CHAPTER

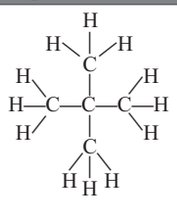
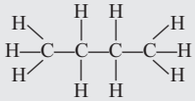
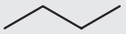
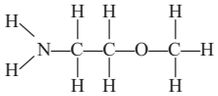
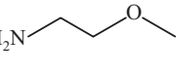
11

Some Basic Principles and Techniques: IUPAC Nomenclature

STRUCTURAL REPRESENTATION OF ORGANIC COMPOUNDS

There are three ways for representation of organic compounds:

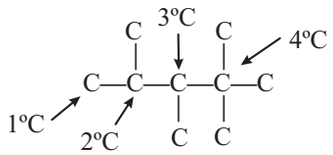
1. **Complete structural formula:** Such a structural formula completely represent all the atoms & all the bonds involved in the molecule. A single dash (–) represents a single (σ) bond, double dash (=) is used for double (one σ & one π) bond and a triple dash (≡) represents triple (one σ & two π) bond. Lone- pairs of electrons on heteroatoms (e.g., oxygen, nitrogen, sulphur, halogens etc.) may or may not be shown.
2. **Condensed structural formula:** Structural formulas can be further abbreviated by omitting some or all of the dashes representing covalent bonds and by indicating the number of identical groups attached to an atom by a subscript. The resulting expression of the compound is called a condensed structural formula.
3. **Bond line formula:** In this formula , carbon and hydrogen atoms bonded to carbon are not shown and the lines representing carbon-carbon bonds or carbon-heteroatoms bonds are drawn in a zig-zag fashion. The only atoms specifically written are oxygen, chlorine, nitrogen etc.

Condensed form	Expanded form	Bond line form
$C(CH_3)_4$		
$CH_3(CH_2)_2CH_3$		
$H_2N(CH_2)_2OCH_3$		

Some Important Definitions

1. **Catenation:** The property of atoms of an element to link with one another forming chains of identical atoms is called catenation.
2. **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.
3. C**lassification of Carbon:** There are four types of carbon present in organic compounds. The carbon which is directly attached with one, two, three and four carbon atoms are known as primary, secondary, tertiary and quaternary carbon atom respectively.

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

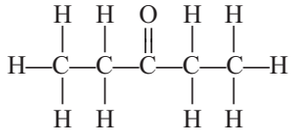


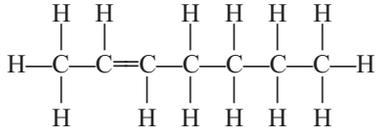
Train Your Brain

Example 1: Expand each of the following condensed formulas into their complete structural formulas.

(*a*) $CH_3CH_2COCH_2CH_3$

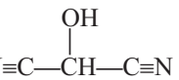
(*b*) $CH_3CH{=}CH(CH_2)_3CH_3$

Sol. (*a*) 

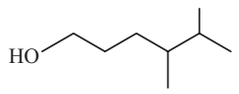
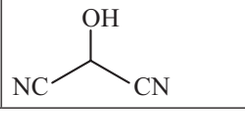
(*b*) 

Example 2: For each of the following compounds,write a condensed formula and also their bond-line formula.

(*a*) $HOCH_2CH_2CH_2CH(CH_3)CH(CH_3)CH_3$

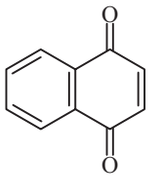
(*b*) 

Sol.

Condensed formula	Bond-line formula
$HO(CH_2)_3CH(CH_3)CH(CH_3)_2$	
$HOCH(CN)_2$	

Concept Application

1. Number of σ and π bonds in the following molecule respectively is



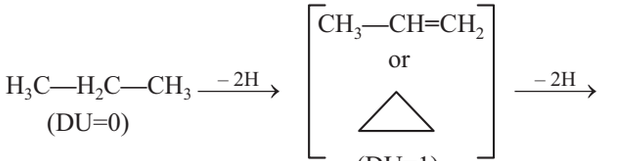
(*a*) 19, 7 (*b*) 20, 7

(*c*) 19, 6 (*d*) 18, 6

DEGREE OF UNSATURATION (DU)

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

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



$CH_3 - C \equiv CH$ or $CH_2 = C = CH_2$ or  (DU=2)

Degree of unsaturation (D.U)

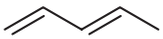
$$= \frac{(2n+2) - (\text{No. of H atoms} + \text{No. of X atoms} - \text{No. of N atoms})}{2}$$

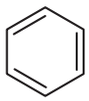
Where n = number of carbon atoms in the molecule

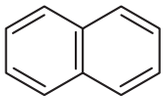
Key Note

- Total no. of cyclic rings + π bonds will gives us degree of unsaturation.
  - One double bond = one DU
  - One ring = one DU
  - One triple bond = two DU

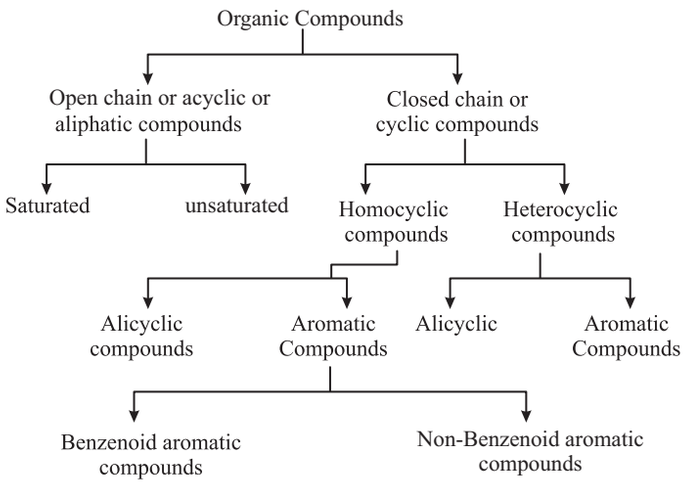
Ex. (*i*) $CH_2 = CH_2$; DU = $\frac{(2 \times 2 + 2) - 4}{2} = (2/2) = 1$

(*ii*)  ; DU = 2

(*iii*)  ; DU = 4

(*iv*)  ; DU = 7

CLASSIFICATION OF ORGANIC COMPOUNDS



ORGANIC COMPOUNDS AND FUNCTIONAL GROUPS

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. Examples are as follows:

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**.

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

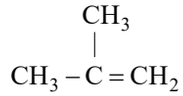
Alkenes [general formula C_nH_{2n} where n = 2, 3, ...]

Alkenes are open chain unsaturated hydrocarbons 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.

Ex. $CH_2 = CH_2$ Ethylene

$CH_3 - CH = CH_2$ Propylene

$CH_3 - CH_2 - CH = CH_2$ Butylene


Isobutylene

Alkynes [general formula C_nH_{2n-2} where n = 2, 3, ...]

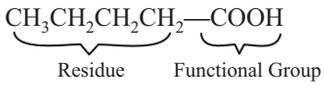
Unsaturated aliphatic hydrocarbons containing a carbon–carbon triple bond are called alkynes.

The common names of a few simple alkynes are given below.

$CH{\equiv}CH$	– Acetylene
$CH_3{-}C{\equiv}CH$	– Methylacetylene
$CH_3{-}CH_2{-}C{\equiv}CH$	– Ethylacetylene
$CH_3{-}C{\equiv}C{-}CH(CH_3)_2$	– Methyl isopropyl acetylene

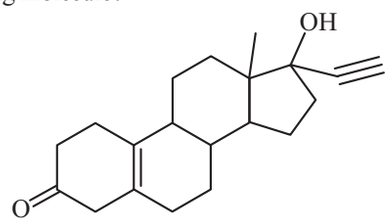
Functional Group and Residue

The characteristic group of atom which decide the physical and chemical properties of an organic molecule 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.

Ex. 

Train Your Brain

Example 3: How many different functional groups are present in following molecule?

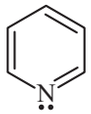


(*a*) 3 (*b*) 4 (*c*) 5 (*d*) 6

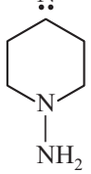
Sol. (—OH), (—≡—) (—═—), (—C(=O)—)

Functional groups.

Example 4: The saturated heterocyclic compound is:

(*a*) 

(*b*) 

(*c*) 

(*d*) 

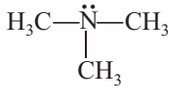
Sol. Saturated heterocyclic compounds do not have any unsaturation & have atleast one hetero atom within the ring.

Example 5: The simplest tertiary amine has:

(*a*) 2 carbons (*b*) 3 carbons

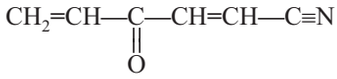
(*c*) 4 carbons (*d*) 5 carbons

Sol. Tertiary amine



Concept Application

2. The number of olefinic bonds in the given compound is/are:



(*a*) 2 (*b*) 3

(*c*) 1 (*d*) 4

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

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 principal functional group) and is based upon the common names of parent 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	Hexadec	100	Hect

Primary Suffix

A primary suffix is always added to the word root to indicate whether the carbon chain is saturated or unsaturated. The three basic primary suffixes are given below:

Type of carbon chain	Primary suffix	General name
(i) Saturated	– ane	Alkane
(ii) Unsaturated with one double bond	– ene	Alkene
(iii) Unsaturated with one triple bond	– yne	Alkyne

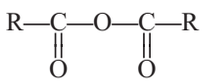
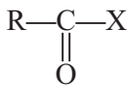
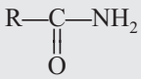
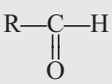
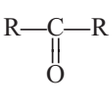
If the parent carbon chain contains two, three or more double or triple bonds, numerical prefix such as di (for two), tri (for three), tetra (for four) etc. are added to the primary suffix.

For example:

Type of carbon chain	Primary suffix	General name
(i) Unsaturated with two double bonds	(a) + diene	Alkadiene
(ii) Unsaturated with two triple bonds	(a) + diyne	Alkadiyne
(iii) Both double and triple bonds	enyne	Alkenyne

Secondary Suffix

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

S.No.	Class	Name	Suffix	Prefix
1.	R – COOH	Alkanoic Acid	– oic acid (carboxylic acid)	Carboxy
2.	$R - SO_3H$	Alkane sulphonic Acid	– sulphonic acid	sulpho
3.		Alkanoic Anhydride	– oic anhydride (carboxylic anhydride)	----------
4.	R – COOR	Alkyl alkanoate	– oate (carboxylate)	alkoxy carbonyl or alkanoyl oxy
5.		Alkanoyl halide	–oyl halide (carbonyl halide)	halo carbonyl
6.		Alkanamide	– amide (carboxamide)	carbamoyl
7.	R – C ≡ N	Alkanenitrile	– nitrile (carbonitrile)	cyano
8.		Alkanal	– al (carbaldehyde)	formyl / oxo
9.		Alkanone	– one	oxo
10.	R – OH	Alkanol	– ol	hydroxy
11.	R – SH	Alkanethiol	– thiol	mercapto
12.	$R - NH_2$	Alkanamine	– amine	amino

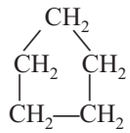
The following examples illustrate the use of word root, primary suffix and secondary suffix in naming of organic compounds.

Organic compounds	Word root	Primary suffix	Secondary suffix	IUPAC name
CH_3CH_2OH	Eth	an(e)	ol	Ethanol
$CH_3CH_2CH_2NH_2$	Prop	an(e)	amine	Propanamine
$CH_3CH_2CH_2COOH$	But	an(e)	oic acid	Butanoic acid
CH_3CH_2CN	Prop	an(e)	nitrile	Propanenitrile
CH_2=CHCHO	Prop	en(e)	al	Propenal
HC = CCOOH	Prop	yn(e)	oic acid	Propynoic acid

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,

Ex. 

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.

Secondary Prefix

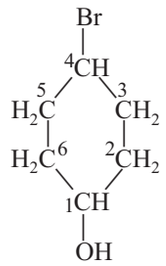
In IUPAC system of nomenclature, certain groups are not considered as functional groups but are treated as substituents. These are called secondary prefixes and are added immediately before the word root (or the primary prefix in case of carbocyclic compounds) in alphabetical order to denote the side 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
$-N^{\oplus}\equiv N$	Diazo	$-CH(CH_3)_2$ (i–Pr)	Isopropyl
– OR	Alkoxy	$-C(CH_3)_3$ (t-Bu)	t-Butyl

Example:

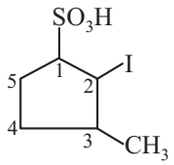
Organic compounds	"Secondary prefix"	Word root	"Primary suffix"	IUPAC name
CH_3CH_2–Br	Bromo	eth	ane	Bromoethane
CH_3–NO_2	Nitro	meth	ane	Nitromethane
C_2H_5–OC_2H_5	Ethoxy	eth	ane	Ethoxyethane

Ex.



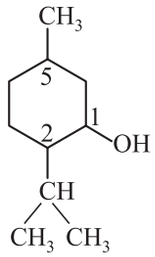
4-Bromo cyclo hex an (e) 1-ol

Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix



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

Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix



2-Isopropyl-5-methyl cyclo hex an(e) ol

Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix

Names of Alkyl radical

(1) Alkyl, Alkenyl & Alkynyl groups

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

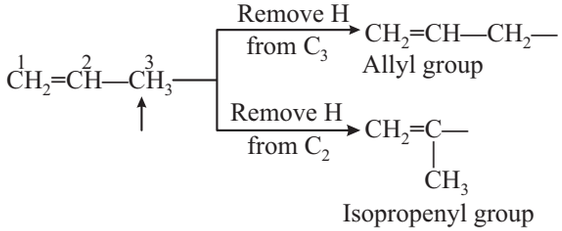
$$\text{Alkene } (C_nH_{2n}) \xrightarrow{-H} \text{Alken + yl } (C_nH_{2n-1})$$

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

Ex. $\text{methane} \xrightarrow[+yl]{-ane} \text{methyl} \quad (CH_4 \xrightarrow{-H} -CH_3)$

$\text{propane} \xrightarrow[+yl]{-ane} \text{propyl} \quad (C_3H_8 \xrightarrow{-H} -C_3H_7)$

$CH_2 = CH_2 \xrightarrow{\text{remove H}} -CH=CH_2$ (vinyl group)/ethenyl.



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

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

(2) Iso alkyl group: A compound having —CH—CH_3 group is called iso alkyl group.

Ex. $CH_3—CH(CH_3)—$ Iso propyl; $CH_3—CH(CH_3)—CH_2—$ Iso butyl

$CH_3—CH(CH_3)—CH_2—CH_2—$ isopentyl

(3) Neo alkyl group: Compound having $\left(CH_3—C(CH_3)_2—CH_2–\right)$ group is called neo alkyl group.

Ex. $CH_3—C(CH_3)_2—CH_2–$ Neopentyl; $CH_3—C(CH_3)_2—CH_2—CH_2–$ Neohexyl

Key Note

$CH_3—C(CH_3)_2—CH_3$ Neopentane ; $CH_3—CH(CH_3)—CH_2—CH_3$ Iso pentane

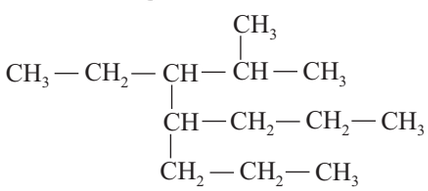
$CH_3—C(CH_3)_2—CH_2—CH_3$ Neohexane

Exception: Isooctane $CH_3—C(CH_3)_2—CH_2—CH(CH_3)—CH_3$

IUPAC NOMENCLATURE OF BRANCHED/ COMPLEX ALKANES

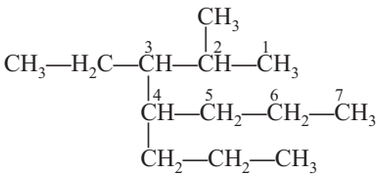
Parent Carbon Chain Selection

(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.



