# IUPAC NOMENCLATURE
# &
# STRUCTURAL ISOMERISM

## CONTENTS



## JEE (Advanced) Syllabus

Hybridisation of carbon; Sigma and pi-bonds; Shapes of molecules; IUPAC nomenclature of simple organic compounds (only hydrocarbons, Monofunctional and bi-functional compounds); Structural isomerism.

## JEE (MAIN) Syllabus

Nomenclature (Trivial and IUPAC) of organic compounds, Tetravalency of carbon : Shapes of simple molecules-hybridization (s and p) ; Classification of organic compounds based on functional groups and those containing halogens, oxygen, nitrogen and sulphur; Homologous series; Structural isomerism

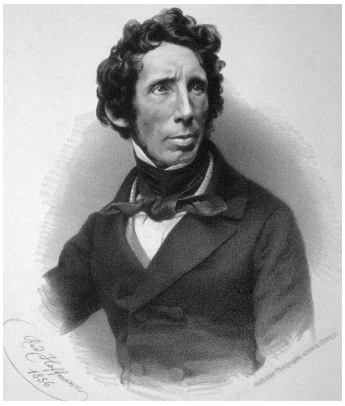
## INTRODUCTION

Friedrich Wohler was born in Eschersheim, a district of Frankfurt .

On 2 September 1823 Wöhler passed his examinations as a Doctor of Medicine, Surgery, and Obstetrics at Heidelberg University.

Wohler has been regarded as a pioneer in organic chemistry as a result of his synthesizing **urea** from ammonium cyanate in the Wöhler synthesis in 1828.

It was the beginning of the end for one popular vitalist hypothesis of Berzelius, the idea that **"organic"** compounds could be made only by living things. Wohler was known for being a co-discoverer of beryllium, silicon, silicon nitride as well as the synthesis of calcium carbide.



***Friedrich Wohler***

# 1. FUNDAMENTALS & CLASSIFICATION OF ORGANIC COMPOUNDS

## 1.1 Definitions

**(a) Catenation :** The property of atoms of an element to link with one another forming chains of identical atoms is called catenation.

**(b) Homologous series :** Homologous series may be defined as a series of similarly constituted compounds in which the members possess the same functional group, have similar chemical characteristics and have a regular gradation in their physical properties. The two consecutive members differ in their molecular formula by $CH_2$.

(i) HCOOH, $CH_3COOH$, $CH_3CH_2COOH$ is the homologous series of carboxylic acid.

(ii) $CH_4$, $C_2H_6$, $C_3H_8$, $C_4H_{10}$, $C_5H_{12}$ is the homologous series of alkanes.

(iii) $C_2H_4$, $C_3H_6$, $C_4H_8$, $C_5H_{10}$ is the homologous series of alkenes.

**(c) Tetravalency of carbon**

The valency of carbon is four as there are four unpaired electrons in outer most orbit in carbon atom.

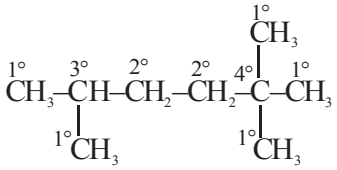
**(d) Types of carbon and hydrogen atoms**

(i) A primary (1°) carbon atom is bonded directly to **one** other carbon atom.

(ii) A secondary (2°) carbon atom is bonded directly to **two** other carbon atoms.

(iii) A tertiary (3°) carbon atom is bonded directly to **three** other carbon atoms.

(iv) A quaternary (4°) carbon atom is bonded directly to **four** other carbon atoms.



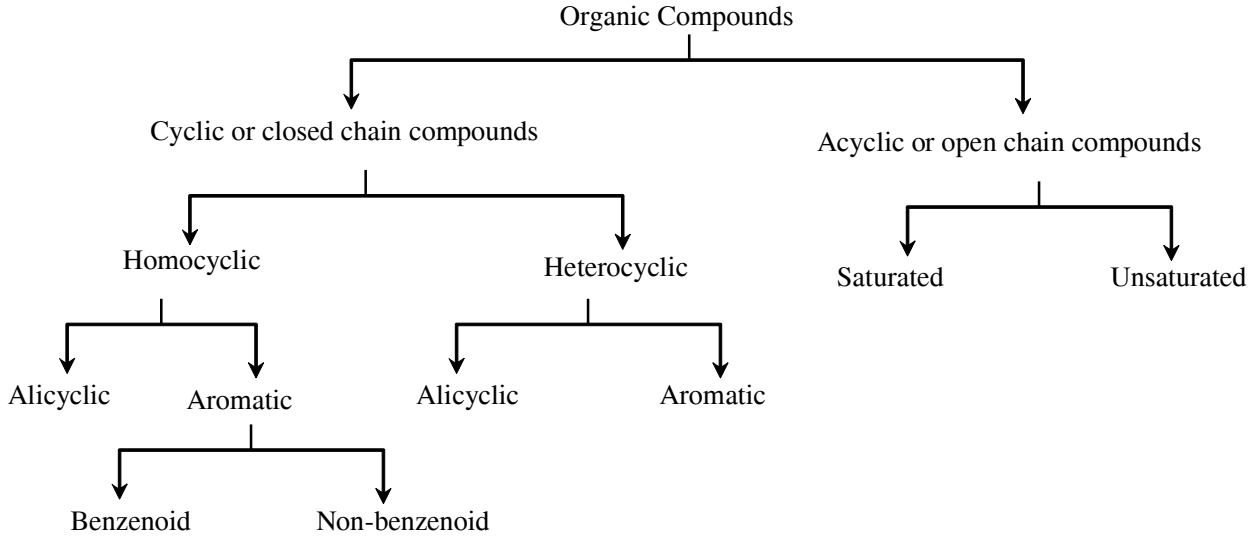
[1°carbon=5, 2°carbon=2, 3°carbon=1, 4°carbon=1]

[1°hydrogen=15, 2°hydrogen=4, 3°hydrogen=1, 4°hydrogen=0]

| Example | Alkane | Alkene | Alkyne |
|---|---|---|---|
| Structure | $CH_3$–$CH_3$(ethane) | $CH_2$=$CH_2$(ethene) | CH≡CH(ethyne) |
| Hybridisation | $sp^3$ | $sp^2$ | sp |
| Bond angle | 109°28′ | 120° | 180° |
| Geometry | Tetrahedral | Trigonal planar | Linear |
| Bonds | 4σ | 3σ + 1π | 2σ + 2π |
| % s character | 25 | 33.3 | 50 |
| % p character | 75 | 66.7 | 50 |
| Electronegativity | 2.54 | 2.7 | 3.25 |

## 1.2. CLASSIFICATION OF ORGANIC COMPOUNDS

Number of known organic compounds is much more than inorganic compounds but, it has been possible to group them into classes or families based on their structural features. This has given organic chemistry a logical and systematic shape.




(i) Alkanes (saturated hydrocarbon) $CH_3CH_2CH_2CH_3$ Butane

(ii) Alkenes (unsaturated hydrocarbon) $CH_3CH{=}CHCH_3$ Butene

(iii) Alkynes (unsaturated hydrocarbon) $CH_3C{\equiv}CH$ Propyne

(iv) Aliphatic compounds with functional groups $CH_3CH_2$–Br Bromoethane

$CH_3COOH$ Ethanoic acid

(v) Homocyclic compound (Alicyclic)

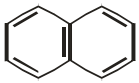

Cyclopentane

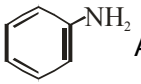
(vi) Heterocyclic compound(Alicyclic)

Tetrahydrofuran

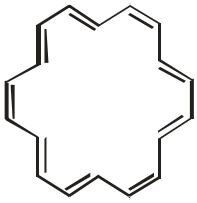
(vii) Homocyclic benzenoid aromatic compound


Benzene


Napthalene


Aniline

(viii) Hetrocyclic benzenoid aromatic compound  Pyridine

(ix) Homocyclic non-benzenoid aromatic compound  [18] annulene

## 1.3 Aliphatic, aromatic organic compounds and functional groups

**(a) Alkanes** [**general formula $C_nH_{2n+2}$ where n = 1, 2, 3, .....**]

These are open–chain aliphatic saturated hydrocarbon which have no functional groups. These are also called **paraffins**.

(i) n = 1 $\Rightarrow$ $CH_4$ – Methane
(ii) n = 2 $\Rightarrow$ $C_2H_6$ – Ethane
(iii) n = 3 $\Rightarrow$ $CH_3CH_2CH_3$ – Propane
(iv) n = 4 $\Rightarrow$ $CH_3CH_2CH_2CH_3$ – Butane
(v) n = 5 $\Rightarrow$ $CH_3CH_2CH_2CH_2CH_3$ – Pentane
(vi) n = 10 $\Rightarrow$ $CH_3(CH_2)_8CH_3$ – Decane

**(b) Alkenes** [**general formula $C_nH_{2n}$ where n = 2, 3, .....**]

Alkenes are open chain unsaturated hydrocarbons and having carbon–carbon double bonds (C=C). These are also called **alkylenes or olefins**. The first three members are generally named by their common names.

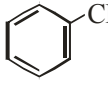
(i) $CH_2=CH_2$ – Ethylene
(ii) $CH_3–CH=CH_2$ – Propylene
(iii) $CH_3–CH_2–CH=CH_2$ – Butylene
(iv) $CH_3–\overset{\overset{CH_3}{|}}{C}=CH_2$ – Isobutylene

**(c) Alkynes** [**general formula $C_nH_{2n-2}$ where n = 2, 3, .....**]

Unsaturated aliphatic hydrocarbons containing a carbon–carbon triple bond are called alkynes.
The common names of a few simple alkynes are given below.

(i) $CH{\equiv}CH$ – Acetylene
(ii) $CH_3–C{\equiv}CH$ – Methyl acetylene
(iii) $CH_3–CH_2–C{\equiv}CH$ – Ethyl acetylene
(iv) $CH_3–C{\equiv}C–CH(CH_3)_2$ – Methyl isopropyl acetylene

**(d) Benzene** [**general formula $C_nH_{2n-6}$ where n = 6, 7, .....**]

(i)  – Benzene
(ii)  – Toluene
(iii)  – Xylene

**(e) Functional group and residue**

The group of atom(s) which is responsible for the charateristic chemical properties of the organic compounds, is called functional group.

Functional group is that portion of molecule which is highly reactive and takes part in chemical reactions. Rest of the molecule is called **residue**.

$\underbrace{CH_3CH_2CH_2CH_2}_{\text{Residue}}\underbrace{-COOH}_{\text{Functional Group}}$

## 2. IUPAC SYSTEM OF NOMENCLATURE

The IUPAC name of any organic compound consists of maximum five parts in the following sequence.
**Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix**

### (a) 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.

| No. of carbon atoms in parent chain | Word root (Alk) | No. of carbon atoms in parent chain | Word root (Alk) | No. of carbon atoms in parent chain | Word root (Alk) |
|---|---|---|---|---|---|
| 1 | Meth | 9 | Non | 20 | Icos |
| 2 | Eth | 10 | Dec | 30 | Triacont |
| 3 | Prop | 11 | Undec | 40 | Tetracont |
| 4 | But | 12 | Dodec | 50 | Pentacont |
| 5 | Pent | 13 | Tridec | 60 | Hexacont |
| 6 | Hex | 14 | Tetradec | 70 | Heptacont |
| 7 | Hept | 15 | Pentadec | 80 | Octacont |
| 8 | Oct | 16 | Hexadeca | 100 | Cent & Hect |

### (b) 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 :

| Type of carbon chain | Primary suffix | General name |
|---|---|---|
| (a) Saturated | – ane | Alkane |
| (b) Unsaturated with one double bond | – ene | Alkene |
| (c) Unsaturated with one triple bond | – yne | Alkyne |

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

| Type of carbon chain | Primary suffix | General name |
|---|---|---|
| (a) Unsaturated with two double bonds | (a) + diene | Alkadiene |
| (b) Unsaturated with two triple bonds | (a) + diyne | Alkadiyne |
| (c) Both double and triple bonds | enyne | Alkenyne |

## (c) Secondary suffix

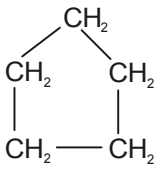
A secondary suffix is then added to the primary suffix to indicate the nature of the functional group present in the organic compound. Secondary suffix of important functional groups are given below in their decreasing order of seniority.

| | Class | Functional group | Name | Suffix | Prefix |
|---|---|---|---|---|---|
| 1. | Carboxylic acid | R – COOH | Alkanoic Acid | – oic acid (carboxylic acid) | Carboxy |
| 2. | Sulfonic acid | $R - SO_3H$ | Alkane sulphonic Acid | – sulfonic acid | sulfo |
| 3. | Acid anhydride | $R-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{C}-R$ | Alkanonic Anhydride | – oic anhydride (carboxylic anhydride) | ---------- |
| 4. | Ester | R – COOR | Alkyl alkanoate | – oate (carboxylate) | alkoxy carbonyl or alkanoyl oxy |
| 5. | Acid halide | $R-\overset{\overset{O}{\|}}{C}-X$ | Alkanoyl halide | –oyl halide (carbonyl halide) | halo carbonyl |
| 6. | Amide | $R-\overset{\overset{O}{\|}}{C}-NH_2$ | Alkanamide | – amide (carboxamide) | carbamoyl |
| 7. | Cyanide | $R - C \equiv N$ | Alkanenitrile | – nitrile (carbonitrile) | cyano |
| 8. | Aldehyde | $R-\overset{\overset{O}{\|}}{C}-H$ | Alkanal | – al (carbaldehyde) | formyl / oxo |
| 9. | Ketone | $R-\overset{\overset{O}{\|}}{C}-R$ | Alkanone | – one | oxo / keto |
| 10. | Alcohol | R – OH | Alkanol | – ol | hydroxy |
| 11. | Thiol | R – SH | Alkanethiol | – thiol | mercapto |
| 12. | Amine | $R - NH_2$ | Alkanamine | – amine | amino |

## (d) Primary prefix

A primary prefix is used simply to distinguish cyclic from acyclic compounds.

For example, in case of carbocyclic compounds, (cyclic compounds containing only carbon atoms in the ring), a primary prefix, **cyclo** is used immediately before the word root. Thus,



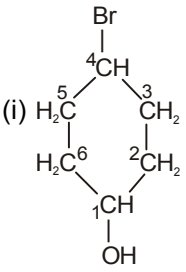
| Cyclo | + | pent | + | ane | = | Cyclopentane |
|---|---|---|---|---|---|---|
| Primary prefix | | Word root | | Primary suffix | | IUPAC name |

If the prefix cyclo is not used, it simply indicates that the compound is acyclic or open chain.

## (e) Secondary prefix

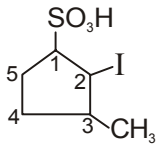
In IUPAC system of nomenclature, certain groups are not considered as principal functional groups but are treated as substituents. These are called secondary prefixes and are added immediately before the word root (or the primary prefix in case of carbocyclic compounds) in alphabetical order to denote the side chains or substituent groups. The secondary prefixes for some groups which are always treated as substituent groups (regardless of the fact whether the organic compound is monofunctional or polyfunctional) are given below :

| Substituent group | Secondary prefix | Substituent group | Secondary prefix |
|---|---|---|---|
| – F | Fluoro | – $OCH_3$ (– OMe) | Methoxy |
| – Cl | Chloro | – $OC_2H_5$(–OEt) | Ethoxy |
| – Br | Bromo | – R | Alkyl |
| – I | Iodo | – $CH_3$ (– Me) | Methyl |
| – $NO_2$ | Nitro | – $C_2H_5$ (– Et) | Ethyl |
| – NO | Nitroso | – $CH_2CH_2CH_3$(n-Pr) | n-Propyl |
| $-\overset{\oplus}{N}\equiv N$ | Diazo | – $CH(CH_3)_2$ (– iPr) | Isopropyl |
| – OR | Alkoxy | – $C(CH_3)_3$ (t-Bu) | t-Butyl |

(i) 

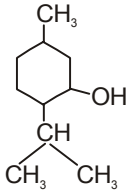
4-Bromo + cyclo + hex + an (e) + 1-ol

Secondary prefix | Primary prefix | Word root | Primary suffix | Secondary suffix

(ii) 

2-Iodo-3-methyl + cyclo + pent + ane + 1-sulphonic acid

Secondary prefix | Primary prefix | Word root | Primary suffix | Secondary suffix

(iii) 

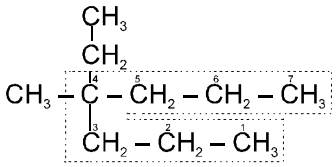
2-Isopropyl-5-methylcyclohexan-1-ol

Here
| | | |
|---|---|---|
| Secondary prefix | = | 2-Isopropyl-5-methyl |
| Primary prefix | = | cyclo |
| Word root | = | hex |
| Primary suffix | = | an(e) |
| Secondary suffix | = | ol |

## 2.1 IUPAC nomenclature of alkanes

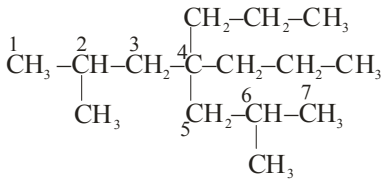
### (a) Parent carbon chain selection

**(1)** Select the longest continuous carbon chain in the molecule.



Longest chain has 7 carbons so word root is "Hept"

**(2)** When chains of equal lengths are competing for selection then that chain is selected which has more number of substituents/branches.



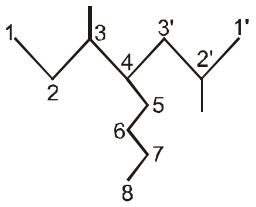
longest chain has 7 carbons & 3 substituents

**(3)** When the number of substituents are same then the substitutents at the nearest positions from the either end is preferred for parent chain selection.

Here , 2 choices for longest chain

Chain-(A) 1–2–3–4–5–6–7–8

Chain-(B) 1'–2'–3'–4–5–6–7–8



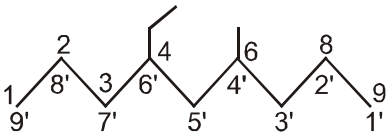
Chain-A & chain-B both have 2 substituents but if chain-B substituent is nearer (at 2nd position) than chain-A substituent (at 3rd position), chain-B will be preferred.

**(4)** If the two substituents are found in equivalent positions the lower number is given to the one coming first in the alphabetical order.

Here , 2 choices for longest chain

Chain-(A) 1–2–3–4–5–6–7–8–9

Chain-(B) 1'–2'–3'–4'–5'–6'–7'–8'–9'



In both chain-A & chain-B, substituents are at same position (4th). In chain-A substituent is ethyl & in chain-B, it is methyl. Alphabetically ethyl will be preferred. So, chain-A is selected.

### (b) Numbering of the parent carbon chain

The numbering is done in such a way that the branched carbon atoms get the lowest possible numbers.

**Note :** **(1)** Write the substituents in place of secondary prefix with their appropriate locations in alphabetical order.

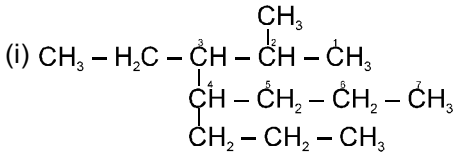
**(2)** If the same substituent occurs more than once in the molecule, the prefix di (for two), tri (for three), etc. are used to indicate how many times it appears.

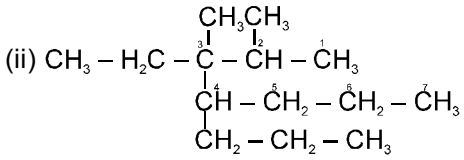
**(3)** Prefixes di, tri, tetra etc. are not considered in deciding alphabetical order for simple substituents but considered for complex substituents.

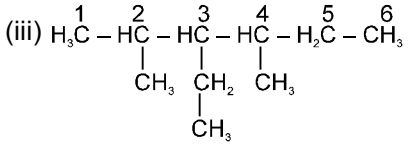
**(4)** Iso & Neo is considered for alphabetical seniority order.

**(5)** Numbers are separated from each other by comma (,).

**(6)** Numbers are separated from words by hyphens and there is no break between name of substituents and word root.

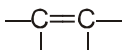
(i)  3–Ethyl–2–methyl–4–propylheptane

(ii)  3–Ethyl–2,3–dimethyl–4–propylheptane

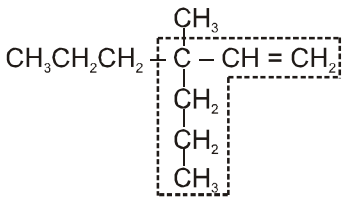
(iii)  3–Ethyl–2,4–dimethylhexane

## 2.2 IUPAC nomenclautre of alkenes, alkynes & alkenynes

### (a) Alkenes

**Functional group :** 

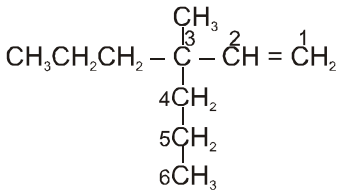
**(1)** Select the longest carbon chain containing carbon–carbon double bond. This need not be the longest chain in the compound as a whole. Parent name will be alkene corresponding to number of carbon atoms in the longest chain.

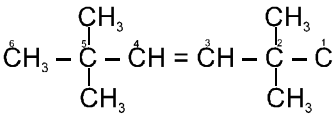


Longest chain has 6 atoms $\Rightarrow$ parent name = hexene

**(2)** Carbon atoms in the longest chain is numbered from that end in such a way that double bonded carbon atom gets the lowest number. The position of double bond is indicated by the smaller of the numbers assigned to two carbon atoms of double bond.

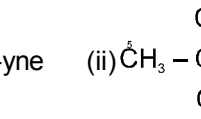
(i) Position of double bond will be indicated as no. 1.

 Hence name will be 3–Methyl–3–propylhex–1–ene

(ii)  2,2,5,5-Tetramethylhex-3-ene

## (b) Alkynes

Parent chain selection and numbering of longest chain is exactly same as that of alkenes.

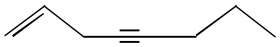
. (i) $CH\equiv C-CH_2-CH_3$ But-1-yne (ii)  4,4-Dimethylpent-1-yne

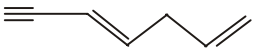
## (c) Alkenyne (containing both double and triple bonds)

Numbering is done in a manner that double and triple bonds get the lowest possible numbers. If double bond and triple bond both have same number, then double bond is prefer over triple bond.

