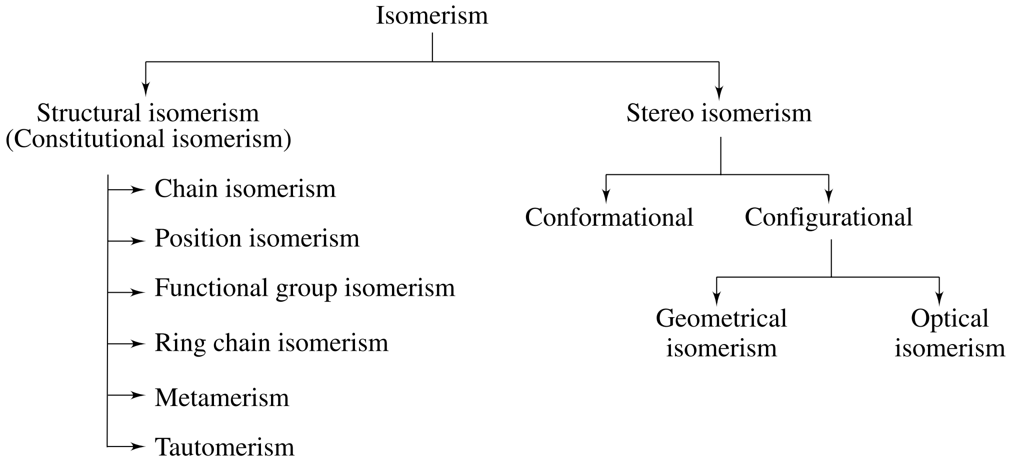
CHAPTER 2

Isomerism

ISOMERISM

Compounds having same molecular formula but which differ in atleast some physical or chemical properties is known as isomers and the phenomena is said to be isomerism.



STRUCTURAL ISOMERISM

It is due to different molecular structural arrangement having same molecular formula so that properties will be different.

The structural isomerism may be classified into six categories. These are:

(i) **Chain Isomerism:** It is due to arrangement of carbon atom so that size of parent chain or size of side chain must be different.

(ii) **Position of isomerism:** It is due to different locant number of functional group or multiple bond or side chain along the same parent chain.

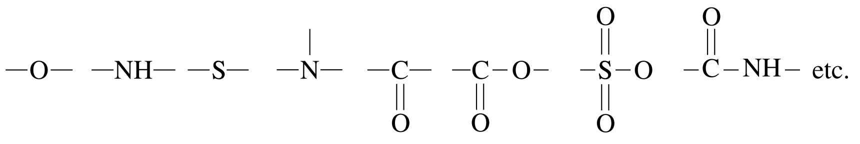
(iii) **Functional group isomerism:** It is due to presence of different functional group.

(iv) **Ring Chain Isomerism:** It is due to mode of linking of carbon atom so that same molecular formula correspond to both open and cyclic skeleton is known ring chain isomerism.

- For ring chain isomerism double bond equivalent (D.B.E) ≠ 0.
- All ring chain isomers are always functional group isomers.

(v) **Metamerism:** It is due to different size of alkyl group along the same divalent functional group.

Condition: Polyvalent functional group containing substances will show metamerism.These are:



$$-O-\quad -NH-\quad -S-\quad -\overset{|}{N}-\quad -\underset{\underset{O}{\|}}{C}-\quad -\underset{\underset{O}{\|}}{C}-O-\quad -\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O\quad -\overset{\overset{O}{\|}}{C}-NH-\ \text{etc.}$$

(vi) Tautomerism:

- Tautomerism is a special type of functional group isomerism which arises due to the oscillation of atom, mostly H-atom as proton between polyvalent atoms.
- Such isomers are directly and readily interconvertible under ordinary conditions, and the isomers are called tautomers.
- Tautomerism is chemical process and catalysed by acid or base.
- Tautomers exist in dynamic equilibrium.
- They have no separate existence under ordinary conditions.
- The other names of tautomerism are 'desmotroprism' or 'prototropy' etc.

Classification in Tautomerism

- **On the basis of migrated atom**

  Cation migrate → Cationotropy

  Proton migrate → Prototropy

  Anion migrate → Anionotropy

- **On the basis of system**

  Shiftting between 1, 2 atom – dyad system

  Shiftting between 1, 3 atom – triad system

  Shiftting between 1, 4 atom – tetrad system

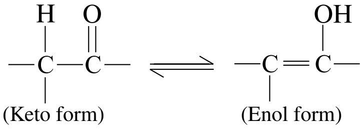
  Shiftting between 1, 5 atom – pentad system

Keto Enol Tautomerism

Condition: Carbonyl compound must have atleast one α-H or acidic-H

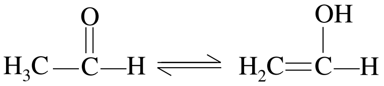
It is Triad system because shiffing of proton occured between 1, 3 position.

- When the tautomers exist in the two forms keto and enol then, such type of tautomerism is called keto-enol tautomerism.

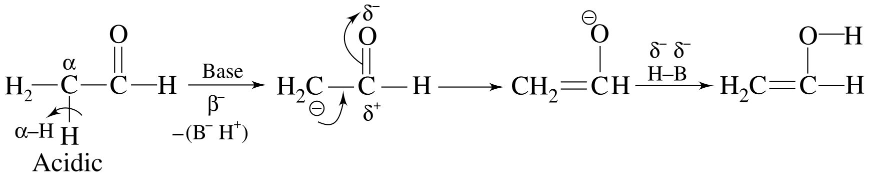


$$-\overset{H}{\underset{|}{\overset{|}{C}}}-\overset{O}{\overset{\|}{C}}- \rightleftharpoons -\underset{|}{C}=\overset{OH}{\overset{|}{C}}-$$

Base catalysed tautomerism mechanism



$$H_3C-\overset{O}{\overset{\|}{C}}-H \rightleftharpoons H_2C=\overset{OH}{\overset{|}{C}}-H$$

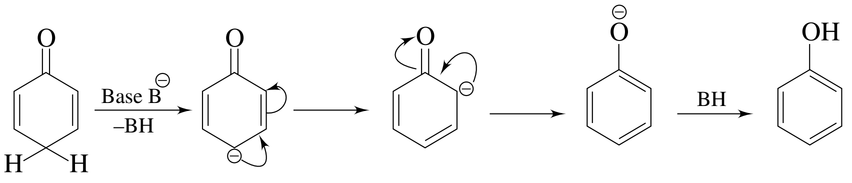


- It is important to recognise that the enol is a real substance capable of independent existence it is not a resonance from of the carbonyl compound.
- **Following compound cannot show keto-enol tautomerism**
  (i) Carbonyl compounds do not have α-H can't show keto-enol tautomerism.
  (ii) Carboxylic acid and acid derivative except acid amide can't show keto-enol tautomerism.

(iii) For keto-enol tautomerism, the tautomeric form must be geometrically favourable.

- **Para tautomerism**

  When double-bond is present between α and β position (between C_3 and C_4) of cyclic ketone then 'H' of C_5 takes part in tautomerism, known as 1, 5 or para tautomerism.



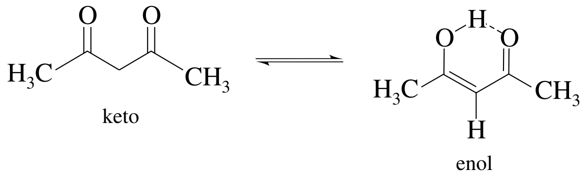
- **% of enol in different compound**

  Enol content $\propto$ number of acidic H
  $\propto$ stability of enolate ion
  $\propto$ stability of enol (due to intramolecular-H/aromatic character)

Comparison of Stability of Keto and Enol Forms

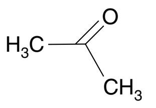
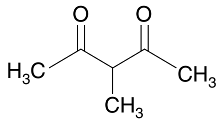
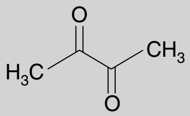
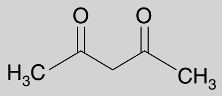
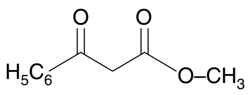
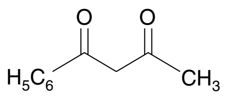
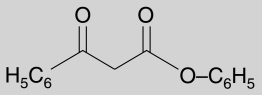
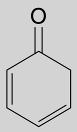
(i) In simple aldehydes and ketones, keto form is more stable than enol form because C=O bond is stronger than C=C bond.

(ii) In complex structures like 1,3-diketo compounds, enol form is more stable because it is stabilized by resonance as well as intramolecular hydrogen bonding.



Percentage Composition of Tautomeric Mixture

Percentage of enol content of some compounds is given below in the table.

Compounds	Enol percentage	Compound	Enol percentage
	0.00025		31.0
	0.0056		80.3
	4.8		89.00
	7.7		99.00

Calculation of Number of Structural Isomers

Profile-1: Isomers of Alkane

Molecular formula of alkane	CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_5H_{12}	C_6H_{14}	C_7H_{16}	C_8H_{18}	C_9H_{20}	$C_{10}H_{22}$
Number of isomer	1	1	1	2	3	5	9	18	35	69

Trick: Number of isomer in alkane = (2n – 1), where n = number of isomer in previous alkane (except C_8H_{18})

Profile-2: Isomers of Alkyl Radical

Type of alkyl	$-CH_3$	$-C_2H_5$	$-C_3H_7$	$-C_4H_9$	$-C_5H_{11}$	$-C_6H_{13}$
Number of isomer	1	1	2	4	8	17

Profile-3: Isomers in different molecular formula

Step-1: Find D.B.E for given molecular formula.

Degree of unsaturated (DU)/Double bond equivalent (DBE) = $(C + 1) - \left(\frac{H + X - N}{2}\right)$

Step-II: Select nature of bonding between C-C

D.B.E	Possible bonding between C–C
0	(–) single bond
1	(=) double bond/| ring
2	1 (≡) triple bond | 2 (=) double bond | 1 (=) double bond + 1 ring | 2 ring
4	Benzene ring (3(=) double bond + 1 ring)

Step-III: Select the possible functional group

- If Molecular formula (M.F.) contains C, H only or C, H and (halogen), then draw and find out number of isomers (for alkane refer above table).
- If M.F. contains C, H, N, O, etc. then select possible functional group as follows:

M.F.	D.B.E	Possible functional group
$C_nH_{2n+2}O$	0	Alcohol/ether
$C_nH_{2n}O$	1	Aldehyde/ketone
$C_nH_{2n}O_2$	1	Carboxylic acid/ester/ hydroxy carbonyl
$C_nH_{2n+3}N$	0	1°/2°/3° amine
$C_nH_{2n-1}N$	2	Cyanide/isocyanide

Step-IV: Separate possible functional groups and radical parts then number of isomers of radical is equal to number structaur of some of corresponding functional group.

Stereo or Space Isomerism

Compound having same molecular formula and structural formula but differ due to spatial orientations of groups or atoms is known as stereo isomers and phenomenon is termed as stereo isomerism.

(1) Geometrical Isomerism

- Compound having same molecular formula but differ in their properties due to the difference in the orientations of attachment of same atoms or group in their molecule.
- It is caused due to the restricted rotation about double bond in open chain and about single bond in cyclo alkane.

Condition of Geometrical isomerism

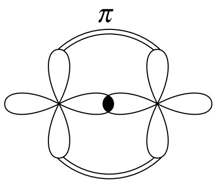
1. Rotation must be restricted.
2. Each blocked atom must have pair of different groups/atoms.

Geometrical isomerism is exhibited by following type of compounds.

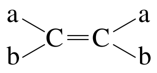
(a) Compounds containing C = C, C = N, N = N, etc.
(b) Compounds containing cyclic structure.

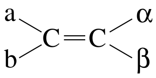
1. Geometrical isomerism in alkene:

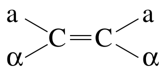
- Generally alkene show Geometrical isomerism because by the overlapping of two unhybridised carbon, formation of π–bond takes place which produce restricted rotation.



- All alkenes do not show Geometrical isomerism but not those in which both the double bonded carbon attach with different group or atoms.





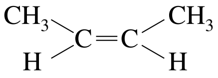


Configuration of Geometrical isomer

1, *cis/trans* configuration:

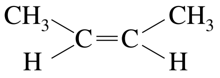
- ***Cis* form:** Such isomer in which atleast one pair of similar groups/atoms attaches on the **same side** of double bonded carbon.
- ***Trans* form:** Such isomer in which atleast one pair of similar groups/atoms attaches on the **opposite side** of double bonded carbon.

ex.



(*cis*-2-Butene)

&



(*trans*-2-Butene)

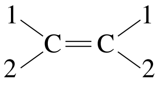
Comparison of properties of *cis* or *trans*-isomers: (With respect to 2-Butene)

S.No.	Properties	Answer	Reason
1.	Stability	*Trans > cis*	Trans have less mutual repulsion between the groups
2.	Dipole moment	*Cis > trans*	Trans have zero dipole moment
3.	Polarity	*Cis > trans*	Cis have more dipole moment so more polar
4.	Solubility in water	*Cis > trans*	Cis is more polar so more soluble in water
5.	Boiling Point (BP)	*Cis > trans*	Cis is more polar so more BP
6.	Melting Point (MP)	*trans > cis*	Trans is symmetrical molecule therefore better packing in crystal lattice, so it has more MP

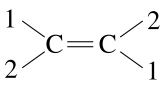
E-Z Configuration:

E → Entgegen (opposite), Z → Zusammen (same)

- **E-form:** when two same priority groups attach on the **opposite side** of double bonded carbon, then it is called as E-form.
- **Z-form:** when two same priority groups attach on the **same side** of double bonded carbon, then it is called as Z-form



Z-form



E-form

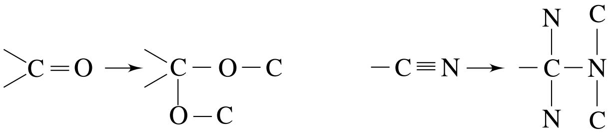
- **Priority rule:** Chan, Ingold and Prelong proposed a **sequence rule** (CIP Rule)

Rule-1 When atom or group of atoms which are directly attached to the stereogenic centre have higher atomic number will have higher priority.

Rule-2 When the atomic number is same, then higher atomic weight group or atom have higher priority

Rule-3 When both atomic number and atomic weight are same then priority will be decided by the next joining atom. If one of the atom from next joining atoms have higher atomic number then it corresponds to higher priority and so on.

Rule-4 If multiple bonded groups attach to the double bonded carbon, then they are considered in following manner.

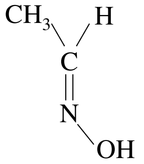


2. Geometrical isomerism in oxime: Oxime of aldehyde and oxime of unsymmetrical ketone also show geometrical isomerism except Oxime of formaldehyde.

- **In aldoximes**

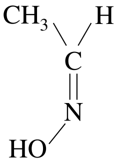
  Syn isomer: When –OH group and H atom is on same side.

  Anti isomer: When –OH group and H atom is on opposite side.



Syn-Acetaldoxime

and

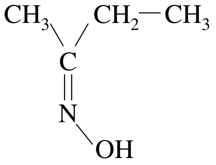


Anti-Acetaldoxime

- **In unsymmetrical ketoxime**

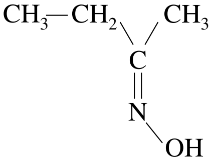
  Syn isomer: When –OH group and the alphabetically preferred alkyl are present on the same side of double bond, then it is called as syn form.

  Anti isomer: When –OH group and the alphabetically preferred alkyl are present on the opposite side of double bond, then it is called as Anti form.



Syn-ethylmethyl ketoxime

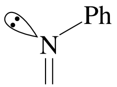
and



Anti-ethylmethyl ketoxime

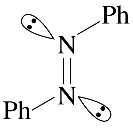
3. **Geometrical isomerism in azo compounds:** All azo compounds show geometrical isomerism

   ex. Ph–N = N–Ph



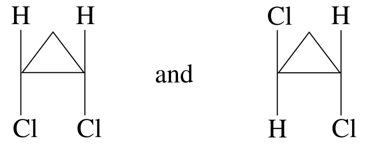
Syn-Azobenzene

and



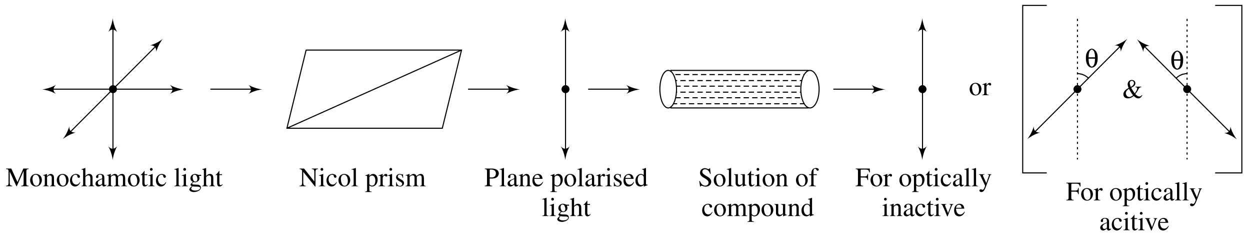
Anti-Azobenzene

4. **Geometrical isomerism in cycloalkane:** In cyclic compound the rotation about C–C single bond is restricted because of the rigidity caused by the presence of other carbon of the ring which keep them tightly held, thus a disubstituted cyclic compound (having the two substitution at the separate carbon) will also show Geometrical isomerism.



(cis form) (trans form)

Optical Isomerism: It is due to behaviour of plane of polarised light. Certain organic compounds, have the ability to rotate plane of polarised light in either of the directions through certain angle when their solution is placed in the path of plane of polarised light known as optical active compounds. This property of substances is termed as **optical activity**.



Specific rotation: Optical rotation caused by 1 gm/ml solution in 1 dm length polarimeter tube at specific temp and source of the light.

$$\text{observed rotation} \propto \text{concentration} \times \text{length}$$

$$\theta = [\alpha]_D^T \times \text{concertration} \times \text{length}$$

$$[\alpha]_D^T = \frac{\theta}{\text{concertration} \times \text{length}}$$

$$[\alpha]_D^T = \frac{\theta}{c \times l}$$

- $$\text{Enantiomeric axis} = \frac{d-\ell}{d+\ell} \times 100 = \frac{\text{Optical Rotation}}{\text{Specific Rotation}} \times 100$$

θ = The observed rotation (Optical rotation)

α = Thereotical rotation (Specific rotation)

The magnitude of observed rotation (θ) depends upon following factors.

(1) Nature of substance.
(2) Nature of solvent.
(3) The concentration of the substance in tube. (C gm/mol)
(4) The length of the solution column. (l dm) [1 dm = 10 cm]
(5) The temperature of the experiment (t°C)
(6) The wavelength of the light used. (λÅ)

Optical Isomers

All these substances are known to exist in two stages.

(1) Optically active isomer:

(a) One rotating the plane of polarised light to the right is named **dextrorotatory** (Latin, Dexter-right) or direction (+) form.

(b) One rotating the plane of polarised light to the left this form is named **laevorotatory** (Latin, laevous = left) or direction (–) form.

(2) Optically inactive isomer:

(a) ***Meso compound:***

- Compound having two or more chiral carbons as well as POS, COS and AAOS is known as meso compounds.
- Meso compounds are optically inactive due to internal compensation.

- Meso are optically inactive, even though considered in optical isomer.
- Two different meso are diastereomers of each other.

(b) ***Racemic mixture:***

- An equimolar mixture of d and l isomer which does not rotate the plane polarised light hence it is optical inactive named (±)- mixture or **Racemic mixture**.
- Racemic mixture are optically inactive due to external compensation.
- Racemic mixture are optically inactive, and not considered in optical isomer.

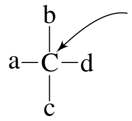
Theoretical Condition for optical activity:

- Compound must be chiral.
- Compound is non-superimposable on their mirror image.

Type-1: Optically active compound with chiral 'C'.

Chiral 'C': Carbon (sp^3) having all four different groups is called as chiral 'C'.

- Chirality is defined only at sp^3 hybridised atom not at sp or sp^2 atom.



$$a-\overset{\displaystyle b}{\underset{\displaystyle c}{C}}-d$$

- Chiral 'C'
- Asymmetric 'C'
- Dissymmdric 'C'
- Stereogenic 'C'

$a \neq b \neq d \neq c$

- Compound having only one chiral C, their molecule must be chiral.
- Compound having more than one chiral C, their molecule may be or may not be chiral depending upon symmetry elements.

Symmetry elements:

(1) Plane of symmetry (POS) (σ)
(2) Centre of symmetry (COS) (i)
(3) Axis of symmetry (AOS) (C_n)
(4) Alternative symmetry(AAOS) (S_n)

POS: An imaginary plane which bisects the molecule into two equal half and equal half must be mirror image of each other is known as plane of symmetry.

COS: An imaginary point within a molecule through which draws a line in opposite directions and gets same atom at same distance is known as centre of symmetry. This rule is applicable for each atom.