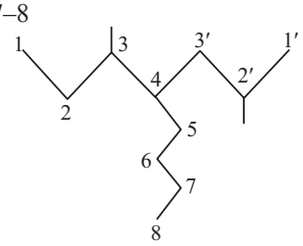
longest chain has 7 carbon & 3 substituents

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

Ex. 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



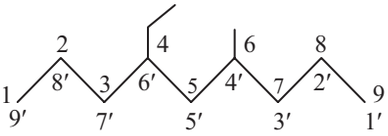
Chain- (A) & Chain- (B) both have 2 substituents but in chain-B substituent is nearer (at 2nd position) than in chain-A (at 3rd position). So, chain-B will be preferred.

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

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

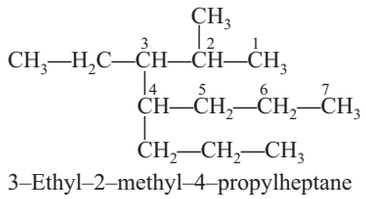
Numbering of the Parent Carbon Chain

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

Key Note

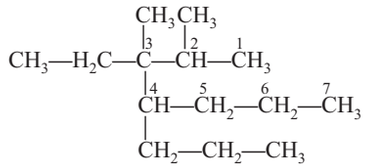
- Write the substituents in place of secondary prefix with their appropriate locations in alphabetical order.
- If the same substituent occurs more than once in the molecule, the prefix di (for two), tri (for three), etc. are used to indicate how many times it appears.
- Prefixes di, tri, tetra etc. are not considered in deciding alphabetical order for simple substituents but considered for complex substituents (if included in their name itself).
- Iso & Neo is considered for alphabetical seniority order.
- Numbers are separated from each other by commas(,).
- Numbers are separated from words by hyphens and there is no break between name of substituents and word root.

Ex. (*i*)



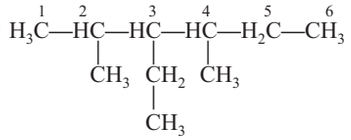
3–Ethyl–2–methyl–4–propylheptane

(*ii*)



3–Ethyl–2,3–dimethyl–4–propylheptane

(*iii*)

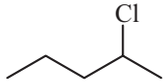


3–Ethyl–2,4–dimethylhexane

Train Your Brain

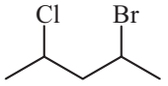
Example 6: Which is incorrect IUPAC name?

(*a*)



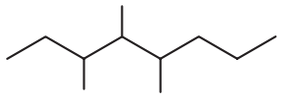
2-Chloropentane

(*b*)



2-Bromo-4-chloropentane

(*c*)



3,4,5-Trimethyloctane

(*d*)

3-Ethyl-5-methylheptane

Sol. Correct IUPAC name of (d) is 2,2- dimethyl butane.

Example 7: A student named a certain compound as 2, 3-diethylbutane. Its correct IUPAC name is:

(*a*) 2, 3-Dimethylhexane

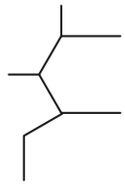
(*b*) 3, 4-Dimethylhexane

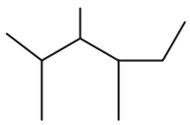
(*c*) 2-Ethyl-3-methylpentane

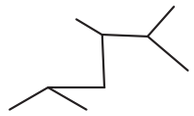
(*d*) 2-Ethylbutane

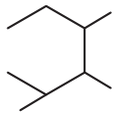
Sol. Longest chain has 6 carbon and at 3, 4 position (—CH_3) is substituent group.

Example 8: Which is the incorrect structure of 2,3,4-Trimethylhexane:

(*a*) 

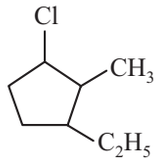
(*b*) 

(*c*) 

(*d*) 

Sol. (*c*) In (c) methyl is present at 2, 3 and at 5 position of the chain.

Concept Application

3.  has the IUPAC name as:

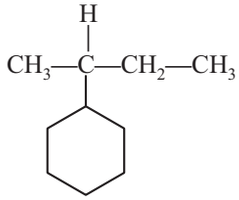
(*a*) 3–Chloro–1–ethyl–2–methylcyclopentane

(*b*) 1–Chloro–3–ethyl–2–methylcyclopentane

(*c*) 4–Chloro–1–ethyl–5–methylcyclopentane

(*d*) None of above

4. IUPAC name of the following compound is:



(*a*) 2–Cyclohexylbutane

(*b*) 2–Phenylbutane

(*c*) 3–Cyclohexylbutane

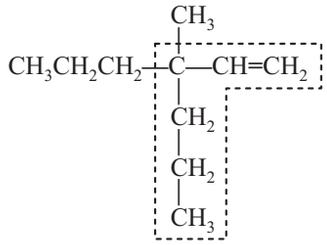
(*d*) (1–Methylpropyl)cyclohexane

IUPAC Nomenclature of Alkenes/Alkynes/Alkenyne

Alkenes

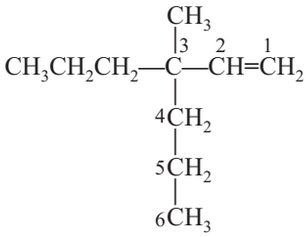
Functional group: 

(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 carbon chain.

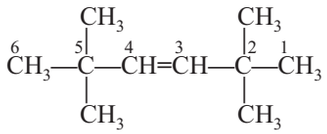
Ex. 

Longest chain has 6 atoms ⇒ parent name = hexene

(2) Carbon atoms in the longest chain is numbered from that end so that doubly 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. The above example can be numbered as,



Position of double bond will be indicated as no. 1, Hence name will be 3–Methyl–3–propylhex–1–ene

Ex. 

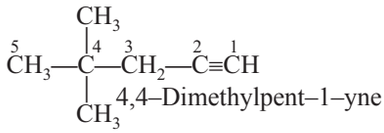
2,2,5,5-Tetramethylhex-3-ene

Alkynes

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

Ex.

But -2-yne


4,4–Dimethylpent–1–yne

Alkenyne (containing both double and triple bonds)

Numbering is done in a manner that double and triple bonds get the lowest possible number. If all other things are same and double bond and triple bond both have same number then double bond is preferred over triple bond.

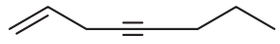
Ex. $HC \equiv C - CH_2 - CH = CH_2$

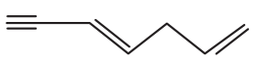
1 2 3 4 5

(Numbering is done from alkyne) (Wrong)

5 4 3 2 1

(Numbering is done from alkene) (Correct)


Oct-1-en-4-yne


Hepta-3, 6-dien -1- yne

IUPAC Nomenclature of Alicyclic Compounds

(1) The names of alicyclic compounds are obtained by adding the prefix "**cyclo**".

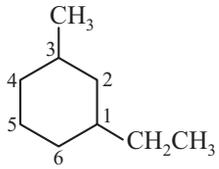
Ex.

Cyclobutane

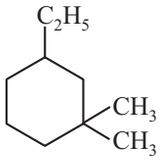
Cyclopentene

(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**.

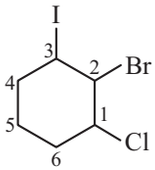
Ex.



1–Ethyl–3–methylcyclohexane



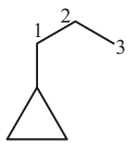
3–Ethyl–1,1–dimethylcyclohexane



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.

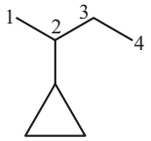
Ex.



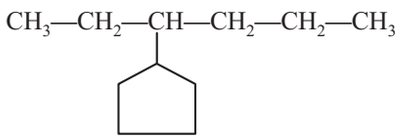
n-Propylcyclopropane

(4) When 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.

Ex.



2–Cyclopropylbutane



3–Cyclopentylhexane

(5) If ring has unsaturation and side chain is saturated then ring is selected as parent chain.

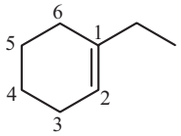
If side chain has unsaturation and ring is saturated then side chain is selected as parent chain.

If both have unsaturation, the chain with maximum unsaturation will be selected as parent chain.

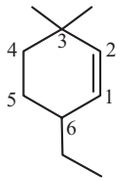
If equal unsaturation, then longest chain is selected as parent chain.

If unsaturation and number of carbon atoms both are equal then ring is selected as parent chain.

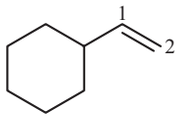
Ex.



1-Ethylcyclohex-1-ene



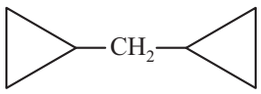
6-Ethyl-3,3-dimethylcyclohex-1-ene



Cyclohexylethene

(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.

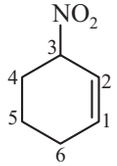
Ex.



Dicyclopropylmethane

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

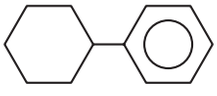
Ex.



3-Nitrocyclohex-1-ene

(8) If a compound contains an alicyclic ring directly linked to the benzene ring. It is named as a derivative of benzene.

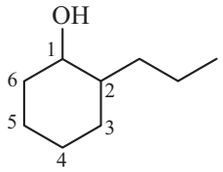
Ex.



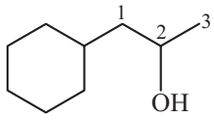
Cyclohexylbenzene

(9) If functional group is present in cyclic compounds then the main chain is taken where the principal functional group is present.

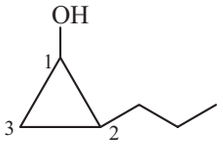
Ex.



2-Propylcyclohexan-1-ol



1-Cyclohexylpropan-2-ol

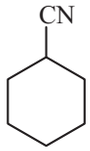


2-Propylcyclopropan-1-ol

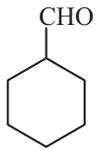
(10) When chain terminating functional group is directly attached with the ring then ring is taken as parent chain & special suffix is used for this functional group.

Functional Group	**Suffix**
–CHO	Carbaldehyde
–COOH	Carboxylic Acid
–COX	Carbonyl halide
–COOR	Alkyl Carboxylate
$–CONH_2$	Carboxamide
–CN	Carbonitrile

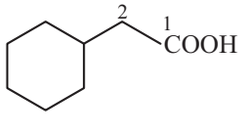
Ex.



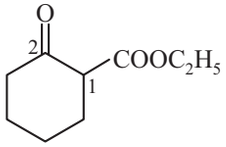
Cyclohexanecarbonitrile



Cyclohexanecarbaldehyde



2-Cyclohexylethanoic acid



Ethyl 2–oxocyclohexane–1–carboxylate

Train Your Brain

Example 9: Select the structure with correct numbering in the chain:

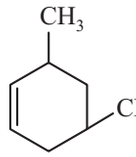
(*a*) $\overset{5}{C}H_2=\overset{4}{C}H—\overset{3}{C}H_2—\overset{2}{C}\equiv\overset{1}{C}H$

(*b*) $\overset{1}{C}H_3—\overset{2}{C}H=\overset{3}{C}H—\overset{4}{C}\equiv\overset{5}{C}H$

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

Sol. In (*d*) lowest sum is (1 + 3 + 6) = 10 and numbering should be from alkene side (alphabetical order) hence correct.

Example 10: The IUPAC name of 

is:

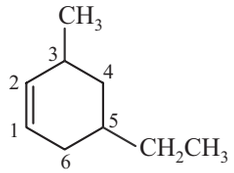
(*a*) 1–Methyl–5–ethylcyclohex–2–ene

(*b*) 5–Ethyl–3–methylcyclohex–1–ene

(*c*) 4–Ethyl–6–methylcyclohex–1–ene

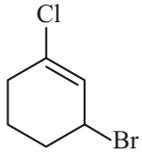
(*d*) 1–Ethyl–5–methylcyclohex–3–ene

Sol.



Concept Application

5. The IUPAC name of the compound shown below is:



(*a*) 2-Bromo-6-chlorocyclohex-1-ene

(*b*) 6-Bromo-2-chlorocyclohexene

(*c*) 3-Bromo-1-chlorocyclohexene

(*d*) 1-Bromo-3-chlorocyclohexene

6. IUPAC name of $CH_3–CH=C=CH–C\equiv CH$ is:

(*a*) 2-Hexen-4-yne

(*b*) Hexa-2,3-dien-1-yne

(*c*) Hexa-3,4-dien-1-yne

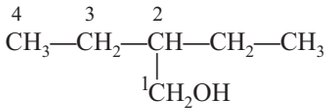
(*d*) None of these

IUPAC Nomenclature of Compounds Containing Functional Groups

Rules for non chain terminating functional groups

(1) Parent chain: Select the longest possible carbon chain with maximum no. of functional groups and maximum unsaturation without caring whether it also denotes the longest possible carbon chain or not.

Ex.



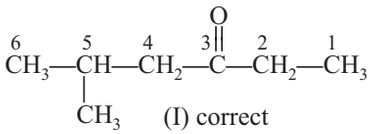
2-Ethylbutan-1-ol

(Parent chain contains four rather than five carbon atoms)

(2) Lowest number for the functional group

Numbering is done from that side of the chain which gives lowest locant to the principle functional group followed by double and triple bonds.

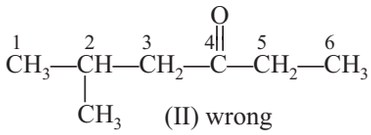
Ex.



(I) correct

5-Methylhexan-3-one

(>C=O group gets lowest number 3)

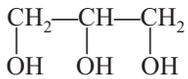


(II) wrong

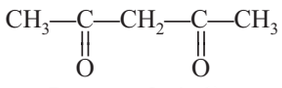
(>C=O group gets number 4 which is not lowest)

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

Ex.



Propane–1,2,3–triol

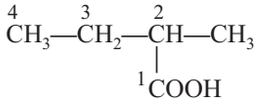


Pentane–2, 4–dione

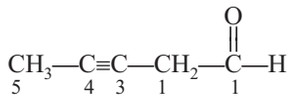
Rules for Chain Terminating Functional Groups

(1) When a chain terminating functional group such as $-CHO$, $-COOH$, $-COOR$, $-CONH_2$, $-COCl$, $-C\equiv N$ etc. is present, it is always given number 1 (one.)

Ex.



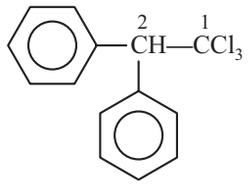
2-Methylbutan-1-oic acid



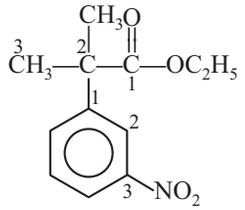
Pent-3-yn-1-al

(2) The name for benzene as substituent is phenyl. In case the phenyl ring is further substituted, the carbon atoms of the ring directly attached to the parent chain are numbered in such a way that the substituent on the ring gets the least possible number.

Ex.



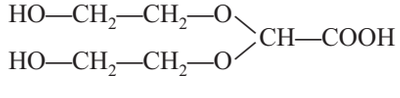
1, 1,1-Trichloro-2,2-diphenylethane



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

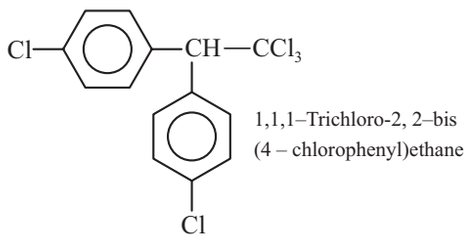
(3) If the organic molecule contains more than one similar complex substituents, then the numeral prefixes such as di, tri, tetra etc. are replaced by bis, tris, tetrakis etc. respectively.