(i) $HC\equiv C-CH_2-CH=CH_2$

**1 2 3 4** **5** (numbering is done from alkyne) **(wrong)**
**5 4 3 2** **1** (numbering is done from alkene) **(Correct)**

(ii)  Oct-1-en-4-yne

(iii)  Hepta-3,6-dien-1-yne

## (d) Some names of hydrocarbon groups

### (1) Alkyl, Alkenyl & Alkynyl groups

Alkane $(C_nH_{2n+2}) \xrightarrow{-H}$ Alk + yl $(C_nH_{2n+1})$

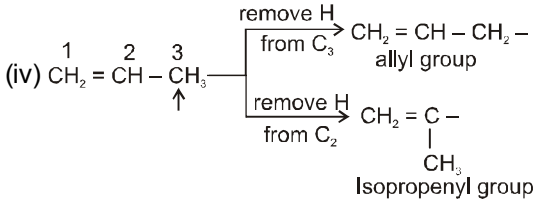
Alkene $(C_nH_{2n}) \xrightarrow{-H}$ Alken + yl $(C_nH_{2n-1})$

Alkyne $(C_nH_{2n-2}) \xrightarrow{-H}$ Alkyn + yl $(C_nH_{2n-3})$

(i) $CH_4 \xrightarrow{-H} -CH_3$ (Methyl)

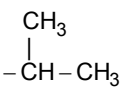
(ii) $C_3H_8 \xrightarrow{-H} -C_3H_7$ (Propyl)

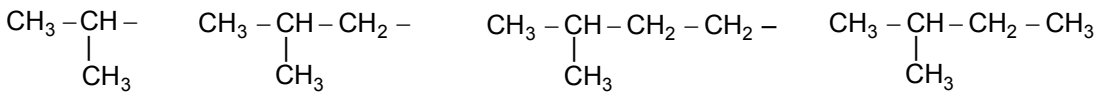
(iii) $CH_2=CH_2 \xrightarrow{-H} -CH=CH_2$ (vinyl group)/Ethenyl.

(iv) 

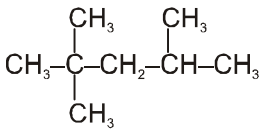

(v) $HC\equiv CH \xrightarrow{-H} HC\equiv C-$ (Ethynyl)

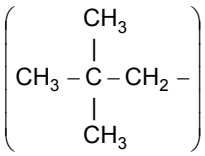
(vi) $H_3C-C\equiv CH \xrightarrow{-H} H_3C-C\equiv C-$ (Propynyl)

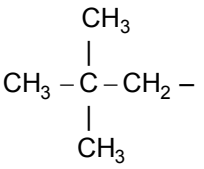
**(2) Iso alkyl group :** A compound having  group is called iso alkyl group.



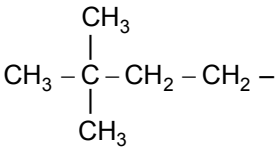

Iso propyl Iso butyl isopentyl Iso pentane

**Exception :** Isooctane 

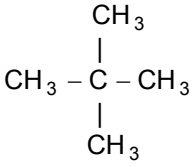
**(3) Neo alkyl group :** Compound having  group is called neo alkyl group.



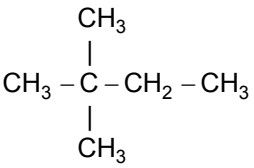
Neopentyl



Neohexyl



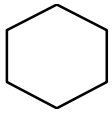
Neopentane



Neohexane

## 2.3 IUPAC Nomenclature of alicyclic compounds

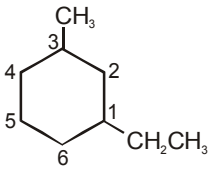
**(1)** In the naming of alicyclic compounds the prefix "**cyclo**" is used before word root.



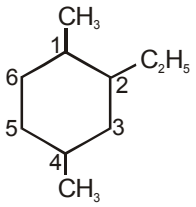
Cyclohexane

Cyclopentene

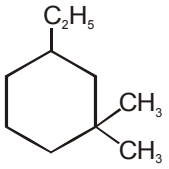
**(2)** The numbering of the carbon atoms in the ring is done in such a way that the substituent which comes first in the alphabetical order is given the lowest possible number and it does not violate the lowest set of locants rule.



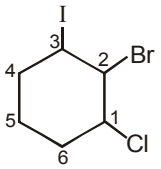
1–Ethyl–3–methylcyclohexane



2–Ethyl–1,4–dimethylcyclohexane

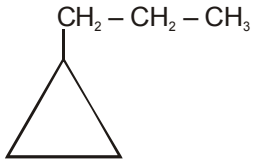


3–Ethyl–1,1–dimethylcyclohexane

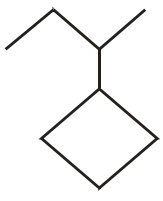


2–Bromo–1–chloro–3–iodocyclohexane

**(3)** When the ring contains more or equal number of carbon atoms than the alkyl group attached to it, then it is named as a derivative of cycloalkane and the alkyl group is treated as substituent.

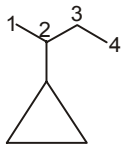


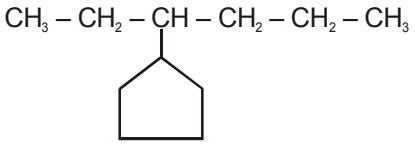
Propylcyclopropane



Sec-butylcyclobutane

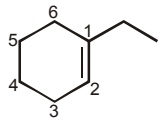
**(4)** If the alkane chain contains greater number of carbon atoms than present in the ring, then the compound is considered as the derivative of alkane and the ring is designated as substituent.

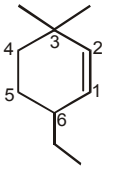


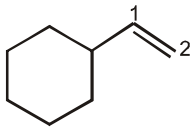




2–Cyclopropylbutane 3–Cyclopentylhexane

**(5)** If ring has unsaturation and side chain is saturated then ring is selected as parent chain.
If side chain has unsaturation and ring is saturated then side chain is selected as parent chain.
If both have unsaturation the chain with maximum unsaturation has selected as parent chain.
If equal unsaturation then longest chain is selected as parent chain.
If unsaturation and number of carbon atoms both are equal then ring is selected as parent chain.

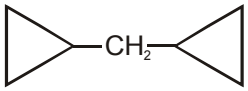


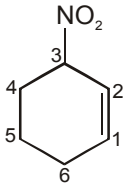

1-Ethylcyclohex-1-ene 6-Ethyl-3,3-dimethylcyclohex-1-ene Cyclohexyl ethene

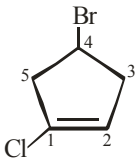
**(6)** If more than one alicyclic ring is attached to a single chain, then the compound is named as a derivative of alkane and the ring are treated as a substituent group.




Dicyclopropylmethane

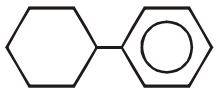
**(7)** If a multiple bond and some other substitutents are present in the ring, the numbering is done in such a way that the multiple bond gets the lowest number.



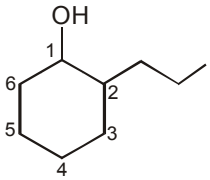

3-Nitrocyclohex-1-ene 4-Bromo-1-chlorocyclopent-1-ene

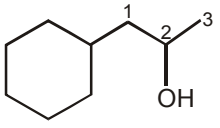
**(8)** If an alicyclic ring is directly linked to the benzene ring, it is named as a derivative of benzene.

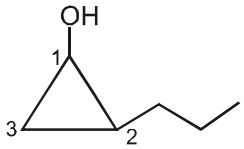


Cyclohexylbenzene

**(9)** If senior most functional group is present in compound, then the chain in which principal functional group exists is considered as main chain.



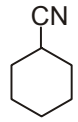



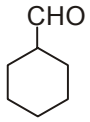

2-Propylcyclohexan-1-ol 1-Cyclohexylpropan-2-ol 2-Propyl cyclopropan-1-ol

**(10)** When chain terminating functional group is directly attached to the ring, then ring is taken as parent chain & special suffix is used for this functional group.

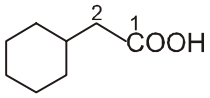
| Functional Group | Special Suffix |
|---|---|
| CHO | Carbaldehyde |
| COOH | Carboxylic Acid |
| COX | Carbonyl halide |
| COOR | Alkyl Carboxylate |
| $CONH_2$ | Carboxamide |
| CN | Carbonitrile |



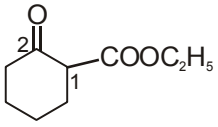
Cyclohexanecarbonitrile



Cyclohexanecarbaldehyde



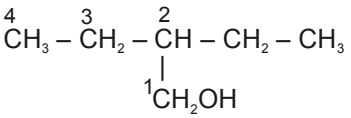
2-Cyclohexylethanoic acid



Ethyl 2–oxocyclohexane–1–carboxylate

## 2.4 IUPAC Rules for non chain terminating functional groups

**(a)** **Parent chain selection :** Select the longest possible chain with maximum number of senior most functional groups and maximum unsaturation.

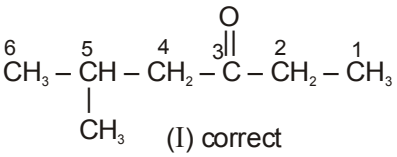


2-Ethylbutan-1-ol

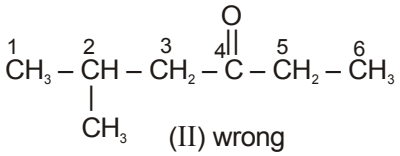
(Parent chain contains four rather than five carbon atoms)

**(b)** **Lowest number for the functional group**

The longest chain of carbon atoms containing the functional group is numbered in such a way that the senior most functional group is attached at the carbon atom possessing lowest possible number in the chain, followed by double and triple bonds.



(I) correct

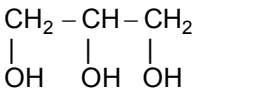


(II) wrong

5-Methylhexan-3-one

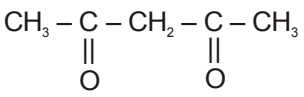
( $\rangle C = O$ group gets lowest number 3) ( $\rangle C = O$ group gets number 4 which is not lowest)

**(3)** If a compound contains two or more like groups, the numerical prefixes di, tri, tetra etc. are used.



(Glycerol)

Propane – 1,2,3 – triol

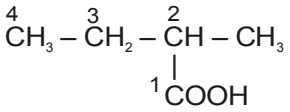


(Acetyl acetone)

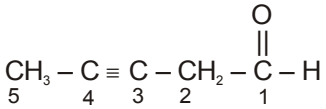
Pentane-2, 4-dione

## 2.5 IUPAC Rules for chain terminating functional groups

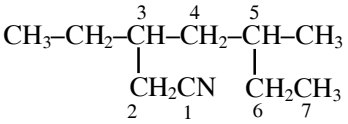
**(a)** When a chain terminating functional group such as –CHO, –COOH, –COOR, –$CONH_2$, –COCl, –C≡N etc. is present in a molecule then it is always given number 1 (one.)



2-Methylbutanoic acid

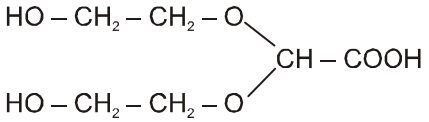


Pent-3-yn-1-al

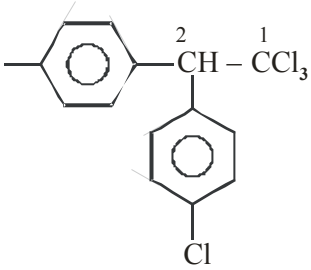
**Que.** IUPAC name of 

**Sol.** 1. The longest chain containing functional group is of **7** carbon atoms. Therefore, the word root is hept & the chain is numbered as shown.
2. There is no multiple bond in it. Hence, the primary suffix is **ane**.
3. The functional groups is –CN. Hence, secondary suffix is **nitrile**
4. Moreover, there is a methyl group on carbon 5 and ethyl group on carbon 3.
5. The IUPAC name is, therefore, **3-Ethyl-5-methylheptanenitrile**

**(b)** If the organic molecule contains more than one similar complex substitutents, then the numeral prefixes such as di, tri, tetra etc. are replaced by bis, tris, tetrakis etc. respectively.

(i) 

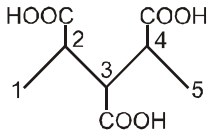
2, 2-Bis (2-hydroxyethoxy) ethanoic acid

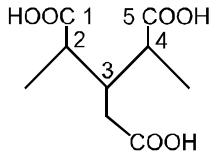
(ii) 

1,1,1-Trichloro-2,2-bis(4-chlorophenyl)ethane
(Common name-DDT)

**Common name is Dichlorodiphenyltrichloroethane (DDT) & it is used as insecticide.**

**(c)** When 3 or more chain terminating principal functional groups are directly attached with an open chain, then special suffix is used.

(i)  Pentane- 2,3,4–tricarboxylic acid.

(ii*)  3-Carboxymethyl-2,4- dimethylpentanedioic acid

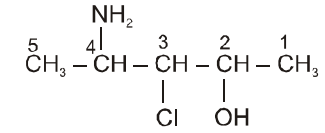
## 2.6 Rules for IUPAC nomenclature of polyfunctional compounds

**(1)** When an organic compound contains two or more different functional groups then senior functional group is selected as the principal functional group while other functional groups are treated as substituents.

**(2)** Some functional groups such as all halo groups (fluoro, bromo, chloro, iodo), nitroso (NO), nitro ($-NO_2$) and alkoxy (–OR) are always treated as substituent groups.

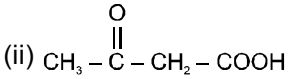
**Numbering preference in the principal chain :**

**[Principal functional group > double, triple bond > substituents and junior functional groups]**

(i) 

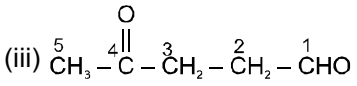
4-Amino-3-chloropentan-2-ol

(– $NH_2$ & – Cl group treated as substituent)

(ii) 

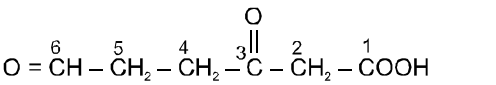
3-Oxobutan-1-oic acid

[– COOH > – CO]

(iii) 

4-Oxopentan-1-al

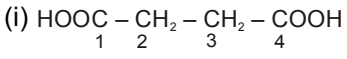
[– CHO > C=O]

(iv) 

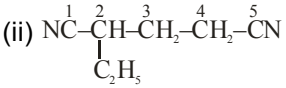
3, 6-Dioxohexanoic acid or 5-Formyl-3-oxopentanoic acid

[COOH > C & CHO]

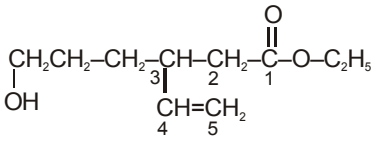
**(3)** If more than one same chain terminating groups are present then the principal chain is selected including the functional groups and numbering is done from that side which gives lowest locant to unsaturation and substituents.

(i) 

Butane-1, 4-dioic acid

(ii) 

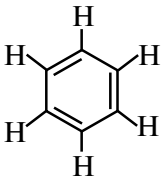
2-Ethylpentanedinitrile

(iii)  Ethyl-3-(3-hydoxypropyl) pent-4-enoate

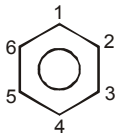
Parent chain contains five rather than six carbon atoms.

## 2.7 Nomenclature of aromatic compounds

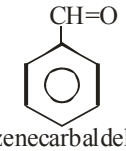
Benzene is the simplest hydrocarbon of aromatic series which has planar cyclic ring of six carbon atoms having three double bonds in alternate positions as shown below.



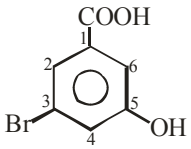
or



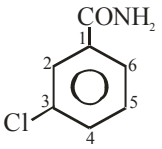
**(a)** **Nuclear substituted :** The functional group is directly attached to the benzene ring, in the IUPAC system these are named as derivatives of benzene. The position of the substituents in disubstituted benzene are indicated either by prefixes such as o-(ortho), m-(meta) or p-(para) position. However, many of their common names have also been adopted by the IUPAC system.

(i) 

Benzenecarbaldehyde

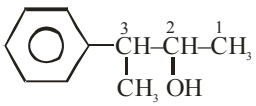
(ii) 

3-Bromo-5-hydroxybenzene-1-carboxylic acid

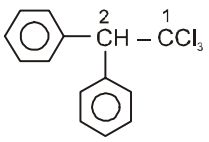
(iii) 

3-Chlorobenzene-1-carboxamide

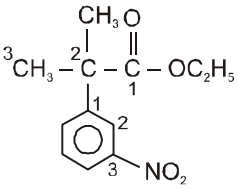
**(b)** **Side chain substituted :** If functional group is present in the side chain of the benzene ring, then these are usually named as phenyl derivatives of the corresponding compound.

(i) 

3-Phenylbutan-2-ol

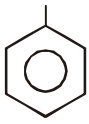
(ii) 

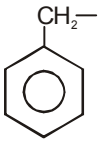
1,1,1-Trichloro-2,2-diphenylethane

(iii) 

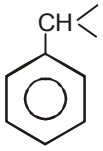
Ethyl- 2-methyl-2-(3-nitrophenyl) propanoate

## (a) Common name of aryl groups

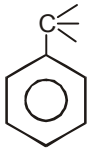

Phenyl



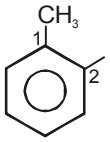
(Benzyl)



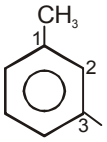
(Benzal)



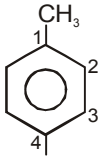
(Benzo)



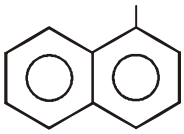
2 – Tolyl
or (o – Tolyl)

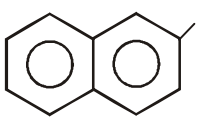


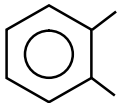
3 – Tolyl
or (m – Tolyl)

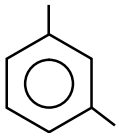


4 – Tolyl
or (p – Tolyl)

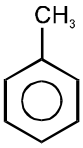
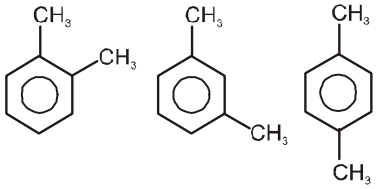
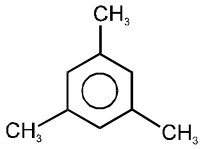
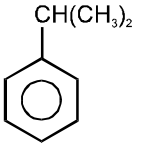
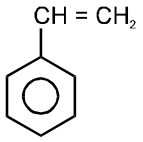
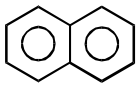
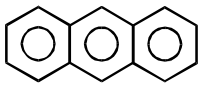
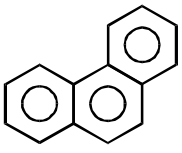
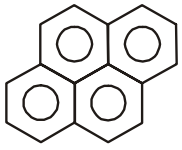
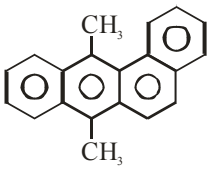

α-Naphthyl


β-Naphthyl


o-phenylene


m-phenylene

## (b) Examples of aromatic hydrocarbon

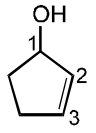
| S.No. | Compounds | Common Name | IUPAC Name |
|---|---|---|---|
| 1. |  | Toluene | Methylbenzene or Toluene |
| 2. |  | Xylene (o,m,p) | (o,m,p) Dimethylbenzene |
| 3. |  | Mesitylene | 1,3,5 – Trimethyl benzene |
| 4. |  | Cumene | Isopropylbenzene |
| 5. |  | Styrene | Phenyl ethene or Ethenylbenzene |
| 6. |  | Naphthalene | Naphthalene |
| 7. |  | Anthracene | Anthracene |
| 8. |  | Phenanthrene | Phenanthrene |
| 9. |  | Pyrene | Pyrene |
| 10. |  | | 9,10-Dimethyl-1,2-benzanthracene |

## 2.8 Some important 1993 recommendations by IUPAC

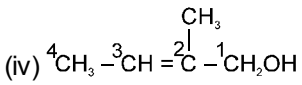
**(1)** Locants (numerals and / or letters) are placed immediately before the part of the name to which they relate. For example :

(i) $CH_3CH_2CH = CH_2$ should be named as but-1-ene

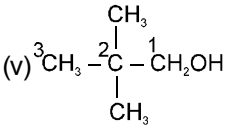
(ii) $CH_3CH_2CH_2OH$ should be named as propan-1-ol

(iii) 

Cyclopent-2-en-1-ol

(iv) 

2-Methylbut-2-en-1-ol

(v) 

2,2-Dimethylpropan-1-ol

**(2)** The locant 1 is often omitted when there is no ambiguity. For example.

(i) $CH_3CH_2CH_2COOH$ Butanoic acid

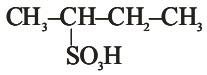
(ii) $CH_3CH_2CHO$ Propanal

(iii) $CH_3CH_2CH_2CN$ Butanenitrile

**Note :** In all the above examples locant 1 for the functional group is omitted because the position of the functional group is unambiguous. However, in the following cases the position of the functional group must be mentioned.

(i) $CH_3CH_2CH_2OH$ Propan-1-ol

(ii) $CH_3CH_2CH_2NH_2$ Propan-1-amine

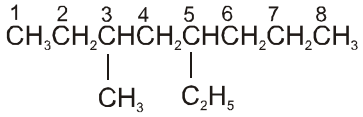
(iii) 

Butane-2-sulphonic acid

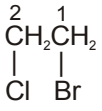
(Here, we cannot write simply propanol (or propanamine) because there are two propanols ; propan-1-ol and propan-2-ol)

**(3) Arrangement of prefixes**

**(a)** Simple prefixes such as methyl, ethyl, chloro, nitro, hydroxy, etc. are arranged alphabetically. The prefixes di, tri, etc. are however not considered for alphabetical comparison.

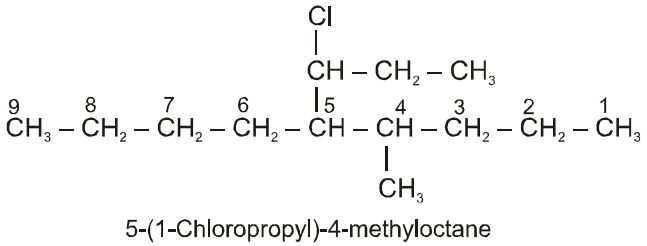
(i) 

5-Ethyl-3-methyl octane

(ii) 

1-Bromo-2-chloroethane

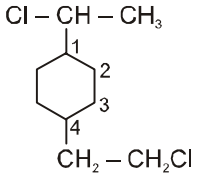
**(b)** The name of the prefix for a substituted substituent is considered to begin with the first letter of its complete name.



5-(1-Chloropropyl)-4-methyloctane

For the substitutent 1-chloropropyl, 'C' is taken as the first letter.

**(c)** When two or more prefixes consist of identical roman letters, priority for citation is given to the group which contains the lowest locant at the first point of difference.