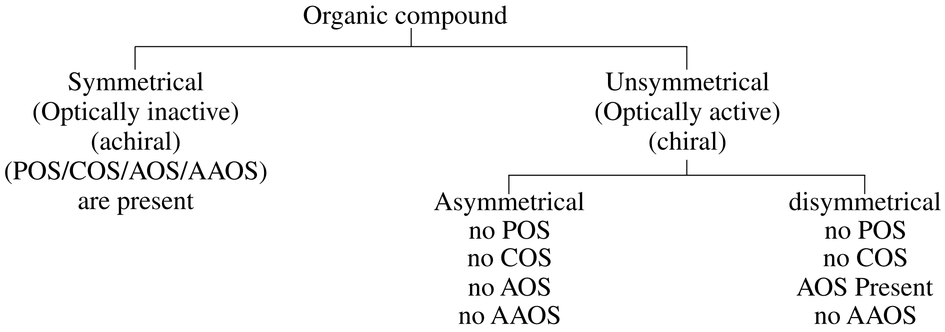
AOS: An imaginary axis through which rotates a molecule by minimum angle that molecule again reappears is known as axis of symmetry

$$n = \frac{360}{\theta}$$

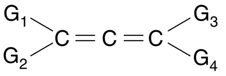
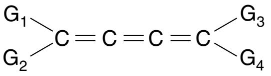
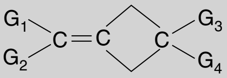
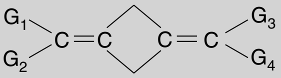
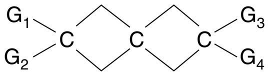
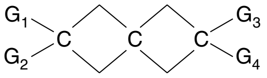
θ	360°	180°	120°	90°	72°	60°
C_n	C_1	C_2	C_3	C_4	C_5	C_6

- C_1 is not included in axis of symmetry.

AAOS: An imaginary symmetry element in which, first consider imaginary axis of symmetry after that consider imaginary POS ⊥ with AOS and again it's molecule reappears then it is known as alternative axis of symmetry.



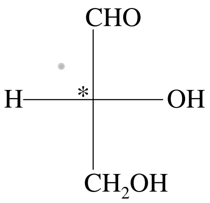
Type-2 Optically active compound without chiral 'C'

Continuous π-bond/ Ring/both	**Even** **• non planer** **• optically active When** $\boxed{G_1 \neq G_2}$, $\boxed{G_3 \neq G_4}$	**Odd** **• Planner** **• Always inactives** **• Can show G.I. When** $\boxed{G_1 \neq G_2}$, $\boxed{G_3 \neq G_4}$
(1) Allenes		
(2) Cyclo-alkylidenes		
(3) Spiranes		

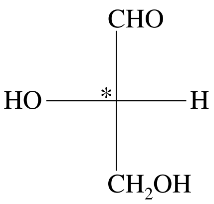
Configuration of optical isomer

(1) D, L-SYSTEM (RELATIVE CONFIGURATION):

- It is applicable for only proper Fischer projection formula
- It is mostly used for assigning D/L configuration of carbohydrate (Poly hydroxy carbonyl compound) and protein (α-amino acid).
- It represents relative configuration with respect to glyceraldehydes.
- Following configuration of glyceraldehydes is considered as standard configuration.



D-glyceraldehyde
(–OH is on R.H.S)



L-glyceraldehyde
(–OH is on L.H.S)

- In carbohydrate, group of only last chiral carbon compares with D/L glyceraldehydes

(2) R–S SYSTEM (ABSOLUTE CONFIGURATION):

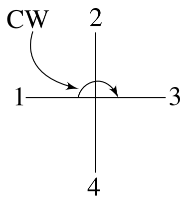
- R → Rectus (Right) S → Sinister (Left)
- R–S nomenclature is assigned as follow:

Rules of R-S configuration in Fischer formula

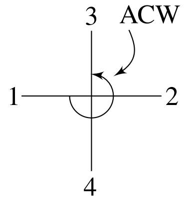
Step-I: By the set of **sequence rule**, we give the priority order of atom or group connected though the chiral carbon.

Step-II: If atom/group of minimum priority is present on the vertical line, then put arrow 1 → 2 → 3.

If it is clockwise ⇒ R but Anti clockwise ⇒ S



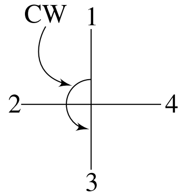
(R-form)



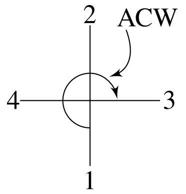
(S-form)

Step-III: If minimum priority group present on the horizontal line, then put arrow 1 → 2 → 3

If it is clockwise ⇒ S but anticlockwise ⇒ R



(R-form)



(S-form)

Rule of R-S configuration in wedge dash formula

Step-I: By the set of sequence rule, we give the priority order of atom or group connected though the chiral carbon.

Step-II: If atom/group of minimum priority is present on upward the plane (broken line), then put arrow 1 → 2 → 3.

If it is clockwise ⇒ R but Anti clockwise ⇒ S

Step-III: Step-II must be satisfied first by **golden rule** as given below.

By interchanging odd pair of groups across the chiral carbon, its R–S configuration will be opposite.

By interchanging even pair of groups across the chiral carbon, its R–S configuration will remain same

Enantiomers

- *d* and *ℓ* form of any compound is called enantiomer.
- Non-superimposable mirror image are called enantiomers.
- Opposite configuration of any compound are called enantiomers.

Properties of enantiomers

(1) Enantiomers have chiral molecule (optically active).
(2) Enantiomers have identical physical properties like BP, MP, refractive index, density, etc.
(3) They rotate PPL in opposite direction but to the equal extent of optical rotation.
(4) They have identical chemical properties, however their rate of reaction will differ if they combine with other optically active reagents.

$$\left\{\begin{array}{l} R + X \xrightarrow{k_1} P \\ S + X \xrightarrow{k_2} P \end{array}\right\} \text{X is optically inactive, then } K_1 = K_2$$

$$\left\{\begin{array}{l} R + Y \xrightarrow{k_3} P \\ S + Y \xrightarrow{k_4} P \end{array}\right\} \text{Y optically active, then } K_3 \neq K_4$$

Diastereomers: Such configurational isomers which are neither mirror images nor superimposable on each other are called as diastereomers.

Properties of diastereomers

(1) They are generally optically active, however geometrical isomers are exceptions.
(2) They have different physical properties like MP, BP, density, solubilities and value of specific rotation.
(3) They are separated by fractional distillation, fractional crystallisation and chromatography, etc.
(4) They exhibit similar but not identical chemical behaviour.

Pseudo chiral carbon: Those achiral carbon converted into chiral carbon whenever stereochemistryof one of the valency will change.

Prochiral carbon: Those achiral carbon converted into chiral carbon if one of the valency changes by different group.

Calculation of stereo isomer

Type-1: Compound showing only geometrical isomers

Case-1 If $R_1 \neq R_2$ (Unsymmetrical Compound)

(R_1–CH=CH–CH=CH–R_2)

$\boxed{\text{Number of Geometrical isomers} = 2^n}$

n → number of stereogenic (double bond) centre

Case-2 If $R_1 = R_2$ (Symmetrical Compound)

(R_1–CH = CH–CH=CH–R_2)

$\boxed{\text{Number of Geometrical isomers} = 2^{n-1} + 2^{p-1}}$

If n is even number then, $p = \frac{n}{2}$;

If n is odd number then, $p = \frac{n+1}{2}$

Type-2: Compound showing only **Optical isomers**

Compound	Optically active isomer (a) or Number of d and ℓ isomer	Number of meso isomer (m)	Total number of optical isomer (a + m)
(1) Unsymmetrical	2^n	0	2^n
(2) Symmetrical n = even number	2^{n-1}	$2^{n/2-1}$	$2^{n-1} + 2^{n/2-1}$
(3) Symmetrical n = odd number	$2^{n-1} - 2^{\frac{n-1}{2}}$	$2^{\frac{n-1}{2}}$	2^{n-1}

n = number of chiral carbon

Type-3: Compound showing both **Optical isomers and Geometrical isomers**

(1) Compound Unsymmetrical

Number of stereo isomer = 2^n

n = Number of chiral carbon and Number of π-bonds which showing geometrical isomersism

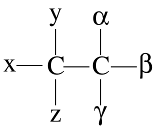
(2) Compound symmetrical – draw and check

Conformational isomerism: Such non-identical arrangements of atoms or group in a molecule obtained by the free rotation about a single bond that can easily be reconverted at room temperature are known as conformational isomers or conformers.

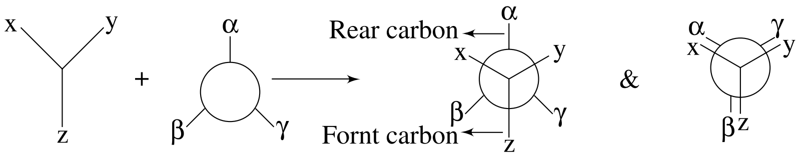
Condition: Molecule must have at least only 3 continuous σ bonds.

Projection of Tetrahedral Carbon Atom:

1. Newman projection: The two σ bonded carbon atoms represented by circle by one behind the other so that only the front carbons are depicted from the centre of the circle while C–H bonds of back carbon are drawn from the circumference of circle as

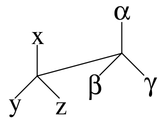


$$x-\overset{\overset{y}{|}}{\underset{\underset{z}{|}}{C}}-\overset{\overset{\alpha}{|}}{\underset{\underset{\gamma}{|}}{C}}-\beta$$



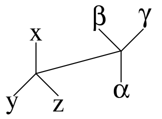
front 'C'   Rear 'C'   Staggered Newman projection   Eclipsed Newman projection

2. Sawhorse Projection: The two σ bonded e expressed by slanted and elongated line



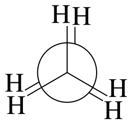
Eclipsed sawhorse projection

&

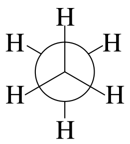


Staggered sawhorse projection

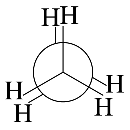
Conformation of ethane:



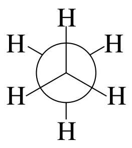
θ = 0°
(i)



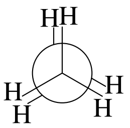
θ = 60°
(ii)



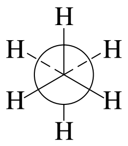
θ = 120°
(iii)



θ = 180°
(iv)



θ = 240°
(v)

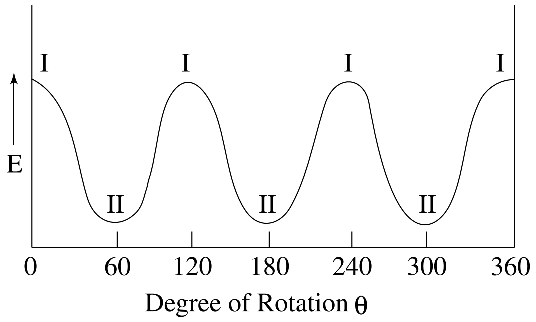


θ = 300°
(vi)

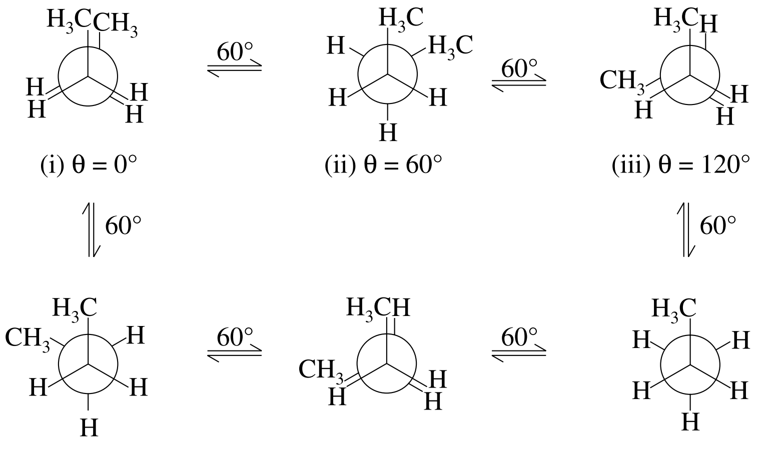
- Ethane molecule contains infinite number of conformers
- The extreme conformation of ethane molecules is staggered and eclipsed
- All other conformer erist in between 0° + 60° known as skew form.
- The energy of staggered conformation is lower than eclipsed conformation by 2.8 kcal/mole (11.7 kJ/mole).
- Staggered conformation is more stable than the eclipsed conformation
- The mixture contains 99% staggered conformation and 1% eclipsed conformation.
- Eclipsed and staggered conformations are not isolated from the mixture.

Order of Stability Staggered > Skew > Eclipsed

Energy Level Comparison of Conformations of Ethane



Conformations of Butane (CH_5–CH_2–CH_2–CH_3):



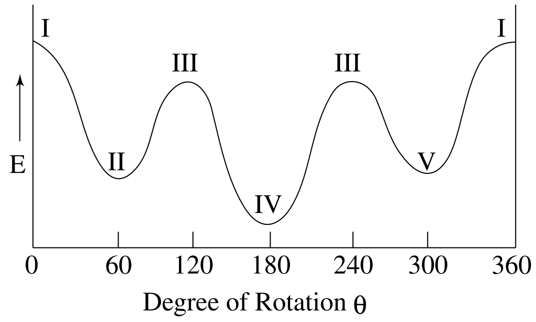
(i) θ = 0° (ii) θ = 60° (iii) θ = 120°

(iv) θ = 300° (v) θ = 240° (vi) θ = 180°

(i) = Fully eclipsed form (CH_3 group eclipsed by CH_3 group)
(ii) = (vi) = partial staggered form
(iv) = *anti* or *trans* (Staggered)
(iii) = (v) = partial eclipsed form (CH_3 group eclipsed by H)
Stability order: iv > ii > iii > i

Order of Stability Anti > Gauche > Partially Eclipsed > Fully Eclipsed

Energy Level Comparison of Conformations of n-butane

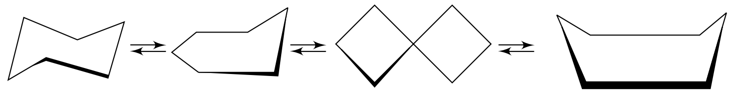


Cycloalkanes

In cyclopropane and cyclobutane (both planar), C–C–C angle are 60° and 90° respectively. Cyclopentane and cyclohexane (considered planar though non-planar) with C–C–C angles 180° and 120° respectively.

Baeyer or angle strain	Cyclopropane	Cyclobutane	Cyclopentane	Cyclohexane
$\frac{1}{2}$ [109°28′ – angle]	24°44′	9°44′	0°44′	–5°16′

Conformations of Cyclohexane: A cyclohexane ring can assume many shapes and any single cyclohexane molecule is in a continuous state of flexing or flipping into different shapes which are illustrated as follows:

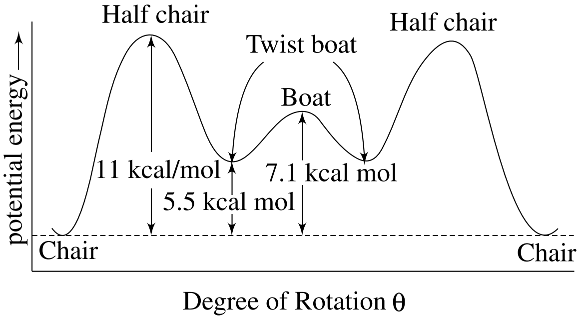


Chair (more stable) Half-chair Twist-boat (optically active) Boat (less stable)

Interconversion of chair forms is known as conformational inversion and occurs by rotation about carbon-carbon bonds.

The most stable conformation of cyclohexane is the chair form.

Relative energies of the conformation of cyclohexane molecule



Actual conformers of cyclohexane with relative energy are as follows :

Conformer	Chair	Twist boat	Boat	Half chair
Relative energy	0.000 kJ mol^{-1}	22.2 kJ mol^{-1}	28.9 kJ mol^{-1}	44 kJ mol^{-1} (approx.)

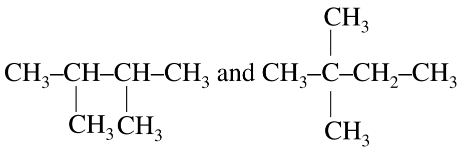
The relative stability of conformations of cyclohexane decreases in the order:

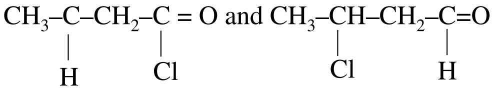
Chair ⟩ Twist boat ⟩ Boat ⟩ Half chair

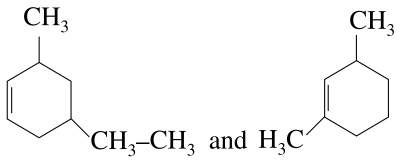
The potential energy barrier for transformation of chair form to other forms is about 37.8-46.0 kJ mol^{-1}

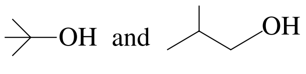
SOLVED EXAMPLE

1. Which are not position isomers?

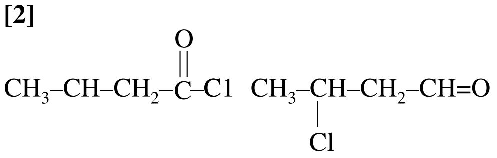
(1) 
$CH_3-\underset{CH_3}{CH}-\underset{CH_3}{CH}-CH_3$ and $CH_3-\overset{CH_3}{\underset{CH_3}{C}}-CH_2-CH_3$

(2) 
$CH_3-\underset{H}{C}-CH_2-\underset{Cl}{C}=O$ and $CH_3-\underset{Cl}{CH}-CH_2-\underset{H}{C}=O$

(3) 

(4) 

Sol. **[2]**


$CH_3-CH-CH_2-\overset{O}{\overset{\|}{C}}-C1$ $CH_3-\underset{Cl}{CH}-CH_2-CH=O$

Functional group isomer

2. Which of the following statements regarding ethanoic acid and methyl methanoate are correct?

I. They are functional group isomers with molecular formula $C_2H_4O_2$.

II. They belong to same homologous series.

III. They have different chemical properties.

(1) I and II (2) I and III

(3) II and III (4) I, II and III

Sol. **[2]**


CH_3-COOH $H-\overset{O}{\overset{\|}{C}}-OCH_3$

Ethanoic acid Methyl methanoate

→ m.f. = $C_2H_4O_2$

→ functional group differ, So belong different homologous series and also have different chemical Properties.

3. Organic compound with molecular formula $C_4H_8O_2$ cannot have the functional group

(1) carboxylic acid (2) ester

(3) dialdehyde (4) cyclic diol

Sol. **[3]**

$$D.B.E = (C + 1) - \frac{H + X - N}{12}$$

$$= (4 + 1) - \left(\frac{8}{2}\right) = 1$$

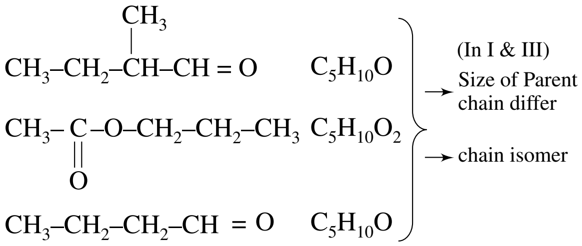
In dialdehyde, D.B.E = 2 (not possible)

4. Which of the following Compounds are structural isomers of $C_5H_{10}O$?

I. 2-methyl butanal
II. Propyl ethanoate
III. Pentanal

(1) I and II (2) I and III
(3) II and III (4) I, II and III

Sol. **[2]**



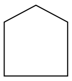
$CH_3-CH_2-\overset{CH_3}{\overset{|}{C}H}-CH=O$ $C_5H_{10}O$

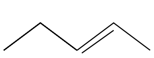
$CH_3-\underset{O}{\underset{\|}{C}}-O-CH_2-CH_2-CH_3$ $C_5H_{10}O_2$

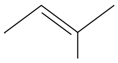
$CH_3-CH_2-CH_2-CH=O$ $C_5H_{10}O$

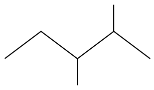
(In I & III) → Size of Parent chain differ → chain isomer

5. Select pair of chain isomers from the following

(I)


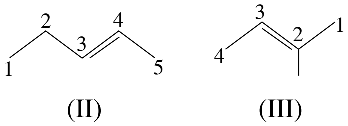
(II)


(III)


(IV)


(1) I and II (2) II and IV
(3) I and IV (4) II and III

Sol. **[4]**



P.C differ so they becomes Chain isomer

6. An alkyne has molar mass 96. How many different isomer (excluding stereochemical designation) are possible considering all of them to be internal alkynes?

(1) 3 (2) 4
(3) 6 (4) 8

Sol. **[3]**

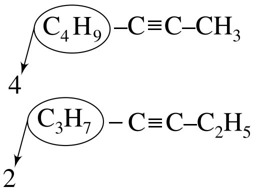
$C_nH_{2n-2} = 96$

$12n + 2n-2 = 96$

$14n = 98$

$n = 7$

m.f. $= C_7H_{12}$



$(C_4H_9)-C\equiv C-CH_3$ → 4

$(C_3H_7)-C\equiv C-C_2H_5$ → 2

number of possible alkyne = 4 + 2 = 6

7. How many structural isomers are possible for compounds containing C, H and O atoms only with their molar masses 100 as well as the isomers are simultaneously ketones?

