}_3$
    - Common name: Bromoform
    - IUPAC name: Tribromomethane

11. $\text{CCl}_4$
    - Common name: Carbon tetrachloride
    - IUPAC name: Tetrachloromethane

12. $\text{CH}_3\text{CH}_2\text{F}$
    - Common name: n-propyl fluoride
    - IUPAC name: 1-fluoropropane

13. ![Image of o-cresol](image)
    - Common name: o-cresol
    - IUPAC name: 2-methyl phenol

14. ![Image of m-cresol](image)
    - Common name: m-cresol
    - IUPAC name: 3-methyl phenol

15. ![Image of p-cresol](image)
    - Common name: p-cresol
    - IUPAC name: 4-methyl phenol

### Alcohols

1. $\text{CH}_3-\text{OH}$
   - Common name: Methyl alcohol
   - IUPAC name: Methanol

2. $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{OH}$
   - Common name: n-propyl alcohol
   - IUPAC name: Propan-1-ol

3. $\text{CH}_3-\text{CH} = \text{CH}_3$
   - Common name: Isopropyl alcohol
   - IUPAC name: Propan-2-ol

4. $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$
   - Common name: n-butyl alcohol
   - IUPAC name: Butan-1-ol
### Naming of Bicyclo Compounds

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CH₃ – CH – CH₂ – CH₃</td>
<td>CH₃ – CH – CH₂ – OH</td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>CH₃</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Butan-2-ol</td>
<td>IUPAC name: 2-methyl propan-1-ol</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CH₃ – C – OH</td>
<td>CH₂ – CH – CH₂</td>
</tr>
<tr>
<td></td>
<td>CH₃</td>
<td>OH – OH – OH</td>
</tr>
<tr>
<td></td>
<td>Common name: tert-butyl alcohol</td>
<td>Common name: Glycerol</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: 2-methyl propan-2-ol</td>
<td>IUPAC name: Propane-1,2,3-triol</td>
</tr>
</tbody>
</table>

### Ethers

<table>
<thead>
<tr>
<th></th>
<th>1. CH₃OCH₃</th>
<th>2. C₆H₅OC₂H₅</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common name: Dimethyl ether</td>
<td>Common name: Diethyl ether</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Methoxy methane</td>
<td>IUPAC name: Ethoxy ethane</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>3. C₆H₅OCH₃</th>
<th>4. C₆H₅OCH₂CH₃</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common name: Methyl phenyl ether (anisole)</td>
<td>Common name: Ethyl phenyl ether (phenetole)</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Methoxyo benzene</td>
<td>IUPAC name: Ethoxy benzene</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>5. C₆H₅O(CH₂)₆–CH₃</th>
<th>6. CH₂O – CH – CH₃</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common name: Heptyl phenyl ether</td>
<td>Common name: Methyl isopropyl ether</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: 1-phenoxy heptane</td>
<td>IUPAC name: 2-metoxy propane</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common name: Phenyl isopentyl ether</td>
<td>Common name: Catechol</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: 3-methyl butoxy benzene</td>
<td>IUPAC name: Benzene-1,2-diol</td>
</tr>
<tr>
<td></td>
<td>Chemical Structure</td>
<td>Common name</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>9.</td>
<td><img src="image" alt="Resorcinol" /></td>
<td>Resorcinol</td>
</tr>
<tr>
<td>10.</td>
<td><img src="image" alt="β-bromobutyraldehyde" /></td>
<td>β-bromobutyraldehyde</td>
</tr>
<tr>
<td>11.</td>
<td><img src="image" alt="Acetone" /></td>
<td>Acetone</td>
</tr>
<tr>
<td>12.</td>
<td><img src="image" alt="Acetophenone" /></td>
<td>Acetophenone</td>
</tr>
<tr>
<td>13.</td>
<td><img src="image" alt="Propiophenone" /></td>
<td>Propiophenone</td>
</tr>
<tr>
<td>14.</td>
<td><img src="image" alt="Benzophenone" /></td>
<td>Benzophenone</td>
</tr>
</tbody>
</table>