(Here, 1-chloroethyl gets priority over 2-chloroethyl)

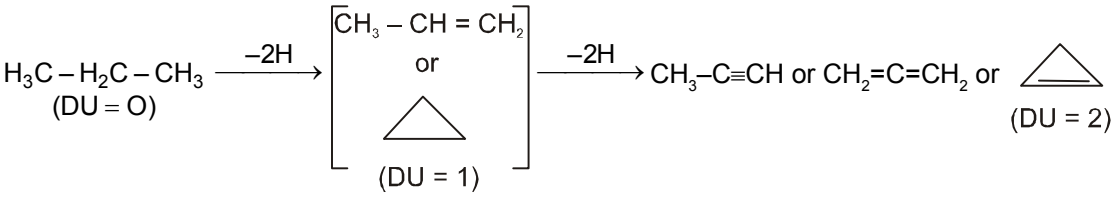
1-(1-Chloroethyl)-4-(2-chloroethyl)cyclohexane

## 3. Degree of unsaturation (DU)

The presence of double bonds or rings within a molecule is indicated by a quantity called degree of unsaturation.

**Applications :** To identify the no. of $\pi$ bonds or rings and also helpful in determining the structure of the molecule.

**Definition :** Deficiency of 2H atoms with respect to fully saturated acyclic hydrocarbon is equivalent to one DU. It is also known as Index of Hydrogen Deficiency (IHD) or Double Bond Equivalence (DBE)




$$\text{Degree of unsaturation (D.U.)} = \frac{(2n+2)-(\text{No. of H atoms}+\text{No. of X atoms}-\text{No. of N atoms})}{2}$$

Where n = number of carbon atoms in the molecule

**Note :** Total no. of cyclic rings + double bonds will give us degree of unsaturation.

One double bond = one DU

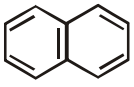
One ring = one DU

One triple bond = two DU

(i) $CH_2=CH_2$ DU= $\frac{(2\times2+2)-4}{2}$ =1

(ii)  DU = 2

(iii)  DU = 4

(iv)  DU = 7

(v) $C_2FClBrI$ DU= $\frac{(2\times2+2)-4}{2}$ = 1

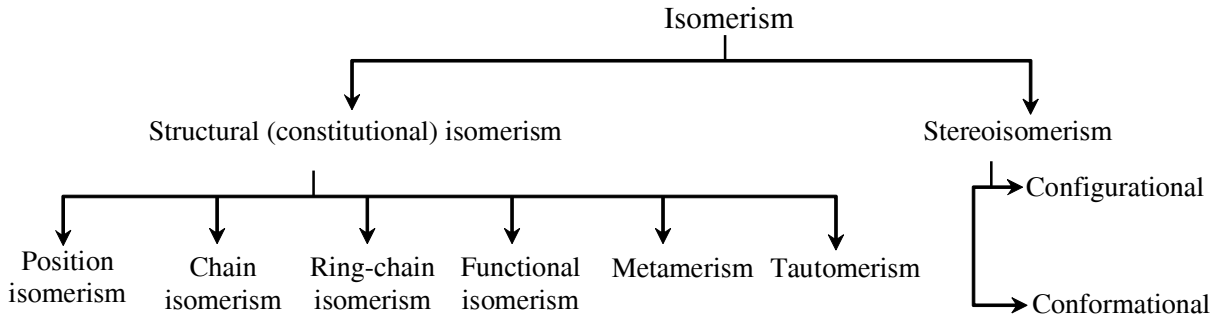
(vi) $C_{15}H_{28}O_2N_2$ DU= $\frac{(2\times15+2)-(28-2)}{2}$ =3

# Structural Isomerism

## 4. Isomerism

The phenomenon of existence of two or more compounds possessing the same molecular formula but different physical or chemical or both properties is known as isomerism. Such compounds are known as isomers.

**Classification of isomerism**




### 4.1 Structural isomerism

When two or more organic compounds have same molecular formula but different structural formula, (i.e., they differ in connectivity of atoms) they are called **structural isomers** and the phenomenon is called structural isomerism.

$\underset{\text{But}-2-\text{ene}}{CH_3-CH=CH-CH_3}$ , $\left.\underset{\text{But}-1-\text{ene}}{CH_3CH_2CH=CH_2}\right]$ structural Isomers

$\begin{array}{l} CH_3 \\ | \\ CH-CH_2-CH_3 \\ | \\ CH_3 \end{array}$ , $\left.\begin{array}{l} CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2CH_3 \\ 2-\text{Methylbutane} \end{array}\right]$ Identical compounds (not isomers)

2 – Methylbutan e

#### 4.1.1 Chain isomerism

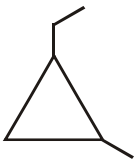
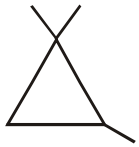
Compounds having same molecular formula but different carbon skeletons (either difference in main chain or side chain) are known as chain isomers & phenomenon is known as chain isomerism.

**Condition : They should have same nature of locants.**

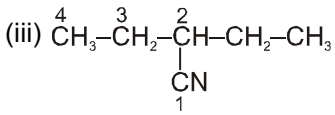
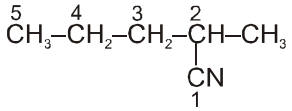
(i) $CH_3-CH_2-CH_2-CH_2-CH_3$ $\quad$ $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3$ $\quad$ $\begin{array}{l} CH_3 \\ | \\ CH_3-C-CH_3 \\ | \\ CH_3 \end{array}$

Pentane (Main chain of 5C) $\quad$ Isopentane (Main chain of 4 C) $\quad$ Neopentane (Main chain of 3C)

All the above are chain isomers.

(ii)  

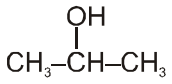
Size of main chain = 3 Size of main chain = 3
Size of longest Side chain = 2 Size of longest side chain = 1
Both are chain isomers due to difference in number of carbon atoms in side chain.

(iii)  & 

2-Ethylbutanenitrile 2-Methylpentanenitrile
Both are chain isomers due to difference in number of carbon atoms in parent chain.

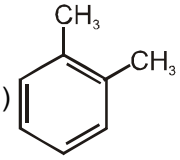
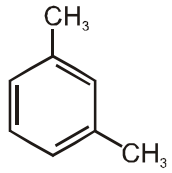
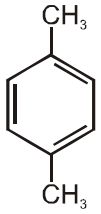
### 4.1.2 Position isomerism

Compounds having same carbon skeleton along with same nature of locants but having different position of locants are known as position isomers & phenomenon is position isomerism.

(i) $CH_3CH_2CH_2OH$ & 

Propan-1-ol Propan-2-ol

Difference only in position of –OH group so these are positional isomers.

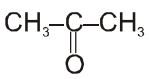
(ii)  ,  & 

o-Xylene m-Xylene p-Xylene

Difference only in position of $–CH_3$ group so these are positional isomers.

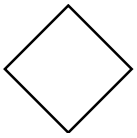
### 4.1.3 Functional isomerism

Compounds having same molecular formula but different functional groups are known as functional isomers & phenomenon is functional isomerism.

(i) $CH_3CH_2–NH_2$ & $CH_3–NH–CH_3$ (ii)  & 

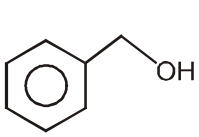
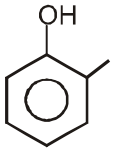
Ethanamine Dimethylamine Propanal Propanone

### 4.1.4 Ring-chain isomerism

$CH_3–CH=CH–CH_3$ (But-2-ene) &  Cyclobutane

Sometimes it is also known as **functional isomerism**.

**Note :** (1) 1º, 2º, 3º amines are functional isomers.
(2) 1º, 2º, 3º amides are functional isomers.
(3) Alcohol attached to $sp^2$ C is chemically different from alcohol attached to $sp^3$ C.
(4) Alchol and enol are functional isomers.



are functional isomers.

(5) Following compounds do not exist at room temperature therefore should not be considered as structural isomers.

(i) –C=C–OH (enol) (ii) –C≡C–OH (ynol) (iii) –C(OH)– OH (gemdiol)

(iv) –C(OR)–OH (hemiacetal) (v) –C(OH)–O–C=C– (vi) –O–O– (peroxy compound)

### 4.1.5. Metamerism

It arises due to different alkyl chains on either side of the functional group.
(Polyvalent hetro atomic functional group must be present in the compounds).

(i) $CH_3–CH_2–O–CH_2–CH_2$ & $CH_3–O–CH_2–CH_2–CH_3$

Ethoxy ethane — Methoxy propane

[Ethyl groups on either sides of O.] [Methyl & propyl groups on either sides of O.]

(ii) $CH_3–C(=O)–O–CH_2–CH_3$ & $CH_3–CH_2–C(=O)–OCH_3$ & $H–C(=O)–O–CH_2–CH_2–CH_3$ are metamers.

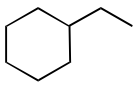
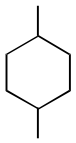
$CH_3–CH_2–N(CH_3)–CH_2–CH_2–CH_3$ & $CH_3–CH_2–N(CH_2–CH_3)–CH_2–CH_3$ are metamers.

**Que.** Identify relationship between the given pair of compounds.

**(1)** (i) $CH_3 – CH_2CH_2 – CH_3$ (ii) $CH_3 – CH(CH_3) – CH_3$

| (i) | (ii) |
|---|---|
| Butane | 2–Methylpropane |
| Size of main chain = 4 | Size of main chain = 3 |
| Size of side chain = 0 | Size of side chain = 1 |

Structure (i) & (ii) are chain isomers.

**(2)** (i)  (ii) 

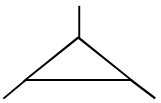
(i) 1–Ethylcyclohexane

(ii) 1,4–Dimethylcyclohexane

| (i) | (ii) |
|---|---|
| Size of main chain = 6 | Size of main chain = 6 |
| Size of side chain = 2 | Size of side chain 1 = 1 |
| | Size of side chain 2 = 1 |

Structure (i) & (ii) are chain isomers.

**(3)** (i) 
Cyclohexane

(ii) 
1,2,3–Trimethylcyclopropane

Size of main chain = 6
Size of side chain = 0

Size of main chain = 3
Size of side chain 1 = 1
Size of side chain 2 = 1
Size of side chain 3 = 1

Structure (i) & (ii) are chain isomers.

**(4)** $H_3C-CH_2-CH=CH_2$ (but – 1 – ene)
$H_3C-CH=CH-CH_2$ (but – 2 – ene)
] position isomers

**(5)** $HC\equiv C-CH_2-CH_2-CH_3$ (pent – 1 – yne)
$H_3C-C\equiv C-CH_2-CH_3$ (pent – 2 – yne)
] position isomers

**(6)** (i) $CH_3-CH_2OH$
Ethanol
Functional group – OH

(ii) $CH_3-O-CH_3$
Methoxymethane
Functional group – O – (Ether)

Structure (i) & (ii) are functional isomers.

**(7)** (i) $CH_3-\overset{\overset{O}{\|}}{C}-OH$
Ethanoic acid

(ii) $H-\overset{\overset{O}{\|}}{C}-OCH_3$
Methyl methanoate

Functional groups – COOH

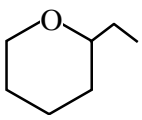
Functional groups $-\overset{\overset{O}{\|}}{C}-O-$ (Ester)

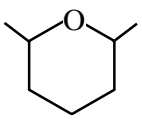
Structure (i) & (ii) are functional isomers.

**(8)** (i) $C_2H_5-O-C_2H_5$
Diethyl ether
Alkyl groups $-C_2H_5$ & $-C_2H_5$

(ii) $C_3H_7-O-CH_3$
Methyl propyl ether
Alkyl groups $-C_3H_7$ & $-CH_3$

Structure (i) & (ii) are metamers.

**(9)** (i) 

(ii) 

Struture (i) and (ii) have different alkyl groups but same functional groups, so these are metamers.

**(10)** (i) $CH_3-O-CH_2-CH_2-CH=O$
Functional groups-ether and aldehyde

(ii) $CH_3-CH_2-CH_2-O-CH=O$
Functional group-Ester

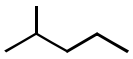
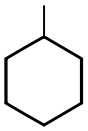
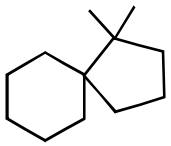
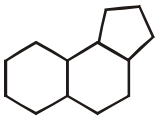
Struture (i) and (ii) have different functional groups, so these are functional isomers.

# Exercise # 1

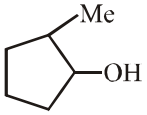
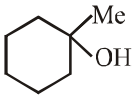
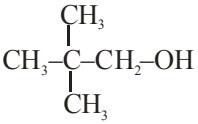
## PART-I : SUBJECTIVE QUESTIONS

### Section (A) : Fundamentals and classification of organic compounds

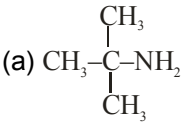
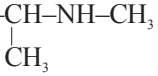
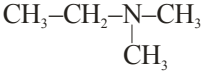
**A-1.** Find the number of 1º, 2º & 3º hydrogen atoms in the following compounds?

(a)  (b)  (c)  (d) 

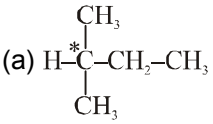
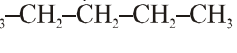
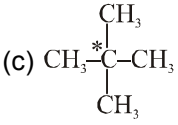
**A-2.** Indicate the following as 1°, 2° and 3° alcohol.

(a)  (b)  (c) 

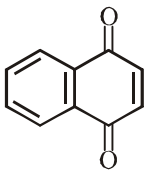
**A-3.** Indicate the following as 1°, 2° and 3° amines.

(a)  (b)  (c)  (d)

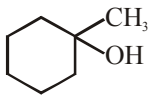
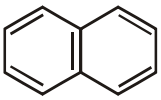
**A-4.** What is the degree of marked carbon atoms in the following compounds?

(a)  (b)  (c) 

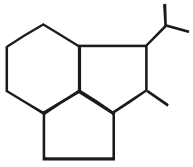
**A-5.** How many $sp^2$–$sp^2$ C–C $\sigma$ bonds are present in the given structure ?



**A-6.** Write the number of $\sigma$ and $\pi$ bonds in the following molecules.

(a)  (b) 

**A-7.** Calculate the number of 3° carbon atoms in the given compound.

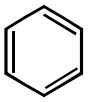
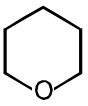
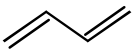


**A-8.** Find the hybridization of each carbon atom in following compound.

$\overset{8}{CH_2}= \overset{7}{C} = \overset{6}{CH} - \overset{5}{CH_2} - \overset{4}{C} \equiv \overset{3}{C} - \overset{2}{CH_2} - \overset{1}{COOH}$

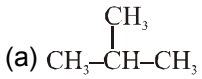
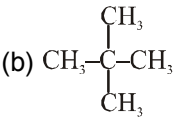
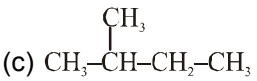
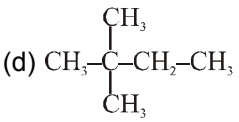
**A-9.** Calculate the molecular weight of the lowest hydrocarbon which contains sp & $sp^2$ hybridised carbon atoms only.

**A-10.** Classify the following compounds as homocyclic, heterocyclic, alicyclic, aromatic, saturated and unsaturated.

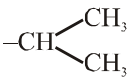
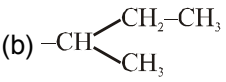
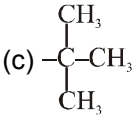
(a)  (b)  (c)  (d) 

## Section (B) : IUPAC-Nomenclature of alkanes and cycloalkanes

**B-1.** Write IUPAC name of the following compounds.

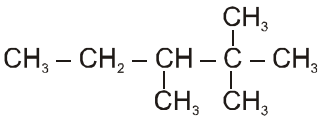
(a)  (b)  (c)  (d) 

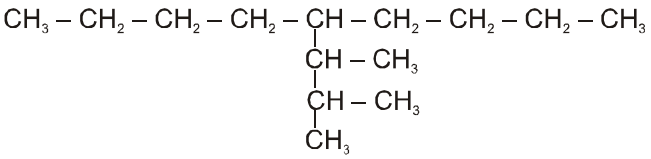
**B-2.** Write the common name of the following alkyl groups.

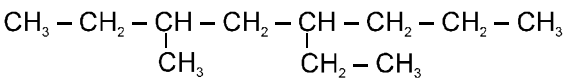
(a)  (b)  (c) 

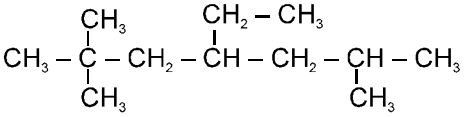
(d) $-CH_2-CH_3$ (e) $CH_3-CH_2-CH_2-$

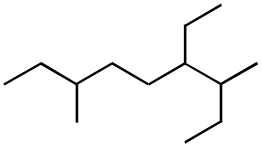
**B-3.** Write the IUPAC name of following compounds

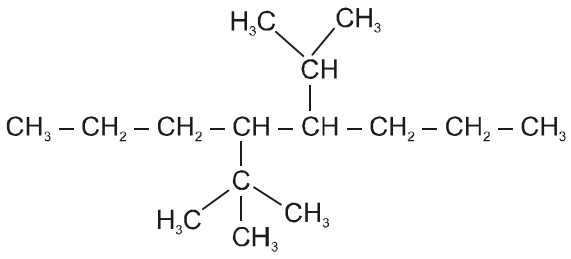
(a) 

(b) 

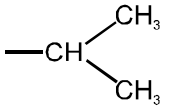
(c) 

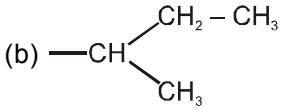
(d) 

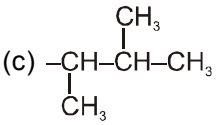
(e) 

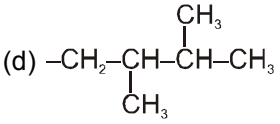
(f) 

**B-4.** Write the correct IUPAC name of the following hydrocarbon (alkyl) groups.

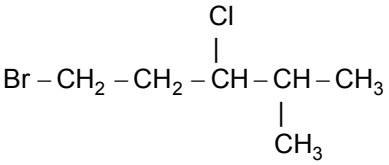
(a) 

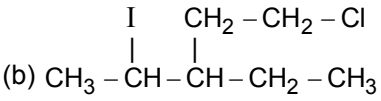
(b) 

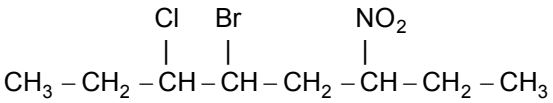
(c) 

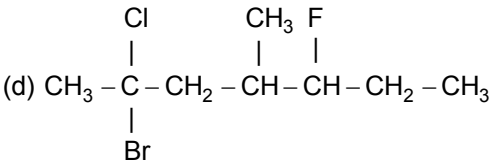
(d) 

**B-5.** Write IUPAC name of the following compounds.

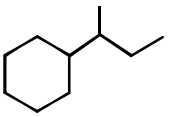
(a) 

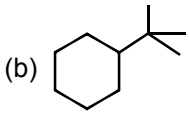
(b) 

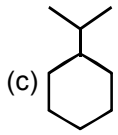
(c) 

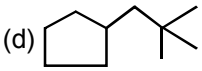
(d) 

**B-6.** Write IUPAC names of the following hydrocarbons (use common naming for hydrocarbon groups.)

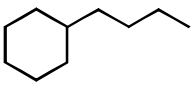
(a) 

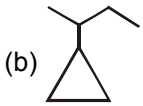
(b) 

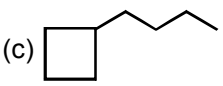
(c) 

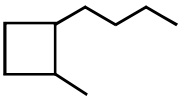
(d) 

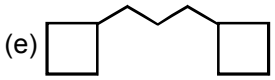
**B-7.** Identify the parent chain in the following compounds as ring or side chain.

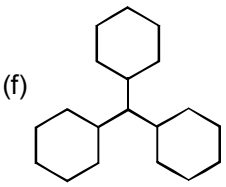
(a) 

(b) 

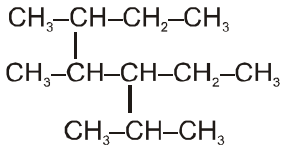
(c) 

(d) 

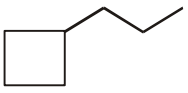
(e) 

(f) 

**B-8.** How many carbon atoms are present in the parent chain of the given compound?

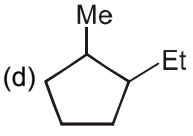


**B-9.** Write IUPAC name of the following compounds.

(a) 

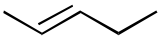
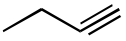
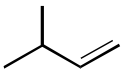
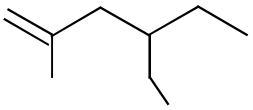
(b) 

(c) 

(d) 

## Section (C) : IUPAC Nomenclature of alkenes, cylcoalkenes, polyenes and alkynes

**C-1.** Write IUPAC name of the following compounds.

(a)  (b)  (c)  (d) 

**C-2.** Write the IUPAC name of the following hydrocarbon groups.

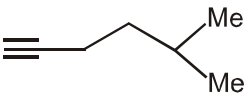
(a) $-CH=CH_2$ (b) $-C\equiv CH$ (c) $\begin{array}{l}CH_3\\|\\-C=CH_2\end{array}$ (d) $-CH_2-CH=CH_2$

(e) $=CH-CH_3$ (f) $\begin{array}{l}CH_3\\|\\=C-CH_3\end{array}$

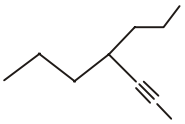
**C-3.** Write the general formula of alkenes. Give common and IUPAC names of first three members.