Ex.



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

Ex.



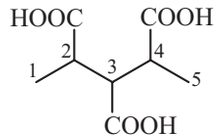
1,1,1–Trichloro-2, 2–bis
(4 – chlorophenyl)ethane

Key Note

Common name is D.D.T. (Dichloro diphenyl trichloro ethane) and is used as insecticide.

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

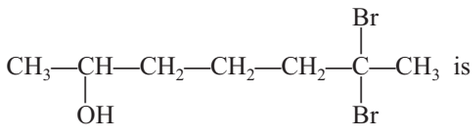
Ex.



Pentane- 2, 3, 4–tricarboxylic acid.

Train Your Brain

Example 11: The IUPAC name of

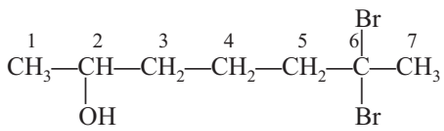


(*a*) 6,6-Dibromoheptan-2-ol

(*b*) 2,2-Dibromoheptan-6-ol

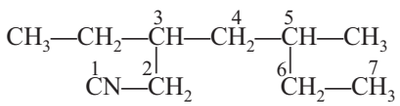
(*c*) 6,6-Dibromoheptan-2-al

(*d*) None of these

Sol. 

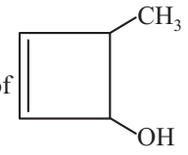
Select the longest chain and alcohol will be in its parent chain.

Example 12: Write the IUPAC name of the given compound.



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 group 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-methyl heptanenitrile**

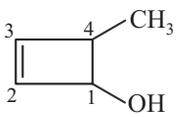
Example 13: The IUPAC name of  is:

(*a*) 4–Methylcyclobut–1–en–3–ol

(*b*) 2–Methylcyclobut–3–en–1–ol

(*c*) 2–Methylcyclobut–1–en–3–ol

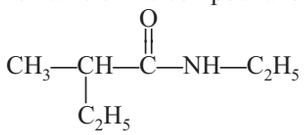
(*d*) 4–Methylcyclobut–2–en–1–ol

Sol. 

Alcohol has been given priority over alkene.

Concept Application

7. The IUPAC name of the compound is:



(*a*) N-Ethyl-2-ethylpropanamide

(*b*) N-Ethyl-2-methylbutanamide

(*c*) N-Ethyl-2-methylpropanecarboxamide

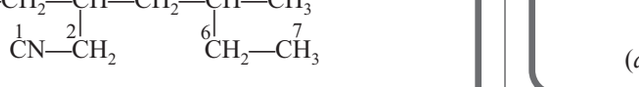
(*d*) N-Ethyl-2-ethylethanecarboxamide

8. The correct structure for the compound Hept-3-en-5-yn-2-one is:

(*a*)

(*b*) 

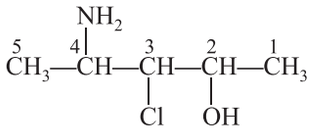
(*c*) 

(*d*) 

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 group such as halo groups (fluoro, bromo, chloro, iodo), nitroso (NO), nitro (– NO_2) and alkoxy (–OR) are always treated as substituent groups.

Ex. 

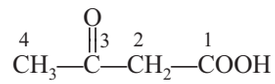
4-Amino-3-chloropentan-2-ol

(–NH_2 & –Cl group are treated as substituents)

Key Note

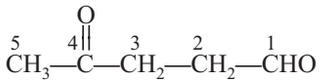
Order of numbering in the principal chain is:

[Principal functional group > double bond > triple bond > substituents]

Ex. 

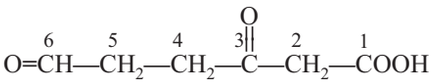
3-Oxobutan-1-oic acid

[–COOH > –CO]



4-Oxopentan-1-al

[–CHO > C=O]

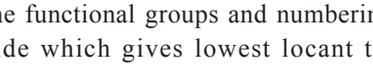


3, 6-Dioxohexanoic acid or 5-Formyl-3-oxopentanoic acid

[—COOH > —C— and —CHO]

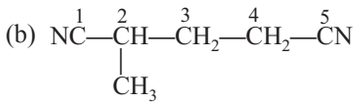
(3) If more than one same chain terminating groups are present then the principal chain is selected including the functional groups and numbering is done from that side which gives lowest locant to unsaturation and substituents.

Ex. (a)



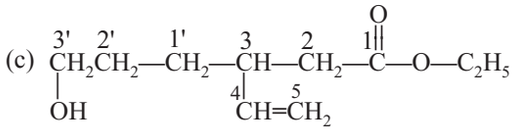
Butane-1, 4 dioic acid

(b)



2-Methylpentane 1,5 - dinitrile

(c)

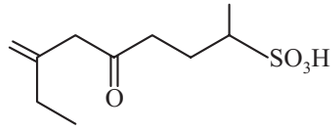


Ethyl-3-(3-hydroxypropyl)pent-4-enoate

Parent chain contains five rather than six carbon atoms.

Train Your Brain

Example 14: The correct IUPAC name of the compound is:



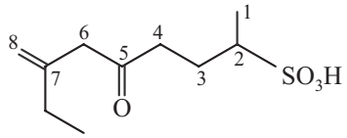
(*a*) 6-Ethyl-1-methyl-4-oxohept-6-ene-1-sulphonic acid

(*b*) 7-Ethyl-5-oxooct-7-ene-2-sulphonic acid

(*c*) 2-Ethyl-7-sulphooct-1-ene-4-one

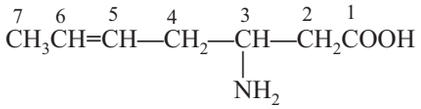
(*d*) 7-Methylene-5-oxononane-2-sulphonic acid

Sol.



(—SO_3H) is given priority over (—C(=O)—) and (—═—).

Example 15: The IUPAC name of the following is:



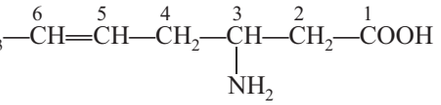
(*a*) 3-Aminohept-5-enoic acid

(*b*) 5-Aminohex-2-enecarboxylic acid

(*c*) 3-Aminohept-4-enoic acid

(*d*) 5-Aminohept-2-enoic acid

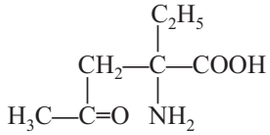
Sol.



(—COOH) had been given priority over (—NH_2) and (—═—) functional group.

Concept Application

9. The IUPAC name of given compound is:



(*a*) 2-Oxo-4-amino-4-ethylpentanoic acid

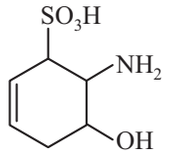
(*b*) 2-Amino-4-oxo-2-ethylpentanoic acid

(*c*) 3-Amino-3-carboxy-5-hexanone

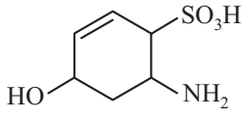
(*d*) 2-Amino-2-ethyl-4-oxopentanoic acid

10. The correct structure of 6-Amino-4-hydroxycylohex-2-ene-1-sulphonic acid:

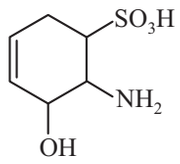
(*a*)



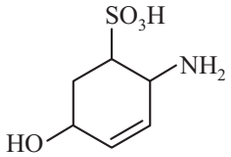
(*b*)



(*c*)

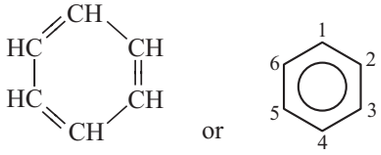


(*d*)



NOMENCLATURE OF AROMATIC COMPOUNDS

The aromatic compounds are cyclic compounds which contain one or more benzene type rings. 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.

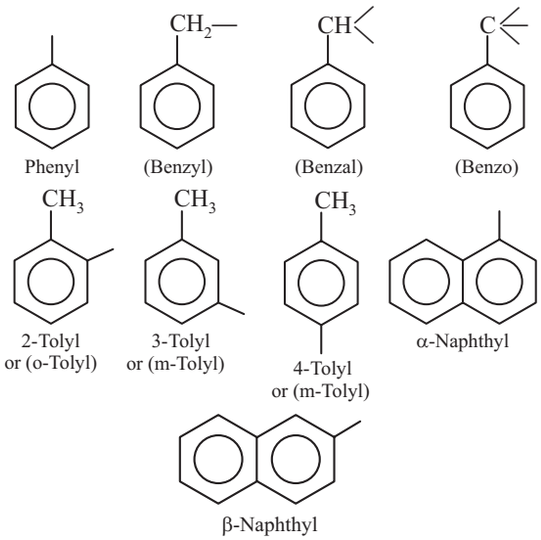


(1) Nuclear substituted: The functional group is directly attached to the benzene ring, in the IUPAC system they are named as derivatives of benzene. The position of the substituents in disubstituted benzenes are indicated either by prefixes such as o-(ortho) for 1,2; m-(meta) for 1, 3 and p-(para) for 1, 4 position. However, many of their common names have also been adopted by the IUPAC system.

(2) Side chain substituted: If functional group is present in the side chain of the benzene ring in the IUPAC system, these are usually named as phenyl derivatives of the corresponding aliphatic compounds.

The IUPAC and common names of a few important members of each family are given below.

1. Aryl groups:



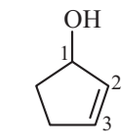
Some important 1993 recommendations for IUPAC nomenclature of organic compounds

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

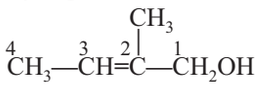
For Example:

$CH_3CH_2CH = CH_2$ should be named as but-1-ene.

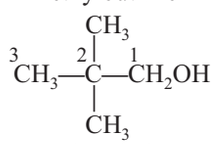
$CH_3CH_2CH_2OH$ should be named as propan-1-ol. Similarly, a few more examples are given as following:



Cyclopent-2-en-1-ol



2-Methylbut-2-en-1-ol



2, 2-Dimethylpropan-1-ol

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

For example:

$CH_3CH_2CH_2COOH$ Butanoic acid $\qquad$ CH_3CH_2CHO Propanal

$CH_3CH_2CH_2CN$ Butanenitrile

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.

$CH_3CH_2CH_2OH$ Propan-1-ol $\qquad$ $CH_3CH_2CH_2NH_2$ Propan-1-amine

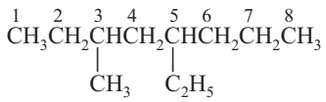
Here, we cannot simply write propanol (or propanamine) because there are two propanols ; propan-1-ol and propan-2-ol.

(3) Arrangement of Prefixes:

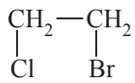
(i) Simple prefixes such as methyl, ethyl, chloro, nitro, hydroxy, etc. are arranged alphabetically.

The prefixes di, tri, etc. are however not considered for alphabetical order.

Ex.



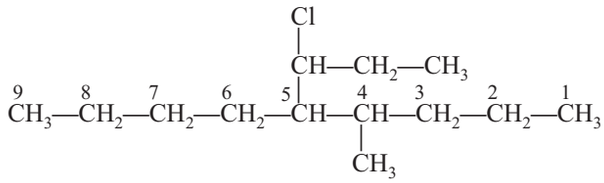
5-Ethyl-3-methyloctane ,



1-Bromo-2-chloroethane

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

Ex.

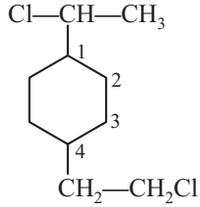


5-(1-Chloropropyl)-4-methylnonane

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

(iii) 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.

For Example:

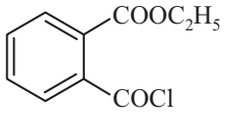


1-(1-Chloroethyl)-4-(2-chloroethyl)cyclohexane

Here, 1-chloroethyl gets priority over 2-chloroethyl.

Train Your Brain

Example 16: IUPAC name of the following compound



is:

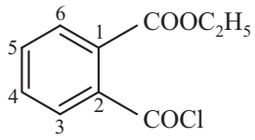
(*a*) 2-Chlorocarbonylethylbenzenecarboxylate

(*b*) 2-Carboxyethylbenzoylchloride

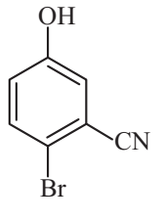
(*c*) Ethyl-2-(chlorocarbonyl)benzoate

(*d*) Ethyl-1-chlorocarbonyl)benzenecarboxylate

Sol.



Example 17: The IUPAC name of the following compound is:



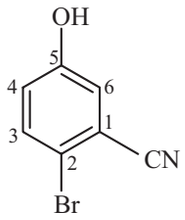
(*a*) 4-Bromo-3-cyanophenol

(*b*) 2-Bromo-5-hydroxybenzonitrile

(*c*) 2-Cyano-4-hydroxybromobenzene

(*d*) 6-Bromo-3-hydroxybenzonitrile

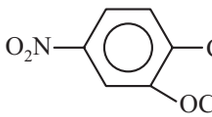
Sol.



(—CN) has been given priority over (—OH) and (—Br).

Concept Application

11. The IUPAC name of the following compound is:



is:

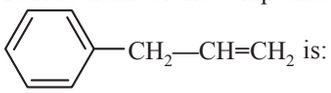
(*a*) 2-Methoxy-4-nitrobenzaldehyde

(*b*) 4-Nitroanisaldehyde

(*c*) 3-Methoxy-4-formylnitrobenzene

(*d*) 2-Formyl-4-nitroanisole

12. IUPAC name of the compound



is:

(*a*) 1-Phenylprop-2-ene

(*b*) 3-Phenylprop-1-ene

(*c*) 1-(Prop-1-enyl) benzene

(*d*) 1-(Prop-2-enyl) benzene

IUPAC NOMENCLATURE OF BICYCLIC COMPOUNDS

When two rings are fused(bridged) at two carbons then prefix Bicyclo is used.

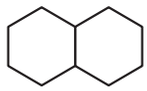
(1) Common carbon atoms present in both the rings are referred as principal points of the bridge.

(2) The line joining the principal points is called the bridge line. Bridge line can have 0, 1, 2 etc carbon atoms.

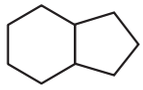
(3) Start numbering from one of the bridgehead carbon atoms. Rings are numbered according to their size – the one with more carbon atoms is numbered first, then the second and etc. The parent chain of bicyclic compounds is given based on the total number of carbons in all the rings.

(4) The name is written as bicyclo[x.y.z]alkane, where x, y, z are in the decreasing order. The numbers in brackets are showing the number of carbon atoms in each ring excluding the bridgehead carbons.

(5) The numbers are separated by full stops.

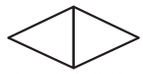


Bicyclo [4.4.0] decane

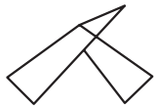


Bicyclo [4.3.0] nonane

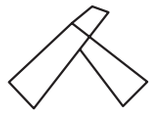
Bicyclo [2.2.0] hexane



Bicyclo [1.1.0] butane



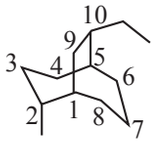
Bicyclo [2.2.1] heptane



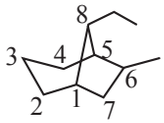
Bicyclo [2.2.2] octane

(6) **Bicyclic compound with substituents:** The presence of substituents in a bicyclic compound doesn't affect the main rule for numbering which is to start it from one of the bridgehead carbon atoms and move in the direction of the larger ring towards the other bridgehead carbon atom.

