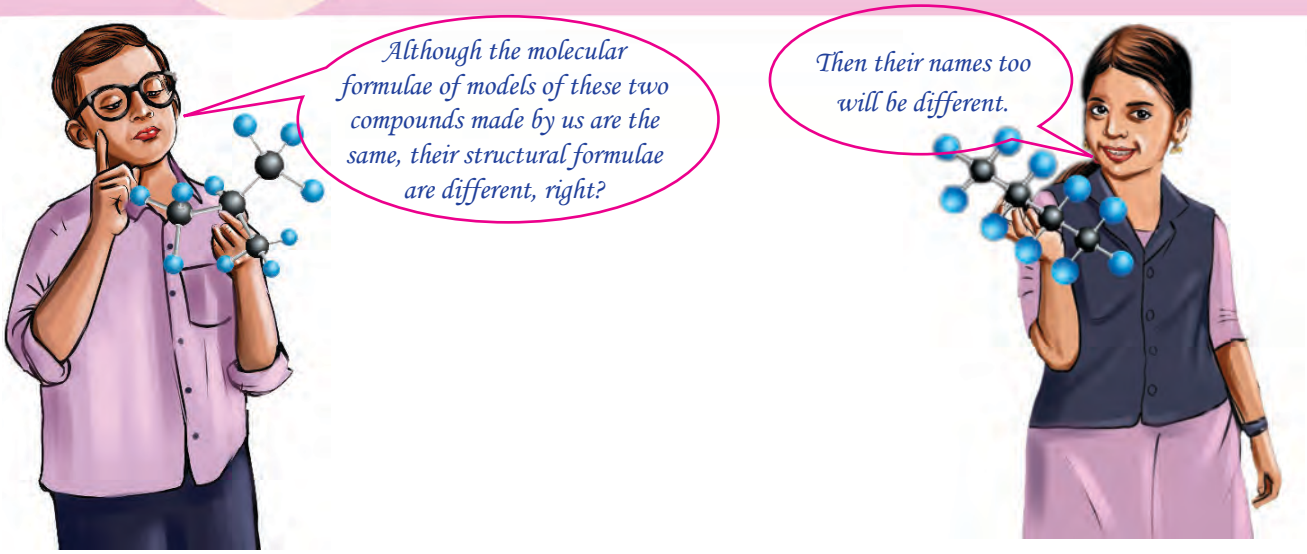
# 1 NOMENCLATURE OF ORGANIC COMPOUNDS AND ISOMERISM




Several substances, used in various fields of daily life, are the contributions of organic chemistry. Billions of carbon compounds have already been discovered. We know that, the astonishing count of compounds, their peculiarities and possibilities have led to the formation of the specific branch of chemistry called "organic chemistry". You have already learnt about an important class of organic compounds, the hydrocarbons and their varieties, their structure, IUPAC rules of nomenclature etc. The world of substances formed when carbon combines with elements like hydrogen, oxygen, nitrogen and few other elements has become indispensable to the modern life. The study of the structure, nomenclature and characteristics of numerous such compounds is fascinating. Let us get acquainted with some of these.

The structural formulae of two hydrocarbons are given below.

$CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ $\qquad$ $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_3$

Hydrocarbon I $\qquad$ Hydrocarbon II

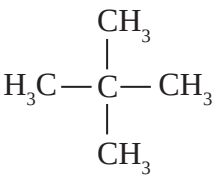
You are familiar with the formula of hydrocarbon I.

- How many carbon atoms are there in this chain? .....
- What is the word root of this carbon chain? .....
- Write the IUPAC name of this compound. .....

Analyse the structural formula of hydrocarbon I and hydrocarbon II.

- What is the molecular formula of these two hydrocarbons?
- How do they differ in the structure of the carbon chain? .....

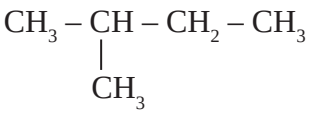
Have a look at the structural formula of another hydrocarbon with the same molecular formula.



It is clear that carbon atoms can form branched compounds.

## Nomenclature of alkanes with one branch

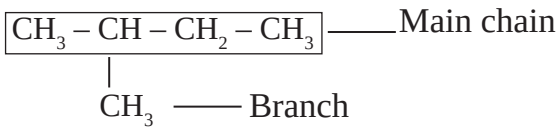
The structural formula of a hydrocarbon with one branch is given below.



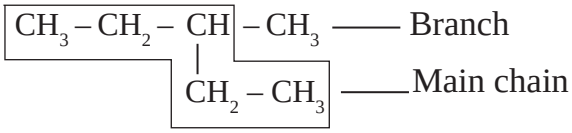
Certain IUPAC rules are to be followed while naming such branched hydrocarbons.

- The longest chain containing maximum number of carbon atoms should be considered as the main chain and the remaining as branches.

i)

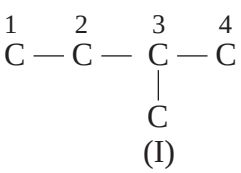



ii)

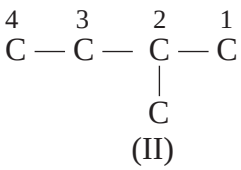


- Numbering should be done in such a way that the carbon atom carrying branch gets the lowest number. For this you can start by numbering either from the right or from the left of the chain.