**C-4.** Write the general formula of alkynes. Give common and IUPAC names of first three members.

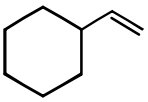
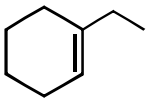
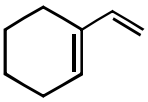
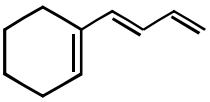
**C-5.** Write IUPAC name of the following compounds :

(a)  (b) $\begin{array}{l}CH_3\\|\\CH_3-CH-C\equiv CH\end{array}$ (c) $\begin{array}{l}CH_3-C\equiv C-CH-CH_3\\\qquad\qquad\quad|\\\qquad\qquad\quad CH_3\end{array}$

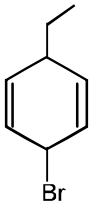
**C-6.** Write the IUPAC name of the following compounds:-

(a) $CH_3-\underset{\underset{CH_3}{|}}{CH}-C\equiv C-CH_3$ (b)  (c) $\begin{array}{l}\qquad\quad CH_3\\\qquad\quad|\\H_3C-CH_2-C-CH-C\equiv CH\\\qquad\quad|\quad|\\\qquad\quad CH_3\,CH_3\end{array}$

**C-7.** Write IUPAC names of the following.

(a)  (b)  (c)  (d) 

**C-8.** What is the position of bromo in the given compound according to IUPAC?



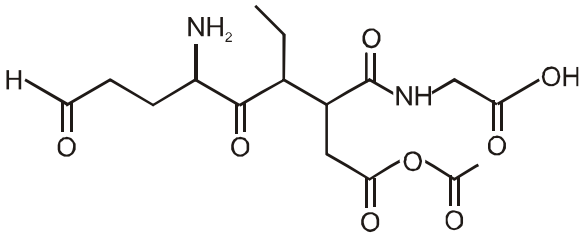

**C-9.** Write the position of ethyl substituent in the IUPAC name of the following compound.

$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_2-CH_3}{|}}{CH}-\underset{\underset{CH_2-CH-CH_3}{\underset{\underset{CH_2-CH_3}{|}}{CH_2}}{|}}{CH}-CH=\underset{\underset{CH_3}{|}}{C}-CH_3$$

## Section (D) : IUPAC naming of non chain terminating functional groups containing compounds

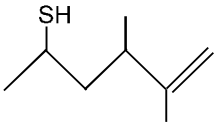
**D-1.** Write the priority order of given functional groups.
–COOH, –CN, –CHO, –OH, $–COCH_3$, $–NH_2$

**D-2.** Number of functional groups present in the following compounds are :



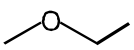
**D-3.** Write the correct IUPAC name of the followings.

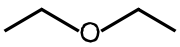
(a) $(CH_3)_2 CHCH = CHCH_2OH$

(b) 

(c) $H_3C — N(CH_3) — CH(CH_3) — CH_3$

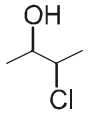
(d) $Cl\,CH_2COCH_2CH(CH_3) – CH_3$

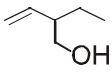
(e) 

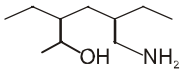
(f) 

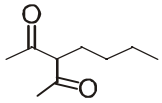
**D-4.** Draw the structures of the following compounds.
(a) 3-Methoxy-5, 5-dimethylcyclohex-2-en-1-ol (b) 5–Methyl-2-(methylethyl)cyclohexan-1-amine
(c) 2–Chloro–3–methylcyclohex–3–ene–1–thiol (d) 3 –Bromo– 4–methylcyclopentan-1-one

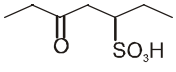
**D-5.** How many of following IUPAC names are correctly matched?

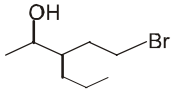
(a)  2-Chlorobutan-3-ol

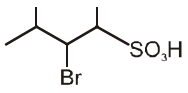
(b)  2-Ethylbut-3-en-1-ol

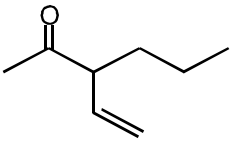
(c)  5-Aminomethyl-3-ethylheptan-2-ol

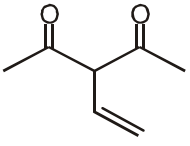
(d)  3-Butylpentane-2,4-dione

(e)  3-Oxoheptane-5-sulphonic acid.

(f)  3-(2-Bromoethyl)hexan-2-ol

(g)  3-Bromo-4-methylpentane-2-sulphonic acid

(h)  3-Propylpent-4-en-2-one

(i)  3-Ethenylpentane-2,4-dione

## Section (E) : IUPAC naming of the chain terminating functional group containing compounds

**E-1.** Write the structure of the following molecules :

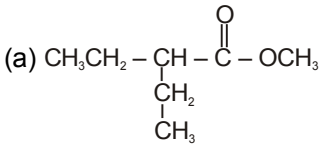
(a) 4-Formyl-2-oxocyclohexane-1-carboxylic acid.

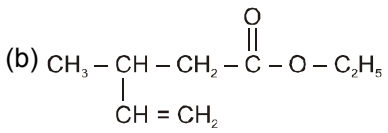
(b) 2-Cyano-3-oxopentanedioic acid

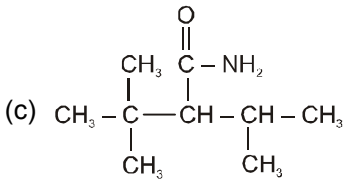
(c) 3-Methyl-2-methylenebut-3-enoic acid

(d) 5-Oxocyclohex-2-ene-1-carbonitrile

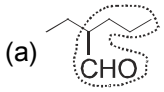
**E-2.** Write IUPAC names of the following compounds :

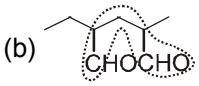


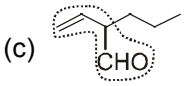



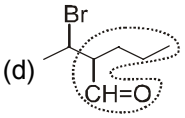



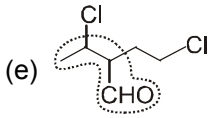

**E-3.** In how many of the following compounds, correct parent chain is selected ?

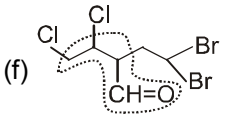


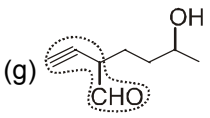



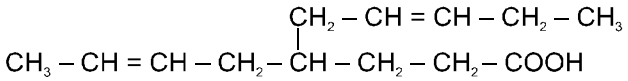



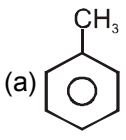



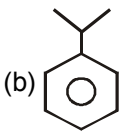

**E-4.** In the given compound, number of carbon atoms in parent chain are X and locant position of double bond in parent chain is Y. Report your answer as X + Y :



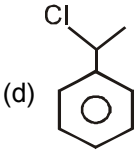

## Section (F) : IUPAC-Nomenclature of aromatic compounds

**F-1.** Write IUPAC names of the following :

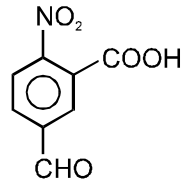


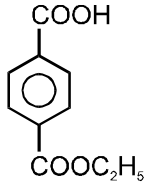



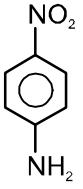

(c) Ph–$CH_2$–Ph

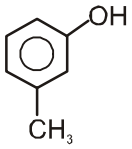


**F-2.** Write the correct IUPAC names of the following :

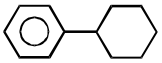
(a) 

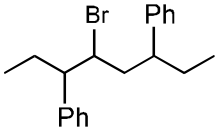

(b) 

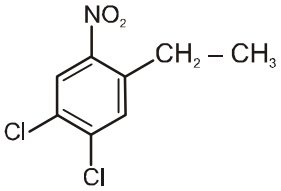

(c) 

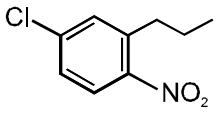

(d) 


**F-3.** In how many of the following compounds, benzene ring is considered as parent chain ?

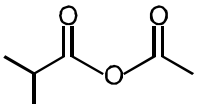
(a) 

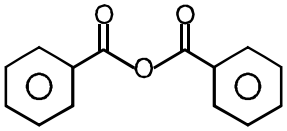
(b) 

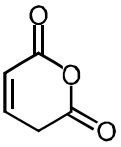

(c) 

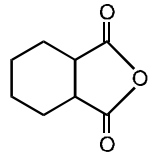

(d) 


**F-4.** Write IUPAC names of following compounds.

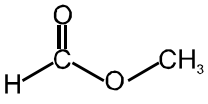
(a) 

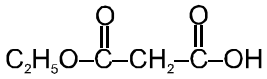
(b) 

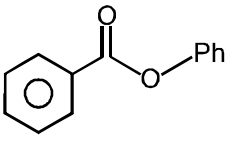
(c) 

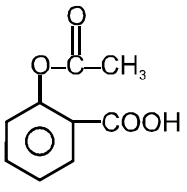
(d) 

**F-5.** Write IUPAC names of following compounds

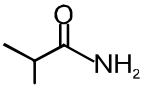
(a) 

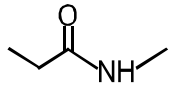

(b) 

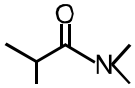

(c) 

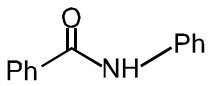

(d) 


**F-6.** Write IUPAC names of following compounds.

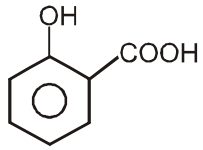
(a) 


(b) 

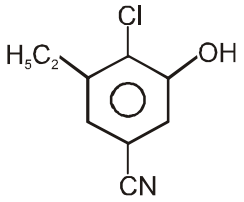

(c) 

(d) 

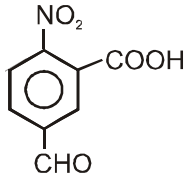
**F-7.** The number of compounds with correct IUPAC name is/are :

(a) 

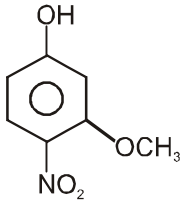
2-Carboxyphenol

(b) 

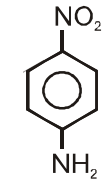
3-Ethyl-4-chloro-5-hydroxybenzenecarbonitrile

(c) 

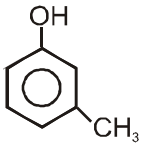
3-Formyl-5-nitrobenzenecarboxylic acid

(d) 

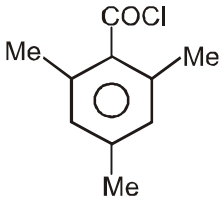
1-Hydroxy-3-methoxy-4-nitrobenzene

(e) 

4-Amino-1-nitrobenzene

(f) 

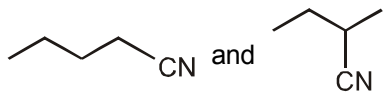
3-Methylphenol

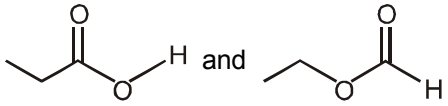
(g) 

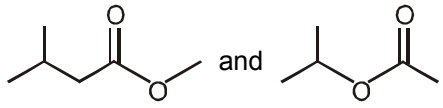
2,4,6-Trimethylbenzenecarbonlychloride

## Section (G) : Structural isomerism

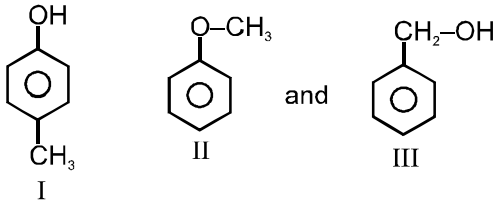
**G-1.** Identify the relationship between the given compounds.

(a) 

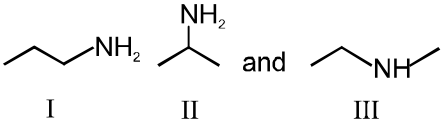
(b) 

(c) 

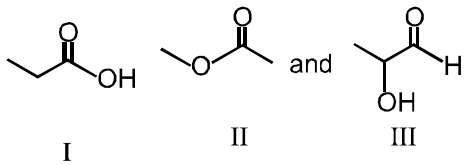
**G-2.** Identify the relationship amongst the following :

(a) 

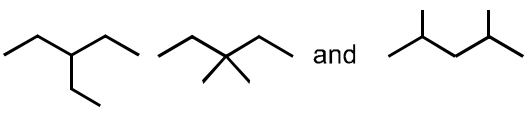
I II III

(b) 

I II III

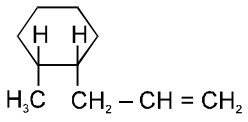
(c) 

I II III

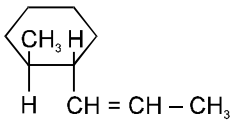
(d) 

I II III

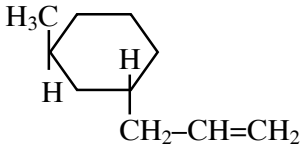
**G-3.** Identify the relationship between compound I, II and III.




I

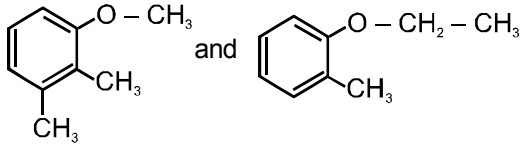


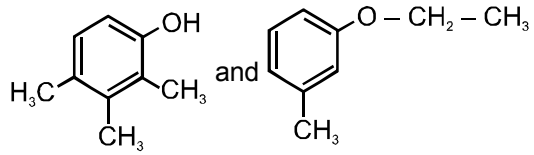

II

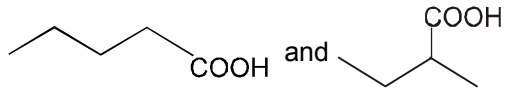


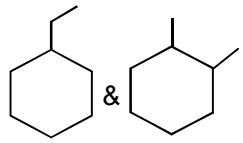

III

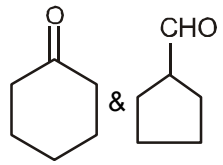
**G-4.** In how many of the following, correct isomeric relation is given?

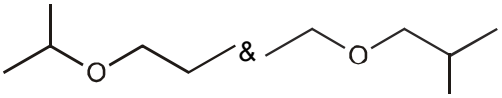
(a)  are metamers

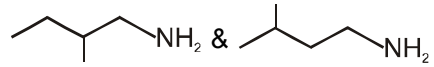
(b)  are functional isomers

(c)  are position isomers

(d)  are chain isomers

(e)  are functional isomers

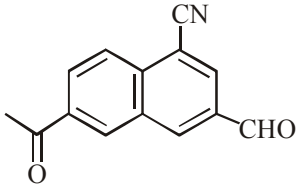
(f)  are metamers

(g)  are position isomers

## Section (H) : Number of structural isomers

**H-1.** What is the degree of unsaturation in a compound with molecular formula $C_9H_6N_4$?

**H-2.** Degree of unsaturation of the following compound is ?




**H-3.** How many esters are possible of formula $C_4H_8O_2$? What is the relation between them?

**H-4.** The ring-chain functional isomers of compound But-2-ene are.

**H-5.** Write all structurally isomeric ethers with molecular formula $C_5H_{12}O$.

## PART-II : OBJECTIVE QUESTIONS

### Section (A) : Fundamentals & classification of organic compounds

**A-1.** How many 1°carbon atoms will be present in a simplest open chain hydrocarbon having two 3° and one 2° carbon atoms ?

(A) 3 (B) 4 (C) 5 (D) 6

**A-2.** Alicyclic compounds are :

(A) Aromatic compounds (B) Aliphatic cyclic compounds

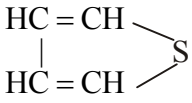
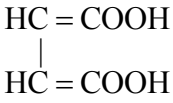
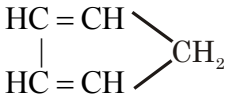
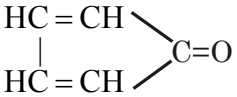
(C) Heterocyclic compounds (D) None of the above

**A-3.** A group of closely related compounds which can be expressed by a general formula & in which two consecutive members differ by 14 in their molecular masses is called

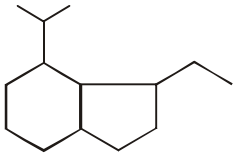
(A) a heterogeneous series (B) a homologous series

(C) a homogeneous series (D) an electrochemical series

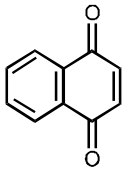
**A-4.** Which of the following is a heterocyclic compound?

(A)  (B)  (C)  (D) 

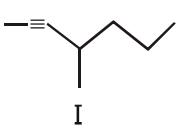
**A-5.** Number of 3º and 2º carbon atoms in the following compound are?

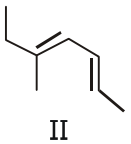


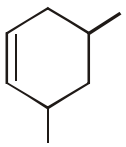
(A) 5, 6 (B) 5, 7 (C) 4, 6 (D) 6, 6

**A-6.** Molecular formula of naphthaquinone  is ?

(A) $C_{12}H_8O_2$ (B) $C_{11}H_6O_2$ (C) $C_{10}H_6O_2$ (D) $C_{10}H_8O_2$

**A-7.** 
I


II

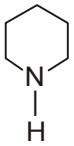

III

Incorrect statement for the above structures is :

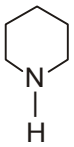
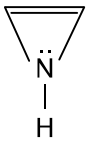
(A) I, II & III have $C_nH_{2n-2}$ general formula (B) I , II & III have same empirical formula

(C) I & II are homologue of compound III. (D) I, II & III have same molecular formula

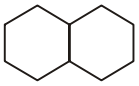
**A-8.** Which of the following is not an alicyclic compound ?

(A)  (B)  (C)  (D) 

**A-9.** The saturated heterocyclic compound is :

(A)  (B)  (C)  (D) 

**A-10.** Which of the following does not have bridgehead carbon ?

(A)  (B)  (C)  (D) 

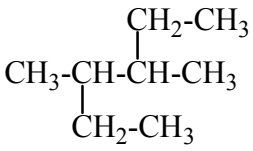
## Section (B) : IUPAC-Nomenclature of alkanes & cycloalkanes

**B-1.** Which of the following compound has isopropyl group ?

(A) 2,2,3,3-Tetramethylpentane (B) 2,2-Dimethylpentane

(C) 2,2,3-Trimethylpentane (D) 2-Methylpentane

**B-2.** IUPAC name of compound is :



(A) 2,3-Diethylbutane (B) 2-Ethyl-3-methylpentane

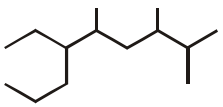
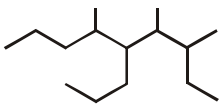
(C) 3-Methyl-2-ethylpentane (D) 3,4-Dimethylhexane

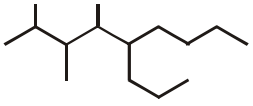
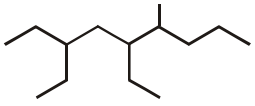
**B-3.** What is the correct systematic name (IUPAC) for the compound $(CH_3)_2CHCH(CH_2CH_3)(CH_2CH_2CH_3)$?

(A) 3-Isopropylhexane (B) 2-Methyl-3-propylpentane

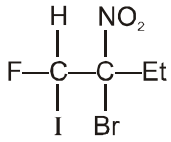
(C) Ethyl isopropyl propyl methane (D) 3-Ethyl-2-methylhexane

**B-4.** The correct structure of 6-Ethyl-2,3,5-trimethylnonane is :

(A)  (B) 

(C)  (D) 

**B-5.** The correct IUPAC name of the following compound is :

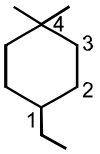


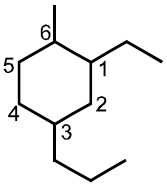
(A) 1-Bromo-1-ethyl-2-fluoro-2-iodo-1-nitroethane (B) 3-Bromo-4-fluoro-4-iodo-3-nitrobutane.
(C) 2-Bromo-1-fluoro-1-iodo-2-nitrobutane. (D) 1-Fluoro-1-iodo-2-bromo-2-ethyl-2-nitroethane.

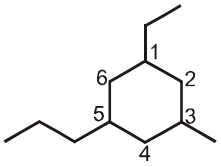
**B-6.** A student named a certain compound as 2,3-Diethylbutane. Its correct IUPAC name is ?
(A) 2,3-Dimethylhexane (B) 3,4-Dimethylhexane
(C) 2-Ethyl-3-methylpentane (D) 2-Ethylbutane

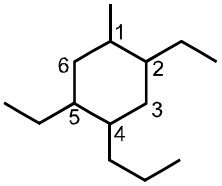
**B-7.** The common and IUPAC names for the group, $-CH_2CH(CH_3)_2$ respectively are
(A) Isobutyl & 2-methylpropyl (B) Isobutyl & 1-methylpropyl
(C) tert-Butyl & 1,1-dimethylethyl (D) sec-Butyl & 2-methylpropyl

**B-8.** In which of the following compound IUPAC numbering is correct?

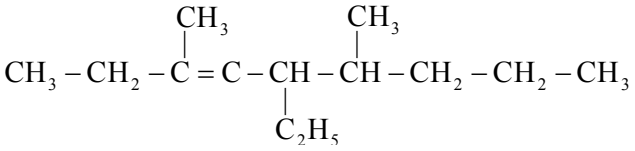
(A) 

(B) 

(C) 

(D) 

## Section (C) : IUPAC Nomenclature of alkenes, cylcoalkenes, polyenes and alkynes

**C-1.** The correct IUPAC name of the compound  is :

(A) 5-Ethyl-3,6-dimethylnon-3-ene (B) 5-Ethyl-4,7-dimethylnon-3-ene
(C) 4-Methyl-5,7-diethyloct-2-ene (D) 2,4-Dimethyl-5-ethyloct-2-ene

**C-2.** The molecular formula of the first member of the family of alkenynes and its name is given by the set

(A) $C_3H_6$, Alkene (B) $C_5H_6$, Pent-1-en-3-yne
(C) $C_6H_8$, Hex-1-en-5-yne (D) $C_4H_4$, Butenyne

**C-3.** The correct IUPAC name of 2-Ethylpent-3-yne is:

(A) 3-Methylhex-4-yne (B) 4-Ethylpent-2-yne
(C) 4-Methylhex-2 yne (D) None of these

**C-4.** The IUPAC name of the compound $CH_3CH = CHCH=CHC\equiv CCH_3$ is:

(A) Octa-4,6-diene-2-yne

(B) Octa-2,4-diene-6-yne

(C) Oct-2-yne-4,6-diene

(D) Oct-6-yne-2,4-diene

**C-5.** Select the structure with correct IUPAC numbering in the chain?

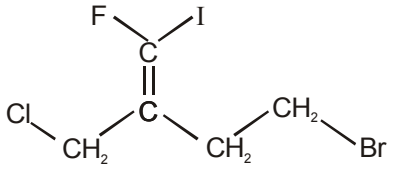
(A) $\overset{5}{C}H_2 = \overset{4}{C}H - \overset{3}{C}H_2 - \overset{2}{C} \equiv \overset{1}{C}H$

(B) $\overset{1}{C}H_3 - \overset{2}{C}H = \overset{3}{C}H - \overset{4}{C}H_2 - \overset{5}{C} \equiv \overset{6}{C}H$

(C) $\overset{7}{C}H_2 = \overset{6}{C}H - \overset{5}{C}H = \overset{4}{C}H - \overset{3}{C}H_2 - \overset{2}{C}H = \overset{1}{C}H_2$

(D) $\overset{1}{C}H_2 = \overset{2}{C}H - \overset{3}{C}H = \overset{4}{C}H - \overset{5}{C}H_2 - \overset{6}{C} \equiv \overset{7}{C}H$

**C-6.** The correct IUPAC name of the compound is -

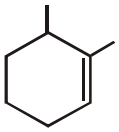



(A) 4-Bromo-1-chloro-2-fluoroiodomethylbutene

(B) 4-Bromo-2-chloromethyl-1-fluoro-1-iodobut-1-ene

(C) 2-(2-Bromoethyl)-3-chloro-1-fluoro-1-iodoprop-1-ene

(D) 1-Bromo-3-chloromethyl-4-fluoro-4-iodobut-1-ene

**C-7.** The IUPAC name of  is :

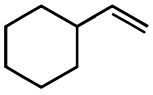
(A) 1,2-Dimethylcyclohexene

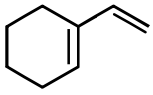
(B) 1,6-Dimethylcyclohexene

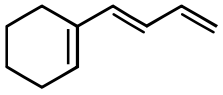
(C) 1,2-Dimethylcyclohex-2-ene

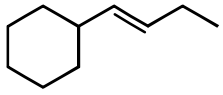
(D) 2,3-Dimethylcyclohexene

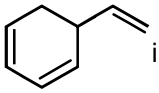
**C-8.** In which of the following, cyclic chain is the main chain ?