The substituent is placed in the beginning of the name just like in the nomenclature of alkanes. Place the locants and substituents before the brackets and the parent chain in the alphabetical order



10-ethyl-2-methylbicyclo [3.3.2]decane



8-ethyl-6-methylbicyclo [3.2.1]octane

IUPAC NOMENCLATURE OF SPIRO COMPOUNDS

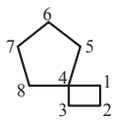
When two rings are fused at one carbon the prefix spiro is used

(1) Numbering of a spiro bicyclic hydrocarbon starts with a ring carbon next to the spiro atom and proceeds first through the smaller ring and then through the spiro atom and around the second ring.

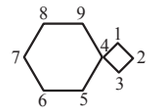
(2) The parent chain is given based on the total number of carbons in all the rings.

(3) The name is written as spiro[x.y]alkane, where x and y are in the increasing order. The numbers in brackets are showing the number of carbon atoms in each ring excluding the bridgehead carbons.

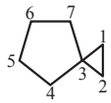
Example:



Spiro [3.4] octane



Spiro [3.5] nonane

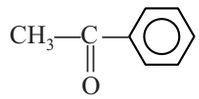
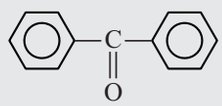


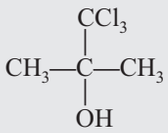
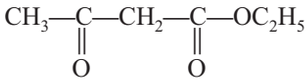
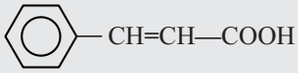
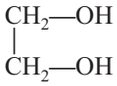
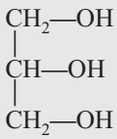
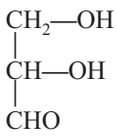
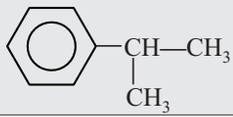
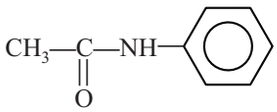
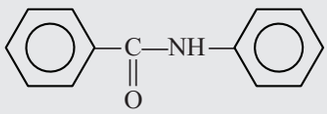
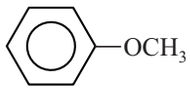
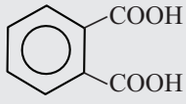
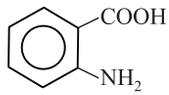
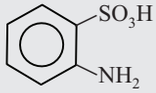
Spiro [2.4] heptane

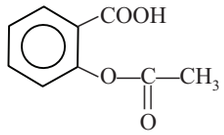
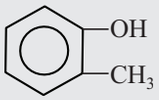
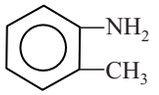
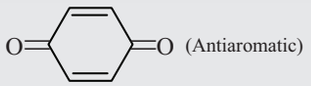
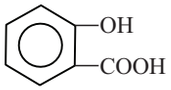
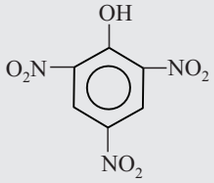
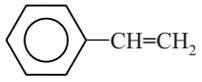
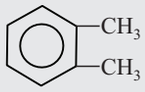
Spiro [4.4] nonane

Spiro [2.4] heptane

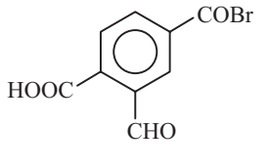
Some Frequently Used Common Names

S. No.	Common Name	Structure Formula
1.	Allene	$CH_2=C=CH_2$
2.	Ketene	$CH_2=C=O$
3.	Acetone or Dimethyl Ketone	$CH_3-\underset{\underset{O}{\|}}{C}-CH_3$
4.	Chloral	Cl_3C-CHO
5.	Acrolein or acraldehyde	$CH_2=CH-CHO$
6.	Acetophenone or Methyl phenyl Ketone	
7.	Benzophenone or Diphenyl Ketone	
8.	Oxalic acid	HOOC–COOH
9.	Malonic acid	$HOOC-CH_2-COOH$
10.	Succinic acid	$HOOC-(CH_2)_2-COOH$
11.	Glutaric acid	$HOOC-(CH_2)_3-COOH$
12.	Adipic acid	$HOOC-(CH_2)_4-COOH$
13.	Maleic acid	$\begin{matrix} H-C-COOH \\ \| \\ H-C-COOH \end{matrix}$ (cis)
14.	Fumaric acid	$\begin{matrix} H-C-COOH \\ \| \\ HOOC-C-H \end{matrix}$ (trans)
15.	Chloroform (Anesthetic agent)	$CHCl_3$
16.	Chloropicrin (Nitro Chloroform)	Cl_3C-NO_2

17.	Chloretone (Chloroform + acetone)	
18.	AAE (Acetoacetic ester) or EAA (Ethylacetoacetate)	
19.	Cinnamic acid	
20.	Glycol	
21.	Glycerol	
22.	Glyceraldehyde	
23.	Glyoxal	
24.	Tilden's reagent	Cl–N=O
25.	Grignard reagent	R–MgX
26.	Lewisite (Explosive used in II-world war)	Cl–CH=CH–$AsCl_2$
27.	Cumene or Isopropyl benzene	
28.	Acetanilide	
29.	Benzanilide	
30.	Anisole	
31.	Phthalic acid	
32.	Anthranilic acid	
33.	Sulphanilic acid (Forms zwitter ion)	

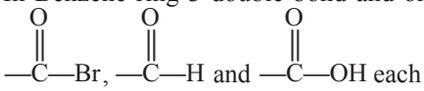
34.	Aspirin (Analgesic) or o-Acetoxy benzoic acid	
35.	o-Cresol	
36.	o-Toluidine	
37.	p-Benzoquinone	 (Antiaromatic)
38.	Salicylic acid	
39.	Picric acid	
40.	Styrene	
41.	o-Xylene	

1. Find degree of unsaturation of given compound:

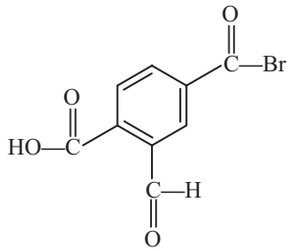


(*a*) 5 (*b*) 6 (*c*) 7 (*d*) 8

Sol. In Benzene ring 3 double bond and one ring is present.



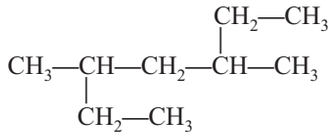
each has double bond.



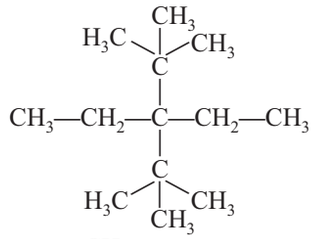
Therefore, option (*c*) is the correct answer.

2. Which of the following has longest parent carbon chain?

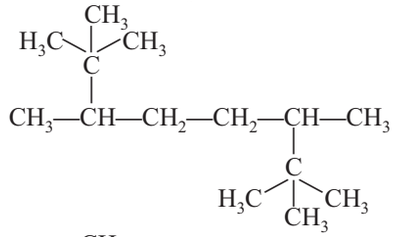
(*a*)



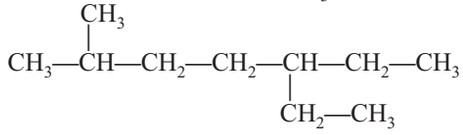
(*b*)



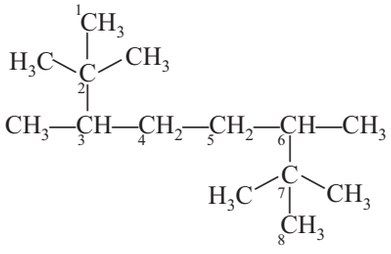
(*c*)



(*d*)

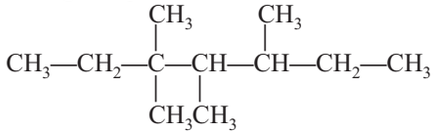


Sol.



Therefore, option (*c*) is the correct answer.

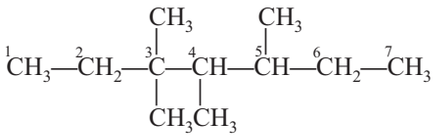
3. In following compound the correct lowest set of locants is:



(*a*) 3,3,4,5 (*b*) 3,4,5,5

(*c*) 4,5,3,3 (*d*) 5,5,4,3

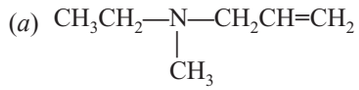
Sol.



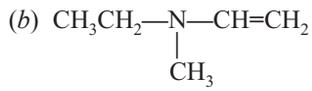
Therefore, option (*a*) is the correct answer.

4. Ethyl methyl vinyl amine has the structure:

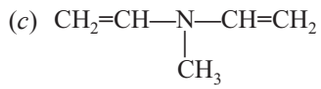
(*a*)



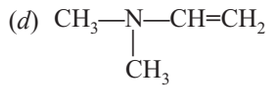
(*b*)



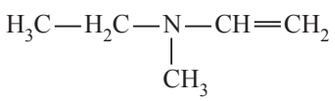
(*c*)



(*d*)

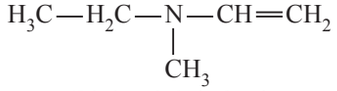


Sol.



As per the name of the molecule amine group should be in vinyl position. Doubly bonded carbon is the vinylic position. Therefore, compound (a) is wrong because it has amine group in allylic position.

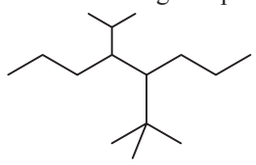
Also according to the name, we have ethyl and methyl substituent to the amine group. Thus only compound (b) has those substituents. Hence compound (b) is the correct one.



Ethyl methyl vinyl amine

Therefore, option (*b*) is the correct answer.

5. IUPAC name of the following compound is:



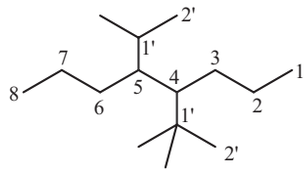
(*a*) 4-(1-methylethyl)-5-(1,1-dimethylethyl)octane

(*b*) 4-(1,1-dimethylethyl)-5-(1-methylethyl)octane

(*c*) 2,2-Trimethyl-4,5-dipropylhexane

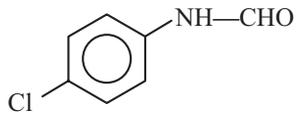
(*d*) 4-Isopropyl-5-(1,1-dimethylethyl)octane

Sol.



Therefore, option (*b*) is the correct answer.

6. The correct IUPAC name of the following compound is:



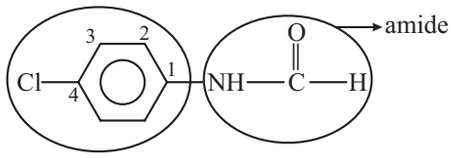
(*a*) N–Formyl-4-chlorobenzenamine

(*b*) N–Formyl-4-chloroaniline

(*c*) N–(4-chlorophenyl)methanamide

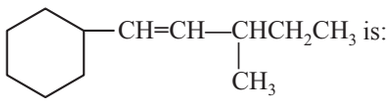
(*d*) N–(Parachlorophenyl)–N–formylaniline

Sol.



Therefore, option (*c*) is the correct answer.

7. The IUPAC name of



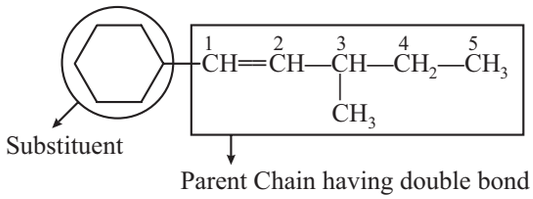
(*a*) 1-Cyclohexyl-3-methyl-1-pentene

(*b*) 3-Methyl-5-cyclohexylpent-1-ene

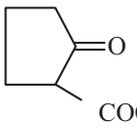
(*c*) 1-Cyclohexyl-3-ethylbut-1-ene

(*d*) 1-Cyclohexyl-3,4-dmethylbut-1-ene

Sol.



Therefore, option (*a*) is the correct answer.

8.  has the IUPAC name:

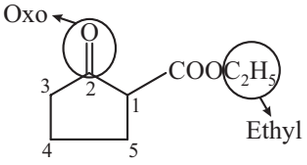
(*a*) Ethyl-2-oxocyclopentanecarboxylate

(*b*) 2-Cyclopentanone-1-carbethoxy

(*c*) 2-Ethylcarbonatecyclopentanone

(*d*) 1-Keto-2-carbethoxycyclopentanone

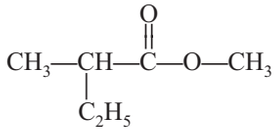
Sol.



(—C—O—) has more priority over (—C—)

Therefore, option (*a*) is the correct answer.

9. The correct IUPAC name of following compound is:



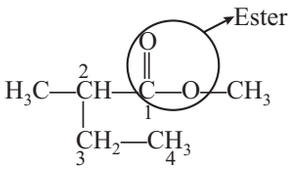
(*a*) Methyl-2-ethylpropanoate

(*b*) Methylbutane-2-carboxylate

(*c*) Methyl-2-methylbutanoate

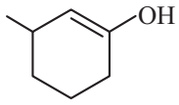
(*d*) Methoxypentanone

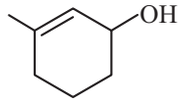
Sol.

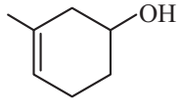


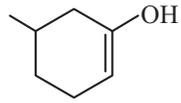
Therefore, option (*c*) is the correct answer.

10. Which of the following is/are 3-Methyl cyclohex-3-enol?

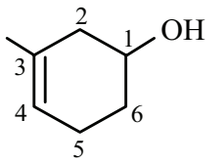
(*a*) 

(*b*) 

(*c*) 

(*d*) 

Sol.

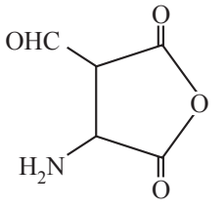


3 – Methylcyclohex – 3 – enol

Therefore, option (*c*) is the correct answer.

11. Write IUPAC names of following compounds.

(i) HOOC–N=CH–CH_2–CH_2–COOH

(ii) 

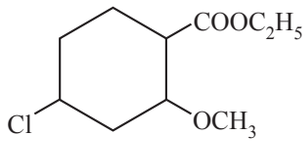
Sol. (i) 4-carboxyiminobutanoicacid

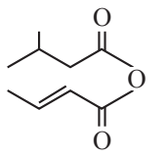
(ii) 2-amino-3-formylbutane-1,4-dioicanhydride

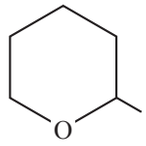
or

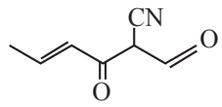
2-amino-3-formylbutanedioicanhydride]

12. Write the IUPAC name of the following compounds.

(i) 

(ii) 

(iii) 

(iv) 

Sol.

(i) ethyl-4-chloro-6-methoxycyclohex-2-enecarboxylate

(ii) but-2-enoic-3-methylbutanoicanhydride

(iii) 1,5-epoxyhexane

(iv) 2-formyl-3-oxohex-4–enenitrile

13. Write structures of the following compound.

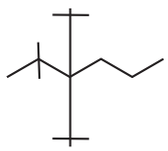
(*a*) 3,3-bis(1,1-Dimethylethyl)-2,2-dimethylhexane

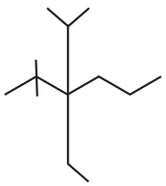
(*b*) 3-(1,1-dimethylethyl)-3-ethyl-2,2-dimethylhexane

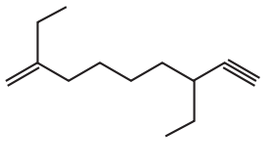
(*c*) 2,7-Diethylnon-1-en-8-yne

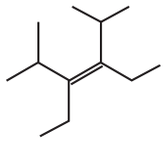
(*d*) 3-Ethyl-2-methyl-4-(1-methylethyl)hex-3-ene

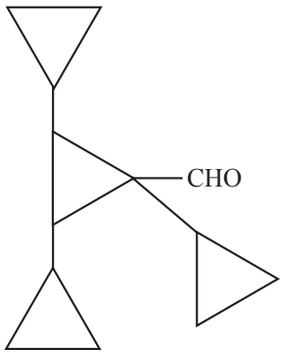
Sol.

