CHAPTER - 08

ORGANIC CHEMISTRY - SOME BASIC PRINCIPLES AND TECHNIQUES - PART I

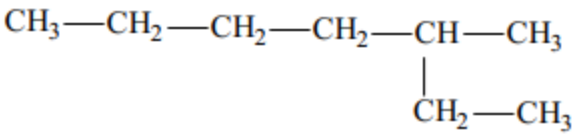
NOMENCLATURE AND ISOMERISM IN ORGANIC COMPOUNDS

SYNOPSIS

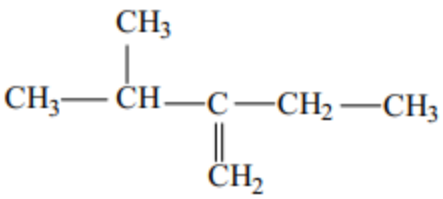
Nomenclature of Organic Compounds Nomenclature of Hydrocarbons

Rule 1 : Longest Chain Rule

Select the longest continuous chain of carbon atoms as the parent chain. If some carbon - carbon multiple bond is present, the parent chain must contain the carbon atoms involved in it. The no. of carbon atoms in the parent chain determines the word 'root'. The carbon atoms which are not included in the parent chain are considered as alkyl substituents and are names as prefixes.

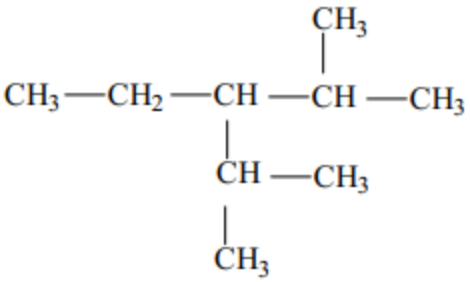


Prefix : methyl
Word root : hept
P. Suffix : ane

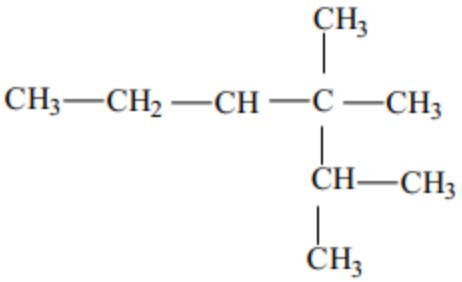


Prefix : ethyl, methyl
Word root : but
P. Suffix : ene

If two equally long chains are possible, the chain with maximum no. of side chains is selected as parent chain. For eg.

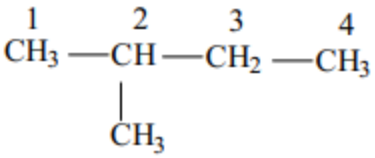


Correct
Three side chains

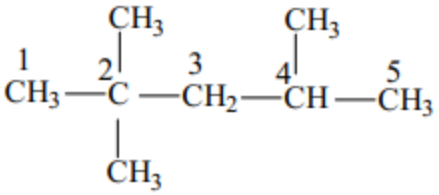


Wrong
Two side chains

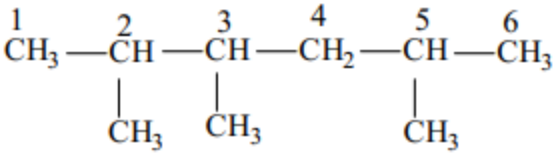
Rule 2 : Lowest No. or lowest Sum Rule



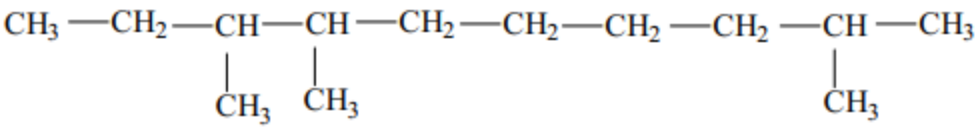
2-methyl butane and Not 3-methyl butane



2, 2, 4 - trimethyl pentane and not
2, 4, 4 - trimethyl pentane

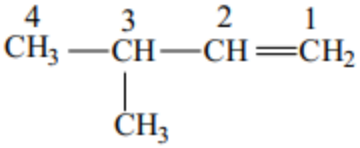


2, 3, 5 - trimethyl hexane and not
2, 4, 5 - tri methyl hexane

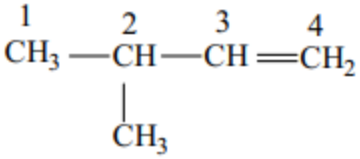


2, 7, 8 - trimethyl decane and not 3, 4, 9 - tri methyl decane

In case of unsaturated hydro carbons, the carbon atoms involved in the multiple bond should get the lowest possible number. For eg.