A carbon chain containing one branch is given below. Note that it is numbered in two ways.



(I)



(II)

Which of the above chains has the lowest position number for the carbon atom carrying the branch?

Put a ✓ mark against the appropriate one.

I ☐ II ☐

- The small branches attached to carbon atoms are called alkyl groups. An alkyl group is obtained when a hydrogen atom is removed from a carbon atom in a saturated hydrocarbon. That is, when a hydrogen atom is removed from a $CH_4$ molecule, $–CH_3$ is obtained .This is called a methyl group. An alkyl group is named by adding 'yl' to the word root of the corresponding alkane.

Name of alkyl group = Word root corresponding to the number of carbon atom / atoms in the branch + 'yl'

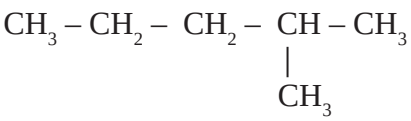
| Name of alkyl group | Structural formula |
|---|---|
| Methyl | $– CH_3$ |
| Ethyl | $– CH_2 – CH_3$ |
| Propyl | $– CH_2 – CH_2 – CH_3$ |

Table 1.1

- While writing the IUPAC name, a hyphen (–) is used to separate numerals and alphabets.

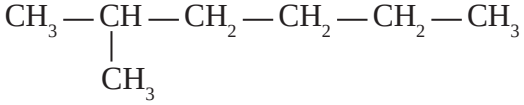
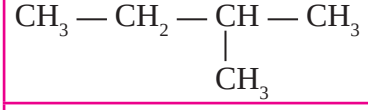
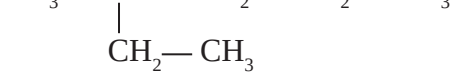
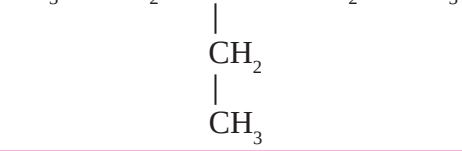
Position number of branch+ hyphen + name of alkyl group + word root + suffix (ane)

Let us examine how to write the IUPAC name of the compound given below, based on these rules.



- Number of carbon atoms in the main chain :
- Word root :
- Suffix :
- Name of the branching alkyl group :
- Position of the branch :
- IUPAC name : 2–Methylpentane

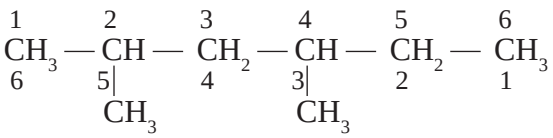
Complete the table.

| Compound | Number of carbon atoms in the longest chain | Name of branch | Position of branch | IUPAC name |
|---|---|---|---|---|
|  | ..... | ..... | ..... | ..... |
|  | ..... | ..... | ..... | ..... |
|  | ..... | ..... | ..... | ..... |
|  | ..... | ..... | ..... | ..... |

## Nomenclature of alkanes with more than one branch

- If more than one branch is present, select the longest carbon chain. Number the carbon atoms from left to right or right to left in such a way that the carbon atoms with branches get the lowest position numbers.

Eg.



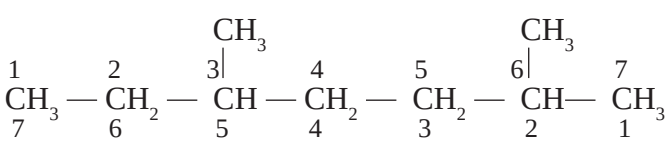
Correct way of numbering : Left to right

Position number of the first branch : 2

Correct position number of the branches : 2, 4

- If the same branch appears more than once in a carbon chain, the number of branches is to be indicated using prefixes like di (two), tri (three), tetra (four) etc. Position numbers should be separated by commas.

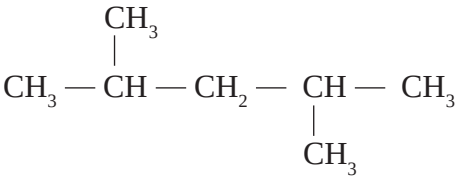
Let us examine how to assign the IUPAC name to the compound given below.



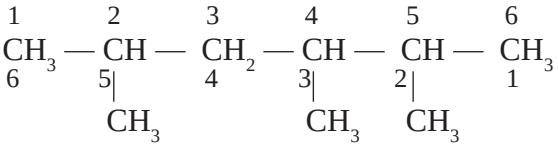
- Number of carbon atoms in the main chain : 7
- Number of branches : 2
- Name of branches : Methyl

- Position of the first branch while numbering from left to right : 3
- Position of the first branch while numbering from right to left : 2
- Correct way of numbering : Right to left
- Correct position number of the branches : 2, 5
- IUPAC name : 2,5–Dimethylheptane

Structural formula of a hydrocarbon is given below. Write the IUPAC name of this compound.