(*a*) 

(*b*) 

(*c*) 

(*d*) 

14. 

Correct IUPAC name of this compound is

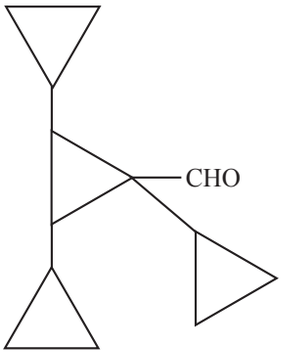
(*a*) Tetracyclopropanal

(*b*) 1,2,3-tricyclopropylcyclopropanal

(*c*) 1,2,3-tricyclopropylcyclopropanecarbaldehyde

(*d*) 1-formyl-1,2,3-tricyclopropylcyclopropane

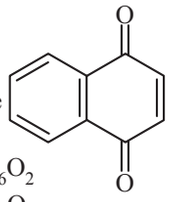
Sol.



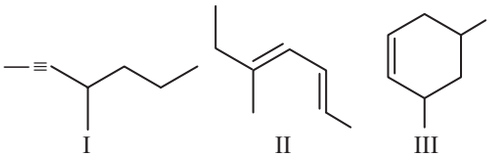
1,2,3-tricyclopropylcyclopropanecarbaldehyde

Therefore, option (*c*) is the correct answer.

INTRODUCTION

1. Molecular formula of naphthaquinone  is:

(*a*) $C_{12}H_8O_2$ (*b*) $C_{11}H_6O_2$
(*c*) $C_{10}H_6O_2$ (*d*) $C_{10}H_8O_2$

2. 

Identify incorrect statement for the above structure:

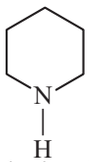
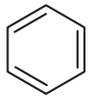
(*a*) I, II & III have C_nH_{2n-2} general formula.

(*b*) I, II & III have same empirical formula.

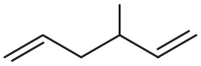
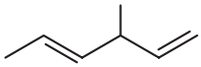
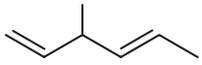
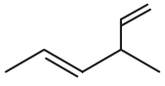
(*c*) I and II are identical and are homologue of compound III.

(*d*) I, II & III have same molecular formula.

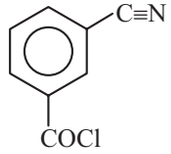
3. Which of the following is not an alicyclic compound ?

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

4. Which of the following is not the bond line structure of $CH_3—CH=CH—\underset{\displaystyle CH_3}{\underset{|}{CH}}—CH=CH_2$?

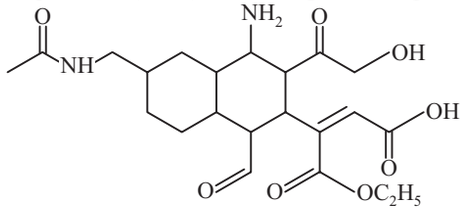
(*a*)  (*b*) 
(*c*)  (*d*) 

5. Identify degree of unsaturation of given compound



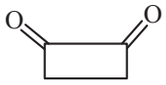
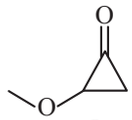
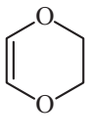
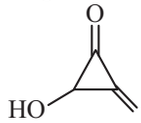
(*a*) 5 (*b*) 6 (*c*) 7 (*d*) 8

6. Sum of total number of different functional groups and double bond equivalent (DBE) value for given compound is:



(*a*) 13 (*b*) 14
(*c*) 15 (*d*) 16

7. Which of the following is heterocyclic compound ?

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

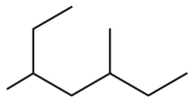
8. Which of the following homologous series has incorrect general formula?

(*a*) Alkyne: C_nH_{2n-2}
(*b*) Alkanol: $C_nH_{2n+2}O$
(*c*) Alkanal: $C_nH_{2n+1}O$
(*d*) Carboxylic acid: $C_nH_{2n}O_2$

9. The third member of the homologous series of aliphatic aldehydes has the structure:

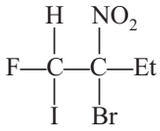
(*a*) CH_3CH_2CHO (*b*) $CH_3(CH_2)_2CHO$
(*c*) $H_3COCH_2CH_3$ (*d*) CH_3COCH_3

IUPAC-NOMENCLATURE OF ALKANE & CYCLO ALKANE

10. The correct IUPAC name of the alkane  is:

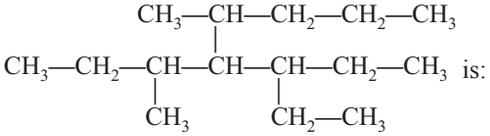
(*a*) 2-Ethyl-4-methylhexane
(*b*) 5-Ethyl-3-methylhexane
(*c*) 3,5-Dimethylheptane
(*d*) 3,5-Dimethylhexane

11. 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.

12. The IUPAC name of the compound

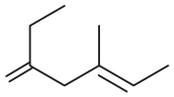
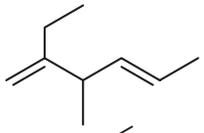


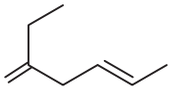
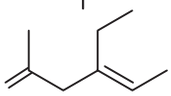
is:

(*a*) 5-Ethyl-3-methyl-4-(1-methylpropyl)octane
(*b*) 4-Ethyl-6-methyl-5-(1-methylpropyl)octane
(*c*) 3-Ethyl-5-methyl-4-(1-methylpropyl)octane
(*d*) 4-Sec-butyl-5-ethyl-5-methylheptane

IUPAC-NOMENCLATURE OF ALKENE, ALKYNE, CYCLO ALKENE AND POLYENES

13. The correct structure of 2-Ethyl-3-methylhexa-1,4-diene is:

(*a*)  (*b*) 

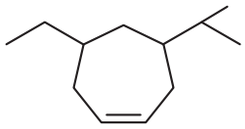
(*c*)  (*d*) 

14. The correct IUPAC name of 2-ethyl-3-pentyne is:

(*a*) 3-Methyl-4-hexyne (*b*) 4-Ethyl-2-pentyne

(*c*) 4-Methyl-2-hexyne (*d*) None of these

15. Correct IUPAC name of the following is:



(*a*) 4-Ethyl-6-(1-methylethyl)cycloheptene

(*b*) 4-(1-Methylethyl)-6-ethylcycloheptene

(*c*) 4-Ethyl-6-isopropylcycloheptene

(*d*) None of these

16. Select the structure with correct 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*) $\overset{7}{C}H_2=\overset{6}{C}H-\overset{5}{C}H-\overset{4}{C}H-\overset{3}{C}H_2-\overset{2}{C}H\equiv\overset{1}{C}H_2$

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

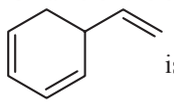
17. Identify correct IUPAC name of the compound

$$CH_2=CH-CH_2-\underset{\displaystyle C_2H_5}{\underset{|}{CH}}-CH_3$$

(*a*) 4-Ethylpent-1-ene (*b*) 2-Ethylpent-4-ene

(*c*) 4-Methylhex-1-ene (*d*) 3-Methylhex-1-ene

18. 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

IUPAC NOMENCLATURE OF NON-CHAIN TERMINATING FUNCTIONAL GROUPS

19. IUPAC name of the compound

$$CH_3-NH-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$$ is:

(*a*) 2-(N-methylamino)-4-methylpentane

(*b*) N-Methyl-4-methylpentan-2-amine

(*c*) 2-(N-methylamino)-3-isopropylpropane

(*d*) 2-(N-methylamino)-1,4,4-trimethylbutane

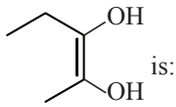
20. Which of the following is a correct priority order of functional groups?

(*a*) $-COOH > -SO_3H > -NH_2 > -\overset{\displaystyle O}{\overset{\|}{C}}-NH_2$

(*b*) $-\overset{\displaystyle O}{\overset{\|}{C}}-H > -\overset{\displaystyle O}{\overset{\|}{C}}-R > -OH > -NH_2$

(*c*) $-SO_3H > -\overset{\displaystyle O}{\overset{\|}{C}}-R > -CHO > -OH$

(*d*) $-\overset{\displaystyle O}{\overset{\|}{C}}-OR < -\overset{\displaystyle O}{\overset{\|}{C}}-X < -\overset{\displaystyle O}{\overset{\|}{C}}-O-\overset{\displaystyle O}{\overset{\|}{C}}- < -CHO$

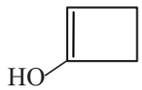
21. IUPAC name of  is:

(*a*) But-2-ene-2,3-diol

(*b*) Pent-2-ene-2,3-diol

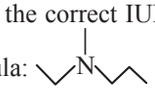
(*c*) 2-Methylbut-2-ene-2,3-diol

(*d*) Pent-3-ene-3,4-diol

22. The IUPAC name of the compound  is:

(*a*) Cyclobut-1-en-1-ol (*b*) Hydroxycyclobutene

(*c*) Cyclobutanol (*d*) None of these

23. Write the correct IUPAC name of the following bond line formula: 

(*a*) N-Methyl-N-ethylpropanamine

(*b*) N-Ethyl-N-methylpropan-1-amine

(*c*) N-Methyl-N-propylethan-1-amine

(*d*) N-Ethyl-N-propyl-N-methyl-amine

24. The IUPAC name of

$$CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_2-\underset{\displaystyle OH}{\underset{|}{C}}(CH_3)_2$$ is:

(*a*) 2-Methyl-2,4-dihydroxypropane

(*b*) 2,2-Dimethyl-4-hydroxybutanol

(*c*) 2-Methyl-2,4-pentanediol

(*d*) 2-Hydroxy-4,4-dimethylbutanol-4

IUPAC-NOMENCLATURE OF CHAIN TERMINATING FUNCTIONAL GROUPS

25. IUPAC name of the compound

$$BrCH_2-\underset{\displaystyle CONH_2}{\underset{|}{CH}}-CO-CH_2-CH_2CH_3$$ is:

(*a*) 2-(Bromomethyl)-3-oxohexanamide

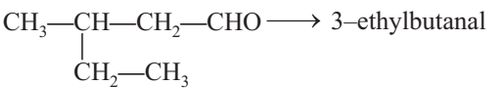
(*b*) 1-Bromo-2-amido-3-oxohexane

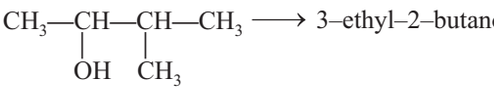
(*c*) 1-Bromo-2-amido-n-propyl ketone

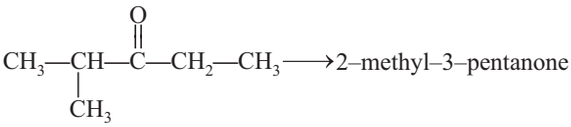
(*d*) 3-Bromo-2-propanoyl-propanamide

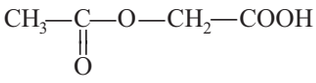
26. Which of the following compounds has wrong IUPAC name?

(*a*) $CH_3-CH_2-CH_2-COO-CH_2CH_3 \longrightarrow$ ethyl butanoate

(*b*)  $\longrightarrow$ 3–ethylbutanal

(*c*)  $\longrightarrow$ 3–ethyl–2–butanol

(*d*)  $\longrightarrow$ 2–methyl–3–pentanone

27. 

The IUPAC name of the above compound is:

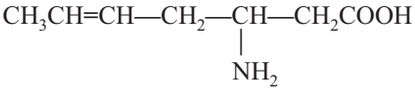
(*a*) 2–Acetoxyethanoic acid

(*b*) 2–Methoxycarbonylethanoic acid

(*c*) 3–Methoxyformylethanoic acid

(*d*) 2–Methoxyformylacetic acid

28. The IUPAC name of the following is:



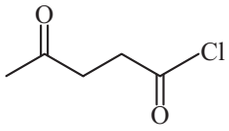
(*a*) 3-Aminohept-5-enoic acid

(*b*) 5-Aminohex-2-enecarboxylic acid

(*c*) 3-Aminohept-4-enoic acid

(*d*) 5-Aminohept-2-enoic acid

29. The correct IUPAC name of compound is:



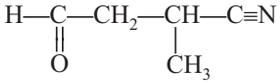
(*a*) 1-Chloropentane-1,4-dione

(*b*) 4-Chlorocarbonylbutan-2-one

(*c*) 4-Oxopentanoyl chloride

(*d*) 3-Oxobutanecarbonyl chloride

30. IUPAC name of given compound is:



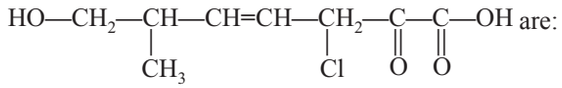
(*a*) 3-Carbonitrile-3-methylbutanal

(*b*) 3-Formyl-2-methylpropanenitrile

(*c*) 3-Cyanobutanal

(*d*) 2-Methyl-4-oxobutanenitrile

31. The suffix of the principal group, the prefixes for the other groups and the name of the parent chain in the structure

 are:

(*a*) -oic acid, chloro, hydroxy, oxo, methyl, 4-heptene

(*b*) -oic acid, chloro, hydroxy, methyl, oxo, 4-heptene

(*c*) -one, carboxy, chloro, methyl, hydroxy, 4-heptene

(*d*) -one, carboxy, chloro, methyl, hydroxy, 4-heptene

32. The IUPAC name of $C_6H_5CH = CH–COOH$ is:

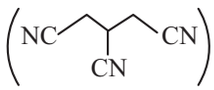
(*a*) Cinnamic acid

(*b*) 1-Phenyl-2-carboxyethene

(*c*) 3-Phenylprop-2-enoic acid

(*d*) Dihydroxy-3-phenylpropionic acid

33. The IUPAC name of the following compound is:



(*a*) Propane-1,2,3-tricarbonitrile

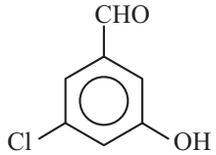
(*b*) 3-Cyanopetane-1,5-dinitrile

(*c*) Pentane-1,3,5-trinitrile

(*d*) All are correct

IUPAC-NOMENCLATURE OF AROMATIC COMPOUNDS

34. The IUPAC name of the following compound is:



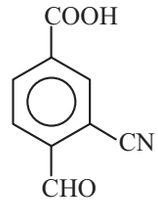
(*a*) 5-Chloro-3-hydroxybenzenecarbaldehyde

(*b*) 3- Chloro-5-formylphenol

(*c*) 3-Chloro-5-hydroxybenzenecarbaldehyde

(*d*) 1-Chloro-3-formyl-5-hydroxybenzene

35. The IUPAC name of the compound is:



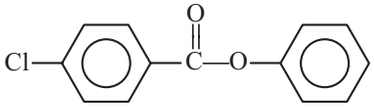
(*a*) 2-Cyano-1-formylbenzene-4-carboxylic acid

(*b*) 3-Cyano-4-formylbenzoic acid

(*c*) 4-Carboxy-2-cyanobenzene-1-carbaldehyde

(*d*) 2-Formyl-5-carboxybenzene-1-carbonitrile

36. IUPAC name of the following compound

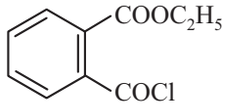
 is:

(*a*) 4-Chlorophenyl benzoate

(*b*) Phenyl-4-chloro benzoate

(*c*) Benzyl-l-4-chlorobenzene carboxylate

(*d*) 4-Chlorodiphenyl carboxylate

37. IUPAC name of the compound  is:

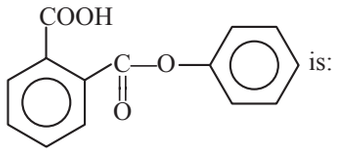
(*a*) 2-Chlorocarbonylethylbenzene carboxylate

(*b*) 2-Carboxyethylbenzoyl chloride

(*c*) Ethyl-2-(chlorocarbonyl)benzene carboxylate

(*d*) Ethyl-1-(chlorocarbonyl)benzene carboxylate

38. The correct IUPAC name of the compound

 is:

(*a*) 2-Phenoxycarbonylbenzene carboxylic acid

(*b*) Phenyl-2-carboxybenzene carboxylate

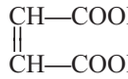
(*c*) 2-Benzoyloxybenzenecarboxylic acid

(*d*) 2-Benzyloxycarbonylbenzenecarboxylic acid

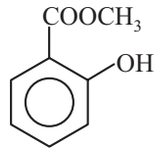
COMMON NAMES SYSTEMS

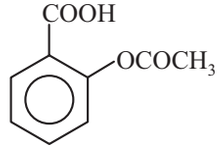
39. Which of the following is crotonic acid?