(A) 

(B) 

(C) 

(D) 

**C-9.** The correct IUPAC name of the compound  is :

(A) 1-Ethenylcyclohexa-2,4-diene

(B) 5-Ethenylcyclohexa-1,3-diene

(C) 6-Ethenylcyclohexa-1,3-diene

(D) Cyclohexa-2,4-dienylethene

## Section (D) : IUPAC naming of non chain terminating functional groups containing compounds

**D-1.** The IUPAC name of $CH_3CH_2 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{N}} - CH_2CH_3$ is:

(A) N-Methyl-N-ethylethanamine

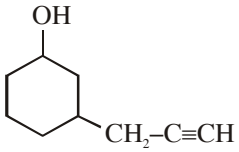
(B) Diethylmethanamine

(C) N-Ethyl-N-methylethanamine

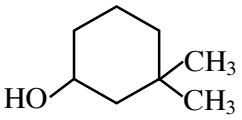
(D) Methyldiethylethanamine

**D-2.** The IUPAC name of acetyl acetone is :

(A) Pentane-2,5- dione
(B) Pentane -2,4-dione
(C) Hexane-2,4-dione
(D)Butane-2,4-dione

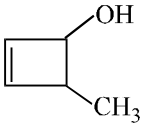
**D-3.** The correct IUPAC name of 


(A) 3-Cyclohexanolpropyne
(B) 3-[3-Hydroxycyclohexyl]propyne
(C) 3-Propynylcyclohexanol
(D) 3-(2-Propynyl)cyclohexanol

**D-4.** The IUPAC name of the compound 

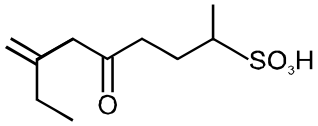
is:

(A) 1,1-Dimethyl-3-hydroxycyclohexane
(B) 3,3-Dimethyl-1-hydroxycyclohexane
(C) 3,3-Dimethylcyclohexanol
(D) 1,1-Dimethylcyclohexan-3-ol

**D-5.** The IUPAC name of 

is :

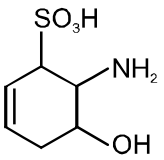
(A) 3-Methylcyclobut-1-en-2-ol
(B) 4-Methylcyclobut-2-en-1-ol
(C) 4-Methylcyclobut-1-en-3-ol
(D) 2-Methylcyclobut-3-en-1-ol

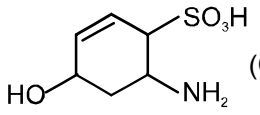
**D-6.** The correct IUPAC name of the compound 

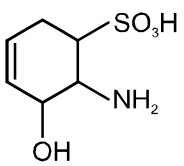
is :

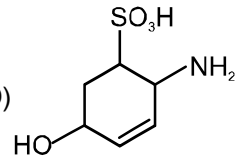
(A) 6-Ethyl-1-methyl-4-oxohept-6-ene-1-sulphonic acid
(B) 7-Ethyl-5-oxooct-7-ene-2-sulphonic acid
(C) 2-Ethyl-7-sulphooct-1-ene-4-one
(D) 7-Methylene-5-oxononane-2-sulphonic acid

**D-7.** The correct structure of 6-Amino-4-hydroxycylohex-2-ene-1-sulphonic acid?

(A) 


(B) 


(C) 


(D) 

## Section (E) : IUPAC naming of the chain terminating functional group containing compounds

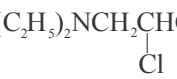
**E-1.** IUPAC name of $CH_2$=CH – CN is:

(A) Ethenenitrile (B) Vinyl cyanide (C) Cyano ethene (D) Prop-2-enenitrile

**E-2.** The correct IUPAC name of  is:

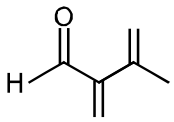
(A) 2-Methylbutanoic acid (B) 2-Ethylprop-2-enoic acid

(C) 2-Carboxybutene (D) None of the above

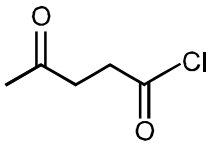
**E-3.** The IUPAC name of  is:

(A) 2-Chloro-4-N-ethylpentanoic acid (B) 2-Chloro-3-(N,N-diethyl amino)-propanoic acid

(C) 2-Chloro-2-oxo diethylamine (D) 2-Chloro-2-carboxy-N-ethylethane

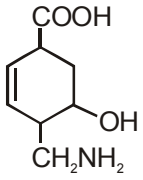
**E-4.**  is named as **:**

(A) 2, 3-Dimethylenebutanal (B) 3-Methyl-2-methylenebut-3-enone
(C) 3-Methyl-2-methylenebut-3-enal (D) 2, 3-Dimethylenebutanone

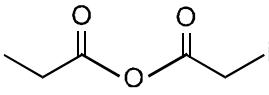
**E-5.** The correct IUPAC name of compound  is :

(A) 1-Chloropentane-1, 4-dione
(B) 4-Chlorocarbonylbutan-2-one
(C) 4-Oxopentanoylchloride
(D) 3-Oxobutanecarbonylchloride

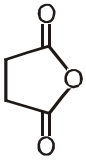
**E-6.** The correct IUPAC name of following compound is :



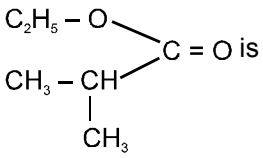
(A) 4-Aminomethyl-3-hydroxycyclohex-5-ene-1-carboxylic acid
(B) 2-Aminomethyl-5-carboxycyclohex-3-en-1-ol
(C) 4-Aminomethyl-5-hydroxycyclohex-2-ene-1-carboxylic acid
(D) 3-Hydroxy-4-aminomethylcyclohex-5-en-1-oic acid

**E-7.** The IUPAC name of the compound  is :

(A) Propanoic anhydride
(B) Dipropanoic anhydride
(C) Ethoxypropanoic acid
(D) 1-Oxopropyl propanoate

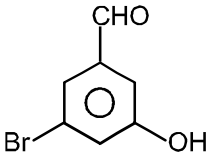
**E-8.** The IUPAC name of the compound  is :

(A) Cyclobutanedioic anhydride
(B) Butanedicarboxylic anhydride
(C) Cyclobutanedicarboxylic anhydride
(D) Butanedioic anhydride

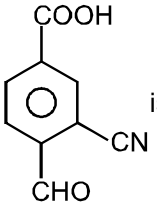
**E-9.** The IUPAC name of  is

(A) Ethoxymethanone
(B) Ethyl 2-methylpropanoate
(C) Ethoxypropanone
(D) 2-Methylethoxypropanone

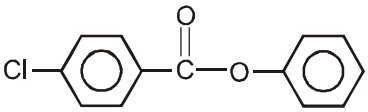
## Section (F) : IUPAC-Nomenclature of aromatic compounds

**F-1.** The IUPAC name of the following compound  is :

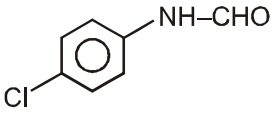
(A) 5-Bromo-3-hydroxybenzenecarbaldehyde
(B) 3-Bromo-5-formylphenol
(C) 3-Bromo-5-hydroxybenzenecarbaldehyde
(D) 1-Bromo-3-formyl-5-hydroxybenzene

**F-2.** The IUPAC name of the compound  is :

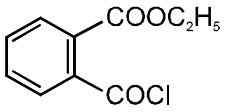
(A) 2-Cyano-1-formylbenzene-4-carboxylic acid
(B) 3-Cyano-4-formylbenzene-1-carboxylic acid
(C) 4-Carboxy-2-cyanobenzene-1-carbaldehyde
(D) 2-Formyl-5-carboxybenzene-1-carbonitrile

**F-3.** IUPAC name of 

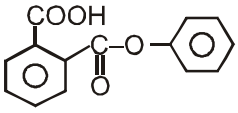
(A) 4-Chlorophenyl benzoate.
(B) Phenyl 4-chlorobenzenecarboxylate.
(C) Benzyl 4-chlorobenzenecarboxylate.
(D) 4-Chlorodiphenylcarboxylate.

**F-4.** The correct IUPAC name of the compound  is

(A) N–Formyl-4-chlorobenzenamine
(B) N–Formyl-4-chloroaniline
(C) N–(4-Chlorophenyl)methanamide
(D) N–(Parachlorophenyl)–N–formylaniline

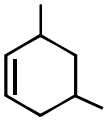
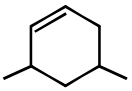
**F-5.** IUPAC name of the compound  is

(A) 2-Chlorocarbonyl ethylbenzenecarboxylate
(B) 2-Carboxyethylbenzoyl chloride
(C) Ethyl 2-(chlorocarbonyl)benzenecarboxylate
(D) Ethyl 1-(chlorocarbonyl)benzenecarboxylate

**F-6.** The correct IUPAC name of the compound  is :

(A) 2-Phenoxycarbonylbenzenecarboxylic acid
(B) Phenyl-2-carboxybenzenecarboxylate
(C) 2-Benzoyloxybenzenecarboxylic acid
(D) 2-Benzyloxycarbonylbenzenecarboxylic acid

## Section (G) : Structural isomerism

**G-1.** Relation between compounds  &  is:

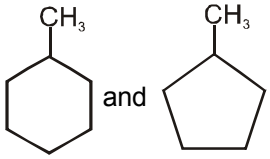
(A) Position isomers (B) Chain isomers (C) Identical (D) Functional isomers

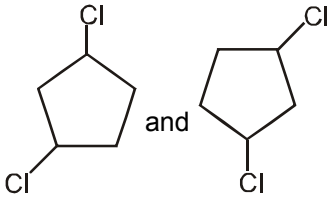
**G-2.** Which type of isomerism is observed between I and II ?

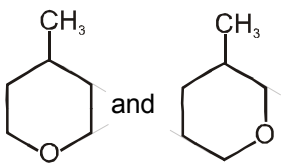
(I) $CH_3 - CH_2 - \underset{\underset{O}{\|}}{C} - OCH_3$ , (II) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-O-CH_3$

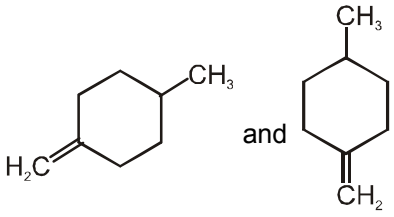
(A) Functional isomerism
(B) Metamerism
(C) Position isomerism
(D) Stereoisomerism

**G-3.** Which of the following is a pair of structural isomers?

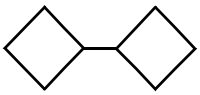
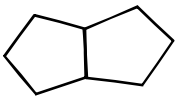
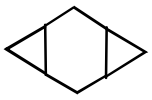
(A) 

(C) 

(C) 

(D) 

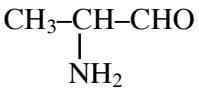
**G-4.** Which one of the follwoing compound is not isomer of others?

(A)  (B)  (C)  (D) 

**G-5.** What is the relation between 3-Ethylpentane and 3-Methylhexane ?

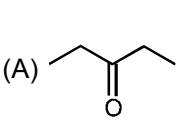
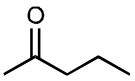
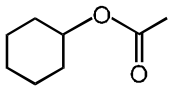
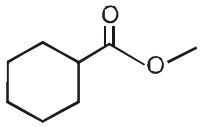
(A) Chain isomers (B) Position isomers (C) Functional isomers (D) No relation

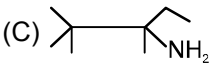
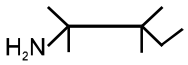
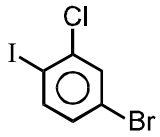
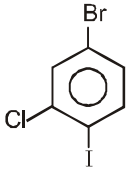
**G-6.** Which type of isomerism is observed between I and II ?

(I) $CH_3 - CH_2 - NH - CHO$ (II) 

(A) Chain isomers (B) Position isomers (C) Functional isomers (D) Metamers

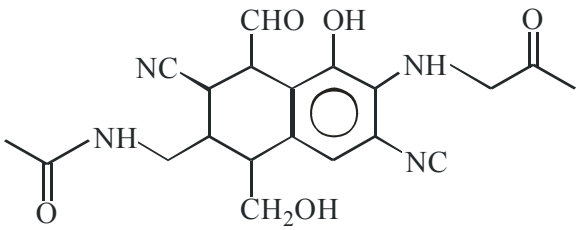
**G-7.** Which of the following pair is identical ?

(A)   (B)  

(C)   (D)  

## Section (H) : Number of structural isomers

**H-1.** Degree of unsaturation (DU) & total number of different functional groups in given compound are?



(A) 8, 7 (B) 9, 8 (C) 12, 8 (D) 12, 7

**H-2.** How many positional isomers are possible for dimethylcyclohexane?

(A) 3 (B) 4 (C) 5 (D) 6

**H-3.** How many aromatic isomers are possible for trichlorobenzene ($C_6H_3Cl_3$) ?

(A) 2 (B) 3 (C) 4 (D) 5

**H-4.** The number of ether isomers represented by formula $C_4H_{10}O$ is (only structural)?

(A) 4 (B) 3 (C) 2 (D) 1

**H-5.** Total number of 2° amine isomers of $C_4H_{11}N$ would be (only structural)?

(A) 4 (B) 3 (C) 5 (D) 2

**H-6.** Find the total number of structurally isomeric 1° amides with molecular formula $C_5H_{11}NO$?

(A) 1 (B) 3 (C) 2 (D) 4

**H-7.** How many structural isomers of all the tertiary alcohols with molecular formula $C_6H_{14}O$ are ?

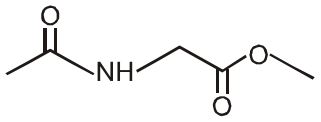
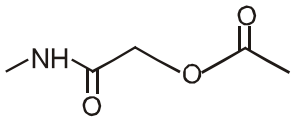
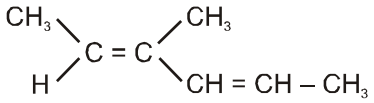
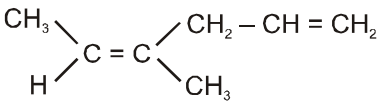
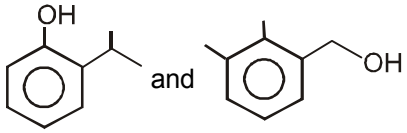
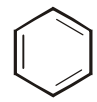
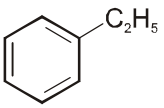
(A) 2 (B) 3 (C) 4 (D) 5

**H-8.** Total number of structural isomers for $C_5H_{10}$ would be?

(A) 8 (B) 6 (C) 9 (D) 10

## PART-III : MATCH THE COLUMN

**1.**

| **Column – I** | **Column – II** |
|---|---|
| (A)  and  | (p) Isomers |
| (B)  and  | (q) Positional Isomers |
| (C)  and  | (r) Functional Isomers |
| (D)  and  | (s) Homologs |

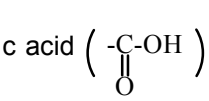
**2.**

| **Column – I (Molecular formula)** **[X = Cl, Y = Br, Z = F]** | **Column – II (Number of benzenoid isomers)** |
|---|---|
| (A) $C_6H_2X_4$ | (p) 3 |
| (B) $C_6H_4XY$ | (q) 6 |
| (C) $C_6H_3XYZ$ | (r) 10 |
| (D) $C_6H_3X_2Y$ | (s) 12 |

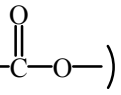
# Exercise # 2

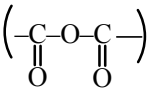
## PART - I : OBJECTIVE QUESTIONS

**1.** A compound of molecular formula $C_6H_{12}O_3$ can never have a functional group-

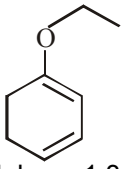
(A) Carboxylic acid 

(B) Aldehyde 

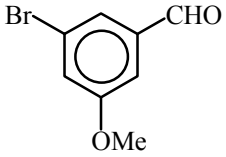
(C) Ester 

(D) Anhydride 

**2.** IUPAC name of the compound is :

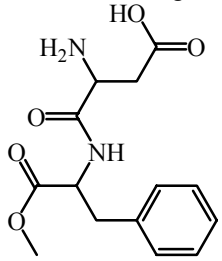


(A) 1-Ethoxycyclohexa-1,3-diene
(B) 1-Ethoxycyclohexa-1,5-diene
(C) 2-Ethoxycyclohexa-1,5-diene
(D) 4-Ethoxycyclohexa-1,3-diene

**3.** Correct IUPAC name for the compound  is :

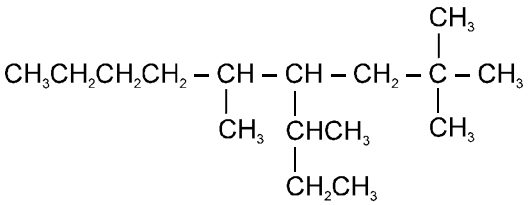
(A) 3-Methoxy-5-bromobenzenecarbaldehyde
(B) 3-Formyl-5-bromophenylmethylether
(C) 3-Formyl-5-bromo-1-methoxybenzene
(D) 3-Bromo-5-methoxybenzenecarbaldehyde

**4.** Number of functional groups present in ASPARTAME are -



ASPARTAME

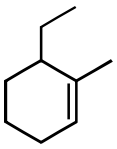
(A) 4 (B) 5 (C) 7 (D) 6

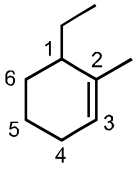
**5.** IUPAC name of the compound  is

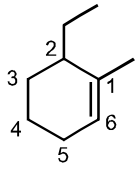
(A) 2,2,5-Trimethyl-4-(1-methylpropyl)nonane
(B) 4,8,8-Trimethyl-6-(1-methylpropyl)nonane
(C) 3,5-Dimethyl-4-(1-methylene tertiary butyl)nonane
(D) 6,6-Dimethyl-2-propyl-4-(1-methylpropyl)heptane

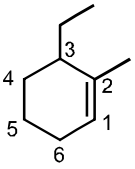
**6.** In the structure of 4-Isopropyl-2,4,5-trimethylheptane, number of $1^0$, $2^0$ & $3^0$ H's are respectively-

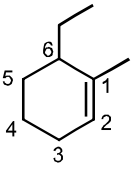
(A) 18, 5, 4 (B) 21, 4, 3 (C) 18, 4, 3 (D) 21, 5, 4

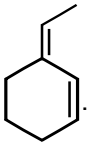
**7.** The correct IUPAC numbering in the compound  is :

(A) 

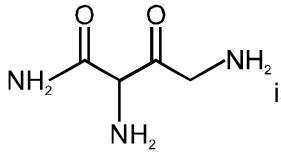

(B) 


(C) 


(D) 

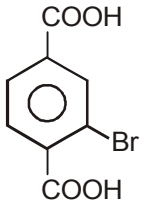

**8.** The correct IUPAC name of  .

(A) 1-Ethylidenecyclohex-2-ene (B) 3-Ethylidenecyclohex-1-ene
(C) 2-Ethylidenecyclohex-1-ene (D) 3-Ethenylcyclohex-1-ene

**9.** The correct IUPAC name of the compound  is :

(A) 1,2,3-Triaminobutane-1,3-dione (B) 2,4-Diamino-3-oxobutanamide
(C) 1,3-Dioxobutane-1,2,4-triamine (D) 1,3,4-Triaminobutane-2,4-dione

**10.** IUPAC name of the following molecule is




(A) 2-Bromobenzene-1,4-dioic acid (B) 3-Bromobenzene-1,4-dicarboxylic acid
(C) 2-Bromobenzene-1,4-dicarboxylic acid (D) 3-Bromobenzene-1,6-dicarboxylic acid

**11.** What is the number of all structurally isomeric alkynes with molecular formula $C_6H_{10}$?

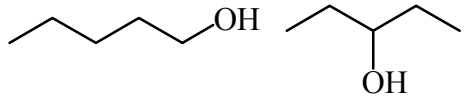
(A) 6 (B) 7 (C) 8 (D) 9

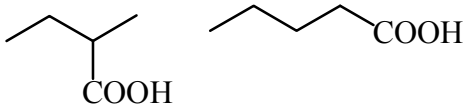
**12.** How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom in an thracene ?

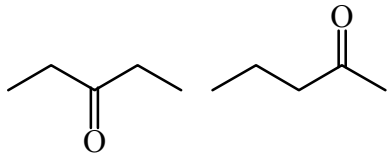
(A) 3 (B) 7 (C) 4 (D) 6

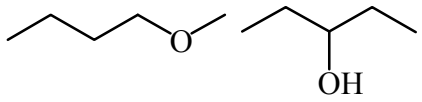
**13.** The number of structural isomers possible from the molecular formula $C_2H_2FClBrI$ are-
(A) 3 (B) 5 (C) 7 (D) 9

**14.** Which of the following represent functional isomers ?

(A) 

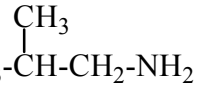

(B) 

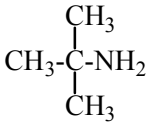

(C) 

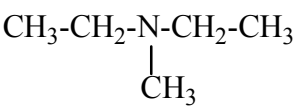

(D) 


**15.** Which one of the following is a functional isomer of $CH_3–CH_2–CH_2–CH_2–NH_2$?

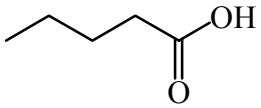
(A) $CH_3–CH_2–NH–CH_2–CH_3$

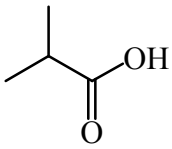
(B) 

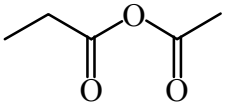
(C) 

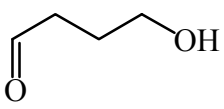
(D) 

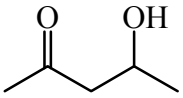
**16.** Number of structure isomers of molecular formula $C_5H_{10}$ having one $\pi$-bond are-
(A) 2 (B) 3 (C) 5 (D) 4

**17.** Compound which is functional isomer of  is-


(A) 


(B) 


(C) 

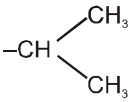

(D) 


## PART - II : NUMERICAL TYPE QUESTIONS

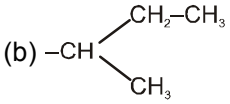
**1.** Possible number of compounds with different structures and IUPAC name $p_1$-bromo -$p_2$-methyl butanoic acid. Where $p_i$ represents position of side chains/substituents?