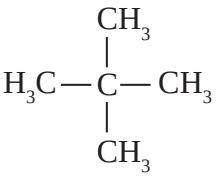


- The longest carbon chain is numbered from left to right or right to left. If the carbon atom containing the first branch gets the same position number when numbered from either side, then the numbering should be done in such a way that the carbon atom containing the second branch gets a lower position number.



- Number of carbon atoms in the main chain :
- Number of branches :
- Name of branches :
- Position number of the first branch while numbering from left to right :
- Position number of the first branch while numbering from right to left :
- When does the second branch get a lower position number? Put a ✓ mark against the correct option. :
  While numbering from left to right : ☐
  While numbering from right to left : ☐
- Correct position number of the branches : 2,3,5
- IUPAC name : 2,3,5–Trimethylhexane

- If a carbon atom has two identical branches, their position numbers should be repeated.



- Number of carbon atoms in the main chain :
- Number of branches :
- Name of branches :
- Position of the branches :
- IUPAC name : 2,2–Dimethylpropane

Now let us see how to write the structural formula of a compound if its IUPAC name is given.

Example : Write the structural formula of 2,3-Dimethylpentane.

- How many carbon atoms are present in its main chain?

  .....

- Let us write the main chain.

  C — C — C — C — C

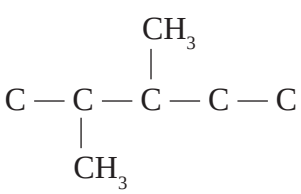
- What are the branches?

  .....

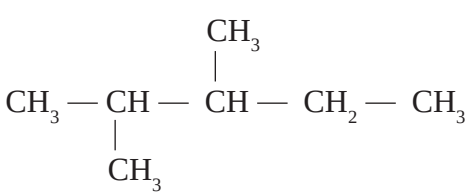
- What are their position numbers?

  .....

- Write the structural formula by attaching the branches to the main chain.



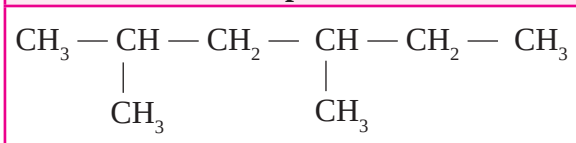
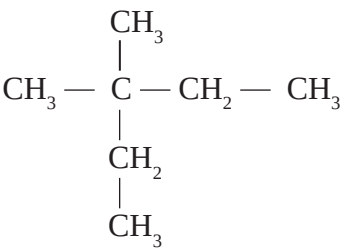
Complete the structure by filling up all valencies of carbon atoms with hydrogen.



- Write the structural formula of the compound 2,4-Dimethylheptane.

  .....

Complete the table given below.

| Compound | IUPAC name |
|---|---|
|  | ..... |
| ..... | 2,2,3–Trimethylpentane |
| ..... | 3,3–Diethylhexane |
|  | ..... |

## Nomenclature of unsaturated hydrocarbons

You got familiar with the structure and IUPAC names of some alkenes and alkynes in standard IX. Now, let us learn how to name them on the basis of the position of the double or triple bonds in the carbon chain.

- In the nomenclature of hydrocarbons with double bonds, the numbering should be done in such a way that the carbon atoms linked by the double bond gets the lowest position number.

Word root + hyphen + position of double bond + hyphen + suffix (ene).

The structural formula of an alkene with molecular formula $C_4H_8$ is given below.

$$CH_2 = CH - CH_2 - CH_3$$

Note that the carbon atoms are numbered in two ways.

$$\overset{1}{CH_2} = \overset{2}{CH} - \overset{3}{CH_2} - \overset{4}{CH_3} \qquad (I)$$

$$\overset{4}{CH_2} = \overset{3}{CH} - \overset{2}{CH_2} - \overset{1}{CH_3} \qquad (II)$$

- In which of these, carbon atoms having double bond gets the lowest position number? Tick ✓ the correct option.

I ☐ II ☐

If so, what will be the IUPAC name of this compound?

- Total number of carbon atoms in this chain : 4
- Word root : But
- The correct position number of carbon atom having double bond. : 1
- Suffix : ene
- IUPAC name : But–1–ene

The structural formula of another alkene with molecular formula $C_4H_8$ is given below. Let us try to write its IUPAC name.

$$\overset{4}{CH_3} - \overset{3}{CH} = \overset{2}{CH} - \overset{1}{CH_3}$$

- Total number of carbon atoms in this chain :
- Word root :
- The correct position number of carbon atom having double bond. :
- Suffix :
- IUPAC name :

Now you are familiar with the structural formulae of two compounds with the molecular formula $C_4H_8$.

- How do they differ in their structures?

.....

Note that the position of the double bond in the carbon chain is different.

$$CH_3 - CH_2 - CH = CH - CH_3$$

Which of the following is the IUPAC name of this compound? Tick ✓ the correct one.

Pent-3-ene ☐ Pent-2-ene ☐

Structural formula of a compound is given below.

$$CH \equiv C - CH_2 - CH_3$$

- What is the molecular formula of this compound? .....
- To which category does this compound belong?