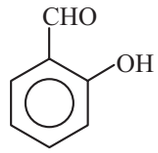
(*a*) CH_2=CH–COOH (*b*) C_6H_5–CH=CH–COOH

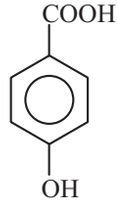
(*c*) CH_3–CH=CH–COOH (*d*) 

40. Which of the following is the structure of Aspirin?

(*a*) 

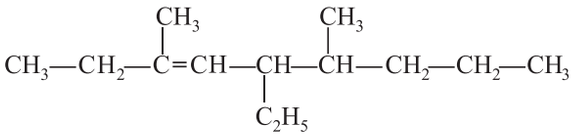
(*b*) 

(*c*) 

(*d*) 

PRABAL (JEE MAIN LEVEL)

1. The correct IUPAC name of the compound

 is:

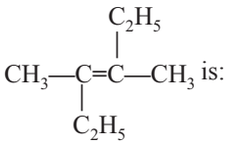
(*a*) 5-Ethyl-3,6-dimethylnon-3-ene

(*b*) 5-Ethyl-4,7-dimethylnon-3-ene

(*c*) 4-Methyl-5,7-diethyloct-2-ene

(*d*) 2,4-Ethyl-5-methyloct-2-ene

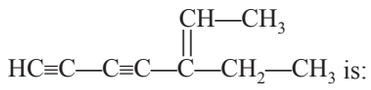
2. The correct IUPAC name of the following compound

 is:

(*a*) 1,2-Diethylbutane (*b*) 2-Ethyl-3-methylpentane

(*c*) 3,4-Dimethyl-3-hexene (*d*) None is correct

3. The IUPAC name of compound

 is:

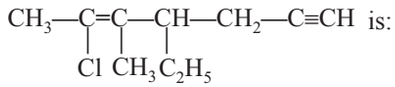
(*a*) 5-Ethyl-5-heptene-1,3-diyne

(*b*) 3-Ethyl-2-heptene-4,6-diyne

(*c*) 5-Ethenyl-1,3-heptatriyne

(*d*) 3-Ethenyl-4,6-heptatriyne

4. The IUPAC name of

 is:

(*a*) 6-Chloro-4-ethyl-5-methyl-5-hepten-1-yne

(*b*) 5-methyl-4-ethyl-6-chloro-5-hepten-1-yne

(*c*) 6-Chloro-4-ethyl-5-methyl-1-hepten-5-yne

(*d*) 2-Chloro-4-ethyl-methyl-6-hepten-2-ene

5. The IUPAC name of the compound $Br(Cl)CHCF_3$ is:

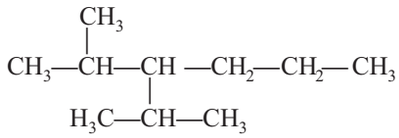
(*a*) Haloethane

(*b*) 1,1,1-Trifluoro-2-bromo-2-chloroethane

(*c*) 2-Bromo-2-chloro-1,1,1-trifluoroethane

(*d*) 1-Bromo-1-chloro-2,2,2-trifloro ethane

6. The correct IUPAC name for the given structure is:

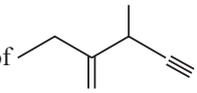


(*a*) 3-Isopropyl-2-methylhexane

(*b*) 4-Isopropyl-3-methylhexane

(*c*) 3-Ethyl-2,5-dimethylhexane

(*d*) 2-Ethyl-3-isopropylpentane

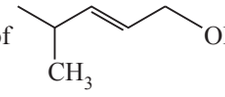
7. The IUPAC name of  is:

(*a*) 2-Ethyl-3-methyl-1-penten-4-yne

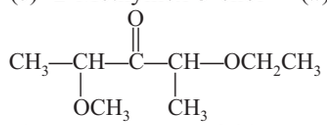
(*b*) 2-Ethyl-3-methyl-4-pentyn-1-ene

(*c*) 4-Ethyl-3-methyl-1-pentyn-4-ene

(*d*) 4-Ethyl-3-ethyl-4-penten-1-yne

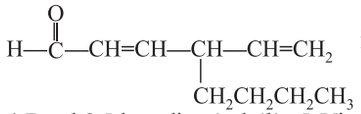
8. IUPAC name of  is:

(*a*) 5-Methylhexanol (*b*) 2-Methylhexanol
(*c*) 2-Methylhex-3-enol (*d*) 4-Methylpent-2-en-1-ol

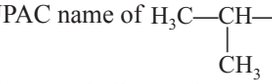
9. 

The IUPAC name of this compound is:
(*a*) 2-Ethoxy-4-methoxypentan-3-one
(*b*) 2-Methoxy-4-ethoxypentan-3-one
(*c*) 2-Ethoxy-4-methoxypentan-3-one
(*d*) None of these

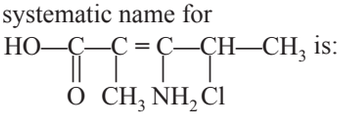
10. IUPAC name of

 is:

(*a*) 4-Butyl-2,5-hexadien-1-al (*b*) 5-Vinyloct-3-en-1-al
(*c*) 5-Vinyloct-5-en-8-al (*d*) 3-Butyl-1,4-hexadien-6-al

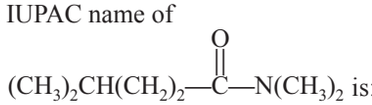
11. IUPAC name of  is:
(*a*) 5-Methylhexanol (*b*) 2-Methylhexanol
(*c*) 2-Methylhex-3-enol (*d*) 4-Methylpent-2-en-1-ol

12. The systematic name for

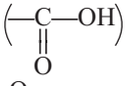
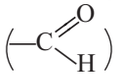
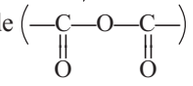
 is:

(*a*) 2-Methyl-3-amino-4-chloro-2-pentenoic acid
(*b*) 1-Hydroxy-1-oxo-2-methyl-3-amino-4-chloro-2-pentene
(*c*) 3-Amino-4-chloro-2-methyl-2-pentenoic acid
(*d*) 3-Amino-2, 4-dimethyl-4-chloro-2-butenoic acid

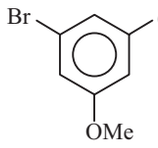
13. The IUPAC name of

 is:

(*a*) N, N, 4-trimethylpentanamide
(*b*) Dimethylamino-4-methylpentanone
(*c*) N, N-dimethylamino-4-methylpentanamide
(*d*) 2-Methyl-5-oxodimethylpentanamine

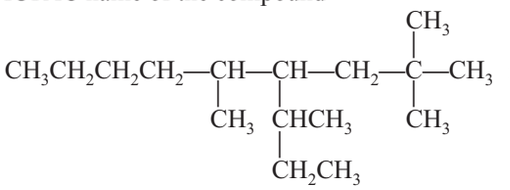
14. A compound of molecular formula $C_6H_{12}O_3$ can never have a functional group:
(*a*) Carboxylic acid 
(*b*) Aldehyde 
(*c*) Ester 
(*d*) Anhydride 

15. Correct IUPAC name for the compound

 is:

(*a*) 3-Methoxy-5-bromobenzene carbaldehyde
(*b*) 3-Formyl-5-bromophenylmethylether
(*c*) 3-Formyl-5-bromo-1-methoxybenzene
(*d*) 3-Bromo-5-methoxybenzene carbaldehyde

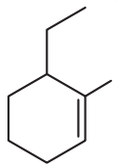
16. IUPAC name of the compound

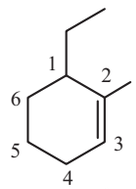
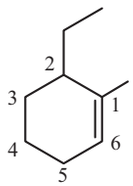
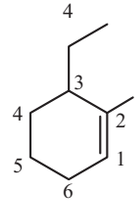
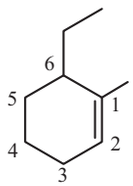
 is:

(*a*) 2,2,5-Trimethyl-4-(1-methylpropyl)nonane
(*b*) 4,8,8-Trimethyl-6-(1-methylpropyl)nonane
(*c*) 3,5-Dimethyl-4-(1-methylenetertiarybutyl)nonane
(*d*) 6,6-Dimethyl-2-propyl-4-(1-methylpropyl)heptane

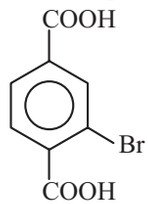
17. In the structure of 4-Isopropyl-2,4,5-trimethylheptane, number of 1°, 2° and 3° H's are respectively:
(*a*) 18, 5, 4 (*b*) 21, 4, 3 (*c*) 18, 4, 3 (*d*) 21, 5, 4

18. The correct IUPAC numbering in the compound

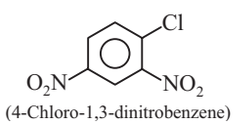
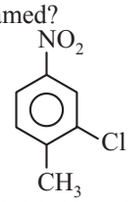
 is:

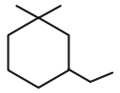
(*a*) 
(*b*) 
(*c*) 
(*d*) 

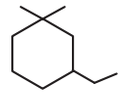
19. IUPAC name of the following molecule is:



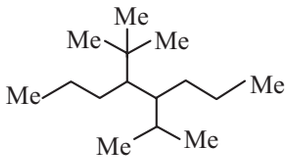
(*a*) 2-Bromobenzene-1,4-dioic acid
(*b*) 3-Bromobenzene-1,4-dicarboxylic acid
(*c*) 2-Bromobenzene-1,4-dicarboxylic acid
(*d*) 3-Bromobenzene-1,6-dicarboxylic acid

20. Which of the following is correctly named?
(*a*) 
(4-Chloro-1,3-dinitrobenzene)
(*b*) 
(4-Methyl-5-chloro-nitro benzene)

(*c*) 
(3-Ethyl-1,1-dimethyl cyclohexane)

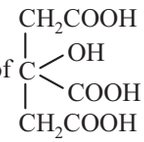
(*d*) 
(1-Ethyl-3,3-dimethyl cyclohexane)

21. Find the IUPAC name of:

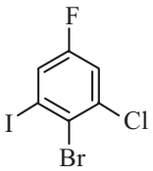


(*a*) 2,2-Dimethyl-3-propyl-4-isopropylheptane.
(*b*) 4-Isopropyl-5-t-butyloctane.
(*c*) 4-t-Butyl-5-isopropyloctane.
(*d*) 2-Methyl-3-propyl-4-isopropylheptane.

22. Which of the following statements is wrong for a homologous series?
(*a*) All members have same general formula.
(*b*) All members have the same functional group.
(*c*) All members have the same chemical properties.
(*d*) All members have the same physical properties.

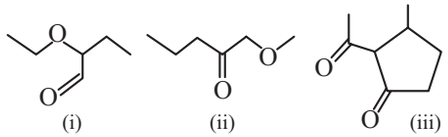
23. The IUPAC name of  is:

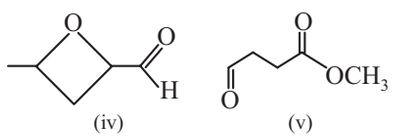
(*a*) 3-Carboxy-3-hydroxypentanedicarboxylic acid.
(*b*) 2-Hydroxypropane-1,2,3-tricarboxylic acid.
(*c*) 2-Hydroxypropane-1,2,3-trioic acid.
(*d*) 3-Hydroxypropane-1,2,3-tricarboxylic acid.

24. The IUPAC name of  is:

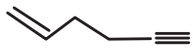
(*a*) 1-Bromo-2-chloro-3-fluoro-6-iodobenzene.
(*b*) 2-Bromo-1-chloro-5-fluoro-3-iodobenzene.
(*c*) 4-Bromo-2-chloro-5-iodo-1-fluorobenzene.
(*d*) 2-Bromo-3-chloro-1-iodo-5-fluorobenzene.

25. Many organic compounds contain more than one functional groups. Which of the following is both an aldehyde and ether?

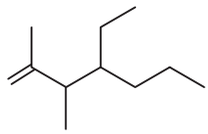
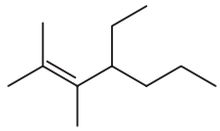


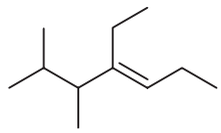
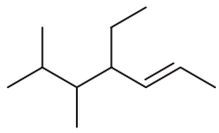


(*a*) (i) only (*b*) (i) and (iv)
(*c*) (ii) and (v) (*d*) (iii) and (iv)

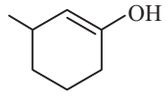
26.  IUPAC name of this compound will be
(*a*) Hex-5-en-1-yne (*b*) Hex-1-en-5-yne
(*c*) Hex-6-en-1-yne (*d*) Hex-1-en-6-yne

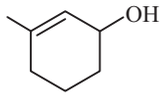
27. Select the structure of 4–ethyl–2,3–dimethyl–2–heptene:

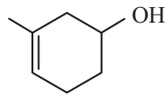
(*a*)  (*b*) 

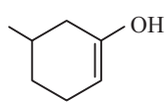
(*c*)  (*d*) 

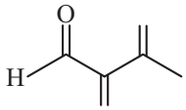
28. Which of the following structure is 3–Methyl cyclohex–3–enol?

(*a*) 

(*b*) 

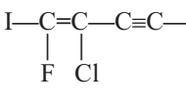
(*c*) 

(*d*) 

29.  is named as**:**

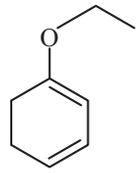
(*a*) 2, 3-Dimethylenebutanal
(*b*) 3-Methyl-2-methylenebut-3-enone
(*c*) 3-Methyl-2-methylidenebut-3-enal
(*d*) 2, 3-Dimethylenebutanone

30. The correct IUPAC name of the given compound is



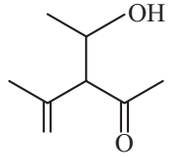
(*a*) 3–Chloro–1–fluoro–1–iodo–4–methoxybut–1–en–3–yne
(*b*) 2–Chloro–1–fluoro–1–iodo–4–methoxybutenyne
(*c*) 3–Chloro–4–fluoro–4–iodo–1–methoxybutenyne
(*d*) 2–Chloro–1–fluoro–1–iodo–4–methoxybutenyne

31. 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

32. The correct IUPAC name of the compound is:



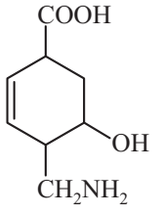
(*a*) 3-(1-Methylethenyl)-4-hydroxypentan-2-one

(*b*) 3-(1-Hydroxyethyl)-4-methylpent-4-en-2-one

(*c*) 3-(1-Hydroxymethyl)-4-methylenepentan-2-one

(*d*) 3-(1-Oxoethyl)-4-methylpent-4-en-2-ol.