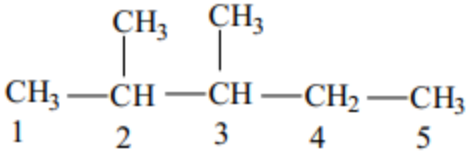


3-methyl but-1-ene
(correct)

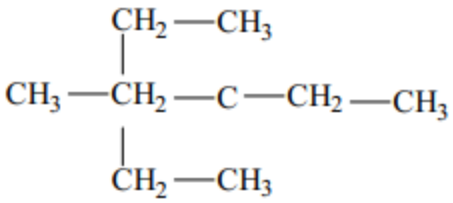


2-methyl but-3-ene
(wrong)

Rule 3 : Use of Prefixes Di, Tri etc.

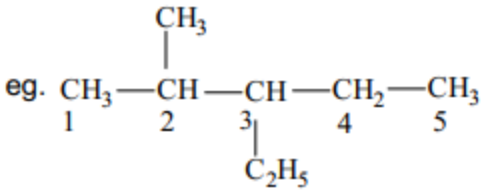
eg. 

2, 3 - Dimethyl pentane

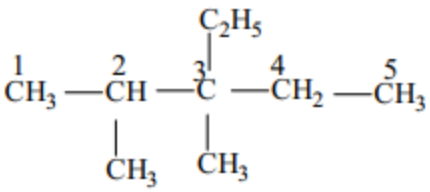


3, 3 - Dimethyl pentane

Rule 4 : Alphabetical arrangement of Prefixes :