(1) 3 (2) 4
(3) 5 (4) 6

Sol. **[4]**

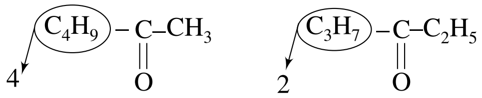
General formula of ketone $C_nH_{2n}O$

$12n + 2n + 16 = 100$

$14n = 84$

$n = 6$

$C_6H_{12}O$

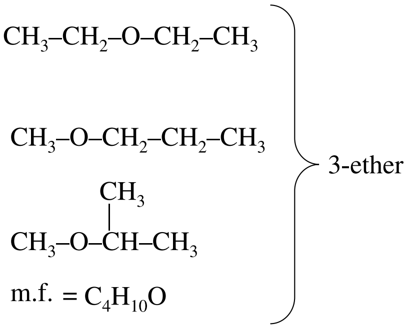


$(C_4H_9)-\underset{O}{\underset{\|}{C}}-CH_3$ → 4 $(C_3H_7)-\underset{O}{\underset{\|}{C}}-C_2H_5$ → 2

8. An organic compound has three ether isomers and it is the smallest ether which satisfy this condition. Which of the following is true regarding this compound?

(1) Only one alcohol isomer exist
(2) Four alcohol isomers exist and they are all constitutional isomers
(3) Five alcohol isomers exist and they are positional isomers of each other
(4) Molecular formula of the compound is $C_5H_{12}O$

Sol. **[2]**



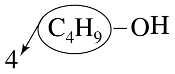
$CH_3-CH_2-O-CH_2-CH_3$

$CH_3-O-CH_2-CH_2-CH_3$

$CH_3-O-\overset{CH_3}{\overset{|}{C}H}-CH_3$

m.f. $= C_4H_{10}O$

3-ether



$(C_4H_9)-OH$ → 4

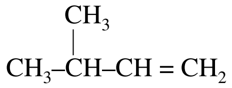
9. How many alkene isomers are possible for compound with molecular formula C_5H_{10}?

(1) 3 (2) 4
(3) 5 (4) 6

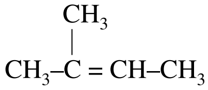
Sol. **[4]**

$CH_3-CH_2-CH_2-CH=CH_2$

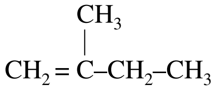
$CH_3-CH_2-CH=CH-CH_3$ (cis/trans)



$CH_3-\overset{\overset{CH_3}{|}}{C}H-CH=CH_2$



$CH_3-\overset{\overset{CH_3}{|}}{C}=CH-CH_3$



$CH_2=\overset{\overset{CH_3}{|}}{C}-CH_2-CH_3$

alkene isomer = 6

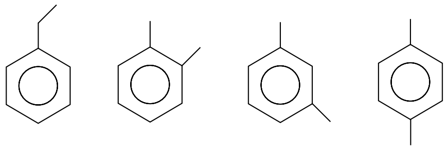
10. How many structural isomer are possible with the molecular formula C_8H_{10}

(1) 3 (2) 4

(3) 5 (4) 6

Sol. **[2]**

$$D.U = (8 + 1) - \frac{10}{2} = 4$$

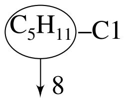


11. How many different secondary halide names can be assigned to the compounds with molecular formula $C_5H_{11}Cl$ (excluding stereoisomers)?

(1) 3 (2) 4

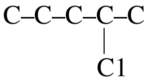
(3) 5 (4) 7

Sol. **[1]**

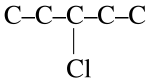


$C_5H_{11}-C1$ $\downarrow 8$

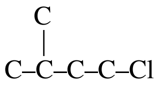
(1) C–C–C–C–C–Cl (1°)

(2) 

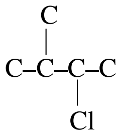
$C-C-C-\underset{\underset{C1}{|}}{C}-C$ (2°)

(3) 

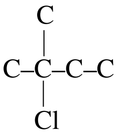
$C-C-\underset{\underset{Cl}{|}}{C}-C-C$ (2°)

(4) 

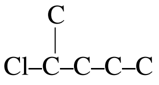
$C-\overset{\overset{C}{|}}{C}-C-C-Cl$ (1°)

(5) 

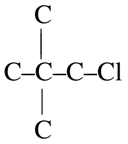
$C-\overset{\overset{C}{|}}{C}-\underset{\underset{Cl}{|}}{C}-C$ (2°)

(6) 

$C-\overset{\overset{C}{|}}{\underset{\underset{Cl}{|}}{C}}-C-C$ (3°)

(7) 

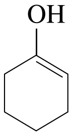
$Cl-\overset{\overset{C}{|}}{C}-C-C-C$ (1°)

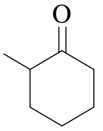
(8) 

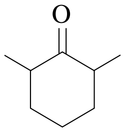
$C-\overset{\overset{C}{|}}{\underset{\underset{C}{|}}{C}}-C-Cl$ (1°)

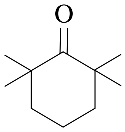
2° halide isomer = 3

12. Which of the following compound will not undergo tautomerism?

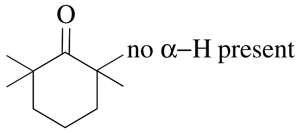
(1) 

(2) 

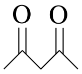
(3) 

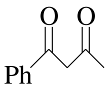
(4) 

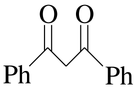
Sol. **[4]**

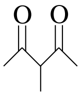


13. Which of the following compound has highest enol content?

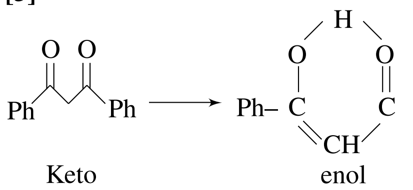
(1) 

(2) 

(3) 

(4) 

Sol. **[3]**



→ Stabilised by intramolecular H-bond

→ Phenyl group, further stabilised via Resonance

14. Which of the following compounds will not show geometrical isomerism?

(1) 3-Phenyl-2-propenoic acid

(2) 2-Butene

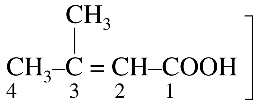
(3) 3-Methyl-2-butenoic acid

(4) 3-Methyl-2-pentenoic acid

Sol. **[3]**

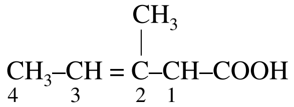
$\overset{3}{C_6H_5\text{–}CH} = \overset{2}{CH}\text{–}\overset{1}{C}OOH$

$CH_3\text{–}CH = CH\text{–}CH_3$



$\underset{4}{CH_3}\text{–}\underset{3}{\overset{CH_3}{C}} = \underset{2}{CH}\text{–}\underset{1}{C}OOH$

2 methyl at same double bonded carbon sop that no G.I



$\underset{4}{CH_3}\text{–}\underset{3}{CH} = \underset{2}{\overset{CH_3}{C}}\text{–}\underset{1}{CH}\text{–}COOH$

15. Which of the following will have zero dipole moment?

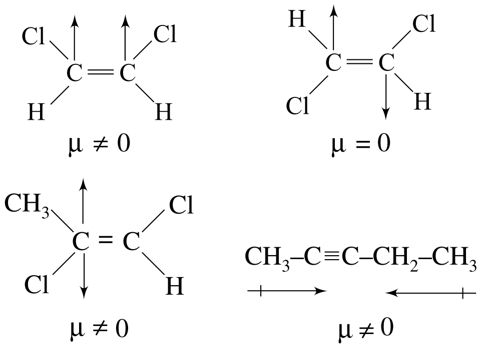
(1) *cis*-1, 2-Dichloroethene

(2) *trans*-1, 2-Dichloroethene

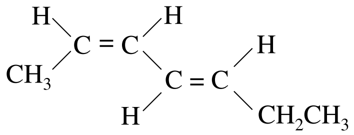
(3) *trans*-1, 2-Dichloropropene

(4) 2-Pentyne

Sol. **[2]**



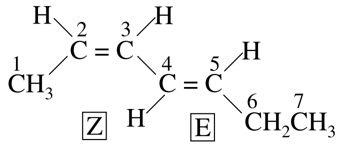
16. What is the IUPAC name of the following compound?



(1) hepta-(2E, 4Z) diene (2) hepta (2E, 4E) diene

(3) hepta-(2Z, 4E) diene (4) hepta-(2Z, 4Z)diene

Sol. **[3]**



(2Z, 4E)

17. Which of the following compounds exhibits stereioisomerism?

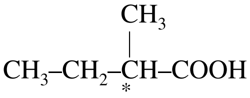
(1) 2-Mehylbutene

(2) 3-Methylbutyne

(3) 3-Methylbutanoic acid

(4) 2-Methylbutanoic acid

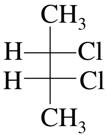
Sol. **[4]**



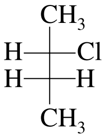
$CH_3\text{–}CH_2\text{–}\underset{*}{\overset{CH_3}{CH}}\text{–}COOH$

18. Which of the following is a meso compound:

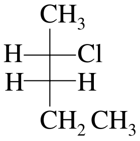
(1)



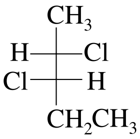
(2)



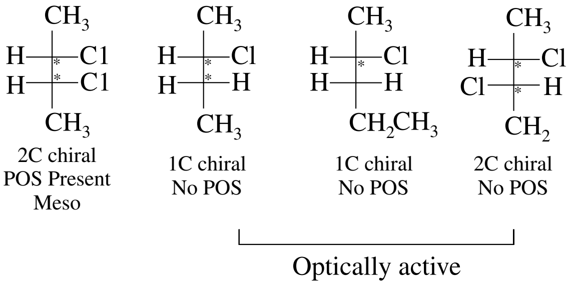
(3)



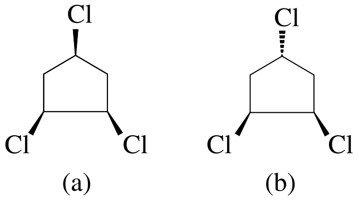
(4)



Sol. **[1]**



19.



Relation between (a) and (b) is:

(1) Enantiomer (2) Diastereomer

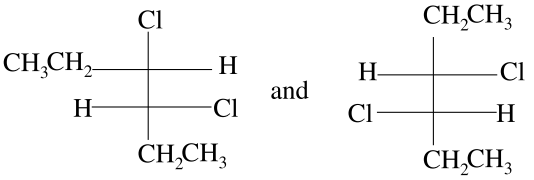
(3) Identical (4) Structural isomer

Sol. **[2]**

Stereoisomer not mirror image

Diastereomer

20. The pair of molecules shown are



(1) enantiomers

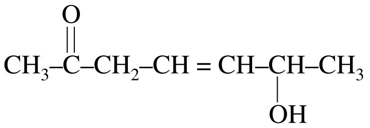
(2) diastereomers

(3) constitutional isomers

(4) two conformations of the same molecule

Sol. **[2]**

For comparison of Fischer projection, like groups should be present on vertical and horizontal lines.

21. 

$\mathrm{CH_3{-}\overset{\overset{O}{\|}}{C}{-}CH_2{-}CH = CH{-}\underset{\underset{OH}{|}}{CH}{-}CH_3}$

Total number of stereoisomers are–

(1) 4　　(2) 6

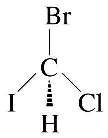
(3) 8　　(4) 12

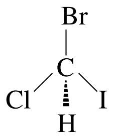
Sol. **[1]**

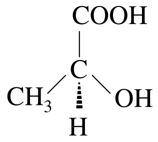
n = 2

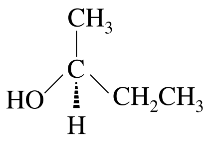
number of streoisomer = $2^2 = 4$

22. Which of the following representations have an R configuration?

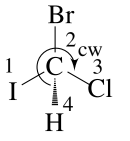
(1) 

(2) 

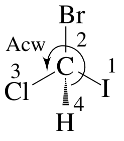
(3) 

(4) 

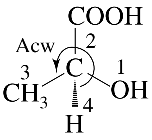
Sol. **[1]**



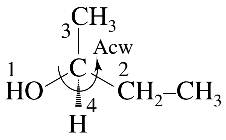
(R)



(S)



(S)



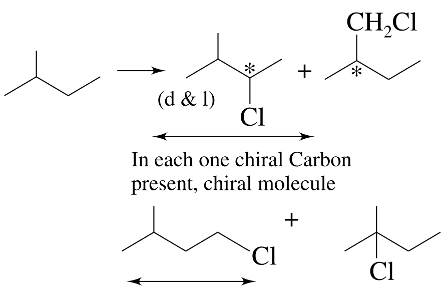
(S)

23. How many chiral compounds are possible on mono-chlorination of 2-methyl butane?

(1) 8　　(2) 2

(3) 4　　(4) 6

Sol. **[3]**



In each one chiral Carbon present, chiral molecule

No chiral Carbon present, achiral molecule

24. An optically pure compound x gave an $[\alpha]_D^{25} = +20.0°$. A mixture of X and its enantiomer Y gave $[\alpha]_D^{25} = +10°$. The ratio of X to Y in the mixture is:

(1) 2 : 1　　(2) 1 : 3

(3) 3 : 1　　(4) 1 : 2

Sol. **[3]**

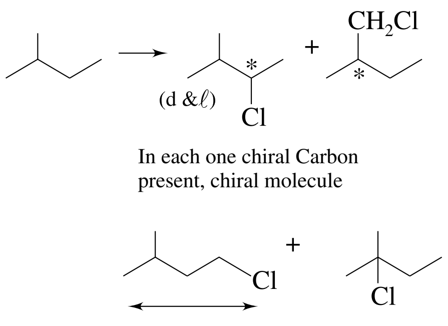
Enantiomeric axis of d $= \frac{10}{20} = \frac{1}{2} \times 100 = 50\%$

Racemic mix = 50%

d = 25%, ℓ = 25

Total d = 50 + 25 = 75%, ℓ = 25%

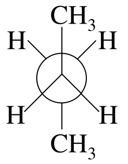
$\frac{d}{\ell} = \frac{75}{25} = 3:1$

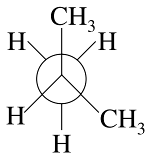


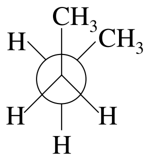
In each one chiral Carbon present, chiral molecule

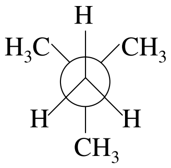
No chiral Carbon present, achiral molecule

25. The most stable conformer of 2-methyl propane is

(1) 

(2) 

(3) 

(4) 

Sol. **[2]**

Only option (2) belongs 2-methyl propane and also it is more stable

EXERCISE 1

1. Which of the following statements are correct?

I. A pair of positional isomers differs in the position of the same functional group.

II. A pair of structural isomers have the same relative molar mass

III. A pair of functional group isomers belongs to different homologous series.

(1) I and II (2) I and III
(3) II and III (4) I, II and III

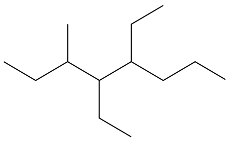
2. Assuming a hydrocarbon C_5H_{10} without any double bond, how many different structures exist that contain only one alkyl group?

(1) 1 (2) 2
(3) 3 (4) 5

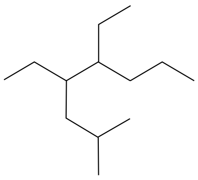
3. Which name is not possible with molecular formula C_6H_{10}?

(1) 2-hexyne (2) 3-hexyne
(3) 4-methyl-2-pentyne (4) 3-cyclopropylpropyne

4. Given compound shows which type of isomerism?



and



(1) Chain isomerism
(2) Positional isomerism
(3) Functional group isomerism
(4) Metamerism

5. How many structural isomers of molecular formula C_3H_6BrCl?

(1) 4 (2) 5
(3) 6 (4) 7

6. The total number of stable acyclic compounds having the molecular formula C_4H_8O is:

(1) 4 (2) 7
(3) 11 (4) 14

7. Which of the following statements concerning 3, 4-dibromo-1-pentene and 3, 5-dibromo-2-pentene are correct?

I. They have same molecular formula $C_5H_8Br_2$

II. They are positional isomers

III. They have similar chemical properties.

(1) I and II (2) I and III
(3) II and III (4) I, II and III

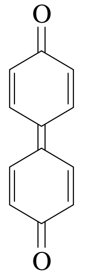
8. Number of structural isomers of compound having molecular formula C_4H_7Cl is:

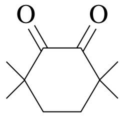
(1) 4 (2) 8
(3) 12 (4) 16

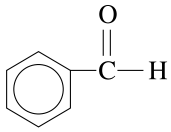
9. How many amide isomers are possible for C_4H_9ON?

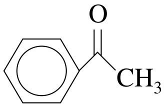
(1) 4 (2) 5
(3) 6 (4) 8

10. Which of the following compounds will undergo tautomerism?

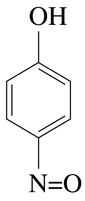
(1) 

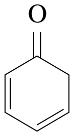
(2) 

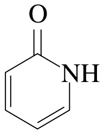
(3) 

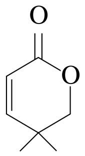
(4) 

11. Which of the following compounds cannot show tautomerism?

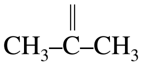
(1) 

(2) 

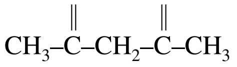
(3) 

(4) 

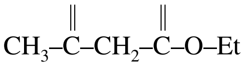
12. Order of stability of enol content:

(a) 

$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

(b) 

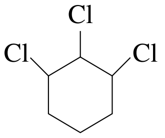
$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

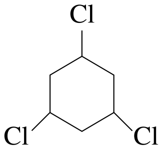
(c) 

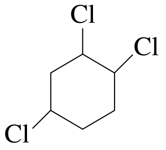
$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-O-Et$

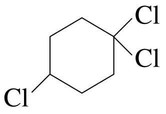
(1) a > b > c (2) b > a > c
(3) b > c > a (4) a > b > c

13. Which of the following compounds does not have any geometrical isomer?

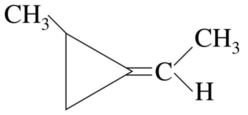
(1) 

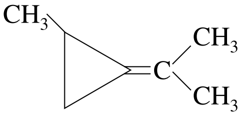
(2) 

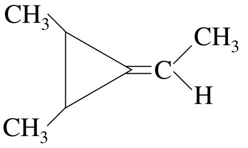
(3) 

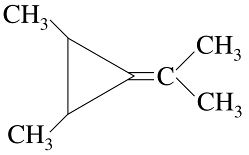
(4) 

14. Which of the following will show optical isomerism as well as geometrical isomerism?

(1) 

(2) 

(3) 

(4) 

15. The correct order of the substituent in each of the following set in order of priority according to CIP rule

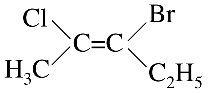
(1) –Cl > –OH > –SH > H

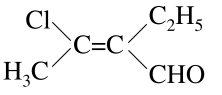
(2) $–CH_2–Br > –CH_2–Cl > –CH_2–OH > –CH_3$

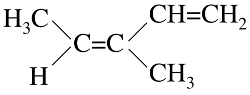
(3) $–CH = O > –OH > –CH_3 > –H$

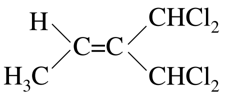
(4) $–OCH_3 > –N(CH_3)_2 > –CH_3 > –CD_3$

16. The E-isomer among the following is

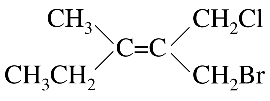
(1) 

(2) 

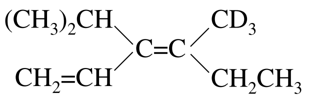
(3) 

(4) 

17. Consider the following compounds,



(i)



(ii)

The correct E/Z configurational notations for the compounds I to II are respectively-

(1) Z, Z	(2) E, Z
(3) E, Z	(4) E, E

18. A cyclic dichloride has a total five constitutional plus geometrical isomers. Which of the following satisfy this condition without altering the carbon skeleton?

(1) Dichloromethyl cyclopropane

(2) Dichlorocyclobutane

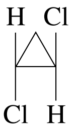
(3) Dichlorocyclopentane

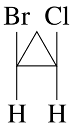
(4) Dichlorocyclohexane

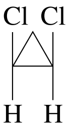
19. How many cyclic isomers exists (structural and geometrical only) for $C_3H_3Cl_3$?