**2.** The number of structurally isomeric compound(s) possible with molecular formula $C_8H_{18}$ containing 5 carbons in main chain and having methyl group(s) as side chain are **-**

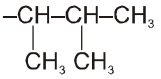
**3.** Number of correct names in the given substituents are :

(a) 

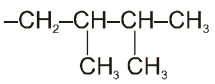
Ethylmethyl

(b) 

1-Methylpropyl

(c) 

2,3-Dimethylpropyl

(d) 

2,3-Dimethylbutyl

(e) = CH–$CH_3$
Ethylidene

(f) 

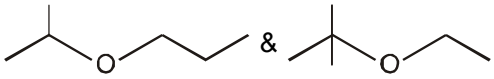
2-Methylethenyl

(g) –C ≡ CH
Ethynyl

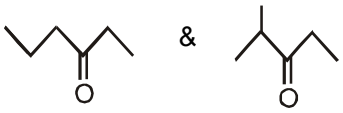
(h) $–CH_2–CH=CH_2$
2-Propenyl

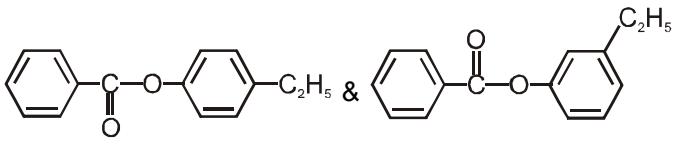
(i) $–CH_2–C \equiv CH$
Prop-1-ynyl

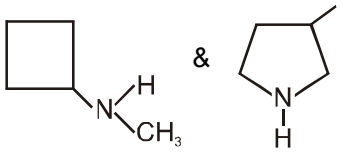
**4.** The number of isomeric pairs with correct relationship specified are :

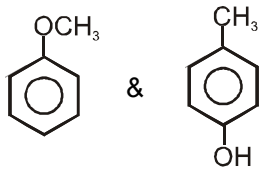
(a)  Metamers

(b) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–H$ & $CH_3–\underset{\underset{O}{\|}}{C}–CH_3$ Functional isomers

(c)  Position isomers

(d)  Position isomers

(e)  Functional isomers

(f)  Functional isomers

**5.** How many number of all structurally isomeric dienes with molecular formula $C_5H_8$ are possible ?

**6.** How many cyclic structurally isomeric amines of molecular formula $C_3H_7N$ are possible?

**7.** How many structurally isomeric ethers with molecular formula $C_5H_{12}O$ are possible?

**8.** How many structurally isomeric esters with molecular formula $C_5H_{10}O_2$ are possible?

**9.** How many structurally isomeric ketones with molecular formula $C_6H_{12}O$ are possible?

**10.** How many number of all aldehydes (structurally isomeric) with molecular formula $C_5H_{10}O$ are possible?

**11.** How many benzenoid structural isomers are possible for $C_7H_8O$ ?

**12.** Observe the compound $CH_3–\underset{\underset{CH_3}{|}}{CH}–CH=CH–\underset{\underset{COOH}{|}}{CH}–CH_2–CH_3$ and answer the given question.

x = Number of carbon atoms in principal carbon chain
y = locant of methyl group
z = locant of C = C
Write your answer as x+y+z.

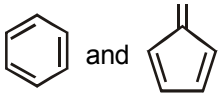
**13.** Total number of benzenoid isomers of molecular formula $C_9H_{12}$ would be-

**14.** How many structural alkenes of formula $C_2FClBrI$ are possible ?

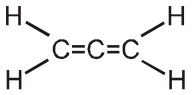
**15.** How many structural isomers can be obtained by the replacement of one hydrogen atom of propene with chlorine ?

## PART - III : ONE OR MORE THAN ONE OPTION CORRECT TYPE

**1.** Select the pair of compounds having same general formula?

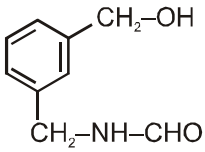
(A)  and

(B)  and 

(C)  and 

(D)  and H—C≡C—C≡C—H

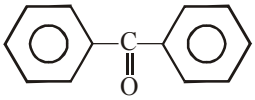
**2.** Which functional groups are not present in given compound ?



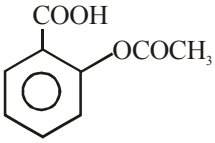
(A) Amide (B) Alcohol (C) Amine (D) Aldehyde

**3.** Select the correct IUPAC name :
(A) Methane-1,1,1,1-tetracarboxylic acid
(B) 5-Carbonyl-heptane-1,7-dioic acid
(C) 2-Chloro ethanoyl chloride
(D) 1-Bromo-3-fluoro-4-methyl cyclohexane

**4.** Which of the following are correct common names ?

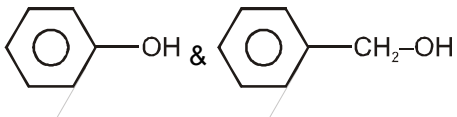
(A)  Acetophenone

(B) $CH_3COCH_3$ Acetone
(C) $PhCOCH_3$ Benzophenone

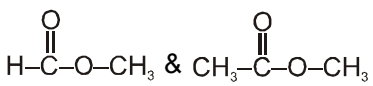
(D)  Aspirin (Acetyl salicylic acid)

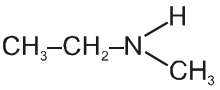
**5.** Which of the following IUPAC name(s) is/are incorrect ?
(A) 4-Chloro-3-methyl cyclopentanol
(B) 1-Amino-3-bromohexan-1-one
(C) 4-chloro-3-methylcyclohexane carboxylic acid
(D) 3-Bromo-1-methylhexan-1-ol

**6.** Which of the following represent correct pair of homologues ?

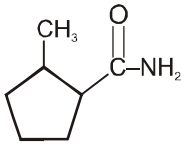
(A) 

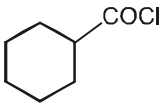
(B) Me–OH & $MeCH_2CH_2OH$

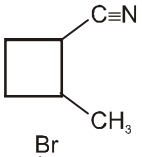
(C) 

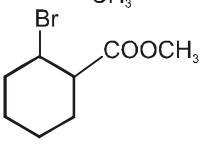
(D) $CH_3–CH_2–NH_2$ & 

**7.** Which of the following IUPAC names are correct?

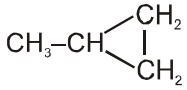
(A)  2-Methylcyclopentanecarboxamide.

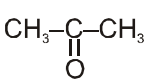
(B)  Cyclohexanoyl chloride.

(C)  2-Methylcyclobutanecarbonitrile

(D)  Methyl 2-bromocyclohexanecarboxylate

**8.** Which of the following pairs of structures represent the constitutional isomers ?

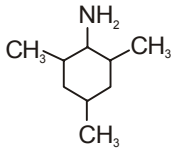
(A) $CH_2=CHCH_2CH_3$ and 

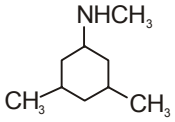
(B) $CH_3OCH_2CH_3$ and 

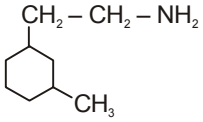
(C) $(CH_3)_3CCH_2CH_2CH_2OH$ and $(CH_3)_2CHCH_2OCH_2CH_2CH_3$

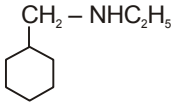
(D) $CH_2ClCHClCH_2CHO$ and $CHCl_2CH=CH–CH_2–OH$

**9.** Which of the following is/are the correct relationship ?


I


II

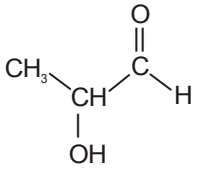
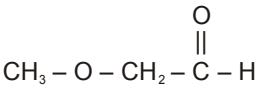
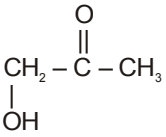

III


IV

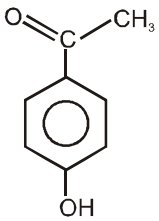
(A) I & II are functional isomers. (B) II & IV are metamers.

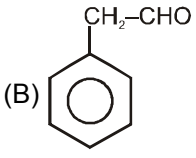
(C) I & IV are position isomers. (D) I & III are chain isomers.

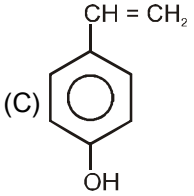
**10.** Which of the following are functional isomers of methyl ethanoate ?

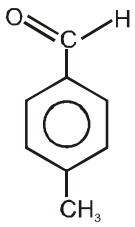
(A) $CH_3 – CH_2 – COOH$ (B)  (C)  (D) 

**11.** Which of the following can be the isomer(s) of $C_8H_8O$ ?

(A) 

(B) 

(C) 

(D) 

## PART - IV : COMPREHENSION

**Comprehension # 1 (Questions 1 to 3)**

A saturated hydrocarbon (P) has six membered ring. Three alkyl groups attached to the ring are alternate to each other.
(i) First group has only two carbon atoms.
(ii) Second group has four carbon atoms and its all hydrogen atoms are chemically same.
(iii) Third group has total five carbon atoms. Its main chain contains three carbon atoms with ethyl as a substituent.

**1.** How many 3° hydrogen atoms are present in the hydrocarbon (P) ?
(A) 2 (B) 3 (C) 4 (D) 5

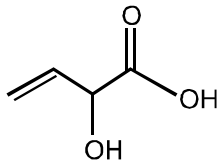
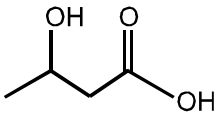
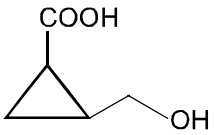
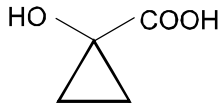
**2.** How many 2° carbon atoms are present in the compound (P)?
(A) 10 (B) 12 (C) 6 (D) 8

**3.** IUPAC name of hydrocarbon (P) is
(A) 1–(1–Ethylpropyl)–3–ethyl–5–(1,1–dimethylethyl)cyclohexane
(B) 1–Ethyl–3–(1–ethylpropyl)–5–(1,1–dimethylethyl)cyclohexane
(C) 1–(1,1–Dimethylethyl)–3–ethyl–5–(1–ethylpropyl)cyclohexane
(D) 1–(1,1–Dimethylethyl)–3–ethyl–5–(2–ethylpropyl)cyclohexane

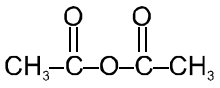
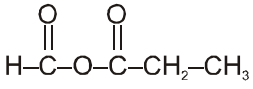
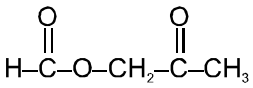
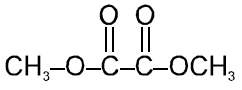
**Comprehension # 2 (Questions 4 to 6)**

There are three isomeric compounds P, Q, R with molecular formula $C_4H_6O_3$. Compound P is a saturated hydroxy carboxylic acid compound Q is a symmetrical anhydride while R is an aldehydic ester.

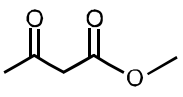
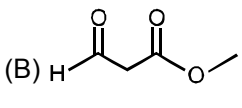
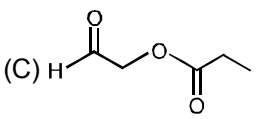
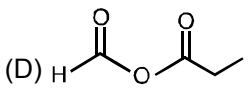
**4.** Which of the following is P ?

(A) 
(B) 
(C) 
(D) 

**5.** Which of the following is the metamer of Q ?

(A) 
(B) 
(C) 
(D) 

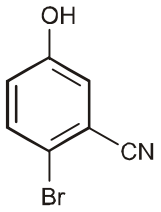
**6.** Which of the following is R ?

(A) 
(B) 
(C) 
(D) 

# Exercise # 3

## PART- I : JEE ADVANCE PROBLEMS (PREVIOUS YEARS)

**1.** The IUPAC name of the following compound is : **[IIT-JEE-2009]**




(A) 4-Bromo-3-cyanophenol (B) 2-Bromo-5-hydroxybenzonitrile
(C) 2-Cyano-4-hydroxybromobenzene (D) 6-Bromo-3-hydroxybenzonitrile

**2.** The total number of cyclic isomers possible for a hydrocarbon molecular formula $C_4H_6$ is / are :

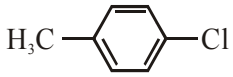
**3.** In allene ($C_3H_4$), the type(s) of hybridisation of the carbon atoms is (are) : **[IIT-JEE 2012]**

(A) sp and $sp^3$ (B) sp and $sp^2$ (C) only $sp^3$ (D) $sp^2$ and $sp^3$

**4.** The carboxyl functional group (– COOH) is present in : **[IIT-JEE 2012]**

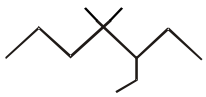
(A) picric acid (B) barbituric acid (C) ascorbic acid (D) aspirin

**5.** The IUPAC name(s) of the following compound is(are) : **[JEE. Adv 2017]**




(A) 4-methylchlorobenzene (B) 4-chlorotoluene
(C) 1-chloro-4-methylbenzene (D) 1-methyl-4-chlorobenzene

## PART - II : JEE MAIN PROBLEMS (PREVIOUS YEARS)

**1.** The IUPAC name of  is : **[AIEEE-2007]**

(1) 5, 5-Diethyl-4, 4-dimethylpentane (2) 3-Ethyl-4,4-dimethylheptane
(3) 1, 1-Diethyl-2, 2-dimethylpentane (4) 4, 4-Dimethyl-5, 5-diethylpentane

**2.** The correct decreasing order of priority for the functional groups of organic compounds in the IUPAC system of nomenclature is- **[AIEEE-2008]**

(1) $–SO_3H$, –COOH, $–CONH_2$, –CHO (2) –CHO, –COOH, $–SO_3H$, $–CONH_2$
(3) $–CONH_2$, –CHO, $–SO_3H$, –COOH (4) –COOH, $–SO_3H$, $–CONH_2$, –CHO

**3.** The IUPAC name of neopentane is : **[AIEEE-2009]**

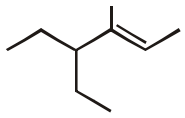
(1) 2, 2-dimethylpropane (2) 2-methylpropane
(3) 2, 2-dimethylbutane (4) 2-methylbutane

**4.** Aspirin is known as : **[AIEEE 2012]**

(1) Acetyl salicylic acid (2) Phenyl salicylate

(3) Acetyl salicylate (4) Methyl salicylic acid

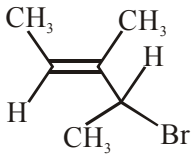
**5.** The IUPAC name of the following compound is : **[JEE Main 2018]**



(1) 4-methyl-3-ethylhex-4-ene (2) 4,4-diethyl-3-methylbut-2-ene

(3) 3-ethyl-4-methylhex-4-ene (4) 4-ethyl-3-methylhex-2-ene

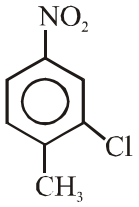
**6.** What is the IUPAC name of the following compound ? **[JEE Main (Jan)-2019]**




(1) 3-Bromo-1,2-dimethylbut-1-ene (2) 4-Bromo-3-methylpent-2-ene

(3) 2-Bromo-3-methylpent-3-ene (4) 3-Bromo-3-methyl-1,2-dimethylprop-1-ene

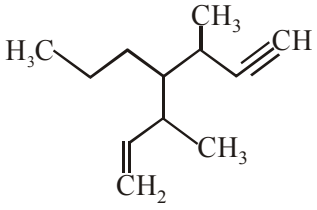
**7.** The correct IUPAC name of the following compound is : **[JEE Main (April)-2019]**




(1) 5-chloro-4-methyl-1-nitrobenzene (2) 2-methyl-5-nitro-1-chlorobenzene

(3) 3-chloro-4-methyl-1-nitrobenzene (4) 2-chloro-1-methyl-4-nitrobenzene

**8.** The IUPAC name of the following compound is : **[JEE Main (April)-2019]**




(1) 3,5-dimethyl-4-propylhept-6-en-1-yne (2) 3-methyl-4-(3-methylprop-1-enyl)-1-heptyne

(3) 3-methyl-4-(1-methylprop-2-ynyl)-1-heptene (4) 3,5-dimethyl-4-propylhept-1-en-6-yne

# ANSWER KEY

## Exercise # 1

### PART - I

**A-1.** (a) (1°, 2°, 3°) H atoms = (9, 4, 1) (b) (1°, 2°, 3°) H atoms = (3, 10, 1)
(c) (1°, 2°, 3°) H atoms = (6, 16, 0) (d) (1°, 2°, 3°) H atoms = (0, 18, 4)

**A-2.** (a) 2° (b) 3° (c) 1°

**A-3.** (a) 1° (b) 2° (c) 3° (d) 3°

**A-4.** (a) 3° carbon (b) 2° carbon (c) 4° carbon

**A-5.** 11

**A-6.** (a) 22 $\sigma$ bonds (b) 19 $\sigma$ bonds, 5$\pi$ bonds

**A-7.** 7

**A-8.** $\overset{sp^2}{CH_2}= \overset{sp}{C} = \overset{sp^2}{CH} - \overset{sp^3}{CH_2} - \overset{sp}{C} \equiv \overset{sp}{C} - \overset{sp^3}{CH_2} - \overset{sp^2}{COOH}$

**A-9.** $H_2C = C = CH_2$ ; M.W. = 40.

**A-10.** (a) Homocyclic, alicyclic, saturated (b) Homocyclic, aromatic, unsaturated
(c) Heterocyclic, alicyclic, saturated (d) unsaturated.

**B-1.** (a) 2-Methyl propane (b) 2, 2-Dimethyl propane
(c) 2-Methyl butane (d) 2, 2-Dimethyl butane

**B-2.** (a) isopropyl group (b) sec-butyl group (c) Tert-butyl group
(d) Ethyl group (e) n-propyl group

**B-3.** (a) 2,2,3-Trimethylpentane (b) 5-(1,2-Dimethylpropyl)nonane
(c) 5-Ethyl-3-methyloctane (d) 4-Ethyl-2,2,6-trimethylheptane
(e) 4-Ethyl-3, 7-dimethylnonane (f) 4-(1,1-Dimethylethyl)-5-(1-methylethyl) octane

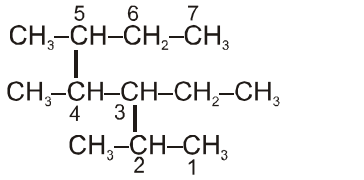
**B-4.** (a) 1-methylethyl (b) 1-methylpropyl (c) 1, 2-dimethylpropyl (d) 2, 3-dimethylbutyl

**B-5.** (a) 1-Bromo-3-chloro-4-methylpentane (b) 1-Chloro-3-ethyl-4-iodopentane
(c) 4-Bromo-3-chloro-6-nitrooctane (d) 2-Bromo-2-chloro-5-fluoro-4-methylheptane

**B-6.** (a) s-Butylcyclohexane (b) t-Butylcyclohexane
(c) Isopropylcyclohexane (d) Neopentylcyclopentane

**B-7.** (a) ring (b) side chain (c) ring (d) ring (e) side chain (f) side chain

**B-8.** 7



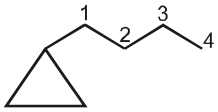
3-Ethyl-2, 4, 5-trimethyl heptane

**B-9.** (a) 

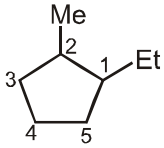
Propyl cyclobutane

(b) 

Propyl cyclopropane

(c) 


1-Cyclopropyl butane

(d) 


1-Ethyl-2-methyl cyclopentane

**C-1.** (a) Pent-2-ene (b) But-1-yne
(c) 3-Methylbut-1-ene (d) 4–Ethyl–2–methylhex-1-ene

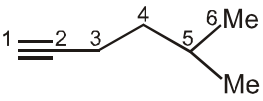
**C-2.** (a) ethenyl (b) ethynyl (c) 1-methylethenyl (d) prop-2-enyl
(e) ethylidene (f) 1-methylethylidene

**C-3.** General formula $\rightarrow C_nH_{2n}$

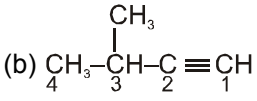
| | | |
|---|---|---|
| $H_2C = CH_2$ | Ethylene | Ethene |
| $CH_3–CH=CH_2$ | Propylene | Propene |
| $CH_3–CH_2–CH=CH_2$ | $\alpha$-Butylene | 1-Butene |

**C-4.** General formula $\rightarrow C_nH_{2n-2}$

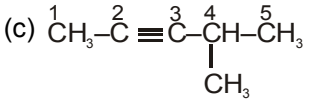
| | | |
|---|---|---|
| (A) $CH \equiv CH$ | Acetylene | Ethyne |
| (B) $CH_3–C\equiv CH$ | Methyl acetylene (Allylene) | Propyne |
| (C) $CH_3–C\equiv C–CH_3$ | Dimethyl acetylene (Crotonylene) | But-2-yne |

**C-5.** (a) 


5-Methyl hexyne

(b) 


3-Methyl butyne

(c) 


4-Methylpent-2-yne

**C-6.** (a) 4-Methylpent-2-yne (b) 4-Propylhept-2-yne (c) 3,4,4-Trimethylhex-1-yne

**C-7.** (a) cyclohexylethene (b) 1-Ethylcyclohex-1-ene
(c) 1-Ethenylcyclohex-1-ene (d) 1-cyclohex-1-enylbuta-1,3-diene

**C-8.** 3
3-Bromo-6-ethylcyclohexa-1, 4-diene

**C-9.** 5
5-Ethyl-2,6-dimethyl-4-(3-methylbutyl)oct-2-ene

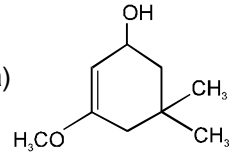
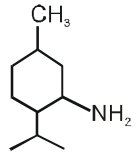
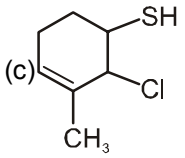
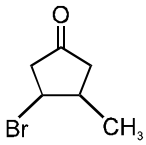
**D-1.** Seniority order of functional groups :

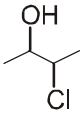
$$–COOH > –CN > –CHO > –\overset{\overset{O}{\|}}{C}–CH_3 > –OH > –NH_2$$

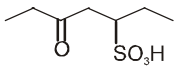
**D-2.** 6

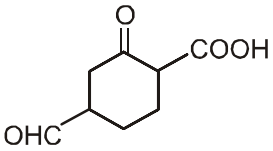
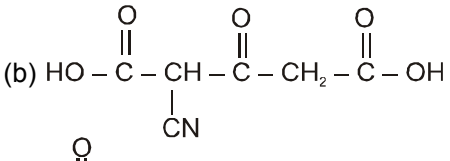
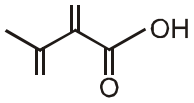
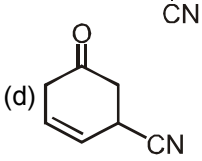
$–CHO$ , $–\overset{\overset{O}{\|}}{C}–$ , $–NH_2$ , $–\overset{\overset{O}{\|}}{C}–N\begin{matrix}H\\ \diagup\\ \diagdown\end{matrix}$ , $–COOH$ , $–\overset{\overset{O}{\|}}{C}–O–\overset{\overset{O}{\|}}{C}–$ are functional group present.