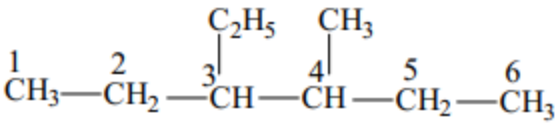


3-ethyl - 2 - methyl pentane



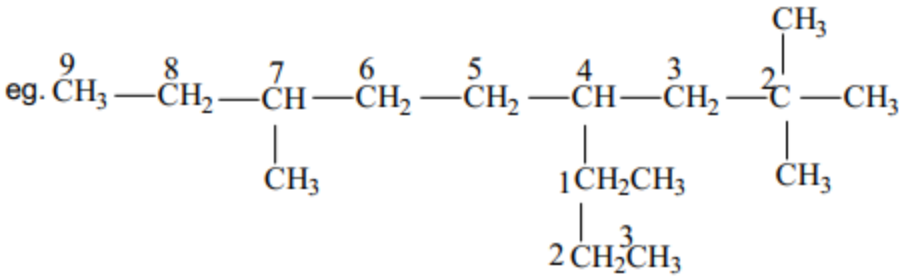
3-ethyl - 2, 3 dimethyl pentane

Naming different alkyl substituents at the equivalent positions

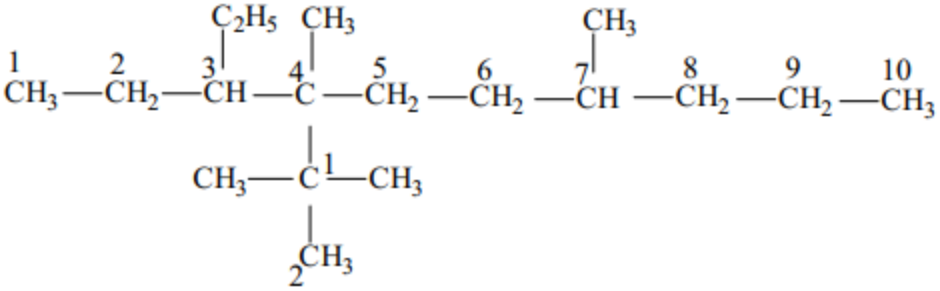


3-ethyl - 4 - methyl hexane

Rule 5 : Naming the complex alkyl substituent

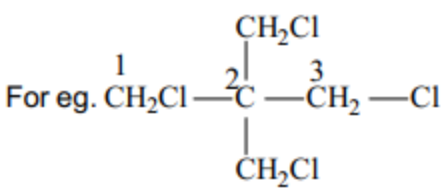


2, 2, 7 trimethyl - 4 - (1-methyl propyl) nonane

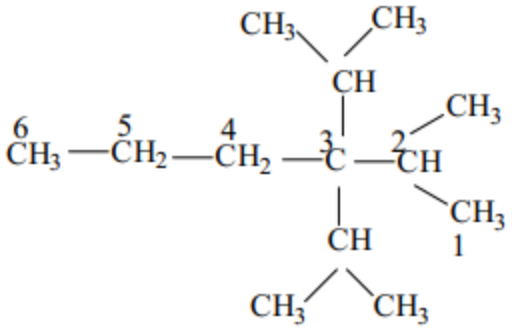


4 - (1, 1 - dimethyl ethyl) - 3 - ethyl - 4, 7 - dimethyl decane

The numerical prefixes bis, tris, tetrakis, pentakis etc. are used to indicate a multiplicity of substituted substituents. The name of the substituted substituent is enclosed in parenthesis.



1, 3 - Di chloro - 2, 2-bis (chloro methyl) propane



2-methyl - 3, 3-bis (1-methyl ethyl) hexane

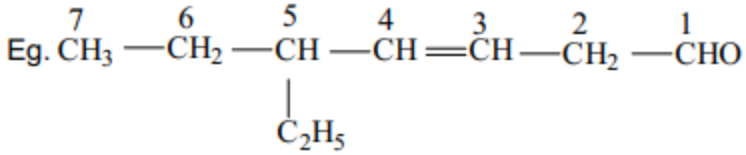
Nomenclature of compounds having one functional group

Rule 1 : Longest chain rule

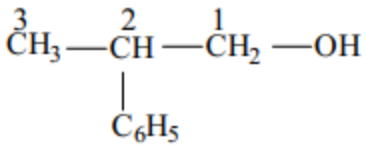
Select the longest continuous chain of the carbon atoms as parent chain. The selected chain must include the carbon atoms involved in the functional groups like -COOH, -CHO, -CN etc. or those which carry the functional groups like -OH, $-NH_2$, -Cl, $-NO_2$ etc. The number of carbon atoms in parent chain decides the word root.

Rule 2 : Lowest No. rule

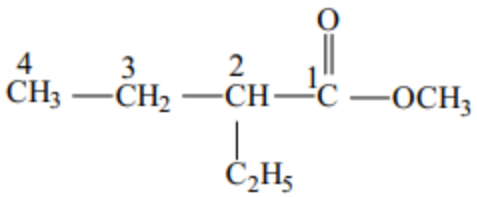
The carbon atoms of the parent chain are numbered in such a way so that the carbon atom of the functional group gets the lowest possible number. In case the functional group does not have the carbon atom, then the carbon atom of the parent chain attached to the functional groups should get the lowest possible number.

Eg. 