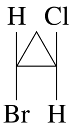
(1) 2	(2) 3
(3) 4	(4) 5

20. Which of the following compounds is a meso compound?

(1) 

(2) 

(3) 

(4) 

21. Which of following is not capable of existing enantiomers

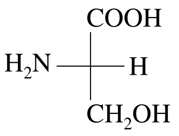
(1) 1, 3-dichloro butane

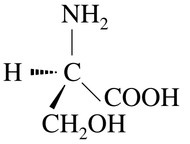
(2) 1, 2-dibromo propane

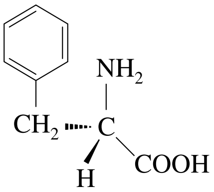
(3) 1, 4-dichloro pentane

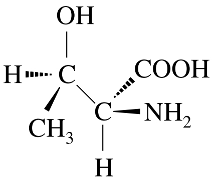
(4) 3-ethyl pentane

22. Which of the following is not correct representation of L-amino acids

(1) 

(2) 

(3) 

(4) 

23. Which isomer below has a stable intramoecular H-bond?

(1) *trans*-3-fluoro propenoic acid

(2) *Cis*-3-fluoro propenoic acid

(3) 2-fluoro propenoic acid

(4) 4-fluoro-3-methyl-3-pentenoic acid

24. If solution of a compound (30 g/100 mL of solution) has measured rotation of +15° in a 2 dm log sample tube, the specific rotation of this compound is

(1) +50° (2) +25°

(3) +15° (4) +7.5°

25. What is true regarding a meso form of a compound?

(1) A meso form is achiral due ot the presence of an axis of symmetry

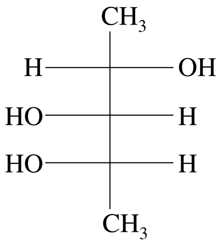
(2) A meso form does not contain any chiral carbon

(3) A meso form cannot be isolated from its optically active stereoisomer by fractional crystallisation

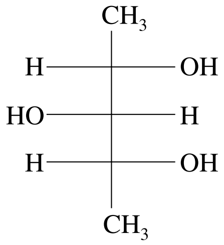
(4) A meso form is achiral due to internal compensation of optical rotation

26. Which structures represent(s) diastereomers of 1?

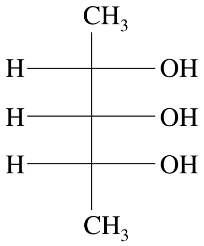
(I)



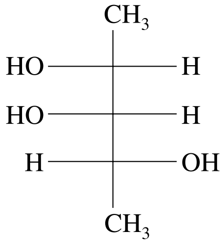
(II)



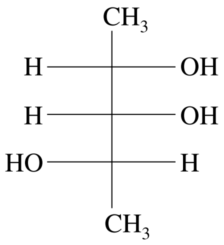
(III)



(IV)



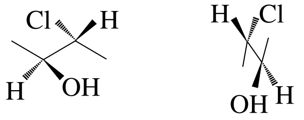
(V)



(1) Only II (2) II and III

(3) II and IV (4) III and IV

27. Relation between given pair is:

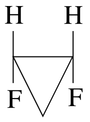


(1) Enantiomer (2) Diastereomers

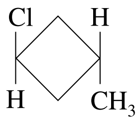
(3) Identical (4) Structural isomer

28. Which compound does not possess a plane of symmetry?

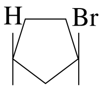
(I)



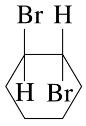
(II)



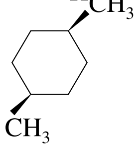
(III)



(IV)



(V)



(1) I, II and V (2) I, III and IV

(3) II, III and IV (4) III and IV

29. Dextrorotatory α-pinene has a specific rotation n $[\alpha]_D^{20} = +\ 51.3°$. A sample of α-pinene containing both the enantiomers was found to have a specific rotation value $[\alpha]_D^{20} = +\ 30.8°$. The percentages of the (+) and (–) enantiomers present in the sample are, respectively:

(1) 70% and 30% (2) 80% and 20%

(3) 20% and 80% (4) 60% and 40%

30. What is wrong about enantiomers of 2-chloropropanoic acid?

(1) Have same solubility in water

(2) Have same pK_a value

(3) Have same refractive Index

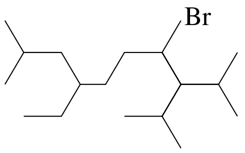
(4) Have same rate of reactions with (+)-2-butanol

31. How many stereoisomers exist for the compound 4-(1-propenyl) cyclohexene?

(1) 2 (2) 3

(3) 4 (4) 5

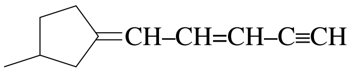
32. Calculate the number of stereoisomerism for



(1) 2 (2) 4

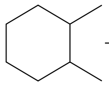
(3) 8 (4) 6

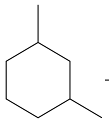
33. The number of stereoisomers possible for the compound is-



(1) 2　　(2) 4

(3) 6　　(4) 8

34.  ⟶ a (stereoisomers)

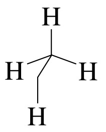
 ⟶ b (stereoisomers)

a and b are stereoismers sum of (a + b = ?)

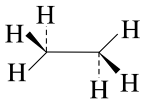
(1) 4　　(2) 6

(3) 8　　(4) 12

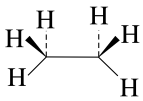
35. Which of the following represents the staggered conformation of ethane?



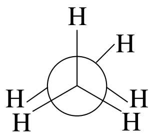
I



II



III

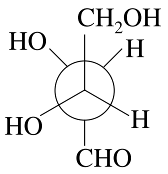


IV

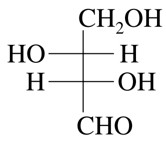
(1) I and II　　(2) I, II and III

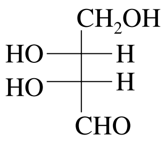
(3) I and III　　(4) II, III and IV

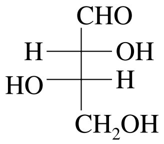
36. Consider the following Newman projection.

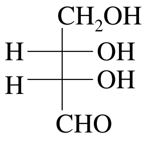


Which of the following is the correct representation of the same compound in Fischer projection formula (ignore conformational aspect)?

(1) 

(2) 

(3) 

(4) 

37. Which is true about conformers of 1, 1, 2, 2-tetrachloroethane?

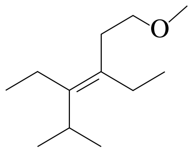
(1) The most stable conformer has dihedral angle of 60° between all adjacent chlorine atoms

(2) In the least stable conformer, two Cl-atoms are eclipsing one another while other two Cl-atoms are eclipsed to hydrogen atoms

(3) In the most stable conformer, dihedral angle between hydrogen atoms is 60°

(4) The most stable conformer is non-polar

38. Consider the following structure



Its IUPAC name is

(1) (Z)-3, 4-diethyl-1-methoxy-5-methyl-3-hexene

(2) (E)-3, 4-diethyl-1-methoxy-5-methyl-3-hexene

(3) (E)-3, 4-diethyl-6-methoxy-2-methyl-3-hexene

(4) (Z)-3, 4-diethyl-6-methoxy-2-methyl-3-hexene

39. Which of the following statements is incorrect about cis and trans isomers ?

(1) *cis*-2-butene can be converted into *trans*-2-butene by irradiation

(2) In general *trans* isomers have zero dipole moment

(3) On heating, fumaric acid (a *trans* acid) gives an anhydride

(4) On heating, maleic acid (a *cis* acid) gives an anhydride

40. The in correct statement concerning various conformers of 2-fluoroethanol is/are

(1) Anti-conformer is the most stable conformer

(2) There is intramolecular H-bonding in its most stable conformer

(3) The most stable conformer has greater steric strain than 2nd most stable conformer

(4) Dissolving in water lower the percentage of most stable conformer

EXERCISE 2

1. How many different isomer can be given to bromodichlorobenzene?

(1) 3 (2) 4

(3) 6 (4) 7

2. How many cycloalkene isomers exist for C_5H_8 which contain at least one methyl locant directly present on the ring?

(1) 2 (2) 4

(3) 5 (4) 6

3. How many structural isomers exist for C_4H_8O which are simultaneously ether? Also there is no atom sp^2-hybridised.

(1) 3 (2) 4

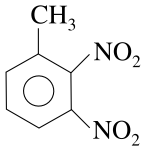
(3) 6 (4) 7

4. A hydrocarbon has molecular formula X(C_6H_6). Also, X has triple bonds as the only type of unsaturation, i.e., it has neither double bonds nor any ring structure. How many different IUPAC name can be assigned to X?

(1) 3 (2) 4

(3) 5 (4) 7

5.

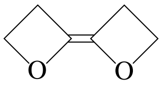


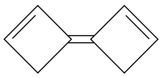
Number of positional isomer are:

(1) 4 (2) 5

(3) 6 (4) 7

6. Which of following compound will not show geometrical isomerism?

(1)


(2)


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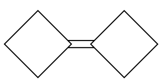

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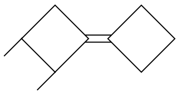
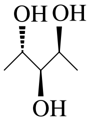
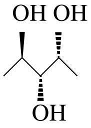


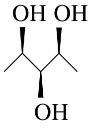
7. Among the configurations



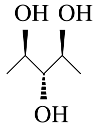
I



II



III



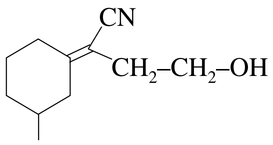
IV

The meso pair is-

(1) I and II (2) I and IV

(3) III and IV (4) II and III

8. False statement about the following compound is–



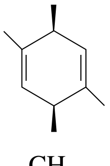
(1) It is having two stereocentres

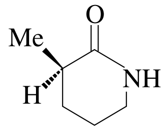
(2) Its configuration at double bond is E

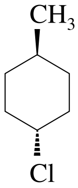
(3) It shows optical isomerism

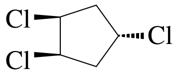
(4) It shows geometrical isomerism

9. Which of the following compound is chiral?

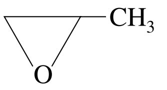
(1)


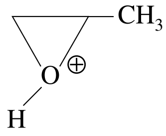
(2)


(3)


(4)


10.



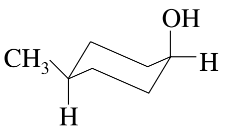


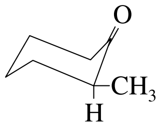
Number of chiral center present in above compounds are:

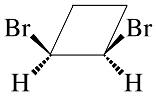
(1) 1, 1 (2) 1, 2

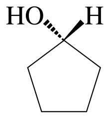
(3) 2, 1 (4) 2, 3

11. Which of the following molecule is chiral?

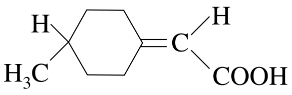
(1)


(2)


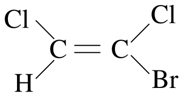
(3)


(4)


12. Consider the following structures,



(X)



(Y)

Which one of the following statements is correct about the structures (X) and (Y)?

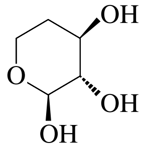
(1) Both (X) and (Y) exhibit enantiomerism

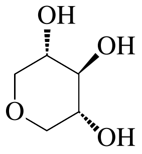
(2) Both (X) and (Y) exhibit distereomerism

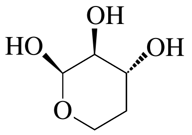
(3) (X) exhibits enantiomerism while (Y) exhibits distereomerism

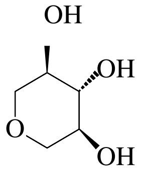
(4) (X) exhibits distereomerism while (Y) exhibits enantiomerism

13. Which two of the following compounds are identical?


(I)


(II)

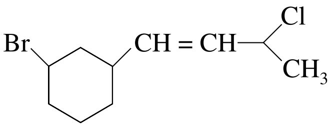

(III)


(IV)

(1) I & II (2) II & IV

(3) III & IV (4) I & III

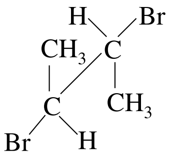
14. How many stereo isomers are possible for the following molecule?

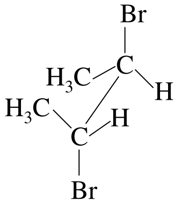


(1) 4 (2) 8

(3) 16 (4) 32

15. The structures shown here are related as being:

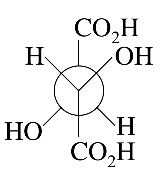


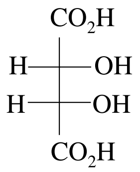


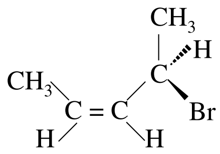
(1) Conformers (2) Enantiomorphs

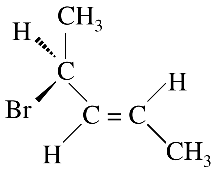
(3) Geometrical isomers (4) Diastereoisomers

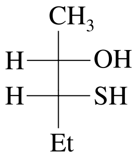
16. Which of following pair is Diastereomers?

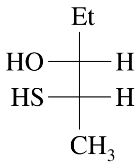
(1)


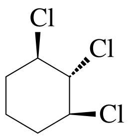


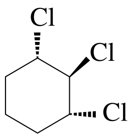
(2)


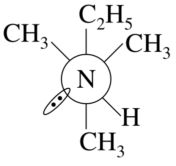


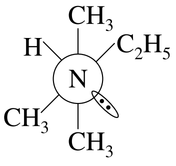
(3)


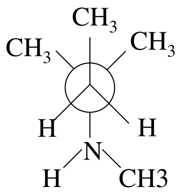


(4)




17.

(I)


(II)


(III)

Which of the following statements is correct?

(1) I and II are conformational isomers while II and III are functional isomers

(2) I and II are functional isomers while II and III are conformational isomers

(3) I and II are functional isomers while I and III are conformational isomers

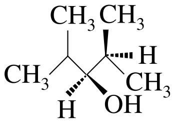
(4) I and II are functional isomers while I and III are metamer isomers

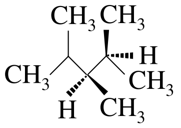
18. The total number of dimethylphenols having the molecular formula $C_8H_{10}O$ is:

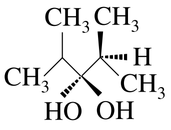
(1) 3 (2) 4

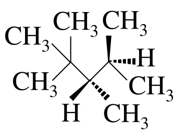
(3) 6 (4) 8

19. Which of the following structures represents a chiral compound?

(1)


(2)


(3)


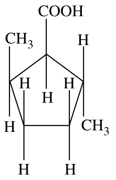
(4)


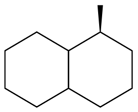
20. (+)-mandelic acid has a specific rotation of 158°. What would be the observed specific rotation of a mixture of 25% (–)-mandelic acid and 75% (+)-mandelic acid?

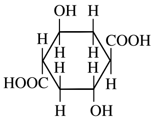
(1) +118.5° (2) –118.5°

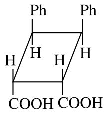
(3) –79° (4) +79°

21. Which species exhibits a plane of symmetry?

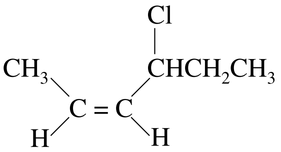
(1) 

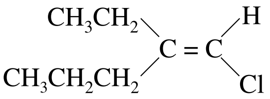
(2) 

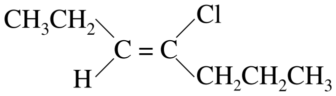
(3) 

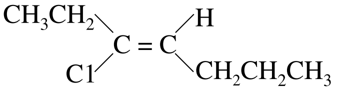
(4) 

22. Which of the following represents Z-3-chloro-3-heptene?

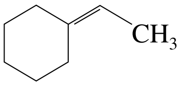
(1) 

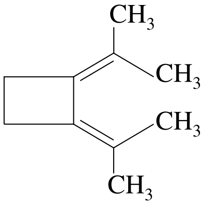
(2) 

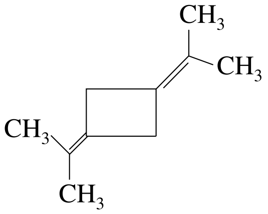
(3) 

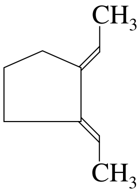
(4) 

23. Which compound below can show geometrical isomerism?

(1) 

(2) 

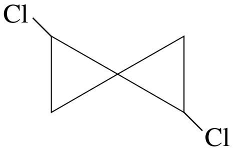
(3) 

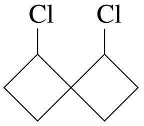
(4) 

24. Which compound below is capable of showing geometrical isomerism?

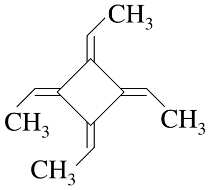
(1) $CH_3–CH=C=CH–CH_3$

(2) $CH_3–CH=C=C=CH–CH_3$

(3) 

(4) 

25. How many geometrical isomers exist for the molecule shown below?



(1) 2	(2) 3
(3) 5	(4) 6

26. If chlorocyclohexane is subjected to further chlorination, how many different isomers (geometrical plus structural only) of dichlorocyclohexane would be produced?

(1) 3	(2) 5
(3) 6	(4) 7

27. The correct statement regarding elements of symmetry and chirality of compound is

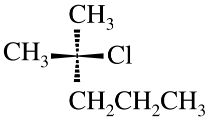
(1) Presence of an axis of symmetry destroy chirality

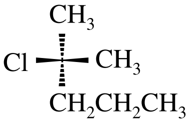
(2) Centre of symmetry has no role to play in chirality of a compound

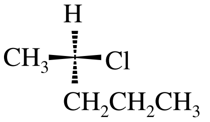
(3) A compound with either plane or centre of symmetry is always achiral

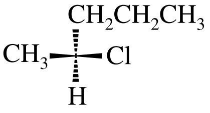
(4) A compound with an axis of symmetry simultaneously contain centre of symmetry

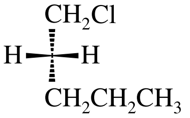
28. Consider the following set of molecules

(I) 

(II) 

(III) 

(IV) 

(V) 

The pairs of enantiomers are

(1) I, II, III and IV (2) I and II
(3) III and IV (4) IV and V

29. How many stereoisomers are possible for the compound 2, 5-heptadiene-4-ol?

(1) 2 (2) 3
(3) 4 (4) 5

30. A stereoisomer of cyclobutane-1,2-diol has lower solubility in water than its other stereoisomer, which is this isomer and why?

(1) Trans, lower dipole moment
(2) *Cis*, higher dipole moment
(3) *Cis*, intramolecular H-bonding
(4) *Trans*, intramolecular H-bonding

31. Which of the following correctly ranks the cycloalkanes in order of increasing ring strain per methylene group?

(1) Cyclopropane < Cyclobutane < Cyclopentane < Cyclohexane
(2) Cyclohexane < Cyclopentane < Cyclobutane < Cyclopropane
(3) Cyclohexane < Cyclobutane < Cyclopentane < Cyclopropane
(4) Cyclopropane < Cyclopentane < Cyclobutane < Cyclohexane

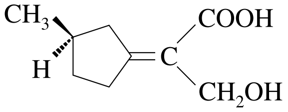
32. The correct statement concerning conformers of 1, 2-dichloroethane is

(1) It's gauche conformer has higher potential energy than an eclipsed conformer in which H–Cl aoms are eclipsing
(2) Syn-periplanar conformer is most stable
(3) Increasing temperature decreases dipole moment of 1, 2-dichloroethane
(4) The two gauche conformers are enantiomers

33. Which of the following is achiral

(1) 2-bromo bicyclo [1, 1, 0] butane
(2) 2-fluoro bicyclo [2, 2, 2] octane
(3) 2-chloro bicyclo [2, 1, 1] hexane
(4) 5-chloro bicyclo [2, 1, 1] hexane

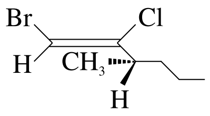
34. In the compound



The configurations at the chiral centre and the double bond are respectively,

(1) R and E (2) R and Z
(3) S and Z (4) S and E

35.



The configurations at the chiral centre and the double bond are respectively,

(1) R and E (2) R and Z
(3) S and Z (4) S and E

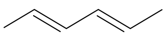
36. If a hydrogen of 1, 3-pentadiene is substituted by chlorine, how many different isomer (excluding stereochemical designation) can be assigned to the chlorinated dienes?

(1) 2 (2) 3
(3) 4 (4) 5

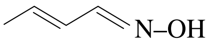
37. How many different structural isomers exist for C_5H_8 that have only sp^3-hybridised carbon atoms?

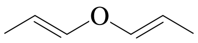
(1) 3 (2) 4
(3) 5 (4) 7

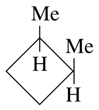
38. Which compound below has four stereoisomers?

(1)


(2) H – N = N – N = N – H

(3)


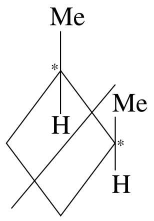
(4)


39.