.....

Is it possible to name alkynes just like we named alkenes?

> Word root + hyphen + position of triple bond + hyphen + suffix (yne)

Let us write the IUPAC name of the alkyne given above.

$$\overset{1}{CH} \equiv \overset{2}{C} - \overset{3}{CH_2} - \overset{4}{CH_3}$$

$$\overset{4}{CH} \equiv \overset{3}{C} - \overset{2}{CH_2} - \overset{1}{CH_3}$$

- Total number of carbon atoms in this chain :
- Word root :
- The correct position number of carbon atom having triple bond. :
- Suffix :
- IUPAC name : But–1–yne

Write the structural formula of another alkyne with molecular formula $C_4H_6$.

.....

Write the IUPAC name of this compound.

.....

IUPAC name of this compound is But-2-yne.

Now you are familiar with the structural formulae of two compounds with molecular formula $C_4H_6$?

How do they differ in their structures?

.....

Note that the position of the triple bond in the carbon chain is different.

Complete the table.

| Compound | IUPAC name |
|---|---|
| $CH_3 - CH = CH_2$ | .....(a)..... |
| .....(b)..... | Hex-2-ene |
| $CH_3 - C \equiv C - CH_2 - CH_3$ | .....(c)..... |
| .....(d)..... | Hept-3-yne |

## Functional groups

What are the constituent elements of the organic compounds discussed so far?

.....

There are compounds in which carbon atoms are bonded to atoms or group of atoms, other than hydrogen.

Examine the structure and name of the organic compounds given in Figure 1.1.

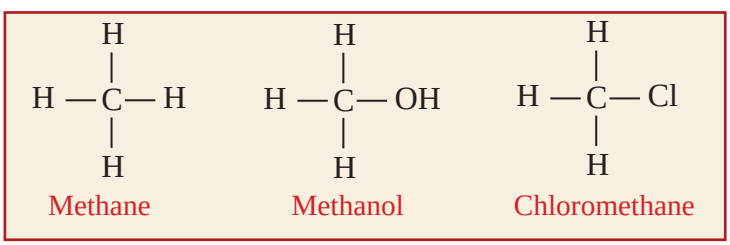



Figure 1.1

Methanol is a compound in which a hydrogen atom in methane is replaced by an –OH group. Similarly, chloromethane is a compound where a –Cl atom is present. The chemical and physical properties of methanol and chloromethane are entirely different from those of methane.

An atom or a group of atoms, bonded to carbon in an organic compound, determines the distinctive chemical and physical properties of that compound. This atom or group of atoms is called a functional group.

Now, let us get familiarised with some functional groups.

### 1. Hydroxyl group (–OH)

It is understood from Figure 1.1 that methanol is formed as a result of replacing a hydrogen atom of methane with an –OH group.

The presence of –OH group in the carbon chain is responsible for the characteristic properties of methanol. The aliphatic hydrocarbons in which –OH group is attached as a functional group are called alcohols.

According to IUPAC method, the alcohols are named by replacing 'e' in the name of the corresponding alkane with 'ol'.

Alkane - e + ol →Alkanol

Eg. Methane - e + ol → Methanol

Have a look at a few examples.

- $CH_3 – OH$ IUPAC name - Methanol
- $CH_3 – CH_2 – OH$ IUPAC name - Ethanol

Analyse the following structures given below.

(i) $CH_3 — CH_2 — CH_2 — OH$

(ii)
$$CH_3 — \underset{\displaystyle OH}{\underset{|}{CH}} — CH_3$$

- What is the functional group in the two compounds? .....
- What is the molecular formula of the two compounds? .....
- What is the structural difference between them?

The position of the functional group in both compounds is different.

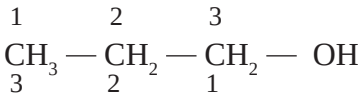
When there are more than two carbon atoms, the position of the –OH group needs to be specified.

For naming such compounds according to IUPAC rules, the following points need to be considered.

- The carbon chain containing the –OH group should be considered as the main chain.
- The carbon atoms should be numbered in such a way that the carbon to which the functional group is attached gets the lowest position number.
- Replace 'e' of the corresponding alkane with 'ol' and indicate the position number of the –OH group before 'ol'.

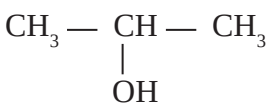
Alkane – e + hyphen + position number of –OH group + hyphen + ol

Let us examine how to write the IUPAC name of the compound (i).



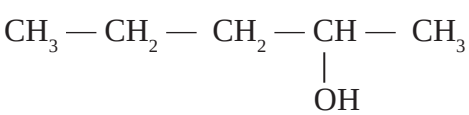
- The total number of carbon atoms in this chain :
- The name of the alkane with 3 carbon atoms :
- The correct position number of the carbon containing the – OH group :
- IUPAC name : Propan–1–ol

Now, write the IUPAC name of the second compound (ii).



IUPAC name : .....