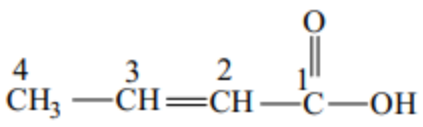
5 - ethyl hept - 3 - enal



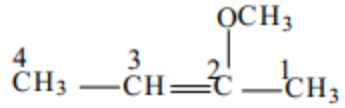
2-Phenyl propan - 1 - ol



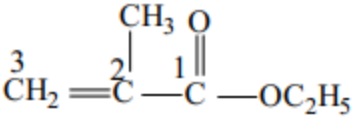
Methyl - 2 - ethyl butanoate



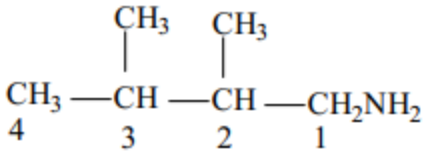
But - 2 - en - 1 - oic acid



2-methoxy but - 2 - ene

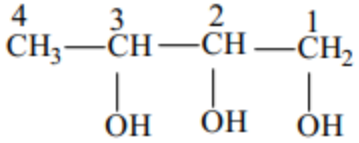


Ethyl - 2 - methyl prop-2-enoate

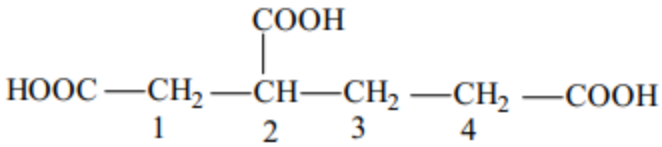


2, 3 - Dimethyl butan - 1 - amine

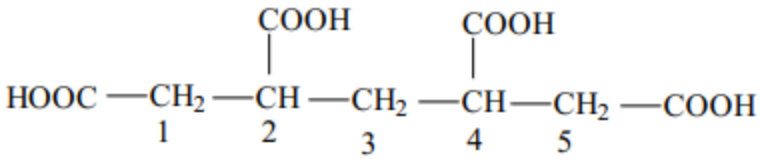
Naming the compounds with more than one similar functional groups.



Butane - 1, 2, 3 - triol

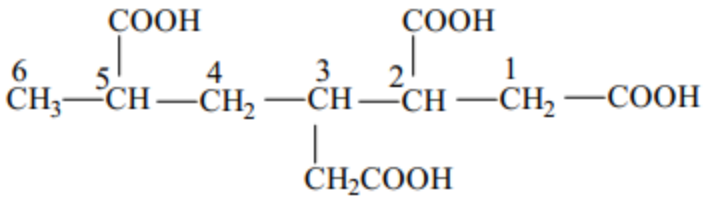


Butane - 1, 2, 4 - tri carboxylic acid



Pentane - 1, 2, 4, 5 - tetra carboxylic acid

The carboxyl groups which are not directly linked to the principal chain are expressed by carboxy alkyl prefixes.



3-(carboxy methyl) hexane - 1, 2, 6 - tri carboxylic acid

Naming the compounds with two or more different functional groups

If the molecule contains more than one dissimilar functional groups, the parent chain must contain maximum possible numbers of functional groups. The numbering of the parent chain is done in such a way so that the functional group of higher priority gets the lower number. The order of priority of various groups for the sake of numbering is, carboxylic acid > Sulphonic acid > acid anhydride > esters > acid chlorides > amides > nitriles, iso cyanides > aldehydes > Ketones > alcohols > amines > alkenes, alkynes > halo, nitro, alkoxy > alkyl

The functional group which gets priority is treated as principal functional group and is indicated by the 2° suffix. One the other hand, the other functional group in the compound are considered as substituents and are indicted by suitable prefixes. The prefixes for such functional groups have been given as :

Functional Group	Prefix	Functional Group	Prefix
-OH	Hydroxy	-COOH	carboxy
-CN	Cyano	-COOR	carbalkoxy
-NC	Isocyano	-COCl	chloroformyl
-CHO	formyl	$-CONH_2$	carbamoyl
-SH	mercapto	$-NH_2$	amino
-SR	Alkyl thio	>CO	keto

I. Isomerism

The phenomenon of existence of two or more compounds possessing the same molecular formula but different physical and chemical properties is knon as isomerism

There are two main types of isomerism

i) Structural isomerism

ii) Stereo isomerism

i) Structural isomerism : When the isomerism is due to the difference in the arrangment of atoms with in the molecule, the phenomenon is called structural isomerism

Some typical examples of different types of structural isomerism are given below

i) Chain isomerism or nuclear isomerism.

Chain isomers differ in the order in which the carbon atoms are bonded to each other

ii) Position isomerism

In this the position of substituents or functional groups are different

iii) Functional isomerism

Functional isomers have the same molecular formula but different functional groups

iv) Tautomerism

It is a special type of functional isomerism in which the isomers are in dynamic equilibrium with each other. Tautomerism arises due to the migration of a proton from one polyvalent atom to the other with in the molecule

v) Metamerism

This type of isomerism is due to the unequal distrbution of carbon atoms on either side of the functional group

vi) Ring chain isomerism : If one isomer has open chain structure and the other has cyclic structure, then isomers are known as ring chain isomers

PART-I (JEE MAIN)