Incorrect statement about this compound is:

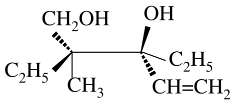
(1) It shows geometrical isomerism
(2) It possess centre of symmetry
(3) It possess plane of symmetry
(4) It shows optical isomerism

Sol. **[2]**



POS present
COS absent
C* present
G.I. present

40. The absolute configuration of the below figure is:



(1) 2R, 3S (2) 3R, 4S
(3) 2S, 3R (4) 3S, 4R

EXERCISE 3

One and More Than One Option Correct Type Question

1. The correct statement(s) regarding the isomers of compound N-ethyl-N-methyl-1-propanamine is/are

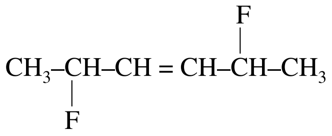
(1) A pair of enantiomers remain in dynamic equilibrium

(2) Addition of HCl results in the formation of enantiomeric hydrochloride salts

(3) Addition of a pure enantiomer of 2-methyl butanoic acid to the solution of amine results in formation of a pair of diastereomeric salts

(4) Its enantiomers can be separated by gas chromatography

2. Consider the following molecule



$CH_3-\underset{F}{CH}-CH=CH-\overset{F}{CH}-CH_3$

The correct statement/s concerning above molecule is/are

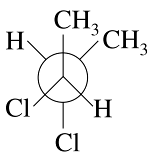
(1) It has a total of six stereoisomers

(2) It's meso form upon ozonolysis followed by Zn-hydrolysis gives racemic mixture

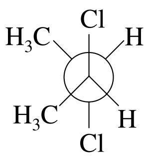
(3) It's optically active isomers, each upon ozonolysis followed by Zn-hydrolysis given a single enantiomer

(4) It has only two optically active isomers

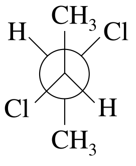
3. The correct statement(s) concerning the following Newmann's projections is/are



(I)



(II)



(III)

(1) I and II correspond to conformers of enantiomers of 2, 3-dichlorobutane

(2) I and III are two conformers of the same enantiomer of 2, 3-dichlorobutane

(3) III is the most stable conformer of meso-2, 3-dichlorobutane

(4) I and II are conformers of a pair of diastereomers of 2, 3-dichlorobutane

4. Which of the following statements is/are correct ?

(1) A meso compound has chiral centres but exhibits no optical activity

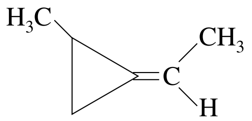
(2) A meso compound has no chiral centres and thus are optically inactive

(3) Meso compounds are superimposable on their mirror images even though they contain chiral centres

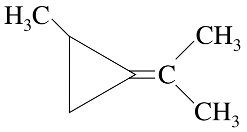
(4) Meso compounds do not show optical activity due to external compensation of optical rotation

5. Which of the following will show optical isomerism as well as geometrical isomerism?

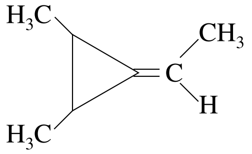
(1)



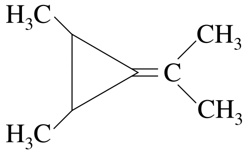
(2)



(3)



(4)



6. The correct statement (s) concerning aldehydes of general formula $C_5H_{10}O$ is/are

(1) It has total five aldehyde isomers

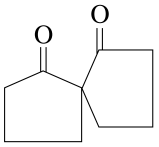
(2) Two of the aldehydes are chiral

(3) Two of the aldehyde isomers have no enol

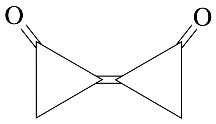
(4) All enols of aldehyde isomers are diastereomeric

7. Which compound below can have a non-polar stereoisomers?

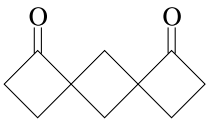
(1)



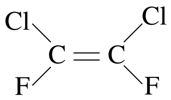
(2)



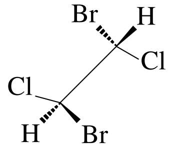
(3)



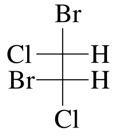
(4)



8. The correct statement(s) concerning the following structures is/are



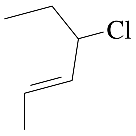
P

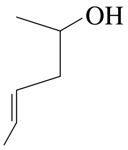


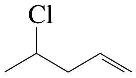
Q

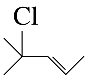
(1) P and Q are enantiomers
(2) P and Q are diastereomers
(3) Both are optically active
(4) P is optically inactive while Q is optically active

9. Which of the following compounds can show geometrical & optical isomerism.

(1) 

(2) 

(3) 

(4) 

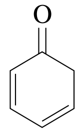
Statement Type Question

(1) If both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
(2) If both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(3) If Statement-I is correct and Statement-II is incorrect
(4) If Statement-I is incorrect and Statement-II is correct

10. **Statement-I:** Molecules that are non-superimposable on their mirror images are chiral

Statement-II: All chiral molecules have chiral centres.

(1) If both statement-I and statement-II are true but statement-II is not a correct explanation of the statement-I
(2) If both statement-I & statement-II are true & the statement-II is a correct explanation of the statement-I
(3) If statement-I is true and statement-II is false
(4) If statement-I is false and statement-II is true

11. **Statement-I:** Percentage enol content for  is almost 100%.

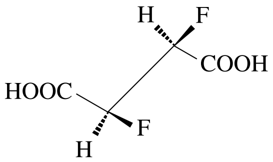
Statement-II: Due to aromaticity, stability of enol increases, hence percentage enol content also increases.

(1) Statement-1 is true, statement-II is true and statement-II is correct explanation for statement-I
(2) Statement-1 is true, statement-II is true and statement-II is NOT the correct explanation for statement-I
(3) Statement-I is true, statement-II is false
(4) Statement-I is false, statement-II is true

12. **Statement-I:** Fluoroethanal has two stereomeric enols in which *cis* enol predominates at equilibrium.

Statement-II: Intramolecular H-bonding increases the stability of a stereomer.

13. **Statement-I:** The compound shown below is optically inactive.



Statement-II: Compound shown above possesses axis of rotation.

14. **Statement-I:** Enantiomers differ in their chemical action with other enantiomer.

Statement-II: A pair of enantiomers have different orientation of collision with another enantiomer forming different transition state.

Comprehension Type Question

Passage (Q. 15–17)

Organic compound with molecular formula C_3H_6O has one degree of unsaturation. One degree of unsaturation can be present in the form of a pi-bond or a ring structure. Pi-bond can be formed between carbon atoms or between carbon and oxygen atom.

15. How many isomers exist for this compound that have a ring structure?

(1) 1 (2) 2
(3) 3 (4) 4

16. If only carbonyl isomers (aldehyde and ketone) are considered, how many corresponding enol isomers would be possible?

(1) 1 (2) 2
(3) 3 (4) 4

17. How many isomers of this compound exist that have no stereoisomer?

(1) 2 (2) 4
(3) 6 (4) 7

Passage (Q. 18–20)

The two major contributors of conformers of 1,2-dichloroethane are anti and gauche. At 32°C in gas phase, the measured dipole moment of 1,2-dichloroethane is 1.12 D.

The dipole moment of a mixture of X and Y is given by the relationship

$$\mu^2 = N_x\mu_x^2 + N_\gamma u_\gamma^2$$

Here, N = mole fraction of each kind of molecule. From bond moment measurement, it has been estimated that gauche conformer of 1, 2-dichloroethane should have a dipole moment of about 3.2 D.

18. What per cent of conformers of 1,2-dichloroethane is anti, at 32°C?

(1) 12% (2) 36%
(3) 60% (4) 89%

19. What is true about percentage of gauche conformer?

(1) There is only one gauche conformer is about 12%
(2) There is only one gauche conformer in about 64%
(3) There is racemic mixture, although inseparable, of gauche conformers, about 12%
(4) There is racemic mixture, although inseparable, of gauche conformers, about 64%

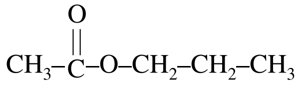
20. What happens if temperature if increased to 52°C?

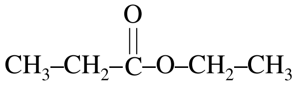
(1) Percentage of gauche conformers decreases and that of anti-conformers
(2) Percentage of both gauche and anti conformers increases
(3) No change in percentage of anti and gauche conformers occur
(4) Percentage of both anti and gauche conformers decreases

Column Matching Type Question

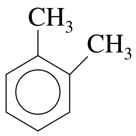
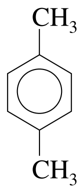
21. Match List I with List II and select the correct answer from the codes given below the lists:

List-I ***List-II***

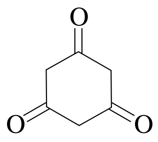
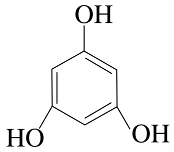
(A) 
$CH_3\text{–}\overset{\overset{\displaystyle O}{\|}}{C}\text{–}O\text{–}CH_2\text{–}CH_2\text{–}CH_3$ and


$CH_3\text{–}CH_2\text{–}\overset{\overset{\displaystyle O}{\|}}{C}\text{–}O\text{–}CH_2\text{–}CH_3$

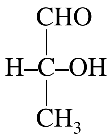
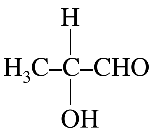
(P) Enantiomer

(B)  

(Q) Position isomers

(C)  and 

(R) Metamers

(D) 
$H\text{–}\underset{\displaystyle CH_3}{\overset{\displaystyle CHO}{C}}\text{–}OH$ and 
$H_3C\text{–}\underset{\displaystyle OH}{\overset{\displaystyle H}{C}}\text{–}CHO$

(S) Tautomers

Codes:

	A	B	C	D
(1)	R	Q	S	P
(2)	R	Q	P	S
(3)	P	Q	R	S
(4)	Q	R	S	P

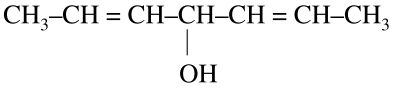
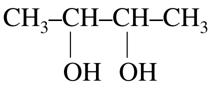
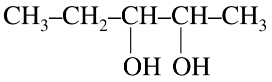
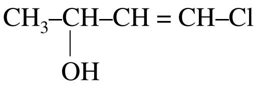
22. Match the quantity from Column I with the types of isomerism from Column II.

	Column I		*Column II*
(i)	Pentene	(p)	Has two positional isomers.
(ii)	1-methoxypropene	(q)	Has two geometrical isomers.
(iii)	Dichlorocyclopropane	(r)	Has six geometrical isomers.
(iv)	2, 4, 6-octatriene	(s)	Has more than four cyclic isomers.

Codes

	(i)	(ii)	(iii)	(iv)
(1)	p, q, s	p, s	p, r, s	p, s
(2)	p	q	r	s
(3)	p, s	p, q, r	s, p, q	p
(4)	q, r	p, s	r, s	q

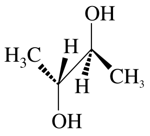
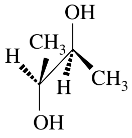
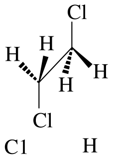
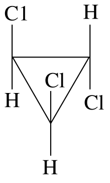
23. Consider the molecules in Column I and match them with their stereochemical properties from Column II.

	Column I		*Column II*
(i)	 $CH_3–CH = CH–\underset{\underset{OH}{\vert}}{CH}–CH = CH–CH_3$	(P)	Have only three stereoisomers
(ii)	 $CH_3–\underset{\underset{OH}{\vert}}{CH}–\underset{\underset{OH}{\vert}}{CH}–CH_3$	(Q)	Have four stereoisomers
(iii)	 $CH_3–CH_2–\underset{\underset{OH}{\vert}}{CH}–\underset{\underset{OH}{\vert}}{CH}–CH_3$	(R)	Have only two optically active isomers.
(iv)	 $CH_3–\underset{\underset{OH}{\vert}}{CH}–CH = CH–Cl$	(S)	Have more than two pairs of diastereomers.

Codes

	(i)	(ii)	(iii)	(iv)
(1)	q, r, s	p, r	q, s	q, s
(2)	p	q	r	s
(3)	p, q	q, s	r	q
(4)	p, q, r	r, s	q, r	p, q

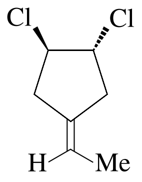
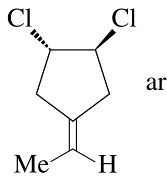
24. Match the structures on the left Column I with the properties on the right Column II.

	Column I		*Column II*
(i)		(p)	Has plane of symmetry
(ii)		(q)	Has axis of symmetry
(iii)		(r)	Has centre of symmetry
(iv)		(s)	Rotate plane polarised light

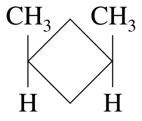
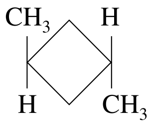
Codes

	(i)	(ii)	(iii)	(iv)
(1)	r,s	p,q	q,r	p,s
(2)	p,q,r,s	r,s	p	q
(3)	p,r	q,s	p,q,r	p,q
(4)	p	q	r	s

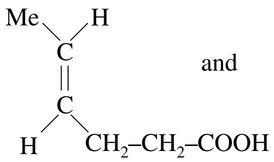
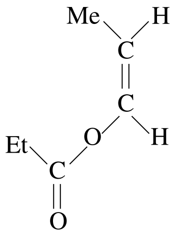
25. ***Column I*** ***Column II***

(A)  and  are

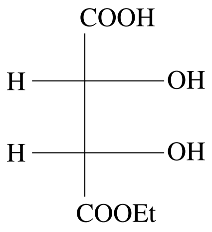
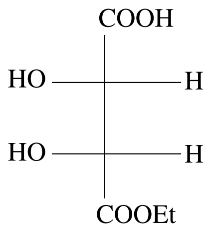
(P) Structural isomers

(B)  and  are

(Q) Enantiomers

(C)  and  are

(R) Compounds which are geometrical isomer and diastereoisomers

(D)  and  are

(S) Compound are geometrical isomers and enantiomers

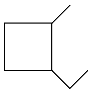
(1) (A)→(R); (B)→(Q); (C)→(P); (D)→(S)

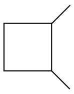
(2) (A)→(Q); (B)→(R); (C)→(P); (D)→(Q)

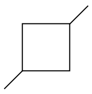
(3) (A)→(R); (B)→(Q); (C)→(S); (D)→(P)

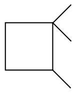
(4) (A)→(R); (B)→(S); (C)→(Q); (D)→(S)

26. ***Column-I*** ***(Compound)*** ***Column-II*** ***(Number of isomer)***

(A)  (P) 2

(B)  (Q) 3

(C)  (R) 4

(D)  (S) 6

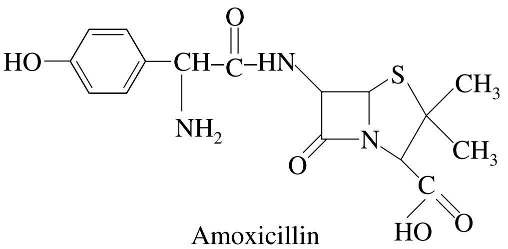
(1) (A)→(Q); (B)→(R); (C)→(P); (D)→(P)
(2) (A)→(R); (B)→(P); (C)→(Q); (D)→(P)
(3) (A)→(R); (B)→(Q); (C)→(P); (D)→(P)
(4) (A)→(R); (B)→(Q); (C)→(Q); (D)→(P)

Single Digit Integer Type Question

27. How many isomers, each containing a phenyl ring, are possible for C_9H_{12}?

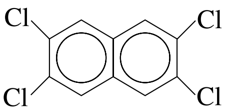
28. How many different isomers of alkene with molecular formula C_7H_{14}, on catalytic hydrogenation, can give 3-methyl hexane?

29. Total number of chiral centers in amoxicillin, which belongs to the family of semisynthetic penicillins.

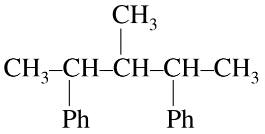


Amoxicillin

30. Total number of plane of symmetry present in given compound is

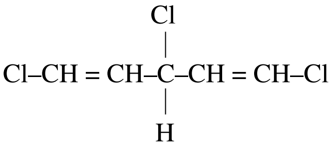


31. How many pairs of diastereomers can be made for the compound shown below?



$$CH_3-\underset{\displaystyle Ph}{CH}-\overset{\displaystyle CH_3}{CH}-\underset{\displaystyle Ph}{CH}-CH_3$$

32. Find out the total number of stereoisomers of the given following compound.



$$Cl-CH=CH-\overset{\displaystyle Cl}{\underset{\displaystyle H}{C}}-CH=CH-Cl$$

33. How many different structural isomers exist for C_3H_6O in which no atom is sp^2 or sp-hybridised?

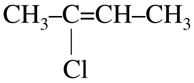
34. Consider the following reaction

$$(X)\ C_6H_{12} \xrightarrow[Ni]{H_2} C_6H_{14} \xrightarrow[h\nu]{Cl_2} \underset{\text{(4 positional isomers)}}{C_6H_{13}Cl(Y)}$$

How many different isomers of X satisfy the above condition?

EXERCISE 4

1. Stereo-Isomerism includes **[AIEEE-2002]**
(1) Geometrical isomerism only
(2) Optical isomerism only
(3) Both geometrical & optical isomerism
(4) Position & Functional isomerism

2. Which of the following does not show geometrical isomerism– **[AIEEE-2002]**
(1) $CH_3-CH=CH-CH_3$
(2) $CH_3-CH_2-CH=CH_2$
(3) 

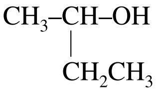
$$CH_3-\underset{\displaystyle Cl}{C}=CH-CH_3$$

(4) $ClHC=CH-CH_2-CH_3$

3. Racemic mixture is formed by mixing two– **[AIEEE-2002]**
(1) Isomeric compounds
(2) Chiral compounds
(3) Meso compounds
(4) Enanitiomers with chiral carbon

4. Geometrical isomerism is not shown by **[AIEEE-2002]**
(1) 1, 1-dichloro-1-pentene
(2) 1, 2-dichloro-1-pentene
(3) 1, 3-dichloro-2-pentene
(4) 1, 4-dichloro-2-pentene

5. Racemic mixture is– **[AIEEE-2002]**
(1) A mixture of chiral carbons
(2) A mixture of isomers
(3) A mixture of aldehydes and ketones
(4) A mixture of alcohols and ethers

6. Following types of compounds (as I and II)
(i) $CH_3CH=CHCH_3$
(ii) 

$$CH_3-\underset{\displaystyle CH_2CH_3}{CH}-OH$$

[AIEEE-2002]

Are studied in terms of isomerism in

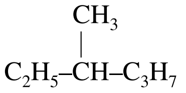
(1) chain isomerism

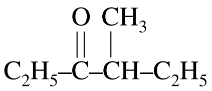
(2) position isomerism

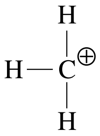
(3) conformers

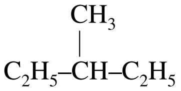
(4) stereoisomerism

7. Among the following four structures i to iv **[AIEEE-2003]**

(I) 
$C_2H_5\text{–}\overset{\overset{\large CH_3}{|}}{C}H\text{–}C_3H_7$

(II) 
$C_2H_5\text{–}\overset{\overset{O}{||}}{C}\text{–}\overset{\overset{CH_3}{|}}{C}H\text{–}C_2H_5$

(III) 
$H\text{—}\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C^{\oplus}}}$

(IV) 
$C_2H_5\text{–}\overset{\overset{CH_3}{|}}{C}H\text{–}C_2H_5$

It is true that–

(1) Only (III) is a chiral compound

(2) Only (II) and (IV) are chiral compounds

(3) All four are chiral compounds

(4) Only (I) and (II) are chiral compounds

8. Which of the following compounds is not chiral? **[AIEEE-2004]**

(1) 1-chloropentane

(2) 2-chloropentane

(3) 1-chloro-2-methyl pentane

(4) 3-chloro-2-methyl pentane

9. Which of the following will have a meso isomer also **[AIEEE-2004]**

(1) 2-Chlorobutane

(2) 2, 3-Dichlorobutane

(3) 2, 3-Dichloropentane

(4) 2-Hudroxypropanoic acid

10. For which of the following parameters, the structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values? (Assume ideal behaviour) **[AIEEE-2004]**

(1) Heat of vaporisation

(2) Vapour pressure at the same temperature

(3) Boiling points

(4) Gaseous densities at the same temperature and pressure

11. Which type of isomerism is shown by 2,3-dichlorobutane **[AIEEE-2005]**

(1) Optical (2) Diastereo isomerism

(3) Structural (4) Geometric

12. Increasing order of stability among the three main conformations (i.e., Eclipse, Anti, Gauche) of 2-fluoroethanol is **[AIEEE-2006]**

(1) Gauche, Eclipse, Anti

(2) Eclipse, Anti, Gauche

(3) Anti, Gauche, Eclipse

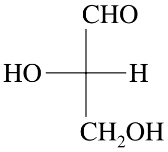
(4) Eclipse, Gauche, Anti

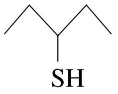
13. Which one of the following conformation of cyclohexane is chiral? **[AIEEE-2007]**

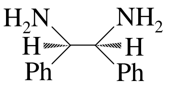
(1) Twist boat (2) Rigid

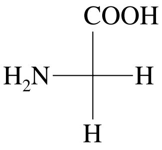
(3) Chair (4) Boat

14. Which of the following molecules is expected to rotate the plane of plane-polarised light? **[AIEEE-2007]**

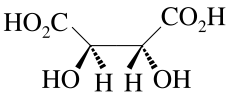
(1) 

(2) 

(3) 

(4) 

15. The absolute configuration of the compound is **[AIEEE-2008]**



is

(1) R, R (2) R, S

(3) S, R (4) S, S

16. The alkene that exhibits geometrical isomerism is **[AIEEE-2009]**

(1) Propene (2) 2-methyl propene

(3) 2-butene (4) 2-methyl-2-butane

17. The number of stereoisomers possible for a compound of the molecular formula $CH_3\text{–}CH{=}CH\text{–}CH(OH)\text{–}Me$ is **[AIEEE-2009]**