**D-3.** (a) 4-Methylpent-2-en-1-ol
(b) 4, 5–Dimethylhex–5–ene–2–thiol
(c) N,N-Dimethylpropan-2-amine
(d) 1-Chloro - 4 - methylpentan - 2 - one
(e) Methoxyethane
(f) Ethoxyethane

**D-4.** (a) 
(b) 
(c) 
(d) 

**D-5.** (a)  3-Chlorobutan-2-ol

(e)  5-Oxoheptane-3-sulphonic acid.

**E-1.** (a) 
(b) 
(c) 
(d) 

**E-2.** (a) Methyl-2-ethylbutanoate
(b) Ethyl-3-methylpent-4-en-1-oate
(c) 3,3 Dimethyl –2 – (1–methylethyl)butanamide

**E-3.** **7**

**E-4.** 9 + 6 = 15
X = 9, Y = 6
4-(But-2-enyl)non-6-enoic acid

**F-1.** (a) Methylbenzene
(b) Isopropylbenzene
(c) Diphenylmethane
(d) 1-Chloro-1-phenylethane.

**F-2.** (a) 5-Formyl-2-nitrobenzoic acid
(b) 4-Ethoxycarbonylbenzoic acid
(c) 4-Nitroaniline
(d) 3-Methylphenol

**F-3.** 3
(a) Cyclohexylbenzene
(b) 4-Bromo-3, 6-diphenyloctane
(c) 1, 2-Dichloro-4-ethyl-5-nitrobenzene
(d) 4-Chloro-1-nitro-2-propylbenzene

**F-4.** (a) Ethanoic-2-methylpropanoic anhydride
(b) Benzenecarboxylic anhydride
(c) Pent-2-enedioic anhydride
(d) Cyclohexane-1, 2-dicarboxylic anhydride

**F-5.** (a) Methyl methanoate
(b) 2-Ethoxycarbonylethanoic acid
(c) Phenyl benzenecarboxylate
(d) 2-Ethanoyloxybenzenecarboxylic acid

**F-6.** (a) 2-Methylpropanamide
(b) N-Methylpropanamide
(c) N, N-Dimethyl-2-methylpropanamide
(d) N-Phenylbenzenecarboxamide

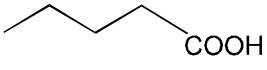
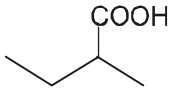
**F-7.** 2
f and g are correct.

**G-1.** (a) Chain isomers (b) Functional isomers (c) Homologs.

**G-2.** (a) I, II & III are functional isomers
(b) I, & II are position isomers, (I or II) & III are functional isomers.
(c) I, II & III are functional isomers
(d) I & II are chain isomers, I & III are chain isomers and II & III are position isomers

**G-3.** 1 & 2 are position isomers, 1 & 3 are position isomers, 2 & 3 are position isomers.

**G-4.** 6

(c)  and  Chain isomers

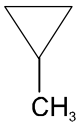
**H-1.** 9

**H-2.** **11**

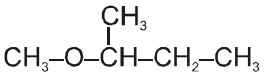
DU = Number of π-bond (unsaturation) + Number of cyclic ring present = 9 +2 = 11

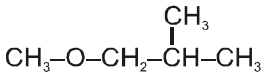
π bond of cyanide group R–C≡N, aldehydic group  & ketonic group  are also considered.

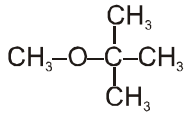
**H-3.** 4, Metamers

**H-4.**  or 

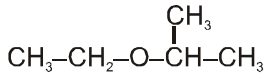
**H-5.** (i) $CH_3–O–CH_2–CH_2–CH_2–CH_3$

(ii) 

(iii) 

(iv) 

(v) $CH_3–CH_2–O–CH_2–CH_2–CH_3$

(vi) 

## PART - II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **A-1.** | (B) | **A-2.** | (B) | **A-3.** | (B) | **A-4.** | (A) | **A-5.** | (A) |
| **A-6.** | (C) | **A-7.** | (C) | **A-8.** | (D) | **A-9.** | (C) | **A-10.** | (D) |
| **B-1.** | (D) | **B-2.** | (D) | **B-3.** | (D) | **B-4.** | (A) | **B-5.** | (C) |
| **B-6.** | (B) | **B-7.** | (A) | **B-8.** | (C) | **C-1.** | (A) | **C-2.** | (D) |
| **C-3.** | (C) | **C-4.** | (B) | **C-5.** | (D) | **C-6.** | (B) | **C-7.** | (B) |
| **C-8.** | (B) | **C-9.** | (B) | **D-1.** | (C) | **D-2.** | (B) | **D-3.** | (D) |
| **D-4.** | (C) | **D-5.** | (B) | **D-6.** | (B) | **D-7.** | (B) | **E-1.** | (D) |
| **E-2.** | (B) | **E-3.** | (B) | **E-4.** | (C) | **E-5.** | (C) | **E-6.** | (C) |
| **E-7.** | (A) | **E-8.** | (D) | **E-9.** | (B) | **F-1.** | (C) | **F-2.** | (B) |
| **F-3.** | (B) | **F-4.** | (C) | **F-5.** | (C) | **F-6.** | (A) | **G-1.** | (C) |
| **G-2.** | (A) | **G-3.** | (C) | **G-4.** | (D) | **G-5.** | (A) | **G-6.** | (C) |
| **G-7.** | (D) | **H-1.** | (C) | **H-2.** | (B) | **H-3.** | (B) | **H-4.** | (B) |
| **H-5.** | (B) | **H-6.** | (D) | **H-7.** | (B) | **H-8.** | (D) | | |

### PART - III

**1.** (A – p), (B – p,q), (C – p,r), (D – s)
**2.** (A – p), (B – p), (C – r), (D – q)

## Exercise # 2

### PART - I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (D) | **2.** | (A) | **3.** | (D) | **4.** | (A) | **5.** | (A) |
| **6.** | (B) | **7.** | (D) | **8.** | (B) | **9.** | (B) | **10.** | (C) |
| **11.** | (B) | **12.** | (A) | **13.** | (C) | **14.** | (D) | **15.** | (A) |
| **16.** | (C) | **17.** | (D) | | | | | | |

### PART - II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | 6 | **2.** | 4 | **3.** | 5 | **4.** | **3** | **5.** | 6 |
| **6.** | 4 | **7.** | 6 | **8.** | 9 | **9.** | 6 | **10.** | 4 |
| **11.** | 5 | **12.** | 14 | **13.** | 8 | **14.** | 3 | **15.** | 3 |

### PART - III

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (AD) | **2.** | (CD) | **3.** | (AC) | **4.** | (BD) | **5.** | (ABD) |
| **6.** | (BC) | **7.** | (ACD) | **8.** | (ACD) | **9.** | (ABD) | **10.** | (ABCD) |
| **11.** | (BCD) | | | | | | | | |

### PART - IV

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (C) | **2.** | (C) | **3.** | (C) | **4.** | (D) | **5.** | (B) |
| **6.** | (B) | | | | | | | | |

## Exercise # 3

### PART - I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (B) | **2.** | 5 | **3.** | (B) | **4.** | (D) | **5.** | (B,C) |

### PART - II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (B) | **2.** | (D) | **3.** | (A) | **4.** | (A) | **5.** | (D) |
| **6.** | (B) | **7.** | (D) | **8.** | (D) | | | | |

***This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the students.***

# Self Assessment Test

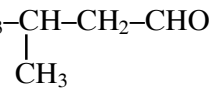
## PART- 1 : PAPER JEE (MAIN) PATTERN

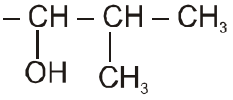
**SECTION–I : (Maximum Marks : 80)**

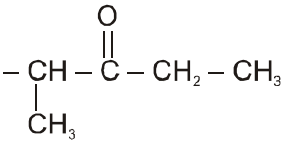
- This section contains **TWENTY** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
  Full Marks : +4 If only the bubble corresponding to the correct option is darkened.
  Zero Marks : 0 If none of the bubbles is darkened.
  Negative Marks : –1 In all other cases

**1.** Which of the following compounds has wrong IUPAC name?

(A) $CH_3 - CH_2 - CH_2 - COO - CH_2CH_3$ → Ethyl butanoate

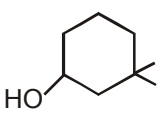
(B)  → 3-Methylbutanal

(C)  → 2-Methyl-3-butanol

(D)  → 2-Methyl-3-pentanone

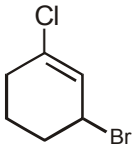
**2.** The general formula $C_nH_{2n}O_2$ could be for open chain

(A) diketones (B) carboxylic acids (C) diols (D) dialdehydes.

**3.** The IUPAC name of the compound  is

(A) 3,3-dimethyl-1-hydroxycyclohexane (B) 1,1-dimethyl-3-hydroxycyclohexane
(C) 3,3-dimethyl-1-cyclohexanol (D) 1,1-dimethyl-3-cyclohexanol

**4.** The IUPAC name of the compound shown below is




(A) 2-Bromo-6-chlorocyclohex-1-ene (C) 6-Bromo-2-chlorocyclohexene
(C) 3-Bromo-1-chlorocyclohex-1-ene (D) 1-Bromo-3-chlorocyclohexene

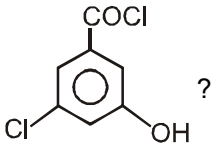
**5.** How many position isomers are possible for chlorophenol ?
(A) 2 (B) 3 (C) 4 (D) 5

**6.** Which of the following is correct IUPAC name?
(A) 2-Bromo cyclohex-5-ene carbaldehyde (B) Ethyl-2-vinyl pentanoate
(C) 5-Bromo-3-chlorohept-3-ene (D) 2-Ethenylhexa-1,5-diene

**7.** $Me-O-\overset{\overset{O}{\|}}{C}-Me$ and Et – O – CH = O are :
(A) Functional isomers (B) Metamers (C) Positional isomers (D) Chain isomers

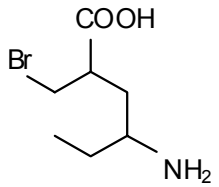
**8.** How many structurally isomeric carbonyl compounds are possible with molecular formula $C_5H_{10}O$ ?
(A) 5 (B) 6 (C) 7 (D) 8

**9.** A compound having straight chain of five carbon atoms has one ketone group and two methyl groups on different-different carbon atoms. The IUPAC name of the compound is :
(A) 2,4-Dimethyl-3-oxopentane (B) 2,4-Dimethylpentan-3-one
(C) 3,4-Dimethyl-2-oxopentane (D) 3,3-Dimethylpentan-2-one

**10.** What is the IUPAC name of  ?

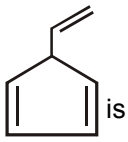

(A) 5-Chloro-3-hydroxybenzenecarbonyl chloride
(B) 3-Hydroxy-5-chlorobenzenecarbonyl chloride
(C) 3-Chloro-5-hydroxybenzenecarbonyl chloride
(D) 1-Chlorocarbonyl-3-chlorobenzen-1-ol

**11.** The correct IUPAC name of compound is :




(A) 3-Amino-6-bromocyclohexane-1-carboxylic acid
(B) 2-Bromo-5-aminocyclohexane-1-carboxylic acid
(C) 5-Amino-2-bromocyclohexane-1-carboxylic acid
(D) 5-Amino-2-bromocyclohexanoic acid

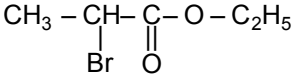
**12.** The IUPAC name of $CH_3-CH_2-\underset{\underset{Ph}{|}}{N}-CH_3$ is :
(A) N-Ethyl-N-phenyl methanamine (B) N-Ethyl-N-methyl aniline
(C) N-Methyl-N-phenyl ethanamine (D) N-Methyl-N-ethyl aniline

**13.** IUPAC name of  is

(A) 5-ethenylcyclopenta-1,3-diene (B) 3-ethenylcyclopenta-1,4-diene
(C) 1-ethenylcyclopenta-2,4-diene (D) 2-ethenylcyclopenta-1,3-diene

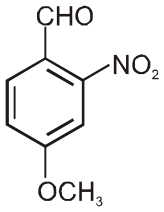
**14.** How many carboxylic acid structure isomers are possible with $C_5H_{10}O_2$ ?
(A) 3 (B) 4 (C) 5 (D) 8

**15.** Correct IUPAC name of given ester is:



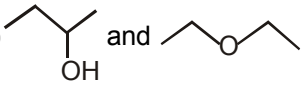
(A) Ethyl 2–bromopropanoate (B) 2–Bromoethylpropanoate
(C) Ethyl 1–bromoethanoate (D) 2–Bromo ethoxyethanecarboxylate

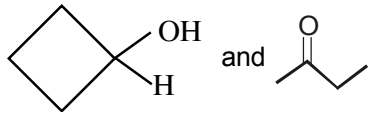
**16.** Relation between Ethyl benzenecarboxylate and Phenyl propanoate is :
(A) Metamers (B) Functional isomers
(C) Chain isomers (D) Homologues

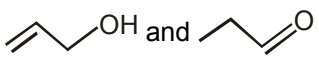
**17.** The correct IUPAC name of the compound  is :

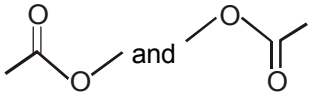
(A) 4-Methoxy-2-nitrobenzaldehyde (B) 4-Formyl-3-nitro anisole
(C) 4-Methoxy-6-nitrobenzaldehyde (D) 2-Formyl-5-methoxy nitrobenzene

**18.** Which of the following pair of compounds is not functional isomers ?

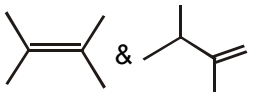
(A) 

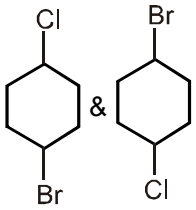
(B) 

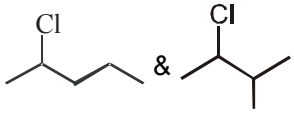
(C) 

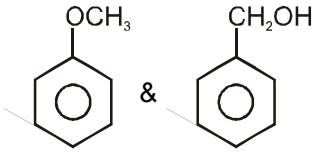
(D) 

**19.** Which of the following is correctly matched?

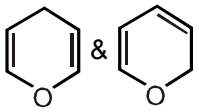
(A)  chain somer

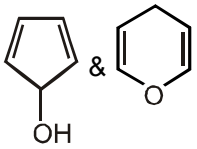
(B)  Identical

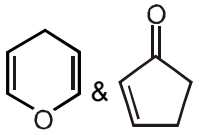
(C)  Positional isomer

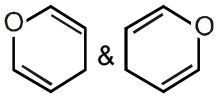
(D)  Metamer

**20.** Which of the following pairs of structures do not represent isomers ?

(A) 

(B) 

(C) 

(D) 

## SECTION-II : (Maximum Marks: 20)

- This section contains **FIVE** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

  **For Example :** If answer is –77.25, 5.2 then fill the bubbles as follows.
- Answer to each question will be evaluated according to the following marking scheme:

  *Full Marks* : +4 If ONLY the correct numerical value is entered as answer.

**21.** The number of metamers of the compound with molecular formula $C_5H_{12}O$ is/are :
(A) 1 (B) 3 (C) 8 (D) 6

**22.** How many tertiary alcohols is/are possible with molecular formula $C_5H_{12}O$ ?
(A) 1 (B) 2 (C) 3 (D) 4

**23.** Total number of structural isomers possible from molecular formula $C_8H_{18}$ that contain 7 carbons in the parent chain are :
(A) 3 (B) 4 (C) 5 (D) 6

**24.** Total number of position isomers of trimethyl cyclohexane are :
(A) 5 (B) 6 (C) 7 (D) 8

**25.** How many 1° amines (only structural isomers) are possible with molecular formula $C_4H_{11}N$?
(A) 3 (B) 4 (C) 5 (D) 6

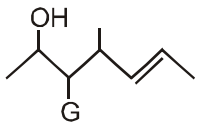
## PART 2 : PAPER JEE (ADVANCED) PATTERN

### SECTION-I : (Maximum Marks : 12)

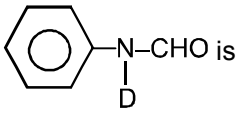
- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

*Full Marks* : +3 If only the bubble corresponding to the correct option is darkened.
*Zero Marks* : 0 If none of the bubbles is darkened.
*Negative Marks* : –1 In all other cases

**1.** In the given formula G is an unknown group.

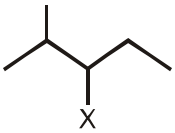



What will be the group G, which can change the word root (parent carbon chain length) of above structure?
(A) $-CH=CH_2$ (B) –Cl (C) $-CH_2-CH_2-CH_3$ (D) –COOH

**2.** IUPAC name of  is

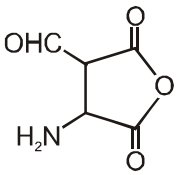

(A) N-Deutero-N-formylbenzenamine
(B) N-Phenylamino-N-deuteromethanal
(C) N-Deutero-N-phenylmethanamide
(D) N-Deuterobenzene carboxamide

**3.** When X group is replaced by –C≡N, then the IUPAC name of the compound below is ?




(A) 2-Methylpentane-3-nitrile
(B) 3-Cyano-2-methylpentane
(C) 2-Ethyl-3-methylbutanenitrile
(D) 2-Methylpentane-3-carbonitrile

**4.** Correct IUPAC name of following compound is




(A) 2-Amino-3-formyl butane-1, 4-dioic anhydride
(B) 3-Amino-2-formyl butane-1, 4-dioic anhydride
(C) 3-Amino-2-oxobutane-1, 4-dioic anhydride
(D) 2-Formyl-3-amino butane-1, 4-dioic anhydride

## SECTION - II : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

| | | |
|---|---|---|
| *Full Marks* | : +4 | If only (all) the correct option(s) is (are) chosen. |
| *Partial Marks* | : +3 | If all the four options are correct but ONLY three options are chosen. |
| *Partial Marks* | : +2 | If three or more options are correct but ONLY two options are chosen, both of which are correct options. |
| *Partial Marks* | : +1 | If two or more options are correct but ONLY one option is chosen and it is a correct option. |
| *Zero Marks* | : 0 | If none of the options is chosen (i.e. the question is unanswered). |
| *Negative Marks* | : –1 | In all other cases. |

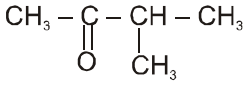
- **For Example :** If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in –1 marks.

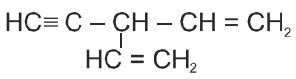
**5.** Which of the following statements are incorrect for aniline?

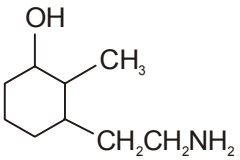
(A) Compound is heterocyclic hydrocarbon.
(B) Number of $\sigma$ bonds are 8.
(C) Degree of unsaturation of the compound is 3.
(D) It contains primary amine functional group.

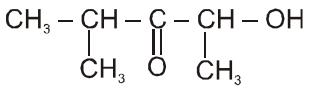
**6.** Correct IUPAC names as per rules are
(A) 1,1,1-Trichloro-2,2-diphenylethane (B) 3-Cyclopentylbut-1-ene
(C) Cyclopenta-2,4-diene (D) 1-Bromo-2,3-dichlorocyclopropane

**7.** Which of the following is/ are incorrect IUPAC name ?

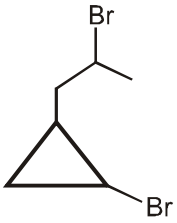
(A)  2-Methylbutan -3-one

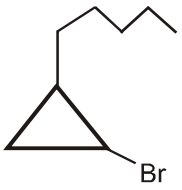
(B)  3-Ethenylpent-1-en-4-yne

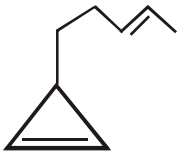
(C)  3-(2-Aminoethyl)-2-methylcyclohexan-1-ol

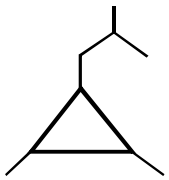
(D)  4-Methyl-3-oxopentan-2-ol

**8.** In which of the given molecules cyclic part is/are parent chain ?

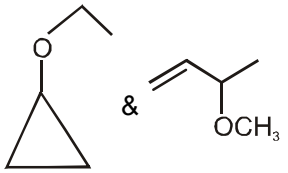
(A) 


(B) 

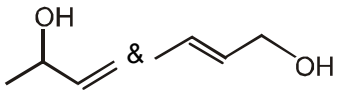

(C) 

(D) 

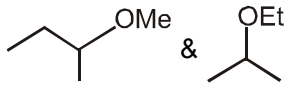
**9.** Which of the following is/are correct statement(s) ?

(A) 

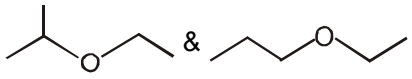
are functional isomers to each other

(B) 

are position isomers to each other

(C) 

are chain isomers to each other

(D) 

are metamers of each other.

**10.** Which of the following is/are correct statement(s) ?
(A) The number of structural isomers for molecular formula $C_3H_8$ are 2.
(B) The number of structural isomers for molecular formula $C_5H_{12}$ are 3.
(C) The number of structural isomers for molecular formula $C_6H_{14}$ are 5.
(D) The number of benzene ring containing structural isomers for molecular formula $C_6H_4BrCl$ are 4.