SECTION-I- Straight objective type questions

1. Which of the following is aromatic heterocyclic compound?

   1) Benzene 2) Tetrahydrofuran 3) Pyrrole 4) Phenol

2. Choose the option that shows the correct order of decreasing priority for functional groups

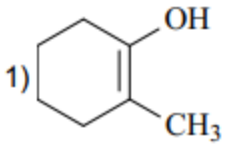
   1) –COOH , –COCl , –CHO , –OH , $–NH_2$

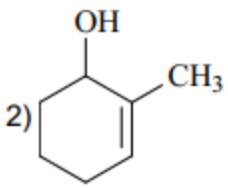
   2) $–NH_2$, –OH , –CHO , –COCl , –COOH

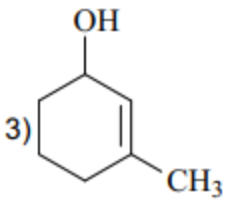
   3) –COOH , –CHO , –COCl , –OH , $–NH_2$,

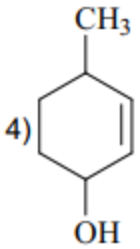
   4) –COCl , –COOH , $–NH_2$, –CHO , –OH

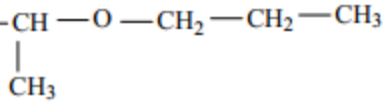
3. The correct structure of 2-methylcyclohex-2-en-1-ol is

   1) 

   2) 

   3) 

   4) 

4. **Assertion (A)** : IUPAC name of  is 2-ethoxy-2-methylpropane

   Reason (R) : In IUPAC nomenclature, ether is regarded as a hydrocarbon derivative in which a hydrogen atom is replaced with –OR or –OAr group.

   In the light of the above statements choose the correct option

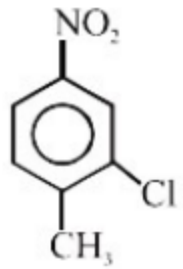
   1) A is wrong but R is correct

   2) A is correct but R is wrong

   3) Both A and R are corect and R is the correct explanation of A

   4) Both A and R are wrong

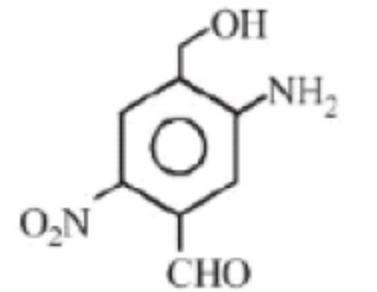
5. The correct IUPAC name of the following compound is:

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

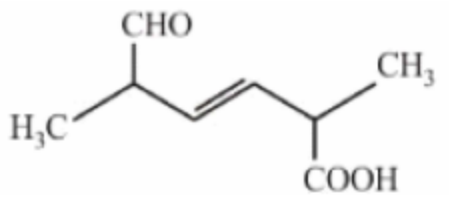
   3) 3-chloro-4-methyl-1-nitrobenzene 4) 2-chloro-1-methyl-4-nitrobenzene

6. The correct IUPAC name of the following compound is



1) 2-nitro-4-hydroxymethyl-5-amino benzaldehyde
2) 3-amino-4-hydroxymethyl-5-nitrobenzaldehyde
3) 5-amino-4-hydroxymethyl-2-nitrobenzaldehyde
4) 4-amino-2-formyl-5-hydroxymethyl nitrobenzene

7. The IUPAC name of the following compound is



1) 2, 5-dimethyl-5-carboxyhex-3-enal
2) 2, 5-dimethyl-6-carboxyhex-3-enal
3) 2, 5-dimethyl-6-oxohex-3-enoic acid
4) 6-formyl-2-methylhex-3-enoic acid

8. Match list I with list II

List - I (common name)	List - II (IUPAC name)
i) Catechol	P) methoxy benzene
ii) o-Cresol	Q) 4-hydroxy-3-methoxybenzaldehyde
iii) Anisole	R) benzene-1,2-diol
iv) Vanillin	S) 4-methylpent-3-en-2-one
v) Mesityl oxide	T) 2-methylphenol

1) i -T, ii-R, iii-P, iv - Q, v-S
2) i-T, ii-R, iii-Q, iv-S, v- P
3) i-R, ii-T, iii-P, iv-Q, v-S
4) i-R, ii-T, iii-Q, iv-S, v-P