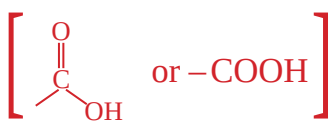
Which of the following is the IUPAC name of the compound given below? Tick ✓ the correct one.



Pentan–4–ol ☐ Pentan–2–ol ☐

**Monosodium glutamate (MSG)**

Monosodium glutamate is often added to food items as a taste enhancer. This compound is the sodium salt of glutamic acid. It is odourless and appears in white crystalline form. This compound is known by the trade name, aginomoto.

## 2. Carboxyl group 

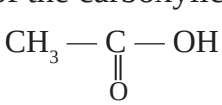
Compounds containing the – COOH functional group are known as carboxylic acids.

To assign IUPAC name to these compounds, we must consider the total number of carbon atoms in the main chain, including the one in the carboxyl group. The last letter 'e' of the corresponding alkane is replaced with 'oic acid' to get the name of the acid.

Alkane – e + oic acid → Alkanoic acid

Eg. Methane – e + oic acid → Methanoic acid

Write the IUPAC name of the carboxylic acid given below.



Number of carbon atoms in this chain : 2

IUPAC name : Ethanoic acid

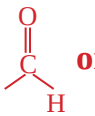
That is,

Ethane – e + oic acid → Ethanoic acid

Complete the Table 1.2.

| Compound | IUPAC name |
|---|---|
| H — COOH | ..... |
| $CH_3$ — COOH | Ethanoic acid |
| ..... | Propanoic acid |
| $CH_3$ — $CH_2$ — $CH_2$ — COOH | ..... |

Table 1.2

### 3. Aldehyde group (  or –CHO)

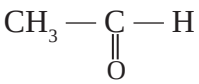
Compounds with – CHO functional group are called aldehydes.

To assign IUPAC names to these compounds, the number of carbon atoms in the main chain, including that in the aldehyde group, must be considered. The last letter 'e' in the name of the corresponding alkane is replaced with '–al' to get the name of the aldehyde.

Alkane – e + al → Alkanal

Eg. Methane – e + al → Methanal

Write the IUPAC name of the aldehyde given below.



- Number of carbon atoms in this chain : 2
- Name of the alkane having 2 carbon atoms : Ethane
- IUPAC name : Ethanal

That is,

Ethane – e + al → Ethanal

**Fatty acids**

Fatty acids are saturated or unsaturated carboxylic acids with long aliphatic chains. Palmitic acid and stearic acid are examples of fatty acids. These acids contain 16 and 18 carbon atoms respectively. Fatty acids have large scale industrial application. They are used in the manufacturing of soaps, detergents and cosmetics. Soaps are metallic salts of fatty acids. You might have heard of omega fatty acids which play a major role in human diet.

Complete the table given below.

| **Compound** | IUPAC name |
|---|---|
| ..... | Butanal |
| $CH_3 — CH_2 — CHO$ | ..... |
| ..... | Pentanal |

Table 1.3

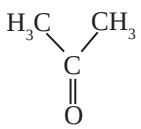
## 4. Keto group ( $>C=O$ )

Ketones are compounds with $>C=O$ as the functional group.

To assign IUPAC names to these compounds, the number of carbon atoms in the main chain, including that in the keto group, must be considered. The letter 'e' of the corresponding alkane is replaced with 'one'.

Alkane – e + one → Alkanone

Write the IUPAC name of the ketone given below.



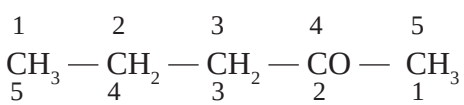
- Number of carbon atom in this chain : 3
- Name of alkane having 3 carbon atoms : Propane
- IUPAC name : Propanone

That is, Propane – e + one → Propanone

This compound is known by the name acetone.

The position of the functional group must be considered while naming ketones with more than 3 carbon atoms.

Write the IUPAC name of the compound given below.



- Number of carbon atoms in the main chain :
- Name of alkane with the same number of carbon atoms :
- Correct position number of the functional group :
- IUPAC name : Pentan–2–one

$CH_3 — CH_2 — CO — CH_2 — CH_3$ Write the IUPAC name of this compound.

.....

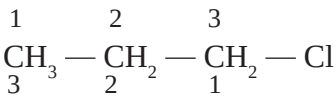
## 5. Halo group (−F, −Cl, −Br, −I)

The compounds formed when one or more hydrogen atoms in a hydrocarbon is replaced with an equal number of halogen atoms are called halo compounds. There are organic compounds with functional groups such as fluoro (–F), chloro (–Cl), bromo (–Br), and iodo (–I).

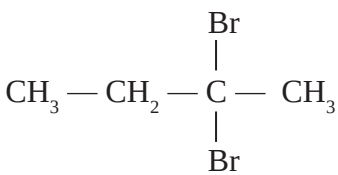
The IUPAC nomenclature of halo compounds with more than two carbon atoms in the main chain is given below.

> Position of the halo group +hyphen + name of the halo group + name of the alkane

Write the IUPAC name of the compound given below.