(1) 3 (2) 2

(3) 4 (4) 6

18. Out of the following the alkene that exhibits optical isomerism is– **[AIEEE-2010]**

(1) 2-methyl-2-pentene (2) 3-methyl-2-pentene

(3) 4-methyl-1-pentene (4) 3-methyl-1-pentene

19. Identify the compound that exhibits tautomerism **[AIEEE-2011]**

(1) 2-Butene (2) Lactic acid

(3) 2-Pentanone (4) Phenol

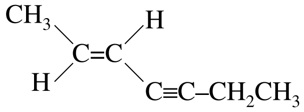
20. How many chiral compounds are possible on monochlorination of 2-methyl butane? **[AIEEE-2012]**

(1) 2 (2) 4

(3) 6 (4) 8

21. Maleic acid and fumaric acids are: **[AIEEE-2012]**
(1) Tautomers
(2) Chain isomers
(3) Geometrical isomers
(4) Functional isomers

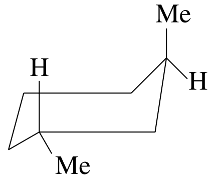
22. The IUPAC name of the following compounds is **[JEE Main Online-2012]**



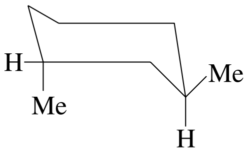
(1) (Z) – 5 – heptene – 3 – yne
(2) (Z) – 2 – heptene – 4 – yne
(3) (E) – 5 – heptene – 3 – yne
(4) (E) – 2 – heptene – 4 – yne

23. Monocarboxylic acids are functional isomers **[JEE Main Online-2013]**
(1) Ethers (2) Amines
(3) Esters (4) Alcohols

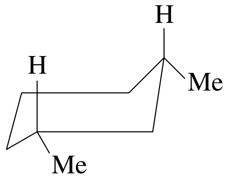
24. Arrange in the correct order of stability (decreasing order) for the following molecules– **[JEE Main Online-2013]**



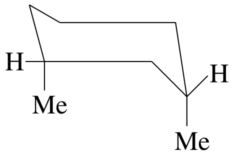
(I)



(II)



(III)



(IV)

(1) I > II > III > IV (2) IV > III > II ≈ I
(3) III > I ≈ II > IV (4) I > II ≈ III > IV

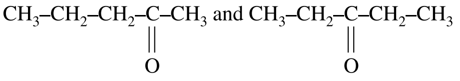
25. Which one of the following acids does not exhibit optical isomerism– **[JEE Main Online-2014]**
(1) Lactic acid (2) Tartaric acid
(3) Maleic acid (4) α-amino acid

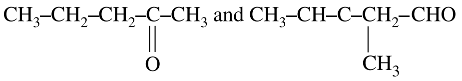
26. Which of the following compounds will exhibit geometrical isomerism? **[JEE-Main-2015]**
(1) 1-Phenyl-2-butene
(2) 3-Phenyl-1-butene
(3) 2-Phenyl-1-butene
(4) 1, 1-Diphenyl-1-propane

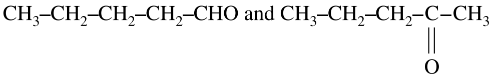
27. The number of structural isomers for C_6H_{14} is– **[JEE Main Online-2015]**
(1) 6 (2) 4
(3) 3 (4) 5

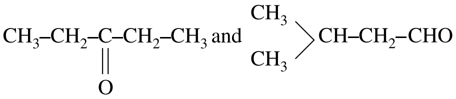
28. The optically inactive compound from the following is– **[JEE Main Online-2015]**
(1) 2-chloropropanal
(2) 2-chlorobutane
(3) 2-chloro-2-methylbutane
(4) 2-chloropentane

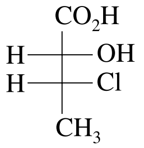
29. Which of the following pairs of compounds are positional isomers– **[JEE Main Online-2015]**

(1) 
$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$ and $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$

(2) 
$CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$ and $CH_3-CH-C-\underset{\underset{CH_3}{|}}{CH_2}-CHO$

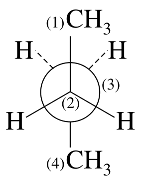
(3) 
$CH_3-CH_2-CH_2-CH_2-CHO$ and $CH_3-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$

(4) 
$CH_3-CH_2-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$ and $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH-CH_2-CHO$

30. The absolute configuration of  is

[JEE-main-2016]
(1) (2S, 3R) (2) (2S, 3S)
(3) (2R, 3R) (4) (2R, 3S)

31. If C_2 in above compound is rotated by 120° angle in anticlockwise direction along C_2–C_3, which of the following form will be produced **[IIT-2004]**



(1) Partial eclipsed
(2) Perfectly eclipsed
(3) Perfectly staggered
(4) Gauche conformation

32. $\mu_{obs} = \Sigma\mu_i X_i$ where μ_I is the dipole moment of stable conformer and X_i is the mole fraction of that conformer. **[IIT-2005, Subjective type]**

(a) Write stable conformer for Z–CH_2–CH_s–Z in Newman's projection.

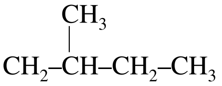
If $\mu_{solution}$ = 1.0 D and mole fraction of anti form

= 0.82, find μ_{gauche}

(b) Write most stable meso conformer of $(CHDY)_2$

If (i) Y = CH_3 about C2-C3 rotation and

(ii) Y = OH about C1-C2 rotation

33. 

$CH_2\text{–}\underset{}{\overset{\overset{\displaystyle CH_3}{|}}{C}}H\text{–}CH_2\text{–}CH_3 \xrightarrow{Cl_2/hv}$ N (no. of isomers)

$\xrightarrow{\text{Fractuional distillation}}$ (F), (N) and (F) are: **[IIT-2006]**

(1) 6, 4
(2) 4, 4
(3) 6, 6
(4) 3, 3

34. The number of structural isomers for C_6H_{14} is **[IIT-2007]**

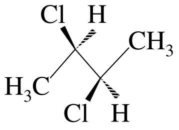
(1) 3
(2) 4
(3) 5
(4) 6

35. **Statement-I:** Molecule that are non superimposable on their mirror images are chiral.

Statement-II: All chiral molecules have chiral centres. **[IIT-2007]**

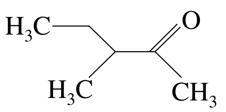
(1) If both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(2) If both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(3) If Statement-I is correct and Statement-II is incorrect.
(4) If Statement-I is incorrect and Statement-II is correct.

36. The correct statement about the compound given below is **[IIT-2008]**

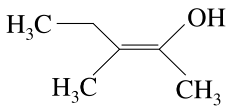


(1) The compound is optically active
(2) The compound possesses center of symmetry
(3) The compound possesses plane of symmetry
(4) The compound possesses axis of symmetry

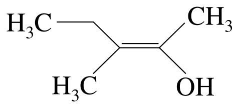
37. Which is correct statement concerning the structures E, F and G is **[IIT-2008]**



(E)



(F)



(G)

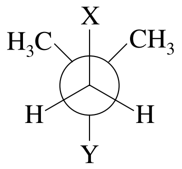
(1) E, F and G are resonance structures
(2) E, F and E, G are tautomers
(3) F and G are geometrical isomers
(4) F and G are diastereomers

38. Give the total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula C_5H_{10}. **[IIT-2009, Integer type]**

39. The correct statement about the compound $H_3C(HO)HC\text{–}CH{=}CH\text{–}CH(OH)CH_3$(X) is **[IIT-2010]**

(1) The total number of stereo isomers possible for X is 6
(2) The total number of distereomers possible for X is 3
(3) If the stereochemistry about the double bond in X is trans, the number of enantiomers possible for X is 4
(4) If the stereochemistry about the double bond in X is *cis*, the number of enantiomers possible for X is 2

40. In the Newman projection for 2, 2-dimethylbutane **[IIT-2010]**



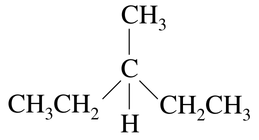
X and Y can respectively be

(1) H and H
(2) H and C_2H_5
(3) C_2H_5 and H
(4) CH_3 and CH_3

41. The total number of cyclic isomers possible for a hydrocarbon with the molecular formula C_4H_6 is **[IIT-2010]**

(1) 5
(2) 4
(3) 2
(4) 3

42. The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound, is– **[IIT-2011]**

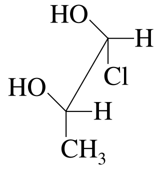


$CH_3CH_2-\overset{\displaystyle CH_3}{\underset{\displaystyle H}{C}}-CH_2CH_3$

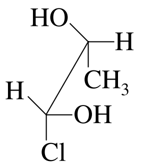
(1) 5 (2) 6

(3) 5 (4) 8

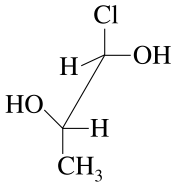
43. Which of the given statement(s) about N, O, P and Q with respect to M is (are) correct? **[IIT-2012]**



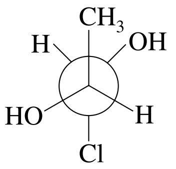
(M)



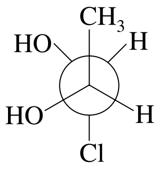
(N)



(O)



(P)



(Q)

(1) M and N are non-mirror image Stereoisomers

(2) M and Q are identical

(3) M and P are enantomers

(4) M and Q are identical

44. The correct combination of names for isomeric alcohols with molecular formula $C_4H_{10}O$ is/are **[JEE-Adv-2014]**

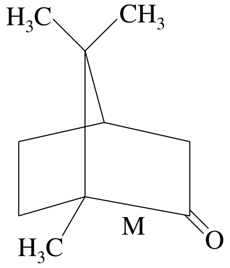
(1) tert-butanol and 2-methylpropan-2-ol

(2) tert-butanol and 1, 1-dimethylethan-1-ol

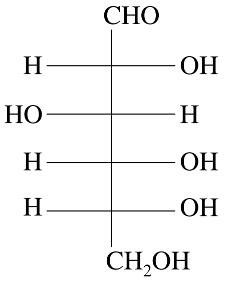
(3) n-butanol and butan-1-ol

(4) isobutyl alcohol and 2-methylpropan-1-ol

45. The total number of stereoisomers that can exist for M is **[JEE-Adv-2015, Integer type]**

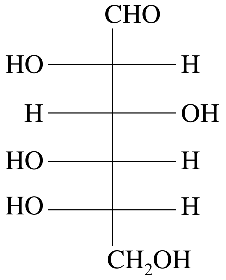


46. The Structure of D-(+)-glucose is **[JEE-Adv-2015, Integer type]**

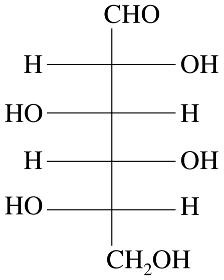


The structure of L-(–)-glucose is

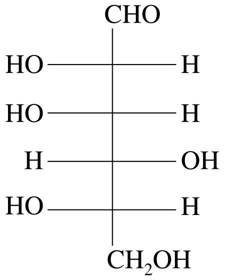
(1)



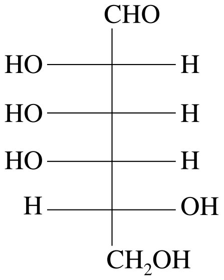
(2)



(3)



(4)



ANSWER KEY

EXERCISE # 1

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

EXERCISE # 2

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

EXERCISE # 3

1. (1,2,3) 2. (1,2,3) 3. (1,3,4) 4. (1,3)
5. (1,3,4) 6. (1,2,4) 7. (2,3,4) 8. (2,4)
9. (1,2) 10. (3) 11. (1) 12. (1) 13. (4)
14. (1) 15. (4) 16. (3) 17. (4) 18. (4)
19. (3) 20. (3) 21. (1) 22. (3) 23. (1)
24. (3) 25. (2) 26. (3) 27. (8) 28. (9)
29. (4) 30. (3) 31. (5) 32. (4) 33. (2)
34. (3)

EXERCISE # 4

1. (3) 2. (2) 3. (4) 4. (1) 5. (1)
6. (4) 7. (4) 8. (1) 9. (2) 10. (4)
11. (1) 12. (2) 13. (1) 14. (1) 15. (1)
16. (3) 17. (3) 18. (4) 19. (3,4) 20. (2)
21. (3) 22. (4) 23. (3) 24. (3) 25. (3)
26. (1) 27. (4) 28. (3) 29. (1) 30. (1)
31. (4) 32. (1) 33. (1) 34. (3) 35. (3)
36. (1,4) 37. (2,3,4) 38. (7) 39. (1,4) 40. (2,4)
41. (1) 42. (4) 43. (1,2,3) 44. (1,3,4) 45. (2)
46. (1)

HINT AND SOLUTION

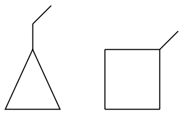
EXERCISE # 1

1. [1]

As per definition

2. [2]

- Given molecular formula C_5H_{10} corresponds to C_nH_{2n} so that isomers should be alkene and cyclo alkane.
- C_5H_{10} do not have double bond so it must be cyclo alkane.
- Alkyl containing cyclo alkane are



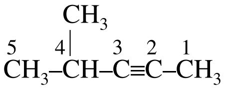
3. [4]

$CH_3{-}CH_2{-}CH_2{-}C{\equiv}C{-}CH_3$

2-hexyne (C_6H_{10})

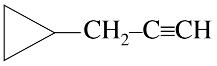
$CH_3{-}CH_2{-}C{\equiv}C{-}CH_2{-}CH_3$

3-hexyne (C_6H_{10})



$\overset{5}{CH_3}{-}\overset{4}{\underset{}{C}H}(CH_3){-}\overset{3}{C}{\equiv}\overset{2}{C}{-}\overset{1}{CH_3}$

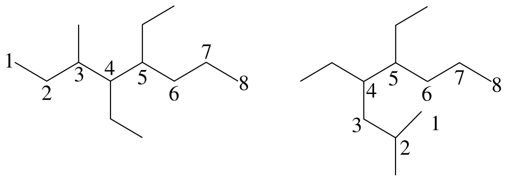
2-methyl 2-pentyne (C_6H_{10})



$\triangleright{-}CH_2{-}C{\equiv}CH$

3-cyclo propyl propyne (C_6H_8) hence it is not possible.

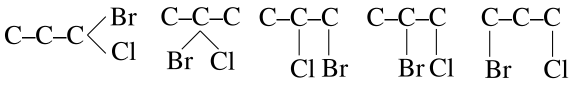
4. [2]



Locant position (3, 4, 5) & (2, 4, 5) differ along same parent chain

5. [2]

$$D.B.E = (C + 1) - \frac{H + X - N}{2} = 3 + 1 - \frac{6 + 2}{2} = 0$$

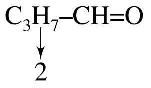


$C{-}C{-}C\begin{smallmatrix}Br\\Cl\end{smallmatrix}$ $\quad C{-}\underset{Br\ \ Cl}{C}{-}C$ $\quad C{-}\underset{Cl}{C}{-}\underset{Br}{C}$ $\quad C{-}\underset{Br}{C}{-}\underset{Cl}{C}$ $\quad \underset{Br}{C}{-}C{-}\underset{Cl}{C}$

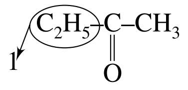
6. [4]

Molecular formula C_4H_8O correspond to $C_nH_{2n}O$ so that isomers are

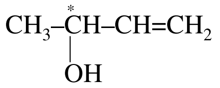
Aldehyde/ketone/unsaturated alcohol/unsaturated ether



$\underset{\downarrow\,2}{C_3H_7}{-}CH{=}O$ ⇒ 2



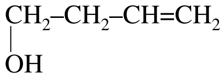
$\underset{1}{C_2H_5}{-}\underset{\|\atop O}{C}{-}CH_3$ ⇒ 1



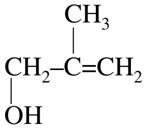
$CH_3{-}\overset{*}{\underset{OH}{C}H}{-}CH{=}CH_2$ ⇒ 2

(Chiral chiral)

Thus d & *l*



$\underset{OH}{CH_2}{-}CH_2{-}CH{=}CH_2$ ⇒ 1



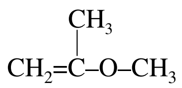
$\underset{OH}{CH_2}{-}\overset{CH_3}{C}{=}CH_2$ ⇒ 1

$CH_2=CH–O–CH_2–CH_3$ ⇒ 1

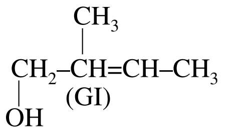
$CH_2=CH–CH_2–O–CH_3$ ⇒ 1

$CH_3–CH=CH–O–CH_3$ ⇒ 2

(GI)



$CH_2=C(CH_3)–O–CH_3$ ⇒ 1

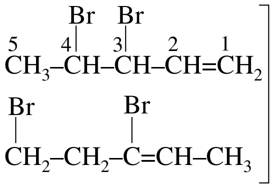


$CH_2(OH)–CH(CH_3)–CH=CH–CH_3$ (GI) ⇒ 2

Total isomer = 14

No unsaturation.

7. [4]



$CH_3–CH(Br)–CH(Br)–CH=CH_2$

$CH_2(Br)–CH_2–C(Br)=CH–CH_3$

→ M.F = $C_5H_8Br_2$

→ Position isomer

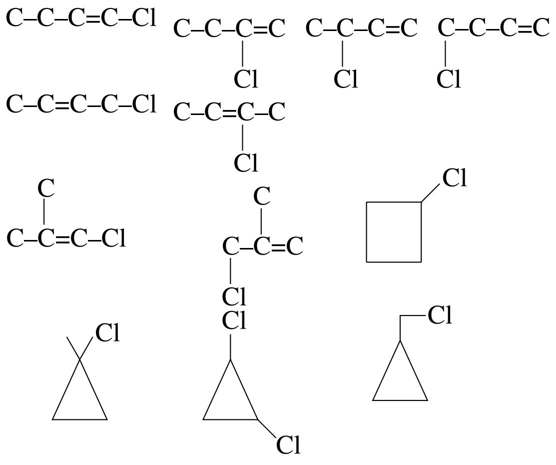
→ functional group same so chemical properties are same

8. [3]

M.P. = C_9H_7Cl

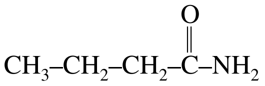
$$D.B.E. = (C + 1) - \left(\frac{H + X - N}{2}\right)$$

$$= (4 + 1) - \frac{7 + 1 - 0}{2} = 1$$

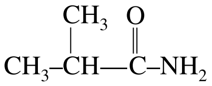


number of isomer = 12

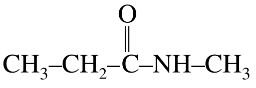
9. [4]



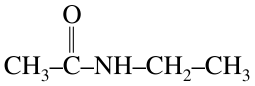
$CH_3–CH_2–CH_2–C(=O)–NH_2$



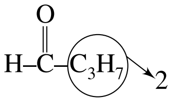
$CH_3–CH(CH_3)–C(=O)–NH_2$



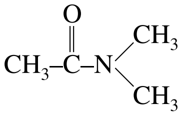
$CH_3–CH_2–C(=O)–NH–CH_3$



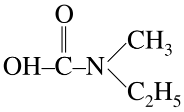
$CH_3–C(=O)–NH–CH_2–CH_3$



$H–C(=O)–C_3H_7$ → 2



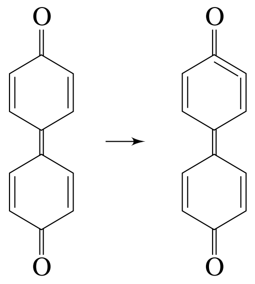
$CH_3–C(=O)–N(CH_3)_2$



$OH–C(=O)–N(CH_3)(C_2H_5)$

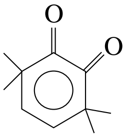
10. [4]

⇒



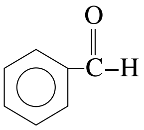
Geometrically unfavourable

⇒



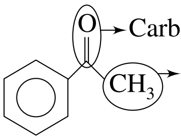
No α – H

⇒



No α – H

⇒

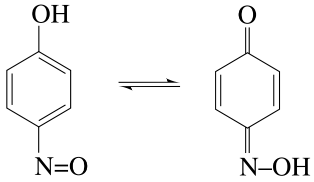


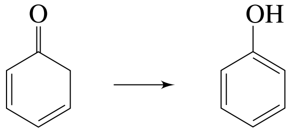
→ Carbonyl group

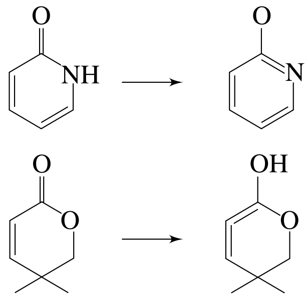
→ α – H

Show tautomerism

11. [4]

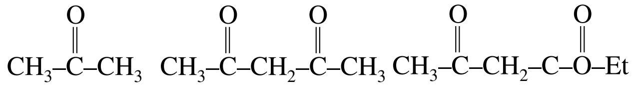






Geometrically unfavourable

12. [3]



$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-O-Et$

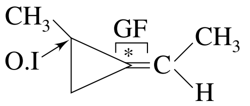
(a) (Monocarbonyl) (b) (β–dicarbonyl) (c) (β–ketoester)

∵ (b > c > a) (refer key concept)

13. [4]

Same substituents at same Carbon

14. [1]

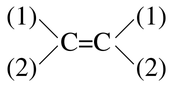


Each blocked atom consist of pair of different groups, so that it shows G.I.