### Aldehydes

<table>
<thead>
<tr>
<th></th>
<th>Chemical Structure</th>
<th>Common name</th>
<th>IUPAC name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><img src="image" alt="Formaldehyde" /></td>
<td>Formaldehyde</td>
<td>Methanal</td>
</tr>
<tr>
<td>2.</td>
<td><img src="image" alt="Acetaldehyde" /></td>
<td>Acetaldehyde</td>
<td>Ethanal</td>
</tr>
<tr>
<td>3.</td>
<td><img src="image" alt="3-methyl cyclohexane carbaldehyde" /></td>
<td>3-methyl cyclohexane carbaldehyde</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td><img src="image" alt="Valeraldehyde" /></td>
<td>Valeraldehyde</td>
<td>Pentanal</td>
</tr>
</tbody>
</table>
### Naming of Bicyclo Compounds

#### 5. \( \text{CH}_2 = \text{CH} - \text{CHO} \)
- **Common name**: Acrolein / Acrylaldehyde
- **IUPAC name**: Prop-2-enal

#### 6. \( \text{CHO} \)
- **Common name**: Phthaldehyde
- **IUPAC name**: Benzene-1,2-dicarbaldehyde

#### 7. \( \text{Br} \)
- **Common name**: m-bromo benzaldehyde
- **IUPAC name**: 3-bromo benzene carbaldehyde

#### Ketones

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( \text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3 )</td>
<td>2. ( (\text{CH}_3)_2\text{CHCOCH(CH}<em>3)</em>{2} )</td>
</tr>
<tr>
<td><strong>Common name</strong>: Methyl n-propyl ketone</td>
<td><strong>Common name</strong>: Diisopropyl ketone</td>
</tr>
<tr>
<td><strong>IUPAC name</strong>: Pentan-2-one</td>
<td><strong>IUPAC name</strong>: 2,4-dimethylpentan-3-one</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>4.</td>
</tr>
<tr>
<td>( \text{CH}_3 )</td>
<td>( (\text{CH}<em>3)</em>{2}C = \text{CHCOCH}_3 )</td>
</tr>
<tr>
<td><strong>Common name</strong>: 2-methyl cyclohexanone</td>
<td><strong>Common name</strong>: Mesityl oxide</td>
</tr>
<tr>
<td><strong>IUPAC name</strong>: 2-methyl cyclohexanone</td>
<td><strong>IUPAC name</strong>: 4-methylpent-3-en-2-one</td>
</tr>
</tbody>
</table>
### Carboxylic Acids

<table>
<thead>
<tr>
<th>No.</th>
<th>Common Name</th>
<th>IUPAC Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HCOOH</td>
<td>Common name: Formic acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Methanoic acid</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>CH$_3$COOH</td>
<td>Common name: Acetic acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Ethanoic acid</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>CH$_3$CH$_2$COOH</td>
<td>Common name: Propionic acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Propanoic acid</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>(CH$_3$)$_2$CHCOOH</td>
<td>Common name: Isobutyric acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: 2-methyl propanoic acid</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>CH$_2$COOH</td>
<td>Common name: Phenylacetic acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: 2-phenyl ethanoic acid</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>[Phthalic acid structure]</td>
<td>Common name: Phthalic acid</td>
</tr>
<tr>
<td></td>
<td>IUPAC name: Benzene-1,2-dicarboxylic acid</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>HOOC–CH$_2$–CH(COOH)–CH$_2$–COOH</td>
<td>IUPAC name: Propane-1,2,3-tricarboxylic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5.</td>
<td>( \text{CH}_3 - \text{N} - \text{CH}_3 )</td>
<td>6.</td>
</tr>
<tr>
<td>Common name: Trimethylamine</td>
<td>Common name: N, N-diethyl butylamine</td>
<td></td>
</tr>
<tr>
<td>IUPAC name: N, N-dimethylmethanamine</td>
<td>IUPAC name: N, N-diethyl butanamine</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>( \text{NH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2 )</td>
<td>8.</td>
</tr>
<tr>
<td>Common name: Allylamine</td>
<td>Common name: Hexamethylene diamine</td>
<td></td>
</tr>
<tr>
<td>IUPAC name: Prop-2-en-1-amine</td>
<td>IUPAC name: Hexane-1,6-diamine</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>10.</td>
</tr>
<tr>
<td>Common name: Aniline</td>
<td>Common name: p-bromo aniline</td>
<td></td>
</tr>
<tr>
<td>IUPAC name: Aniline or benzenamine</td>
<td>IUPAC name: 4-bromobenzenamine or 4-bromo aniline</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>( \text{N} (\text{CH}_3)_2 )</td>
<td></td>
</tr>
<tr>
<td>Common name: N, N-dimethylaniline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUPAC name: N, N-dimethylbenzenamine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>