- Number of carbon atoms in the main chain :
- Name of alkane with the same number of carbon atoms :
- Name of halo group :
- Correct position number of the carbon to which the halo group is attached :
- IUPAC name : 1–Chloropropane



• Write the IUPAC name of this compound.

Complete the table given below.

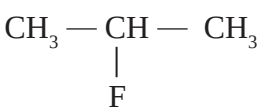
| Compound | IUPAC name |
|---|---|
| ..... | 2,3–Dichlorobutane |
|  | ..... |
|  | ..... |

Table 1.4

## 6. Alkoxy group (−O−R)

Ethers are compounds containing alkoxy group.

'R' denotes an alkyl group. Let us see how they are named according to IUPAC rules.

$CH_3 — O — CH_2 — CH_3$ : IUPAC name Methoxyethane

Ethers are named as alkoxyalkane.

–O– group is called ether linkage. Of the alkyl groups on either side of ether linkage (–O–), the longer alkyl group is considered as alkane and the shorter as alkoxy group.

Complete the table given below.

| Compound | IUPAC name |
|---|---|
| $CH_3 — O — CH_3$ | Methoxymethane |
| $CH_3 — CH_2 — CH_2 — O — CH_3$ | ..... |
| ..... | Ethoxypropane |

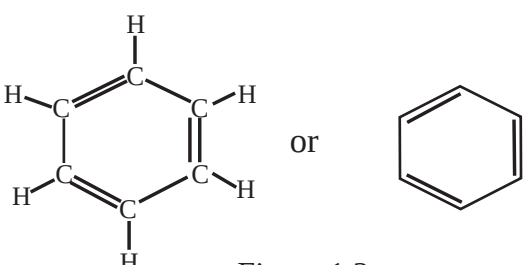
Table 1.5

Complete the table.

| Functional group | Name of functional group | Common name |
|---|---|---|
| – OH | Hydroxyl | Alcohol |
| – COOH | ..... | Carboxylic acid |
| – CHO | Aldehydic | ..... |
| $>C = O$ | Keto | ..... |
| – O – R | ..... | Ether |
| – F, – Cl, – Br, – I | ..... | Halo compounds |

## Aromatic compounds

You have learnt some basic concepts about aromatic hydrocarbons in the previous class. Analyse the structure of the compound given below.




or

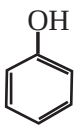


Figure 1.2

- Which category does this compound belong to? (Aliphatic / Alicyclic/ Aromatic)
- What is the name of this compound?
- Write the molecular formula of this compound.

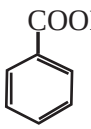
Phenol is the compound obtained when a hydrogen atom in benzene is replaced with an –OH group. Similarly, when a hydrogen atom is replaced with a –COOH group, the resulting compound is benzoic acid.

The structures of these compounds are given below.




Phenol

($C_6H_5$ – OH)




Benzoic acid

($C_6H_5$ – COOH)

Figure 1.3

## Isomerism

The presence of different functional groups contributes to the vast number and diversity of organic compounds.

The structural formulae of certain compounds are given below. Analyse them.

i) $CH_3 — \underset{\displaystyle Cl}{\underset{|}{CH}} — CH_3$

ii) $CH_3 — CH_2 — CH_2 — OH$

iii) $CH_3 — CH_2 — OH$

iv) $CH_3 — CH_2 — CH_2 — Cl$

- Which of these compounds have the same molecular formula?

  .....

- What is the functional group in each of these? .....
- Write the IUPAC name of these compounds. .....

You can see that the position number of carbon atoms to which the halo (–Cl) group is attached differ in these compounds. Although the compounds have same molecular formulae, they differ in their

structural formulae. Therefore, these compounds exhibit differences in their chemical and physical properties. They are known as isomers.

Compounds having same molecular formula and different chemical and physical properties are called isomers. This phenomenon is called isomerism. The structural formulae of these compounds are different.

Organic compounds show different types of isomerism based on the difference in structures. Let us get familiarised with some of them.

## Chain isomerism

The structural formulae of two compounds are given below.

i) $CH_3 — CH_2 — CH_2 — CH_3$

ii) $CH_3 — \underset{\displaystyle CH_3}{\underset{|}{CH}} — CH_3$

- Write the molecular formulae of these two compounds.....
- What is the peculiarity in the molecular formulae? .....
- Write their IUPAC names.

i) .....

ii) .....

It is clear that these are isomers. How do these compounds differ in their structures? Draw the structures of these compounds with the carbon atoms alone.

i) .....

C — C — C — C

ii) .....

$$\begin{array}{c} C — C — C \\ \quad | \\ \quad C \end{array}$$

Although the molecular formulae of these compounds are the same, the structures of the carbon chain are different. Such isomers are called chain isomers.

Compounds that have the same molecular formula but differ in the structures of carbon chain are called chain isomers. This phenomenon is known as chain isomerism.

- The structural formulae of two chain isomers of pentane ($C_5H_{12}$) are given.

Write the structural formula of the third isomer.

i) $CH_3 — CH_2 — CH_2 — CH_2 — CH_3$

ii) $CH_3 — \underset{\displaystyle CH_3}{\underset{|}{CH}} — CH_2 — CH_3$

iii) .....