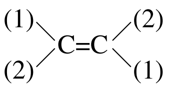
15. [2]

Use sequence rule or CIP rule

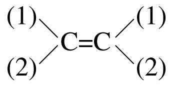
16. [2]

(1) 

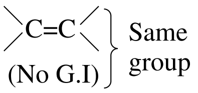
(Z)

(2) 

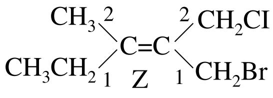
(E)

(3) 

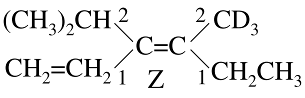
(Z)

(4) 

17. [1]

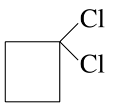


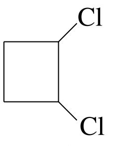
I



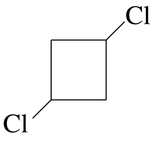
II

18. [2]



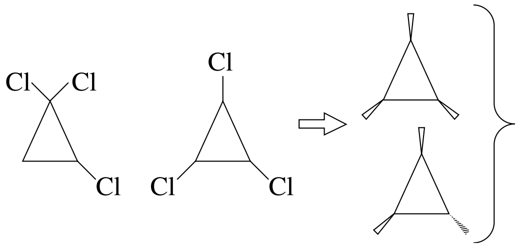


Cis and *trans*



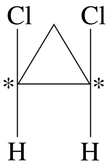
Cis and *trans*

19. [2]



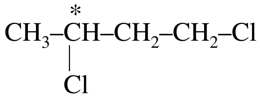
Total isomer = 3

20. [3]

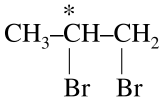


2 C chiral
POS present
Achiral molecule
Meso isomer

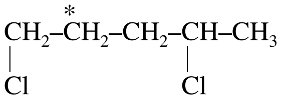
21. [4]



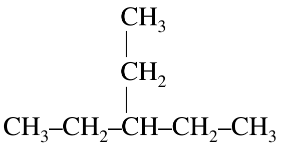
$CH_3-\underset{\underset{Cl}{|}}{\overset{*}{C}H}-CH_2-CH_2-Cl$



$CH_3-\underset{\underset{Br}{|}}{\overset{*}{C}H}-\underset{\underset{Br}{|}}{CH_2}$

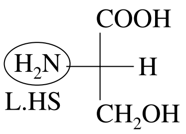


$\underset{\underset{Cl}{|}}{CH_2}-\overset{*}{C}H_2-CH_2-\underset{\underset{Cl}{|}}{CH}-CH_3$

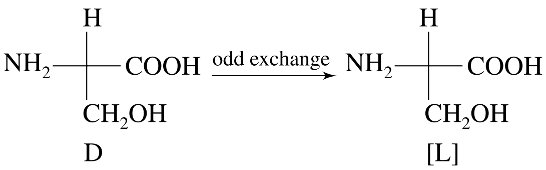


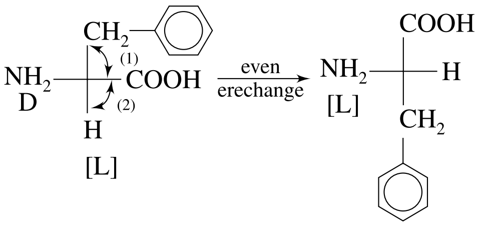
$CH_3-CH_2-\overset{\overset{\overset{CH_3}{|}}{CH_2}}{\overset{|}{CH}}-CH_2-CH_3$ (no chiral C)

22. [2]

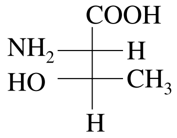
(1) 

L series

(2) 

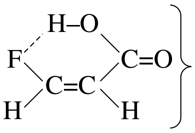
(3) 

(4)



L Series

23. [2]



Stable, six membered ring due to intra molecular H-bonding

24. [2]

$$C = \frac{30\ \text{g}}{100\ \text{mL}} = 0.3\ \text{g/mL}$$

$$\{\alpha\}_T^\lambda = \frac{\alpha}{\ell.C} = \frac{15}{0.3 \times 2} = +25^\circ$$

25. [4]

A meso form, although containing chiral carbons is optically inactive due to the presence of plane of symmetry. Optical activity of one half of the molecule is exactly cancelled by other half, i.e., internally compensated.

26. [2]

II and III are meso form of hence diastereomers

27. [1]

Hint: Calculating R-S Configration of both chiral carbon & compare with R-S configration of other combound.

→ Opposite configulation bf some locant carbon shows enantiomerism.

28. [4]

III and IV are enantiomeric so that they do not have plane of symmetry.

29. [2]

$$\text{Enantionmeric axis (d)} = \frac{30.8}{51.3} \times 100 = 60\%$$

Racemic mix = 40%

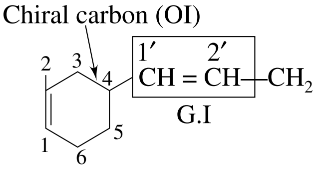
$d = 20\%$ $\ell = 20\%$

Total $d = 60 + 20 = 80\%$ $\ell = 20$

30. [4]

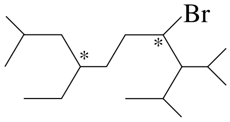
Pair of enantiomers react differently with a pure enantiomer of other compound.

31. [3]



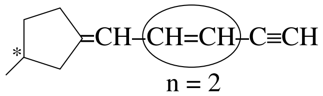
4-(1–propenyl) cyclohexene n = 2 (stereogenic centre)
number of stereo isomer = $2^2 = 4$

32. [2]



Chiral carbon = 2, number of S.I. = $2^2 = 4$

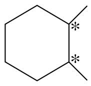
33. [2]



n = 2

number of S.I. = 2^2
= 4

34. [2]

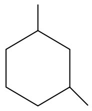


n = 2 (symmetrical)

$$a = 2^{n-1} + 2^{\frac{n}{2}-1}$$

$$= 2^{2-1} + 2^{\frac{2}{2}-1}$$

$$= 2 + 1 = 3$$



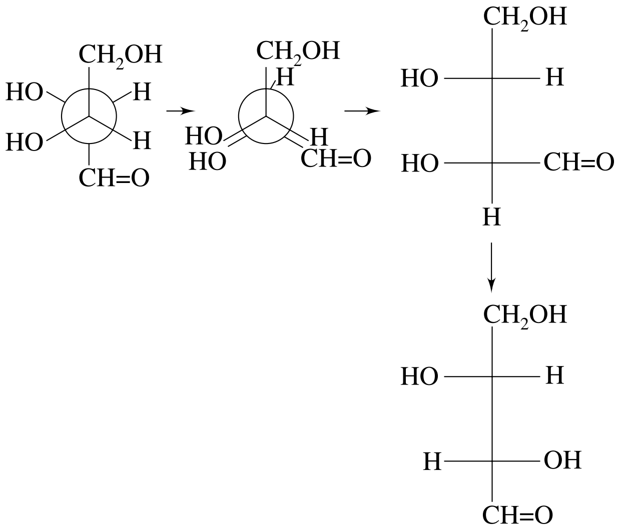
n = 2 (Symmetrical)

a + b = 3 + 3 = 6

35. [1]

By viewing structure properly

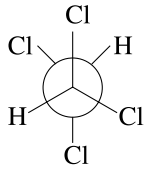
36. [1]



Only eclipsed form will convert into fisher projection.

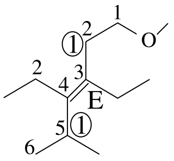
37. [4]

The most stable conformer is



Non-polar

38. **[2]**

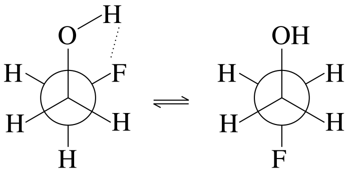


Numbering of parent chain takes place according to locant number rule.

39. **[3]**

refer Key Concept

40. **[2]**



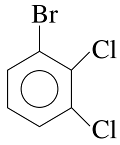
Most stable
I

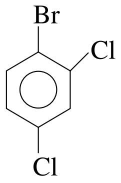
2nd most stable
II

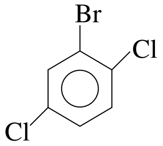
Conformer II has less steric strain than I.

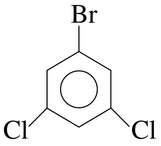
EXERCISE # 2

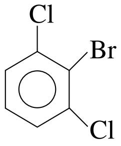
1. **[3]**

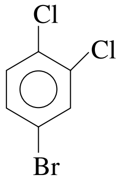






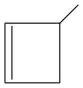


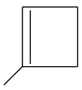


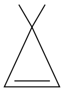


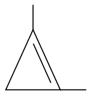
Number of isomer = 6

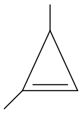
2. **[4]**

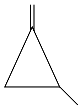




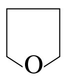


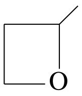


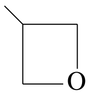


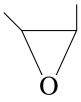


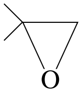
3. **[3]**

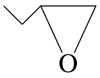










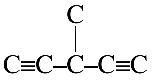


4. **[3]**

C≡C–C≡C–C–C

C≡C–C–C≡C–C

C≡C–C–C–C≡C

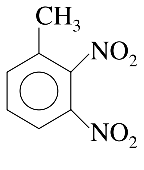


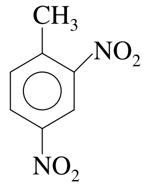
$$\overset{\displaystyle C}{\overset{|}{C{\equiv}C{-}C{-}C{\equiv}C}}$$

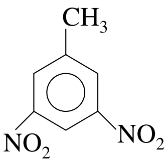
C–C≡C–C≡C–C

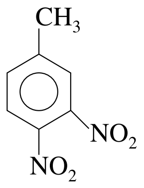
Number of alkyne isomer = 5

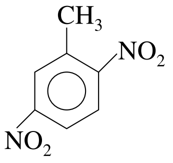
5. **[3]**

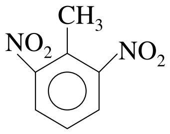












6. **[3]**

Condition for G.I.

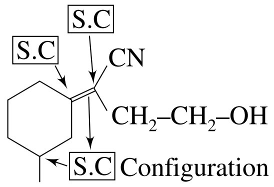
Each double bonded atom consist of pair of different group.

7. **[3]**

(I), (II) POS absent (optically active compound)

(III), (IV) POS present (Meso compound)

8. **[1]**

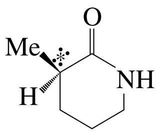


Configuration is E

→ 3 Stereo center

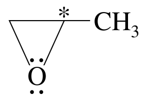
Number of isomer = 6

9. **[2]**

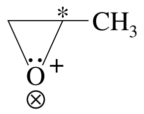


1 C chiral so molecule chiral

10. [2]

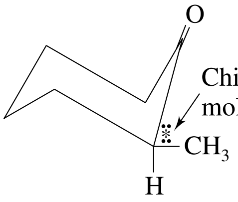


Chiral centre = 1



Chiral centre = 2

11. [2]



Chiral carbon = 1
molecule chiral

12. [3]

X → Show optical isomerism because (ring + double bond = even number)

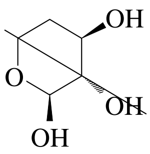
→ Exhibits enantiomerism.

Y → Show geometrical isomerism

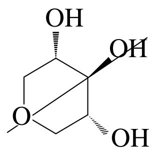
→ Exhibits distereomerism.

13. [2]

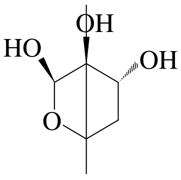
(II) and (IV) are identical



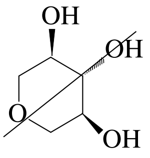
(I)
POS absent
Optically active



(II)
POS present
Meso

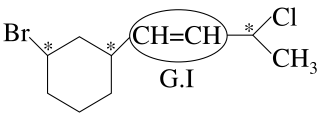


(III)
POS absent
Optically active



(IV)
POS present
Meso

14. [3]

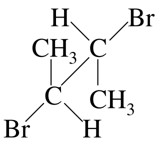


n = 4

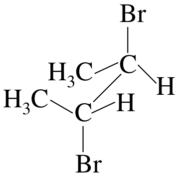
Number of Stereo isomer = 2^4 = 16

15. [4]

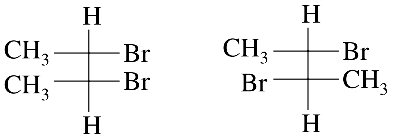
Eclipsed form of show Sawhorse be change into Fischer form.



I

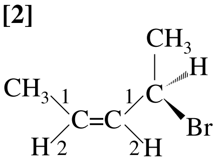


II

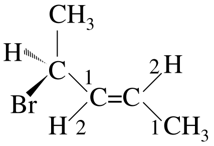


Distereomer

16. [2]



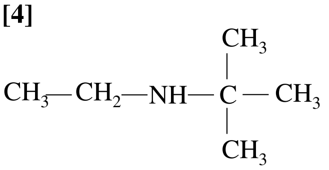
[Z]



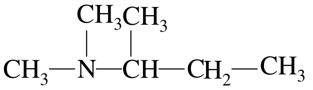
[E]

→ Diastereomers

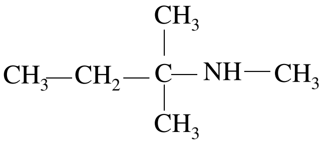
17. [4]



$CH_3-CH_2-NH-\underset{CH_3}{\overset{CH_3}{C}}-CH_3$ I



$CH_3-\overset{CH_3}{N}-\overset{CH_3}{CH}-CH_2-CH_3$ II

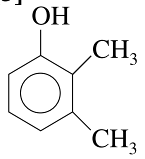


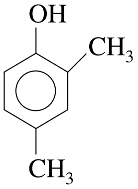
$CH_3-CH_2-\underset{CH_3}{\overset{CH_3}{C}}-NH-CH_3$ III

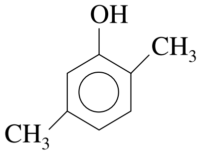
I & II – Functional Group will be differ.

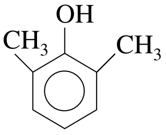
I & III – Alkyl groups will differ along same functional group. Hence they are metamers.

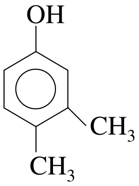
18. [3]

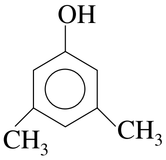






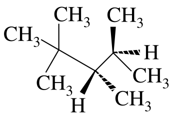






Number of isomer=6

19. [4]



- 1 carbon is chiral so that molecule is always chiral.
- In rest 1, 2, 3 potion no chiral carbon is present.

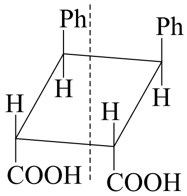
20. [4]

$$\text{Enantiomeric axis} = \frac{d - \ell}{d + \ell} = \frac{\text{Observed rotation}}{\text{Specific rotation}}$$

$$\Rightarrow \quad \frac{75 - 25}{75 + 25} = \frac{\text{Observed rotation}}{+158}$$

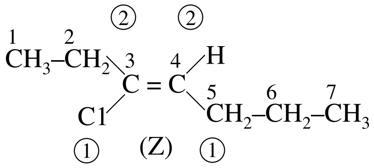
$$\text{Observed rotation} = \frac{158}{2} = +79°$$

21. [4]



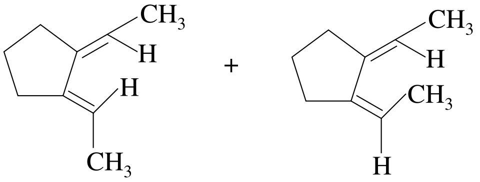
Equal half have mirror image of one another so that POS is present.

22. [4]



In rest other option, either E-form or double bond at 2nd carbon of parent chain

23. [4]



24. [2]

When there is three consecutive double bonds, terminals lie in the same plane giving geometrical isomerism

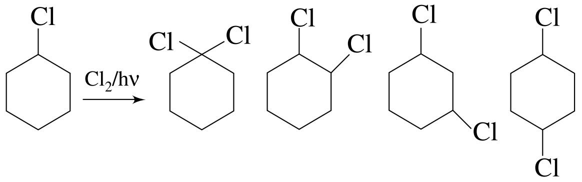
25. [2]

→ *Cis-cis*

→ *trans-trans*

→ *cis-trans*

26. [4]



All have pair of geometrical isomers

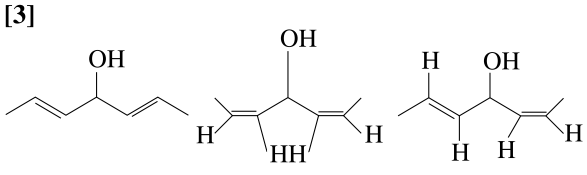
27. [3]

Presence of either plane of symmetry or centre of symmetry makes a molecule superimposable its mirror image, Presence or absence of axis of symmetry has no role to play in optical activity.

28. [3]

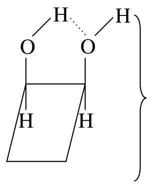
III and IV both are chiral and mirror images of one another.

29. [3]



Achiral Achiral Chiral (d + ℓ)

30. [3]

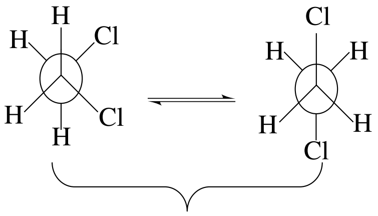


Intramolecular H-bonding in cis-isomer

31. [2]

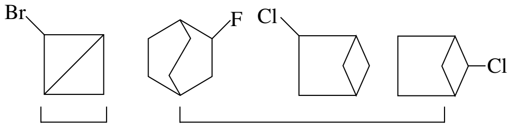
Cyclohexane has least angle strain. Cyclopropane has highest angle strain and angle strain decreases with increase in ring size reaches minimum in cyclohexane

32. [4]



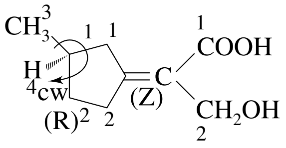
Enantiomers

33. [1]

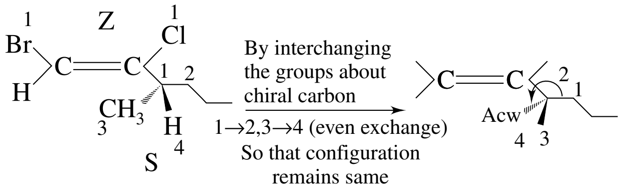


No chiral C Have Chiral C

34. [2]



35. [3]



36. [4]

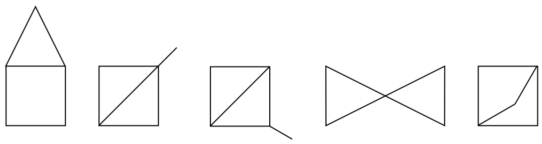
$\overset{1}{C}H_2 = \overset{2}{C}H–\overset{3}{C}H = \overset{4}{C}H–\overset{5}{C}H_3$

Type of C = 5

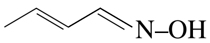
Type of H = 5

Number of monochloro product = type of H = 5

37. [3]



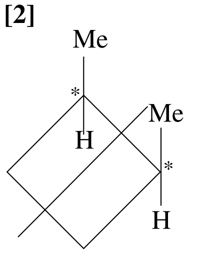
38. [3]



It is unsymmetrical compound having 2-stereogenic double bond

Number of S.I = 2^2 = 4

39. [2]



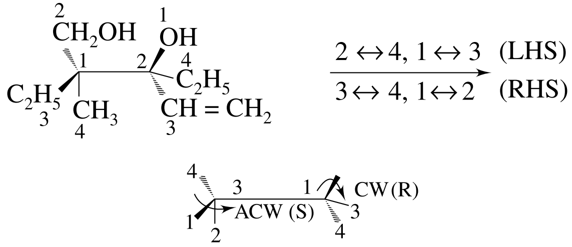
POS present

COS absent

C* present

G.I. present

40. [3]



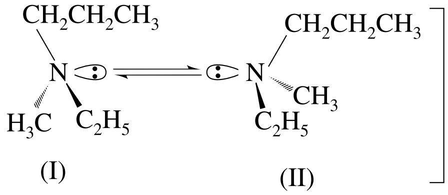
- Least proirity group always takes at inward the plane.
- By even exchange between the groups about chiral carbon then configuration remains same.
- Locant number of chiral carbon decided by IUPAC rule

EXERCISE # 3

One and More Than One Option Correct Type Question

1. [1, 2, 3]

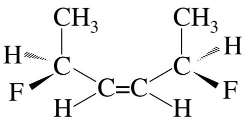
It show fluxional inversion at nitrogen and the two enantiomers remain in dynamic equilibrium



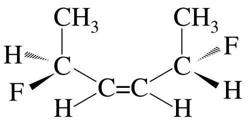
(I) (II)

Protonation of I and II with HCl gives enantiomers hydrochloride salts.

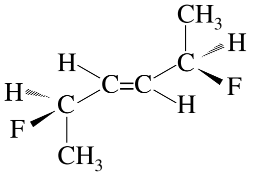
2. [1, 2, 3]



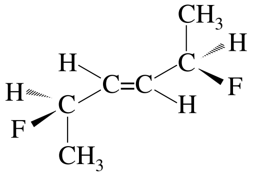
(I)
Meso



(II)
Chiral (d + l)



(III)
Meso



(III)
Chiral (d + l)

Total six isomers, two optically incactive and four optically active. Both I and III upon ozonolysis followed by Zn-hydrolysis produces racemic mixture. II and IV on similar treatment yields a single optically active product in each case.