9. Identify the incorrectly matched pair

1) 2-methylpropan-2-ol : 3° alcohol

2) Ethylidene chloride : gem-dihalide

3) N,N - dimethyl methanamine: 3° amine

4) Propan-2-amine: 2° amine

10. The IUPAC name of allylamine and $\underset{\underset{|}{CN}}{CH_2} - \underset{\underset{|}{CN}}{CH} - \underset{\underset{|}{CN}}{CH_2}$ are

1) prop-1-en-2-amine and propane-1,2,3-tricarbonitrile

2) prop-2-en-1-amine and 3-cyano-1,5-pentanedinitrile

3) prop-1-en-2-amine and 3 cyano 1, 5-pentanedinitrile

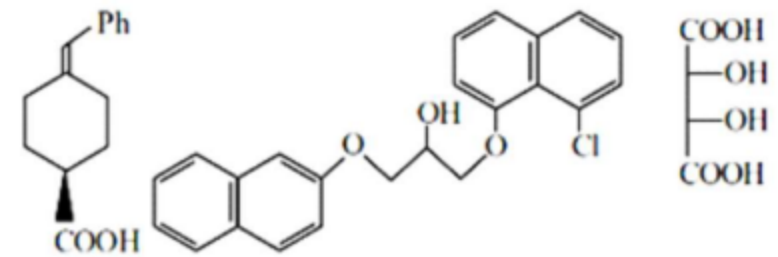
4) prop-2-en-1-amine and propane-1,2,3-tricarbonitrile

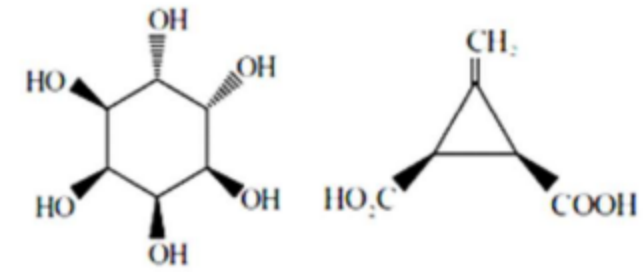
SECTION-II - Numerical Type Questions

11. Total number of structural isomers for C_6H_{14} and C_7H_{16} is ——

12. The total number of stereoisomers possible for a compound of the molecular formula $CH_3 - CH = CH - CH(OH) - Me$ is ____

13. The total number of chiral compound/s from the following is _____

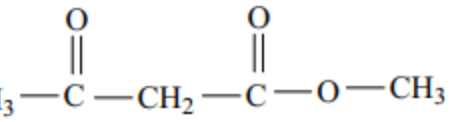


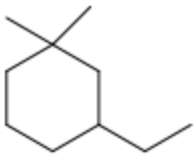
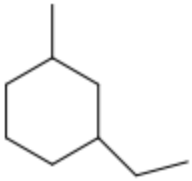


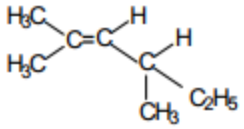
14. How many monochloroderivatves (including stereoisomers) are possible for 2-methylpentane?
15. How many optically active stereoisomers are possible for butane-2,3-diol?

PART-II (JEE ADVANCED)

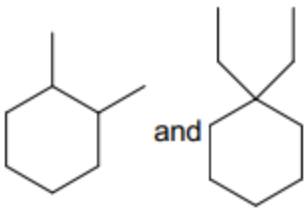
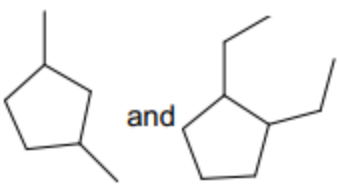
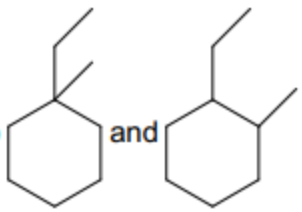
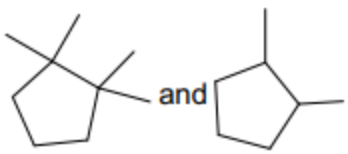
Section-III - Only one option correct type