- How many chain isomers are possible for the compound $CH_3 — CH_2 — CH_2 — CH_2 — CH_2 — CH_3$? Write it down.

## Position isomerism

The structural formulae of two familiar compounds are provided below. Analyse them.

i) $CH_3 — CH_2 — CH_2 — OH$ ii) $CH_3 — \underset{\displaystyle OH}{\underset{|}{CH}} — CH_3$

- What is the functional group present in them? .....
- What is their molecular formula? .....
- Write their IUPAC name.

  Compound (i) .....

  Compound (ii) .....

By analysing the structural formulae of these two compounds, it is clear that their molecular formulae are the same but the position numbers of their functional groups are different. Such isomers are known as position isomers.

When two compounds have same molecular formula and same functional group, but differ in the position of the functional group, they are called position isomers, and this phenomenon is known as position isomerism.

Analyse the structural formulae of the two pairs of compounds given below.

### Pair I

i) $CH_3 — CH_2 — CH = CH_2$ ii) $CH_3 — CH = CH — CH_3$

- What is the molecular formula of these compounds? .....
- Write their IUPAC names.

  Compound (i) ..... Compound (ii) .....

- What type of isomerism do they exhibit? .....

Although their molecular formulae are the same, the position of the double bond in them differs. Hence, they exhibit position isomerism.

**Pair II**

i) $CH_3 — CH_2 — C \equiv CH$ ii) $CH_3 — C \equiv C — CH_3$

- What is the molecular formulae of these compounds? .....
- Write their IUPAC names.

Compound (i) ..... Compound (ii) .....

- What type of isomerism do they exhibit? .....

Although their molecular formulae are the same, the position of the triple bond in them are different. Hence, they exhibit position isomerism.

After analysing the previous examples, it is clear that double bond and triple bond are also considered as functional groups.

- Write down the structural formulae of all the possible position isomers of the compound $CH_3 — CH_2 — CH_2 — CH_2 — CH_2 — Cl$.
- Write the structural formula and IUPAC name of the position isomers of the compound pentan-2-one.

## Functional isomerism

The structural formulae and IUPAC names of two compounds are given.

i) $CH_3 — CH_2 — OH$ IUPAC name - Ethanol

ii) $CH_3 – O – CH_3$ IUPAC name - Methoxymethane

- What is the functional group present in each compound?

Compound (i) ....., Compound (ii) .....

- Write their molecular formula. .....

After analysing the structural formulae of these two compounds, it is clear that they have the same molecular formula but different functional groups. Such isomers are called functional isomers.

When compounds have the same molecular formula but different functional groups, they are known as functional isomers, and this phenomenon is called functional isomerism.

The structural formulae of two compounds are given below.

i) $CH_3 — CH_2 — CHO$ ii) $CH_3 — CO — CH_3$

- What are the functional groups in them?

  Compound (i) ..... , Compound (ii) .....
- Write their molecular formula. .....
- What type of isomerism do they exhibit? .....
- Write the structural formula and IUPAC name of the functional isomer of the compound $CH_3 — CH_2 — CH_2 — CHO$.

## Metamerism

The structural formulae of two ethers are given below.

i) $CH_3 — CH_2 — O — CH_2 — CH_3$

ii) $CH_3 — O — CH_2 — CH_2 — CH_3$

- Write the molecular formulae of these compounds. .....

Now, examine the alkyl groups on either side of the ether linkage (— O —).

- What is peculiar about the alkyl groups on either side of the ether linkage (— O —) in compound (i)? .....
- What is peculiar about the alkyl groups on either side of the ether linkage (— O —) in compound (ii)? .....

In compound (i), the ether linkage (— O —) has same alkyl groups on either side, whereas in compound (ii), the ether linkage (— O —) has different alkyl groups on either side. These types of isomers are called metamers.

Compounds having same molecular formula but different alkyl groups attached to either side of the functional group are called metamers.

Look at another example.

i) $CH_3 — CH_2 — CO — CH_2 — CH_3$

ii) $CH_3 — CO — CH_2 — CH_2 — CH_3$

- Write their molecular formula. .....

These are also metamers.

The isomerism exhibited by compounds with the same molecular formula but different alkyl groups on either side of the bivalent functional group (group having valency 2, eg. (— O — , $>C=O$) is known as metamerism.

It is understood that the above metamers are also examples of position isomers.

- Write the structural formulae and IUPAC names of any two metamers of the compound
  $CH_3 — CH_2 — CH_2 — O — CH_2 — CH_2 — CH_3$.