33. The correct IUPAC name of following compound is



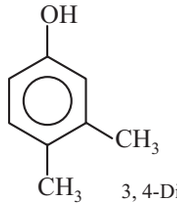
(*a*) 4-Aminomethyl-3-hydroxycyclohex-5-ene-1-carboxylic acid

(*b*) 2-Aminomethyl-5-carboxycyclohex-3-en-1-ol

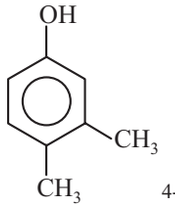
(*c*) 4-Aminomethyl-5-hydroxycyclohex-2-ene-1-carboxylic acid

(*d*) 3-Hydroxy-4-aminomethylcyclohex-5-en-1-oic acid

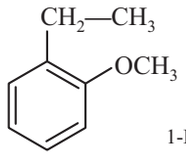
34. Which of the following is correct IUPAC name?

(*a*) 

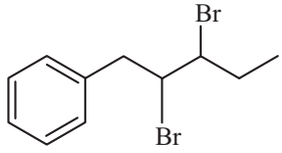
3, 4-Dimethylphenol.

(*b*) 

4-Hydroxy-2-methyltoluene.

(*c*) 

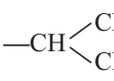
1-Ethyl-2-anisole.

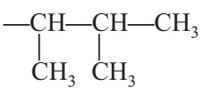
(*d*) 

1-(2,3-Dibromopentyl)benzene.

INTEGER TYPE QUESTIONS

35. Number of correct IUPAC names in the given substituents are:

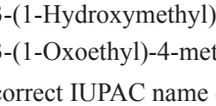
(*a*)  Ethylmethyl

(*b*)  2,3-Dimethylpropyl

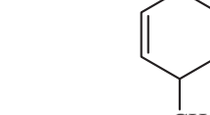
(*c*) $= CH–CH_3$ Ethylidene

(*d*) $–C\equiv CH$ Ethynyl

(*e*) $–CH_2–C\equiv CH$ Prop-1-ynyl

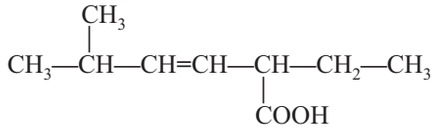
(*f*)  1-Methylpropyl

(*g*)  2,3-Dimethylbutyl

(*h*)  2-Methylethenyl

(*i*) $–CH_2–CH=CH_2$ 2-Propenyl

36. Observe the compound



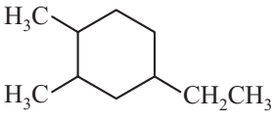
and answer the given question.

x = Number of carbon atoms in principal carbon chain.

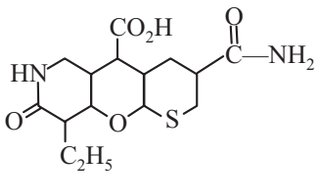
y = locant of methyl group.

z = locant of C = C.

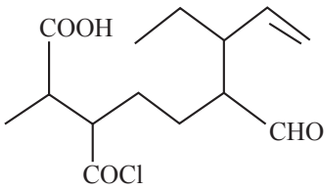
Write your answer as x + y + z.

37. 

When IUPAC name of above compound is given, then substituents gets respectively (x, y and z) number, so the sum of (x + y + z) will be.

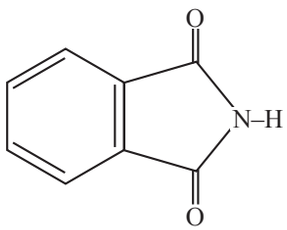
38. 

Number of functional groups in the above compound is …….

39. 

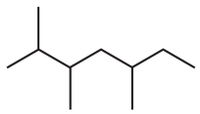
According to IUPAC rules, find number of carbon atoms present in principal chain.

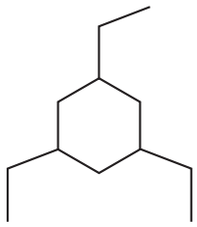
40. Find the sum of number of σ-bond + number of π-bond + degree of unsaturation for the following compound.

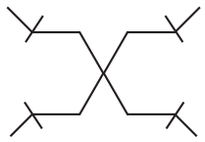


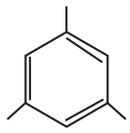
SINGLE CORRECT TYPE QUESTIONS

1. Which compound has same number of 1°, 2°, 3° carbon atoms?

(*a*) 

(*b*) 

(*c*) 

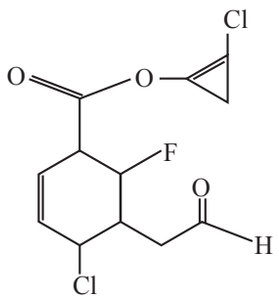
(*d*) 

2. Build 5-ethyl-2,3,4-trimethylheptane by dragging the groups to the question marks:

(*a*) A(1) B(2) (*b*) A(2) B(l)

(*c*) A(l) A(2) (*d*) B(1) B(2)

3. IUPAC name of the following compound is / are:



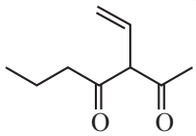
(*a*) (2-chlorocyclopropenyl)-4-chloro-2-fluoro-3 (2-oxoformyl)cyclohex-5-ene-1-carboxylate

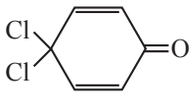
(*b*) (2-chlorocyclopropenyl)-4-chloro-6-fluoro-5 (2-oxoethyl)cyclohex-2-ene-1-carboxylate

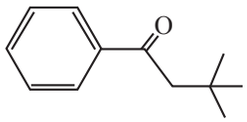
(*c*) (2-chlorocyclopropenyl)-4-chloro-6-fluoro-5 (formylmethyl)cyclohexane-1-carboxylate

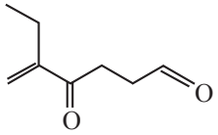
(*d*) (2-chlorocyclopropenyl)-4-chloro-2-fluoro-3 (formylmethyl)cyclohex-5-ene-1-carboxylate

4. Which of the following compound is not named correctly?

(*a*)  3-ethenyl-2,4-heptanedione

(*b*)  4,4-dichloro-2,5-cyclohexadien-1-one

(*c*)  3,3-dimethyl-1-phenyl-1-butanone

(*d*)  5-methylene-hepta-1,4-dione

5. Write the correct IUPAC name of 2-amino-1, 3, 7-trihydroxy hept-4-ene-1, 7-dione?

(*a*) 6-Amino-5-hydroxyhept-3-ene-1,7-dioicacid

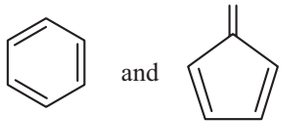
(*b*) 2-Amino-3-hydroxyhept-4-ene-1,7-dioicacid

(*c*) 6-Amino-5-hydroxyhept-4-ene-1,7-dicarboxylic acid

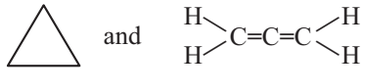
(*d*) 6-Amino-5-hydroxyhept-3-ene-1,7-dicarboxylic acid

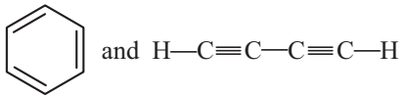
MULTIPLE CORRECT TYPE QUESTIONS

6. Select the pair of compounds having same general formula?

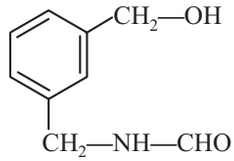
(*a*) 

(*b*) 

(*c*) 

(*d*) 

7. Which functional groups are not present in given compound?



(*a*) Amide (*b*) Alcohol

(*c*) Amine (*d*) Aldehyde

8. Select the correct IUPAC name:

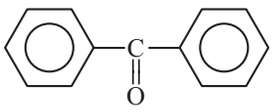
(*a*) Methane-1,1,1,1-tetracarboxylic acid

(*b*) 5-Carbonyl-heptane-1,7-dioic acid

(*c*) 2-Chloroethanoyl chloride

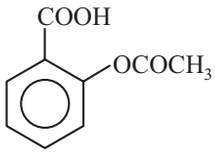
(*d*) 1-Bromo-3-fluoro-4-methylcyclohexane

9. Which of the following are correct common names?

(*a*)  Acetophenone

(*b*) CH_3COCH_3 Acetone

(*c*) $PhCOCH_3$ Benzophenone

(*d*)  Aspirin (Acetyl salicylic acid)

10. Which of the following IUPAC name(s) is/are incorrect?

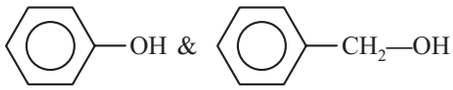
(*a*) 4-Chloro-3-methylcyclopentanol

(*b*) 1-Amino-3-bromohexan-1-one

(*c*) 4-chloro-3-methylcyclohexane carboxylic acid

(*d*) 3-Bromo-1-methylhexan-1-ol

11. Which of the following represent correct pair of homologues?

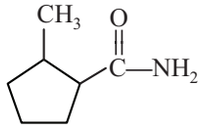
(*a*) 

(*b*) Me–OH & $MeCH_2CH_2OH$

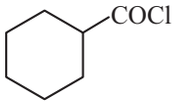
(*c*) 

(*d*) 

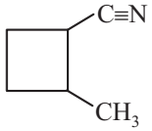
12. Which of the following IUPAC names are correct?

(*a*) 

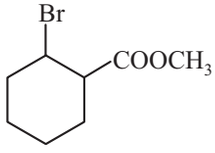
2-Methylcyclopentane carboxamide.

(*b*) 

Cyclohexanoyl chloride.

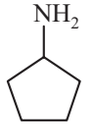
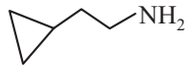
(*c*) 

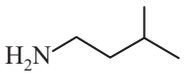
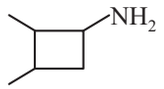
2-Methylcyclobutane carbonitrile

(*d*) 

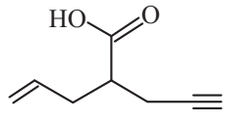
Methyl-2-bromocyclohexane carboxylate

13. Which among the following compound(s) is a primary amine with the molecular formula $C_5H_{11}N$?

(*a*)  (*b*) 

(*c*)  (*d*) 

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



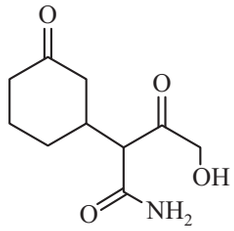
(*a*) Double bond equivalent (DBE) value of the compound is 4.

(*b*) Total 3 different functional groups are present.

(*c*) Correct IUPAC name is 2-(prop-2-ynyl)pent-4-enoic acid.

(*d*) Correct IUPAC name is 2-(prop-2-enyl)pent-4-ynoic acid.

15. Functional group present in given compound is/are?



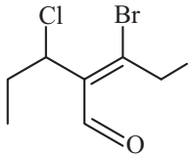
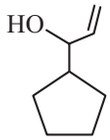
(*a*) Alcohol

(*b*) Ketone

(*c*) Carboxylic acid

(*d*) Amide

16. Correct statement about the following compounds (P) and (Q) is:

Compound (P) Compound (Q)

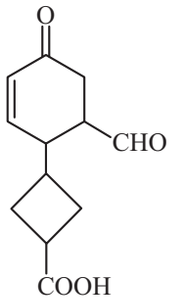
(*a*) Total number of substituents in compound (P) is (1).

(*b*) Total number of carbon atoms in parent chain of compound (Q) is (3).

(*c*) IUPAC name of compound (Q) is 1-Cyclopentylprop-2-en-1-ol.

(*d*) Total number of carbons in parent chain of compound (P) are 5.

17. Which of the following statements are correct for the given compound?



(*a*) Double bond equivalent value is 5.

(*b*) Number of carbon in parent chain is 4.

(*c*) Correct IUPAC name is 3-(2-formyl-4-oxocyclohex-5-enyl)cyclobutane carboxylic acid.

(*d*) All of these

COMPREHENSION BASED QUESTIONS

Comprehension (Q. 18 to 20): 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.

18. How many 3° hydrogen atoms are present in the hydrocarbon (P)?

(*a*) 2 (*b*) 3

(*c*) 4 (*d*) 5

19. How many 2º carbon atoms are present in the compound (P)?

(*a*) 10 (*b*) 12

(*c*) 6 (*d*) 8

20. IUPAC name of hydrocarbon (P) is:

(*a*) 1-(1-Ethylpropyl)-3-ethyl-5-(1,1-dimethylethyl) cyclohexane

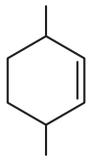
(*b*) 1-Ethyl-3-(1-ethylpropyl)-5-(1,1-dimethylethyl) cyclohexane

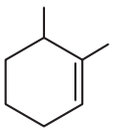
(*c*) 1-(1,1-Dimethylethyl)-3-ethyl-5-(1-ethylpropyl) cyclohexane

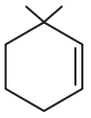
(*d*) 1-(1,1-Dimethylethyl)-3-ethyl-5-(2-ethylpropyl) cyclohexane

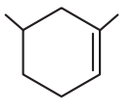
Comprehension (Q. 21 to 22): To avoid having to memorize the names of thousands of structural units, chemists have devised rules that name compounds on the basis of their structures. That way, only the rules have to be learned because the name is based on the structure, these rules make it possible to deduce the structure of a compound from its name. This method of nomenclature is called systematic nomenclature. It is also called IUPAC nomenclature

21. Which of the following name will be not correct?

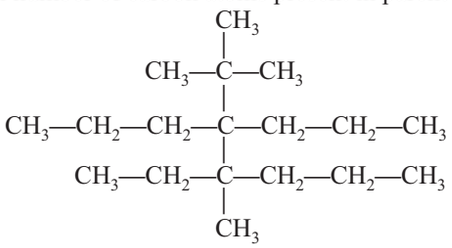
(*a*)  3,6-Dimethylcyclohexene

(*b*)  1,6-Dimethylcyclohexene

(*c*)  6,6-Dimethylcyclohexene

(*d*)  1,5-Dimethylcyclohexene

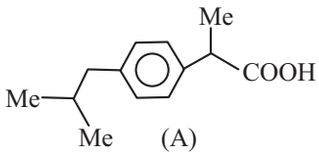
22. Total number of carbon atoms present in parent chain is:



(*a*) 5 (*b*) 6

(*c*) 7 (*d*) 8

Comprehension (Q. 23 to 26): The analgesic drug ibuprofen (A) is chiral and exists in (+) and (–) forms. One enantiomer is physiologically active, while the other is physiologically inactive. The structure of ibuprofen is given below:



23. The principal functional group in (A) is:

(*a*) Phenyl (*b*) —COOH group

(*c*) Isopropyl (*d*) Both (*a*) and (*b*)