16. IUPAC name of the compound 
    A) Methoxybutan-2,4-dione
    B) Methyl-3-oxobutanoate
    C) 3-oxomethylbutanoate
    D) 2-oxomethylbutanoate

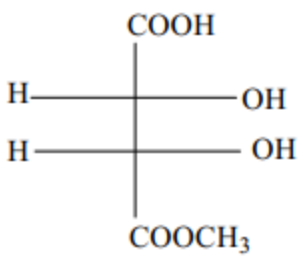
17. The correct IUPAC name of  and  are, respectively
    A) 3-ethyl-1,1-dimethylcyclohexane and 1-ethyl-3-methylcyclohexane
    B) 3-ethyl-1, 1-dimethylcyclohexane and 1-methyl-3-ethylcyclohexane
    C) 1-ethyl-3,3-dimethylcyclohexane and 1-ethyl-3-methylcyclohexane
    D) 1-ethyl-3,3-dimethylcyclohexane and 1-methyl-3-ethylcyclohexane

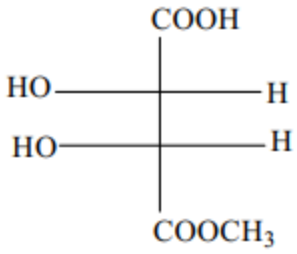
18. The structure  shows:
    A) geometrical isomerism only
    B) optical isomerism only
    C) both geometrical and optical isomerism
    D) Neither geometrical nor optical isomerism

19. Which of the following compounds exhibits stereoisomerism?
    A) 2-methylbut-1-ene
    B) 3-methylbut-1-yne
    C) 3-methylbutanoic acid
    D) But-2-enoic acid

20. Which of the following compounds can show geometrical isomerism?
    A) 
    B) 
    C) 
    D) 

21. The following two structures are





A) Enantiomers B) Diastereomers C) Identical D) Meso forms

22. Statement-I : Meso tartaric acid is optically inactive

Statement-II : Mesotartaric acid has two chiral centres

A) Statement-I is incorrect and Statement-II is correct

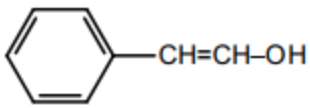
B) Both Statement-I and Statement-II are correct

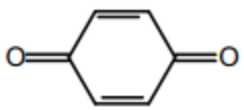
C) Both Statement-I and Statement-II are incorrect

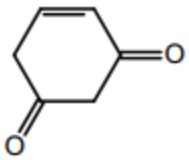
D) Statement-I is correct and Statement-II is incorrect

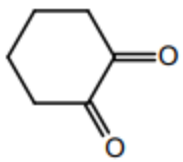
Section IV - One or more option correct type

23. Tautomerism is exhibited by

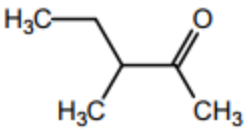
A) 

B) 

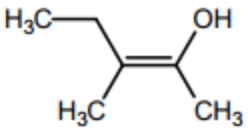
C) 

D) 

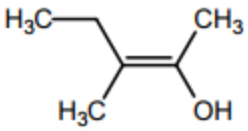
24. The correct statement(s) concerning the structures E, F and G is (are)



(E)



(F)

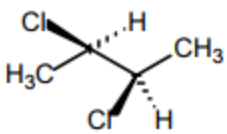


(G)

A) E, F, and G are resonance structure B) E, F and E, G are tautomers

C) F and G are geometrical isomers D) F and G are diastereomers

25. The correct statement(s) about the compound given below is (are)



A) the compound is optically active

B) the compound possesses centre of symmetry

C) the compound possesses plane of symmetry

D) the compound is optically inactive

26. The correct statement(s) about the compound $H_3C(HO)HC-CH=CH-CH(OH)CH_3$ (**X**) is/are

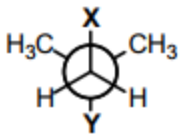
A) The total number of stereoisomers possible for X is 6

B) The total number of diastereomers possible for X is 3

C) If the stereochemistry about the double bond in X is trans, the number of enantiomers possible for X is 4

D) If the stereochemistry about the double bond in X is cis, the number of enantiomers possible for X is 2.