Examine the compounds given below and identify the isomeric pairs. Specify the type of isomerism exhibited by each pair.

i) $CH_3 — CH_2 — CH_2 — CH_2 — OH$

ii) $CH_3 — CH_2 — CH_2 — CH_2 — CH_3$

iii) $CH_3 — CH_2 — CH_2 — O — CH_3$

iv) $CH_3 — CH_2 — \underset{\displaystyle CH_3}{\underset{|}{CH}} — CH_3$

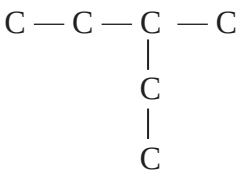
v) $CH_3 — CH_2 — O — CH_2 — CH_3$

vi) $CH_3 — CH_2 — \underset{\displaystyle OH}{\underset{|}{CH}} — CH_3$

| | |
|---|---|
| Chain isomerism | |
| Position isomerism | |
| Functional isomerism | |
| Metamerism | |

# Let us assess

1. A chain having 6 carbon atoms is given below.



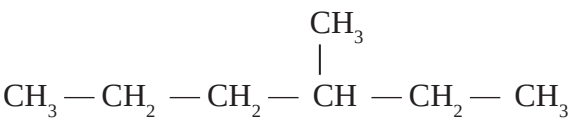
   a) Complete the structure by adding hydrogen atoms to each carbon atom.

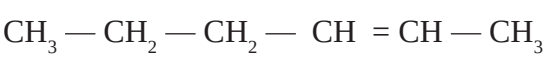
   b) Write the molecular formula of this compound.

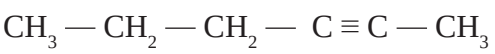
   c) How many carbon atoms are there in the main chain of this compound?

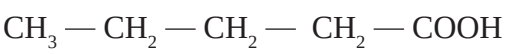
   d) Write its IUPAC name.

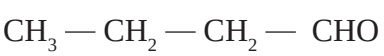
2. Write down the IUPAC names of the given compounds.

a) 

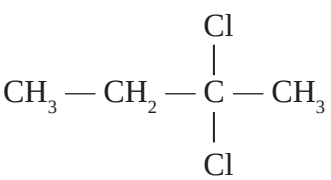
b) 

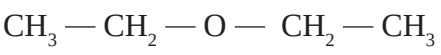
c) 

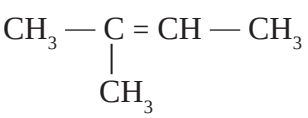
d) 

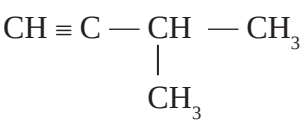
e) 

f) 

g) 

h) 

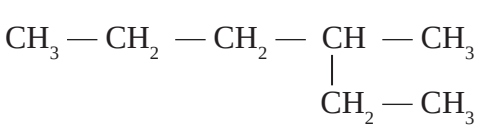
i) 

j) 

3. Write the structural formulae of the compounds given below.

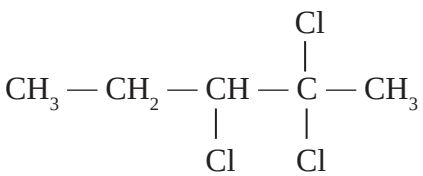
a) 2,3,3–Trimethylhexane
b) Ethoxybutane
c) Butan-2-one
d) Pent–1–yne
e) Hexan–2–ol
f) 3–Bromoheptane
g) Pentanal

4. The structural formulae and IUPAC names of certain compounds are given. Identify the wrong ones and correct them.

i)  2–Ethylpentane

ii) $CH_3 — CH_2 — CH_2 — CO — CH_3$ Pentan–2–one

iii) $CH_3 — CH_2 — CH_2 — C \equiv C — CH_3$ Hex–3–yne

iv)  2,3–Dichloropentane

5. i) $CH_3 – CH_2 – O — CH_2 — CH_3$ ii) $CH_3 – CH_2 – CH_2 – CH_2 — OH$

a) What type of isomerism do these compounds exhibit?

b) Write the structural formula of the metamer of compound (i).

6. The structural formulae of two compounds are given.

i) $CH_3 – CH_2 – CH_2 – CH_2 — CHO$ ii) $CH_3 – CH_2 – CH_2 – CO — CH_3$

a) What is the IUPAC name of the first compound?
b) These two compounds are isomers. Why?
c) What type of isomerism do these compounds exhibit?
d) Write the structural formula of the position isomer of the second compound.

7. Examine the compounds given below and identify the isomeric pairs. What type of isomerism is shown by each pair?

a) Methoxypropane
b) 2,3–Dimethylbutane
c) Propan–1–ol
d) Ethoxyethane
e) Propan–2–ol
f) Hexane

# Extended activities

1. Make and display the ball and stick models of the following compounds.
   a) 2, 2–Dimethylbutane
   b) But–2–ene
   c) Pent–1–yne
2. The molecular formulae of two compounds are given below. Draw their structures.
   a) $C_6H_5$–OH  b) $C_6H_5$–COOH
3. Prepare and present a brief note on isomerism.
4. A student assigned the name 2–Ethyl–3–methylpentane to an organic compound.
   a) Write the structural formula of the compound and verify if the name given is correct.
   b) If incorrect, write the correct name of the compound.
   c) Write the molecular formula of the compound.
   d) Record the structural formulae of all the possible isomers of the compound in your science diary, along with their IUPAC names. Mention the type of isomerism they exhibit.