24. The IUPAC name of (A) is:

(*a*) 3-(p-Isobutylphenyl)propanoic acid

(*b*) 2-(p-Isobutylphenyl)propanoic acid

(*c*) 3-(p-Sec-Butylphenyl)propanoic acid

(*d*) 2-(p-Sec-Butylphenyl)propanoic acid

25. The number of π-bonds in (A) is:

(*a*) 2 (*b*) 3

(*c*) 4 (*d*) 5

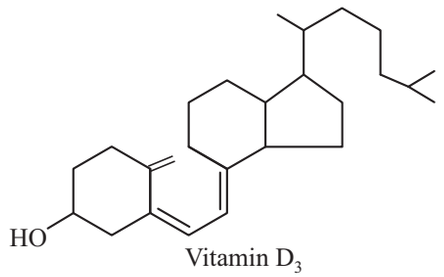
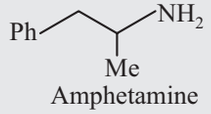
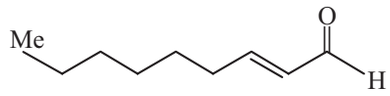
26. The number of σ-bonds in (A) is:

(*a*) 30 (*b*) 31

(*c*) 32 (*d*) 33

MATCH THE COLUMN TYPE QUESTIONS

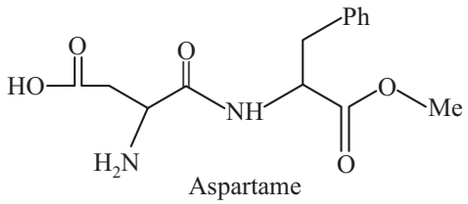
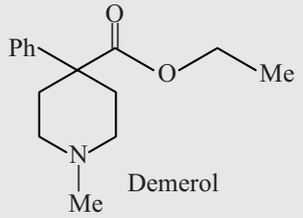
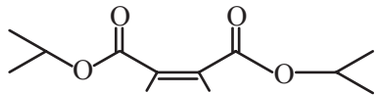
27. Match the column

Column-I Compound		Column-II Contains the functional groups	
A.	 Vitamin D_3	p.	1° amine
B.	 Amphetamine	q.	2° alcohol
C.		r.	Triene
		s.	Aldehyde and ene

(*a*) A → r,q; B → p; C → s (*b*) A → r; B → p; C → s

(*c*) A → p; B → q; C → s (*d*) A → s; B → p; C → q

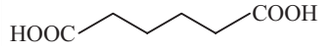
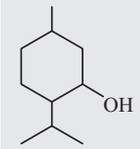
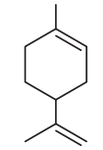
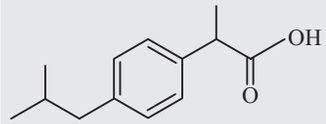
28. Match the column

Column-I Compound		Column-II Contains the functional groups	
A.	 Aspartame	p.	ene and diester
B.	 Demerol	q.	Carboxylic acid, 1° amine, amide
C.		r.	Ester
		s.	3° amine

(*a*) A → p; B → r,s; C → q,r (*b*) A → q,r; B → r,s; C → p

(*c*) A → q; B → r; C → p (*d*) A → p; B → r; C → q

29. Match the column

Column-I Compound		Column-II Contains the functional groups	
A.	 (Adipic acid)	p.	6 Carbons in parent chain.
B.	 (Muscarine)	q.	3 Carbons in parent chain.
C.	 (Limonene)	r.	D.B.E. (Double bond equivalent) value is 5.
D.		s.	Only 1 type of functional group is present.
		t.	IUPAC name is 2-[4-(2-methylpropyl)phenyl]propanoic acid.

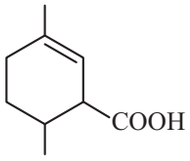
(*a*) A → q,r,t; B → p,s; C → p,s; D → p,s

(*b*) A → r,s,t; B → p,s; C → p,s; D → q,r,t

(*c*) A → q,r,t; B → p,q; C → p,s; D → p,s

(*d*) A → p,s; B → p,s; C → p,s; D → q,r,t

INTEGER TYPE QUESTIONS

30. 

Number of position isomers by changing position of –COOH only = X.

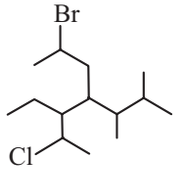
Number of position isomers by changing position of double bond only = Y.

(Include the given compound in both X & Y).

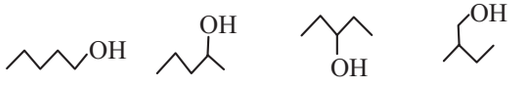
What is the value of |X–Y|?

31. A cyclic organic compound contains nitrogen atom and 5 carbon atom with DBE 4 then find the total value of (σ - π) bonds.

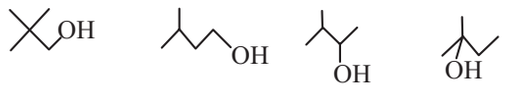
32. How many total number of substituents are present in the following compound?



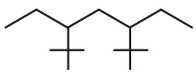
33. How many number of compounds among the following, will have same IUPAC name?



(i) (ii) (iii) (iv)



(v) (vi) (vii) (viii)

34. 

Find the sum of the following

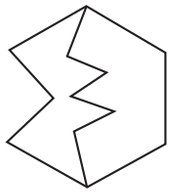
(*a*) Number of carbon atoms in the principal carbon chain

(*b*) Number of side chain

(*c*) Number of methyl substituent in the principal carbon chain

(*d*) Number of ethyl substituent in principal carbon chain

35. The IUPAC name of following compound is Bicyclo [x,y,z] dodecane. What is the value of x+y +z?



36.

(*a*) 3,6-Bis-(1,1-dimethylethyl)octane

(*b*) Octa-4,7-dien-2-amine

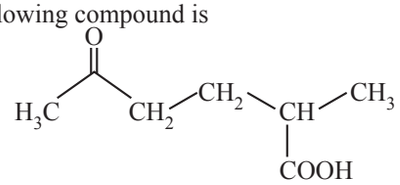
(*c*) 3-Hydroxymethylcyclohexanecarboxylic acid

(*d*) 2-Nitropent-3-ene

If the given IUPAC name is correct then write 1 and if it is wrong then write 2. **[If Answer is 2121 then write 2121]**

PYQ's (PAST YEAR QUESTIONS)

1. The correct IUPAC nomenclature for the following compound is **[8 April, 2023 (Shift-II)]**

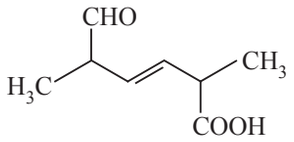


(*a*) 5–Formyl–2–methylhexanoic acid
(*b*) 2–Methyl–5–oxohexanoic acid
(*c*) 2–Formyl–5–methylhexan–6–oic acid
(*d*) 5–Methyl–2–oxohexan–6–oic acid

2. The correct decreasing order of priority of functional groups in naming an organic compound as per IUPAC system of nomenclature is **[26 July, 2022 (Shift-II)]**

(*a*) $-COOH > -CONH_2 > -COCl > -CHO$
(*b*) $-SO_3H > -COCl > -CONH_2 > -CN$
(*c*) $-COOR > -COCl > -NH_2 > C=O$
(*d*) $-COOH > -COOR > -CONH_2 > -COCl$

3. The IUPAC name for the following compound is:



[2 Sept, 2020 (Shift-I)]

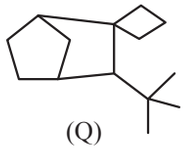
(*a*) 2,5-Dimethyl-6-carboxy-hex-3-enal
(*b*) 6-Formyl-2-methyl-hex-3-enoic acid
(*c*) 2,5-Dimethyl-6-oxo-hex-3-enoic acid
(*d*) 2,5-Dimethyl-5-carboxy-hex-3-enal

PW CHALLENGERS

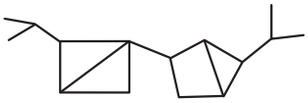
MULTIPLE CORRECT TYPE QUESTIONS

1.

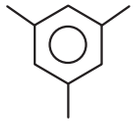
(P)



(Q)



(R)



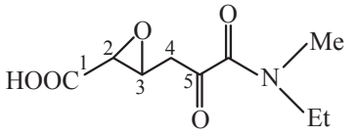
(S)

Consider the above compounds and identify true statements among the following:

(*a*) P is having four 2° & four 3° carbons
(*b*) Q is having three 1°, six 2°, three 3° & two 4° carbons
(*c*) R is having four 1°, two 2°, eight 3° carbons & one 4°carbon
(*d*) S is having three 1°, three 2° & three 3° carbons

SINGLE CORRECT TYPE QUESTIONS

2. Identify correct I.U.P.A.C. name of the following compound.

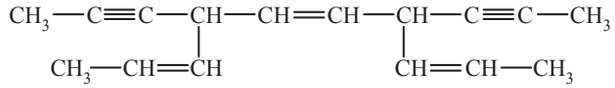


(*a*) 5,6-Dioxo-6-(N-ethyl-N-methyl-amino)-2,3-epoxy hexanoic acid.
(*b*) 6-(N-Ethyl-N-methylamino)-2,3-epoxy-5,6-dioxohexanoic acid.
(*c*) 5-(N-Ethyl-N-methylcarbamoyl)-2,3-epoxy-5-oxopentanoic acid
(*d*) 5-(N-Ethyl-N-methylcarbamoyl)-1,2-epoxy-4-oxobutanoic carboxylic acid.

3. Which of the following is correct IUPAC name?

(*a*) 2-Bromocyclohex-5-enecarbaldehyde
(*b*) Ethyl-2-vinylpentanoate
(*c*) 5-Bromo-3-chlorohept-3-ene
(*d*) 2-Ethenylhexa-1,5-diene

4. Identify true statement regarding the following compound:



(*a*) Parent Carbon Chain contains three double bonds.
(*b*) Parent Carbon Chain contains one double bond and two triple bonds.
(*c*) Parent Carbon Chain contains two double bonds and one triple bond.
(*d*) Parent Carbon Chain contains two double bonds and two triple bonds.

5. Which is the correct IUPAC name of 2-amino-1,3,7-trihydroxyhept-4-ene-1,7-dione?

(*a*) 6-Amino-5-hydroxyhept-3-ene-1,7-dioicacid
(*b*) 2-Amino-3-hydroxyhept-4-ene-1,7-dioicacid
(*c*) 6-Amino-5-hydroxyhept-4-ene-1,7-dicarboxylic acid
(*d*) 6-Amino-5-hydroxyhept-3-ene-1,7-dicarboxylic acid

6. A hydrocarbon (R) has six membered ring in which there is no unsaturation. Two alkyl groups are attached to the ring adjacent to each other. One group has 3 carbon atoms with branching at 1st carbon atom of chain and another has 4 carbon atoms. The larger alkyl group has main chain of three carbon atoms of which second carbon is substituted. Correct IUPAC name of compound (R) is

(*a*) 1-(1-Methylethyl)-2-(1-methylpropyl)cyclohexane

(*b*) 1-(2-Methylethyl)-2-(1-methylpropyl)cyclohexane

(*c*) 1-(1-Methylethyl)-2-(2-methylpropyl)cyclohexane

(*d*) 1-(1-Methylethyl)-2-butylcyclohexane

7. Find the value of $N_1 + N_2 + N_3 + N_4$ where

N_1 = lowest molecular weight of saturated cyclic hydrocarbon which has four substituents,

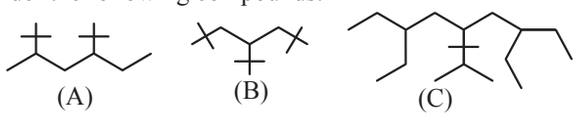
N_2 = degree of unsaturation in a compound with molecular formula $C_9H_6N_4$,

N_3 = the number of possible isomers for di-nitronaphthalene,

N_4 = the number of possible alkynes (structural only) having molecular formula $C_3FClBrI$

PASSAGE-I

Consider the following compounds:



8. Which one of these three compounds contains maximum number of carbon atoms in its principal carbon chain?

(*a*) A (*b*) B

(*c*) C (*d*) Equal in A & C

9. Which one of these three compounds contains maximum number of side chains in its principal carbon chain?

(*a*) A (*b*) B

(*c*) C (*d*) Equal in A & B

10. Which one of these three compounds contains maximum number of quaternary carbon atoms (4°)?

(*a*) A (*b*) B

(*c*) C (*d*) Equal in B & C

Answer Key

CONCEPT APPLICATION

1. (*c*)	**2.** (*a*)	**3.** (*b*)	**4.** (*d*)	**5.** (*c*)	**6.** (*c*)	**7.** (*b*)	**8.** (*d*)	**9.** (*d*)	**10.** (*b*)
11. (*a*)	**12.** (*b*)								

PRARAMBH (TOPICWISE)

1. (*c*)	**2.** (*c*)	**3.** (*d*)	**4.** (*a*)	**5.** (*c*)	**6.** (*d*)	**7.** (*c*)	**8.** (*c*)	**9.** (*a*)	**10.** (*c*)
11. (*c*)	**12.** (*c*)	**13.** (*b*)	**14.** (*c*)	**15.** (*c*)	**16.** (*d*)	**17.** (*c*)	**18.** (*b*)	**19.** (*b*)	**20.** (*b*)
21. (*b*)	**22.** (*a*)	**23.** (*b*)	**24.** (*c*)	**25.** (*a*)	**26.** (*b*)	**27.** (*a*)	**28.** (*a*)	**29.** (*c*)	**30.** (*d*)
31. (*b*)	**32.** (*c*)	**33.** (*a*)	**34.** (*a*)	**35.** (*b*)	**36.** (*b*)	**37.** (*c*)	**38.** (*a*)	**39.** (*c*)	**40.** (*b*)

PRABAL (JEE MAIN LEVEL)

1. (*a*)	**2.** (*c*)	**3.** (*a*)	**4.** (*a*)	**5.** (*c*)	**6.** (*a*)	**7.** (*a*)	**8.** (*d*)	**9.** (*a*)	**10.** (*a*)
11. (*d*)	**12.** (*c*)	**13.** (*a*)	**14.** (*d*)	**15.** (*d*)	**16.** (*a*)	**17.** (*b*)	**18.** (*d*)	**19.** (*c*)	**20.** (*c*)
21. (*c*)	**22.** (*d*)	**23.** (*b*)	**24.** (*b*)	**25.** (*b*)	**26.** (*b*)	**27.** (*b*)	**28.** (*c*)	**29.** (*c*)	**30.** (*b*)
31. (*a*)	**32.** (*a*)	**33.** (*c*)	**34.** (*a*)	**35.** [5]	**36.** [14]	**37.** [7]	**38.** [5]	**39.** [9]	**40.** [29]

PARIKSHIT (JEE ADVANCED LEVEL)

1. (*d*)	**2.** (*a*)	**3.** (*b*)	**4.** (*d*)	**5.** (*a*)	**6.** (*a,b,d*)	**7.** (*c,d*)	**8.** (*a,c*)	**9.** (*b,d*)	**10.** (*a,b,d*)
11. (*b,c*)	**12.** (*a,c,d*)	**13.** (*a,b*)	**14.** (*a,b,c*)	**15.** (*a,b,d*)	**16.** (*b,c,d*)	**17.** (*b,c*)	**18.** (*c*)	**19.** (*c*)	**20.** (*c*)
21. (*c*)	**22.** (*d*)	**23.** (*b*)	**24.** (*b*)	**25.** (*c*)	**26.** (*d*)	**27.** (*a*)	**28.** (*b*)	**29.** (*d*)	**30.** [1]
31. [8]	**32.** [4]	**33.** [0]	**34.** [19]	**35.** [10]	**36.** [2112]				

PYQ's (PAST YEAR QUESTIONS)

1. (*b*)	2. (*b*)	3. (*c*)

PW CHALLENGERS

1. (*a,b,c,d*)	**2.** (*c*)	**3.** (*c*)	**4.** (*a*)	**5.** (*a*)	**6.** (*c*)	**7.** [121]	**8.** (*c*)	**9.** (*a*)	**10.** (*b*)