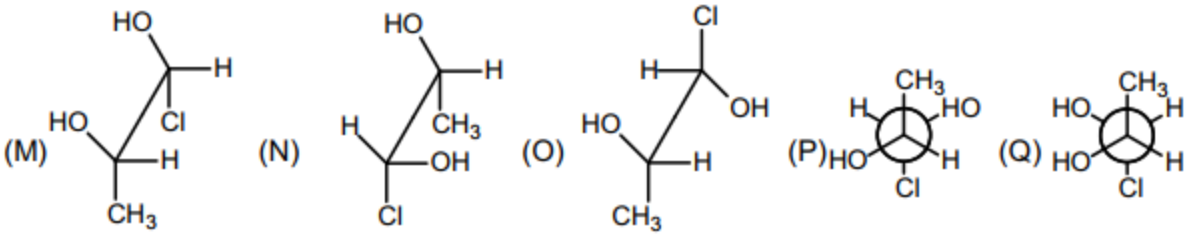
27. In the Newman projection for 2, 2-dimethylbutane



X and Y can respectively be

(A) H and H (B) H and C_2H_5 (C) C_2H_5 and H (D) CH_3 and CH_3

28. Which of the given statement(s) about N, O, P and Q with respect to M is (are) correct?



(A) M and N are non-mirror image stereoisomers

(B) M and O are identical

(C) M and P are enantiomers

(D) M and Q are identical

Section V - Numerical type questions

29. The total number of cyclic and acyclic isomers (including stereoisomers) possible for a compound with molecular formula C_5H_{10} is ——

30. Number of geometrical isomers possible for the following compound is ——

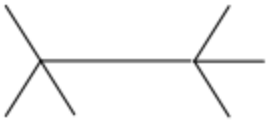
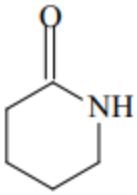
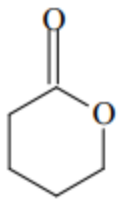
$$CH_3-CH=\underset{\displaystyle Br}{\overset{|}{C}}-\underset{\displaystyle Cl}{\overset{|}{C}}=CH-CH_3$$

31. How many of the following functional groups is/are always treated as prefix substituent(s) according to IUPAC system of nomenclature?

$-C\equiv C-$, $-CO-$, $-CN$, $-OCH_3$, $-NO_2$, $-Br$, $-NH_2$, $-OH$, $-CH_3$, $-SO_3H$, $-F$, $\rangle C=C\langle$

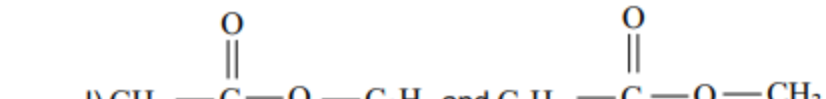
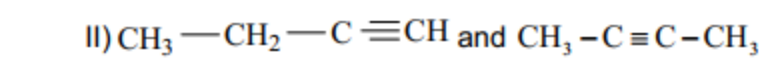
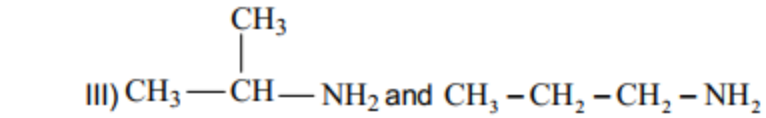
Section-VI - Matrix match type

32. Match the following

Column-I	**Column-II**
I) Hydrocarbon with only 1° H atoms	P) 
II) Hydrocarbon with no 3°C atom(s)	Q) 
III) Lactone	R) 
IV) Lactam	S) 

A) I-P, II - Q, III- R, IV - S
B) I-Q, II - P, III -S, IV - R
C) I–S, II- R, III- P, IV - Q
D) I-Q, II-PQ, III - S, IV - R

33. Match the following

Column I	**Column - II**
I) 	P) Metamers
II) 	Q) Positions isomers
III) 	R) Chain isomers
IV-) $CH_3 - CH_2 - OH$ and $(CH_3)_2O$	S) Functional group isomers

A) I - Q, II - Q, III - R, IV – P
B) I - P, II - P, III - Q, IV - S
C) I - P, II -Q, III - Q, IV - S
D) I-P, II - Q, III - R, IV - S