**11.** Which is/are the isomer of butanoic acid?
(A) 3-Hydroxybutanal
(B) Ethyl ethanoate
(C) 2-Methylpropanoic acid
(D) Butane-2,3-diol

**12.** In the following skeleton Z can be, if the molecular formula is $C_5H_{10}O_2$ :

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

(A) A carboxylic acid
(B) An ester
(C) Hydroxyaldehyde
(D) Alkanediol

## SECTION-III : (Maximum Marks: 18)

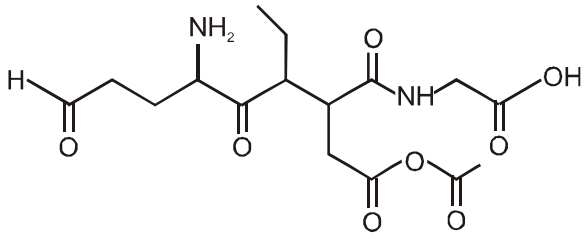
- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

  **For Example :** If answer is –77.25, 5.2 then fill the bubbles as follows.
- Answer to each question will be evaluated according to the following marking scheme:

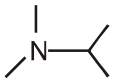
  *Full Marks* : +3 If ONLY the correct numerical value is entered as answer.

  *Zero Marks* : 0 In all other cases.

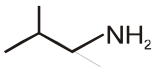
**13.** Number of functional groups present in the following compounds are :



**14.** The no. of amine(s) with correct IUPAC name is/are

(a) 

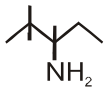
N,N-Dimethyl-2-methylethanamine

(b) 

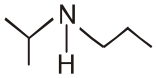
2-Methylpropanamine

(c) $Ph–N(CH_3)C_2H_5$

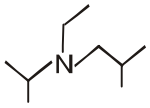
N-Ethyl-N-methyl aniline

(d) 

3,4,4-Trimethylpentan-3-amine

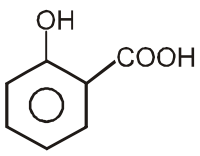
(e) 

N-Propyl-2-methylethanamine

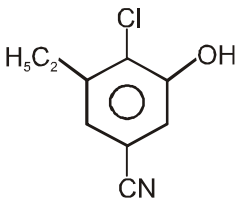
(f) 

N-Ethyl-N-isopropyl -2-methyl propan-1-amine

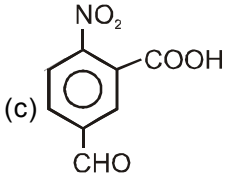
**15.** The no. of compound with correct IUPAC name is/are :

(a) 

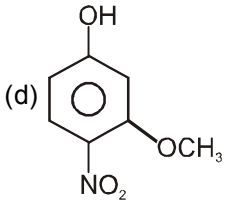
2-Carboxyphenol

(b) 

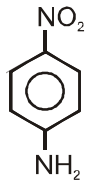
3-Ethyl-4-chloro-5-hydroxybenzenecarbonitrile

(c) 

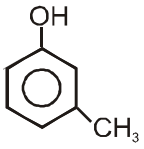
3-Formyl-5-nitrobenzenecarboxylic acid

(d) 

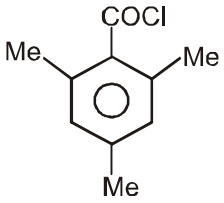
1-Hydroxy-3-methoxy-4-nitrobenzene

(e) 

4-Amino-1-nitrobenzene

(f) 

3-Methylphenol

(g) 

2,4,6-Trimethylbenzenecarbonlychloride

**16.** How many alkynes isomers are formed with molecular formula $C_4H_6$?

**17.** Possible number of compounds with IUPAC name $P_1$-bromo -$P_2$-methyl propanoic acid where $P_i$ represents position of side chains/substituents are ?

**18.** The number of possible alkynes (strucutral only) for the compound having molecular formula $C_3FClBrI$ is :

## PART - 3 : OLYMPIAD (PREVIOUS YEARS)

### STAGE - I (NATION STANDARD EXAMINATION IN CHEMISTRY (NSEC))

**1.** The compound 2-Chloro-3-methyl-1-butanol has the following formula **(NSEC-2006)**

(A) $CH_3CH(CH_3)CHClCH_2OH$ (B) $CH_3CHOHCH(CH_3)CH_2Cl$

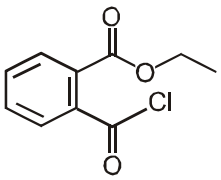
(C) $CH_2ClC(CH_3)_2CH_2OH$ (D) $CH_3CHClCH(CH_3)CH_2OH$.

**2.** How many different alcohols (not including optical isomers) are possible with the molecular formula : $C_4H_{10}O$? **(NSEC-2006)**

(A) 3 (B) 4 (C) 5 (D) 6

**3.** The C–C–H bond angle in ethylene is : **(NSEC-2007)**

(A) $180^0$ (B) $109^028^0$ (C) $120^0$ (D) $90^0$

**4.** The IUPAC name of  is : **(NSEC-2007)**

(A) 2–Chlorocarbonylethyl benzoate (B) 2–Carboxyethylbenzoylchloride

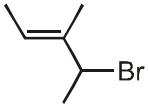
(C) Ethyl 2–(chlorocarbonyl) benzoate (D) Ethyl 1–(chlorocarbonyl) benzoate

**5.** How many sigma bonds and pi bonds are present in $CH_2=C=CH_2$? **(NSEC-2007)**

(A) 6 sigma and 1pi (B) 8 sigma and 0 pi

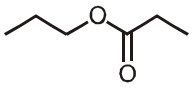
(C) 4 sigma and 4 pi (D) 6 sigma and 2 pi

**6.** The number of ether metamers represented by the molecular formula $C_4H_{10}O$ are : **(NSEC-2009)**
(A) 1 (B) 2 (C) 3 (D) 4

**7.** The IUPAC name of  is : **(NSEC-2009)**

(A) 2-Bromo-3-methylbut-3-ene (B) 4-Bromo-3-methylpent-2-ene
(C) 2-Bromo-3-methylpent-3-ene (D) 4-Bromo-2,3-dimethylbut-2-ene

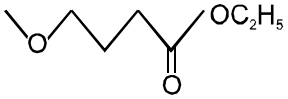
**8.** The IUPAC name of the following compound is : **(NSEC-2010)**



(A) n-Propyl ethanoate (B) Ethyl propanoate
(C) Pentanoic anhydride (D) n-Propyl propanoate

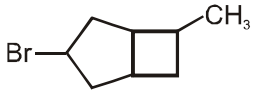
**9.** The number of isomers of dibromobiphenyl (Biphenyl = $C_6H_5$-$C_6H_5$) is **(NSEC-2011)**
(A) 8 (B) 10 (C) 12 (D) 4

**10.** The IUPAC name of the following compound is : **(NSEC-2011)**

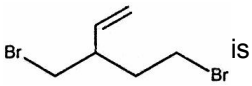


(A) 3-Methoxy ethylpropanoate (B) Ethyl 4-methoxybutanoate
(C) 1,4-Diethoxybutane (D) Ethoxy 3-methoxybutyrate

**11.** The correct IUPAC name of the following compound is : **(NSEC-2012)**

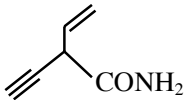


(A) 2-Bromo-5-methylbicyclo[5.4.0]heptanes (B) 3-Bromo-7-methylbicyclo[3.2.0]heptane
(C) 3-Bromo-6-methylbicyclo[3.2.0]heptane (D)2-Methyl-6-bromobicyclo[2.3.0]heptane

**12.** The IUPAC name of the following compounds  is **(NSEC-2014)**

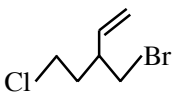
(A) 5-Bromo-3-(bromomethyl) pent-1-ene (B) 3-(1-Bromomethyl)-4-bromobut-1-ene
(C) 1,4-Dibromo-3-ethenylbutane (D) 1-Bromo-3-(bromomethyl) but-4-ene

**13.** The IUPAC name of the following compound is **(NSEC-2016)**



(A) 3-Aminocarbonylpent-1-en-4-yne (B) 2-Ethenylbut-3-yn-1-amide
(C) 2-Ethynylbut-3-en-1-amide (D) 3-Aminocarbonylpent-4-en-1-yne

**14.** The IUPAC name of the following compound is **(NSEC-2018)**

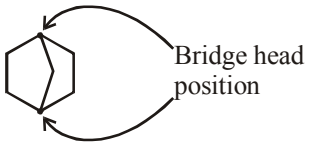


(A) 1-Bromo-4-chloro-3-ethenylbutane (B) 4-Bromo-1Chloro-3-ethenylbutane
(C) 3-(Bromomethyl)-5-chloropent-1-ene (D) 3-(Bromomethyl)-1-chloropent-4-ene

## PART-4 : ADDITIONAL THEORY

### (A) Bicyclo Compounds

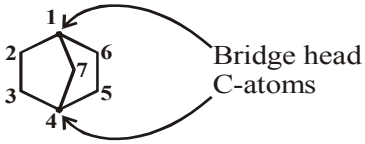
Compounds with two fused cycloalkane rings are called bicyclo compounds. The carbon atoms common to both rings are called bridgehead atoms. A bond or chain of carbon atoms connecting the bridgeheads is called a bridge.



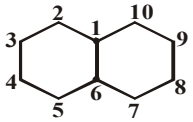

A bicyclic compound is named by attaching the prefix bicyclo to the name of hydrocarbon corresponding to the total number of carbon atoms is two rings.

**Numbering starts from bridgehead** to larger ring and then back to smaller ring.

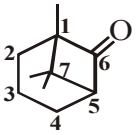
The bracketed number show the number of carbon atoms (except bridgehead carbon atoms) in each bridge and they cited in **decreasing order.**




Bicyclo[2.2.1]heptane



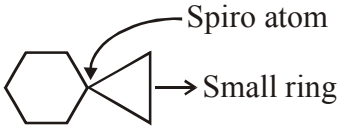
Bicyclo[4.4.0]decane



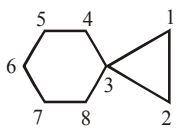
1,7,7-Trimethylbicyclo[2.2.1]heptan-6-one

### (B) Spiro compound :

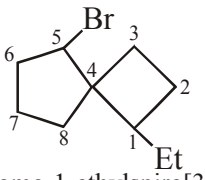
Spiro are polycyclic compounds that share only one carbon atom between two rings. In substituted spiro, the **numbering is started next to the spiro atom in lower membered ring.**



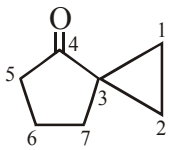

The prefix spiro is followed by bracket containing the number of carbon atoms in **ascending order,** in each ring attached to common carbon atom and ending with the name of hydrocarbon corresponding to the total number of carbon atoms in two rings.



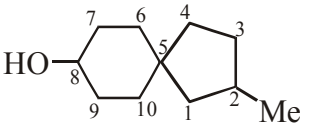
Spiro[2.5]octane




5-Bromo-1-ethylspiro[3.4]octane



Spiro[2.4]heptan-4-one




2-Methylspiro[4.5]decan-8-ol

# RRP ANSWER KEY

## PART- 1

### SECTION–I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (C) | **2.** | (B) | **3.** | (C) | **4.** | (C) | **5.** | (B) |
| **6.** | (C) | **7.** | (B) | **8.** | (C) | **9.** | (B) | **10.** | (C) |
| **11.** | (C) | **12.** | (C) | **13.** | (A) | **14.** | (B) | **15.** | (A) |
| **16.** | (A) | **17.** | (A) | **18.** | (D) | **19.** | (B) | **20.** | (D) |

### SECTION-II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **21.** | (D) | **22.** | (A) | **23.** | (A) | **24.** | (B) | **25.** | (B) |

## PART 2

### SECTION-I

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (D) | **2.** | (C) | **3.** | (C) | **4.** | (A) | | |

### SECTION-II

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **5.** | (A,B,C) | **6.** | (A, B, D) | **7.** | (A, B, D) | **8.** | (A, D) | **9.** | (A, B, D) |
| **10.** | (B, C) | **11.** | (A, B, C) | **12.** | (A, B) | | | | |

### SECTION-III

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **13.** | 6 | **14.** | 3 | **15.** | 2 | **16.** | 2 | **17.** | 2 |
| **18.** | 4 | | | | | | | | |

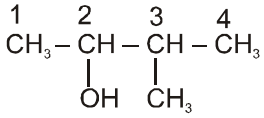
## PART - 3

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | (A) | **2.** | (B) | **3.** | (C) | **4.** | (C) | **5.** | (D) |
| **6.** | (C) | **7.** | (B) | **8.** | (D) | **9.** | (C) | **10.** | (B) |
| **11.** | (C) | **12.** | (A) | **13.** | (C) | **14.** | (C) | | |

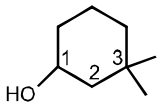
# RRP SOLUTIONS

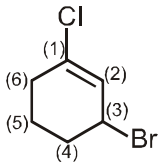
## PART - 1

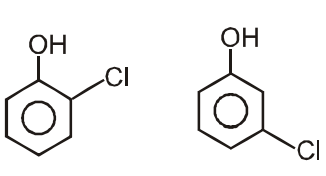
### SECTION - I

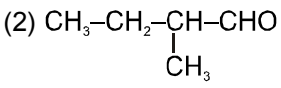
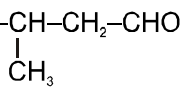
**1.**  3-Methyl-2-butanol

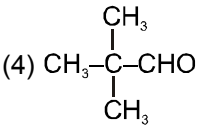
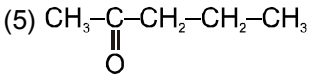
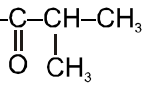
**2.** Diketones : $C_nH_{2n-2}O_2$, Carboxylic acid : $C_nH_{2n}O_2$, Diols : $C_nH_{2n+2}O_2$, Dialdehydes : $C_nH_{2n-2}O_2$

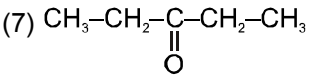
**3.**  3.3 dimethy1-1-cyclohexanol

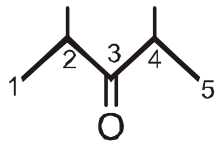
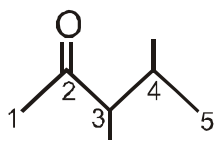
**4.**  3- Bromo -1-chlorocyclohex-1-ene

**5.**  Total = 3

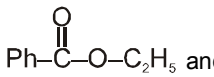
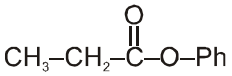
**8.** (1) $CH_3–CH_2–CH_2–CH_2–CHO$ (2)  (3) 

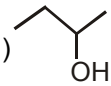
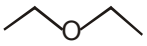
(4)  (5)  (6) 

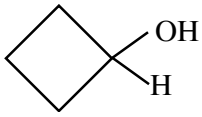
(7) 

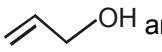
**9.**  OR 

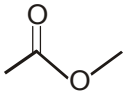
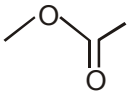
2,4-Dimethylpentan-3-one 3,4-Dimethylpentan-2-one

**16.**  and  are metamers

**18.** (1)  and  are functional isomer.

(2)  and  are functional isomers.

(3)  and  are functional isomers.

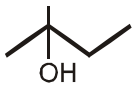
(4)  and  are identical.

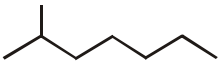
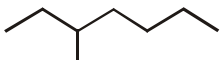
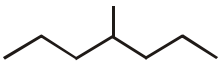
**20.** In (4), both are identical.

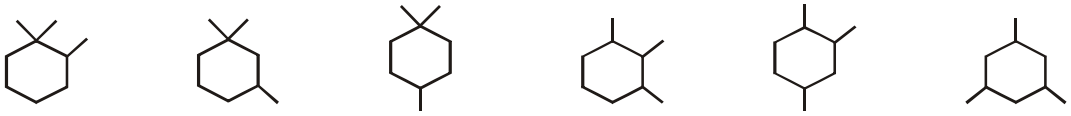
**SECTION - II**

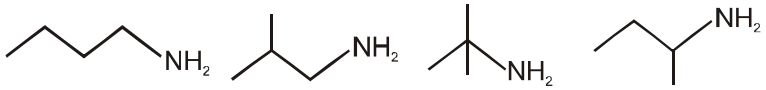
**21.** $CH_3–O–CH_2–CH_2–CH_2–CH_3$ ; $CH_3–O–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$ ; $CH_3–O–CH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_3$ ;

$CH_3–O–\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}–CH_3$ ; $CH_3–CH_2–O–CH_2–CH_2–CH_3$ ; $CH_3–CH_2–O–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_3$

**22.**  (Only one tertiary alcohol with $C_5H_{12}O$)

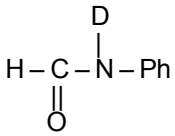
**23.** (1)  (2)  (3) 

**24.** 

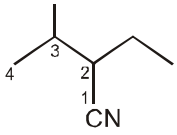
**25.** 

## PART - 2

**SECTION - I**

**2.** 

N-Deutero-N-phenylmethanamide.

**3.** 

## SECTION-II

**5.** The number of $\sigma$ bonds are 14 and DU = 4.

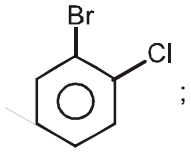
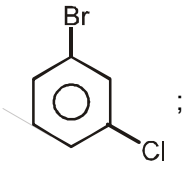
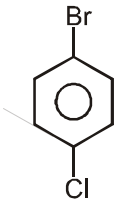
**9.** (C) These are metamers.

**10.** (A) $CH_3–CH_2–CH_3$

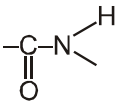
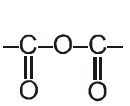
(B) $CH_3–CH_2–CH_2–CH_2–CH_3$ ; $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$ ; $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}–CH_3$

(C) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$ ; $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_3–CH_2–CH_3$ ;

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

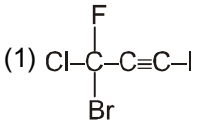
(D)  ;  ; 

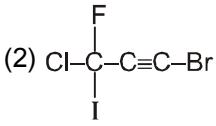
## SECTION-III

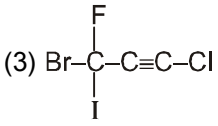
**13.** –CHO ,  , $–NH_2$ ,  , –COOH ,  are functional group present.

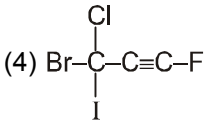
**14.** b,c,f are correct

**15.** f and g are correct.

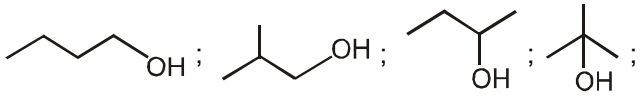
**18.** (1) 

(2) 

(3) 

(4) 

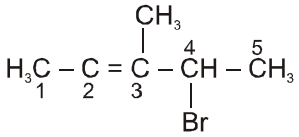
## PART - 3

**2.** 

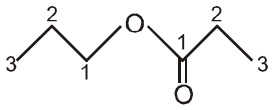
**6.** $CH_3 – CH_2 – CH_2 – O – CH_3$

$CH_3 – \underset{\displaystyle CH_3}{\underset{|}{CH_2}} – O – CH_3$

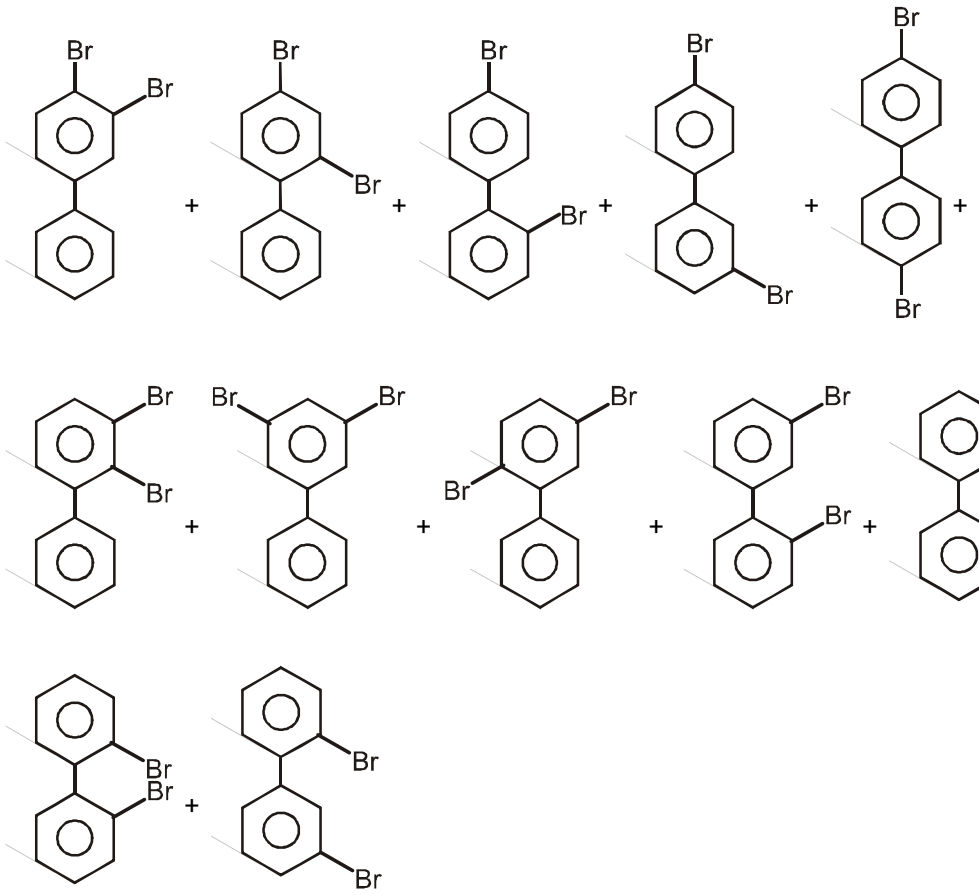
$CH_3 – CH_2 – O – CH_2 – CH_3$

**7.** 

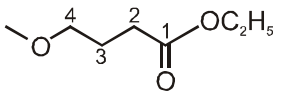
4-Bromo-3-methlypent-2-ene

**8.** 

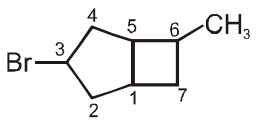
It is n-propyl propanoate.

**9.** 

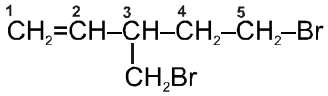
Overall 12 isomers.

**10.** 

ethyl-4-methoxybutanoate

**11.** 

IUPAC name : 3-Bromo-6-methylbicyclo[3.2.0]heptane.

**12.** 

5-Bromo-3-(bromomethyl) pent-1-ene