3. [1, 3, 4]

I and II conformers of enantiomers.

III is most stable due to largest groups at maximum distance.

I is enantiomeric while III is meso, hence I and II are diastereomers.

4. [1, 3]

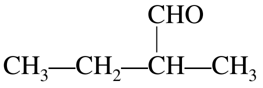
Meso form is optically inactive as it is superimposable on its mirror image. In meso form, optical activity of one half is compensated by other half of the molecule, i.e., internally compensated.

5. [1, 3, 4]

Option 2 has a chiral carbon, show optical isomerism but cannot show geometrical isomerism.

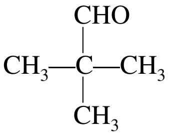
6. [1, 2, 4]

$CH_3—CH_2—CH_2—CH_2—CHO$

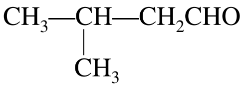


$CH_3—CH_2—\overset{\overset{CHO}{|}}{C}H—CH_3$

(d + I)



$CH_3—\underset{\underset{CH_3}{|}}{\overset{\overset{CHO}{|}}{C}}—CH_3$



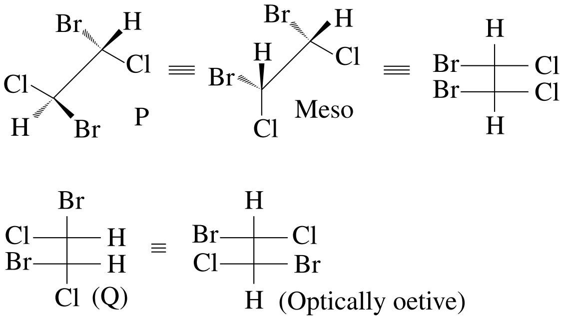
$CH_3—\underset{\underset{CH_3}{|}}{CH}—CH_2CHO$

Total five aldehyde isomers. Out of five above shown aldehydes, two are chiral. All of the above aldehydes are capable of showing keto-enol tautomerism have diastereomeric enols.

7. [2, 3, 4]

All these have functional groups are in same plane can be non-polar. In (1), the two rings are in different plane, always polar.

8. [2,4]



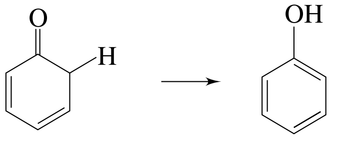
9. [1,2]

10. [3]

Statement-I is true but II is false. Because allene type substance do not have chiral centre even that they have chiral molecule.

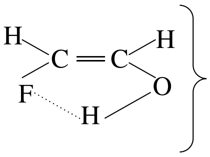
11. [1]

enol content ∝ stability of enol



≈100% enol content
aromatic substance

12. [1]



Intramoleclar
H-bonding stabilises
tautomer

13. [4]

Compound is optically active inspite of possessing axis of symmetry.

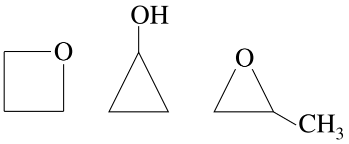
14. [1]

Enantiomers have opposite orientation of groups at chiral carbon.

Comprehension Type Question

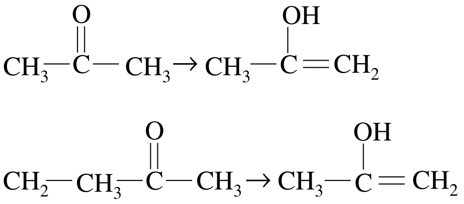
Passage (15 to 17):

15. [4]



Chiral (d + l)

16. [3]

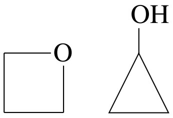


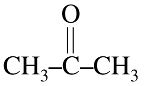
$CH_3—\overset{\overset{O}{||}}{C}—CH_3 \rightarrow CH_3—\overset{\overset{OH}{|}}{C}=CH_2$

$CH_2—CH_3—\overset{\overset{O}{||}}{C}—CH_3 \rightarrow CH_3—\overset{\overset{OH}{|}}{C}=CH_2$

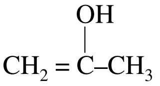
Pair of geometrical isomers

17. [4]





$CH_3–\overset{\overset{O}{||}}{C}–CH_3$



$CH_2=\overset{\overset{OH}{|}}{C}–CH_3$

$CH_3–CH_2–CHO$

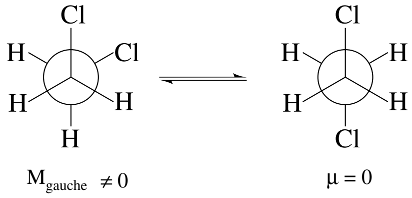
$CH_2 = CH–CH_2OH$

$CH_2 = CH–O–CH_3$

None of the above isomer has any stereocentre

Passage (Q. 18 to 20):

18. [4]



$1.12\ D = (3.2)^2x + 0(1 - x)$

$x = 0.11$

Mole fraction of anti = $1 - x = 0.89$

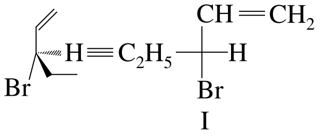
% anti-conformer = 89%

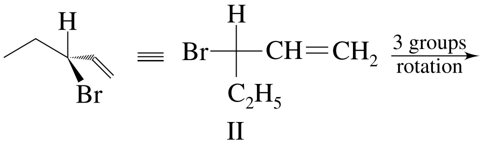
19. [3]

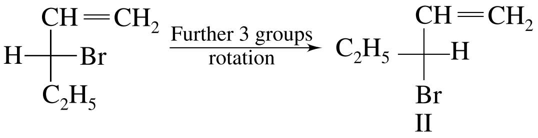
The two gauche conformers are enatiomers, combined they are 11%

20. [3]

Increasing temperature will decrease percentage of both anti and gauche conformers as it will increase percentages of less stable eclipsed conformers.



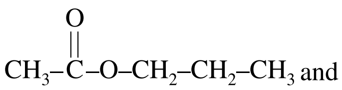


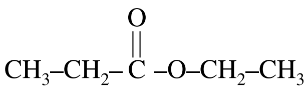


I and II are here same isomers.

Column Matching Type Question

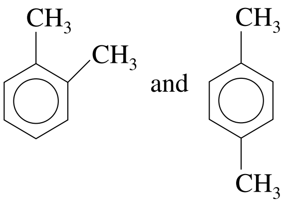
21. [1]

(A) 
$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_2-CH_3$ and


$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

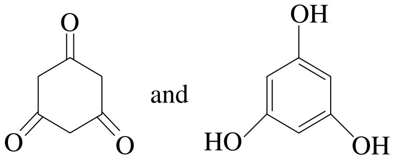
(R) metamers

Size of alkyl differ along same bivalent functional group

(B) 

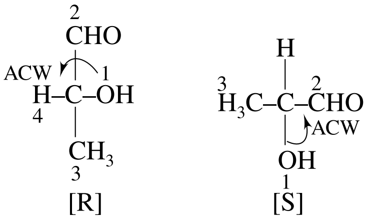
(Q) Position isomers

Locant number will be differ along same parent chain

(C) 

(S) Tautomers

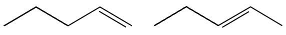
Functional group will be differ due to migration of proton

(D) 

(P) Enantiomer

22. [3]

(i) Pentene has several cyclic isomers.

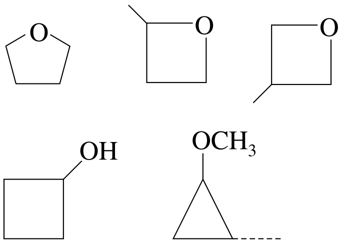


Cis + trans

Hence, (i) → (p, q, s)

(ii) $CH_3-CH=CH-OCH_3$, shows *cis-trans* isomerism

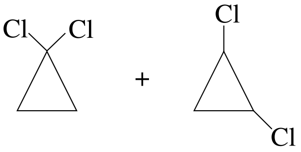
1-methoxy propene



(Cyclic isomrs)

Hence, (ii) → (q, s)

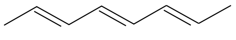
(iii) Dichlorocyclopropane



(Positional isomers)

(Geometrical isomers)

Hence, (iii) → (p, q)

(iv) 

(2, 4, 6-ocatriene)

It has several positional isomers and six geometrical isomers, i.e.,

cis-cis-cis

trans-trans-trans

cis-trans-cis

trans-cis-trans

cis-cis-trans

trans-trans-cis

It has several ring isomers.

∴ (iv) → (r, s)

23. [1]

(i) → (q, r, s); (ii) → (p, r);

(iii) → (q, s); (iv) → (q, s)

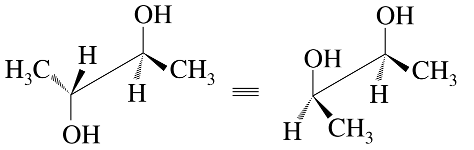
(i) *cis-cis* and *trans-trans* are achiral while *cis-trans* is chiral giving total four stereoisomers.

(ii) Diastereomers can be both optically active, inactive can be separated meso form consist of plane of symmetry.

(iii) Meso form is optically inactive, usually consists of plane of symmetry.

(iv) Racemic mixture consists of equal amount of enantiomers, hence optically inactive. However, it can be resolved into enantiomers.

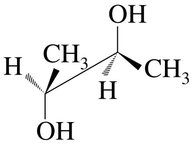
24. [3]

(i) 

Has centre of symmetry

Has plane of symmetry

(i) → (p, r)

(ii) 

It has C-2 axis of symmetry passing through centre of C_2–C_3 bond. However, this compound is optically active.

(ii) → (q, s)

(iii) Compound is achiral, has all three types of symmetry.

(iii) → (p, q, r)

(iv) It ahs both plane and axis of symmetry.

(iv) → (p, q)

25.

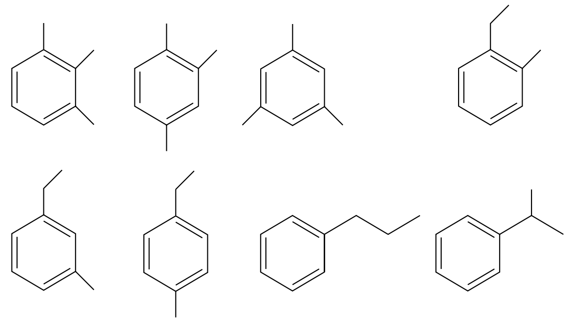
Sol. (A)→(Q); (B)→(R); (C)→(P); (D)→(Q)

26.

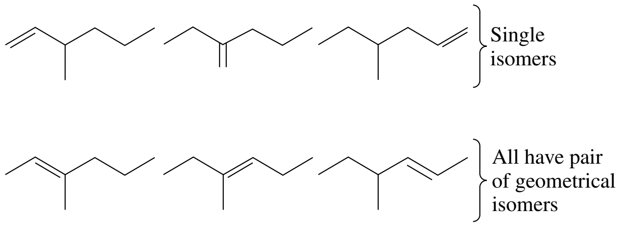
Sol. (A)→(R); (B)→(Q); (C)→(P); (D)→(P)

Single Digit Integer Type Question

27. [8]

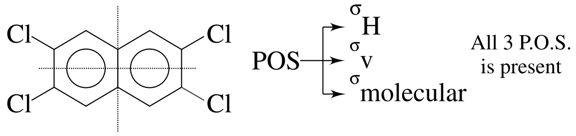


28. [9]

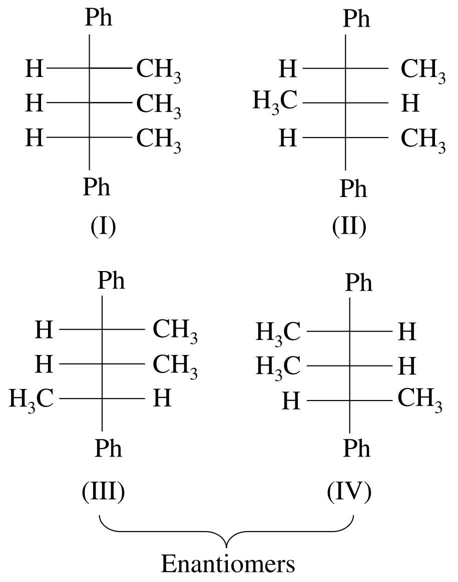


29. [4]

30. [3]



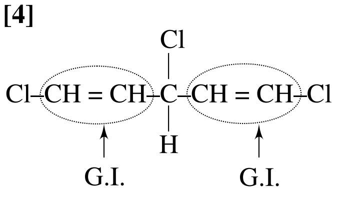
31. [5]



Pair of diastereomers are

I + III, I + IV, II + III, II + IV and I + II.

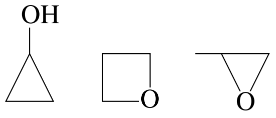
32. [4]



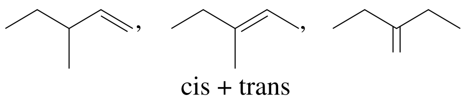
S.I = 4
(Makes cases)

33. [2]

Given condition (no sp & sp^2 atom) satisfied only when ring isomer exist



34. [3]



EXERCISE # 4

1. [3]

Geometrical & Optical isomerism are different type of Stereo-Isomerism.

2. [2]

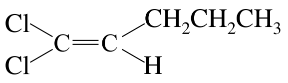
two groups or atoms attached to doubly bonded carbon atoms should be different for G.I.

$CH_3–CH_2–CH=CH_2$

3. [4]

Racemic mixture is an equimolar mixture of enantiomers.

4. [1]

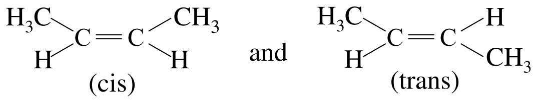


two groups or atoms attached to doubly bonded carbon atoms should be different for G.I.

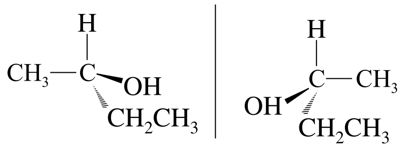
5. [1]

Racemic mixture is mixture of chiral carbons

6. [4]



Geometrical isomers (cis-trans)



Molecule is optically active enantiomers

Geometrical isomers and enantiomers both are stereoisomers.

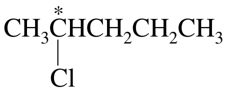
7. [4]

Chiral compounds are those which have one chiral centre, i.e., all four atoms or groups attached to same carbon are different. Here, I and II are chiral but III and IV are achiral compounds.

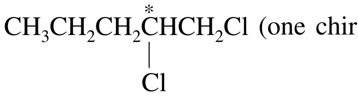
8. [1]

Chiral carbon has all the four different groups attached to it.

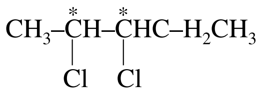
(1) $CH_3CH_2CH_2CH_2CH_2Cl$ (no chiral carbon atom)

(2)  $CH_3\overset{*}{C}HCH_2CH_2CH_3$ with Cl on $\overset{*}{C}$ (one chiral carbon atom)

$$CH_3\underset{\displaystyle Cl}{\overset{*}{C}}HCH_2CH_2CH_3$$

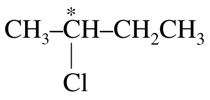
(3)  (one chiral carbon atom)

$$CH_3CH_2CH_2\underset{\displaystyle Cl}{\overset{*}{C}}HCH_2Cl$$

(4)  (two chiral carbon atoms)

$$CH_3–\underset{\displaystyle Cl}{\overset{*}{C}}H–\underset{\displaystyle Cl}{\overset{*}{C}}HC–H_2CH_3$$

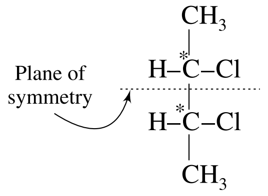
9. [2]

(1) 

$$CH_3–\underset{\displaystyle Cl}{\overset{*}{C}}H–CH_2CH_3$$

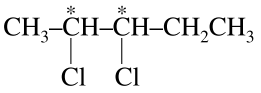
One asymmetric carbon atom, forms *d*-and *l*-optical isomers.

(2)

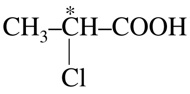


Meso due to intemal compensation

Two asymmetric carbon atoms, forms *d*-, *l*-and meso forms.

(3) 
$CH_3-\underset{\underset{Cl}{|}}{\overset{*}{C}}H-\underset{\underset{Cl}{|}}{\overset{*}{C}}H-CH_2CH_3$

Two asymmetric carbon atoms but does not have symmetry. Hence, meso form is not formed.

(4) 
$CH_3-\underset{\underset{Cl}{|}}{\overset{*}{C}}H-COOH$

One asymmetric carbon atom, meso form is not fomed

10. **[4]**

In CH_3CH_2OH, there is intermolecular H-bonding while it is absent in isomeric ether CH_3OCH_3.

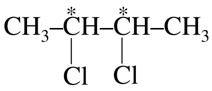
Larger heat is required to vaporise CH_3CH_2OH, as compared to CH_3OCH_3, thus (1) is incorrect.

CH_3CH_2OH is less volatile than CH_3OCH_3, thus vapour pressures are different, thus (2) is incorrect.

Boiling point of $CH_3CH_2OH > CH_3OCH_3$, thus (3) is incorrect.

Density $= \frac{\text{mass}}{\text{volume}}$, due to ideal behaviour at a given temperature and pressure, volume and molar mass are same. Hence, they have same vapour density.

11. **[1]**

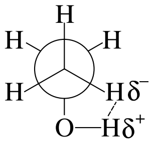

$CH_3-\underset{\underset{Cl}{|}}{\overset{*}{C}}H-\underset{\underset{Cl}{|}}{\overset{*}{C}}H-CH_3$

There are two chiral C-atom (*)

Thus, it shows optical isomerism.

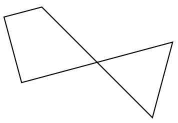
12. **[2]**

$HO-CH_2-CH_2-F$



Gauche-conformation is comparatively more stable due to hydrogen linkage in between F and H (at O-atom), hence increasing order of stability is eclipsed, anti (staggered), gauche.

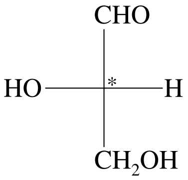
13. **[1]**



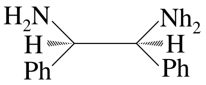
Chair form is unsymmetrical and has absence of any element of symmetry.

14. **[1]**

The molecule, which is optically active, has chiral centre, is expected to rotate the plane of polarised light.

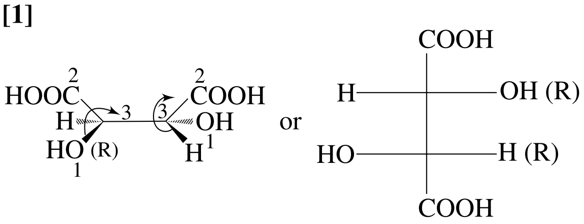


One chiral centre hence, optically active



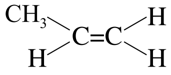
Two chiral centres, but plane of symmetry within molecule hence, optically inactive.

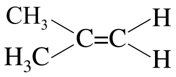
15. **[1]**

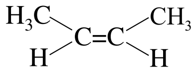


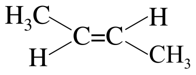
16. **[3]**

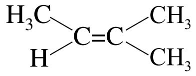
Geometrical isomerism is shown by those alkenes only in which atoms or groups attached to each carbon atom are different. Thus,


Propene
(three-atoms H linked to doubly bonded C-atoms are same, thus no geometrical isomerism)


2-methyl propene
(no geometrical isomerism)


cis-2-butene
(methyl group and H-atom linked to doubly bonded C-atom lie on same side, hence, cis isomer)


Trans-2-butene
H-atom lie on opposite side to one another, hence, trans isomer


2-methyl-2-butene
(no geometrical isomerism)

17. **[3]**

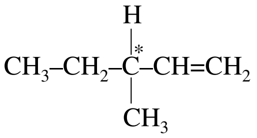
There are four stereoisomers

cis (R), *cis* (S), *trans* (R), *trans* (S)

18. **[4]**

Optical isomerism is shown by the carbon compounds which possess atleast one chiral carbon.

Thus, 3-methyl-1-pentene possess a chiral carbon, hence it shows optical isomerism

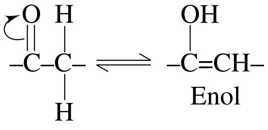


$CH_3-CH_2-\underset{CH_3}{\overset{H}{\overset{*}{C}}}-CH=CH_2$

3-methyl-1-pentence
(It has one chiral centre)

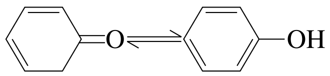
19. [3,4]

Tautomerism is due to spontaneous interconversion of two isomeric forms with different functional groups into one another. The term tautomer means constitutional isomers that undergo such rapid interconversion that cannot be independently isolated



$-\overset{O}{\overset{\|}{C}}-\underset{H}{\overset{H}{C}}- \rightleftharpoons -\overset{OH}{C}=CH-$

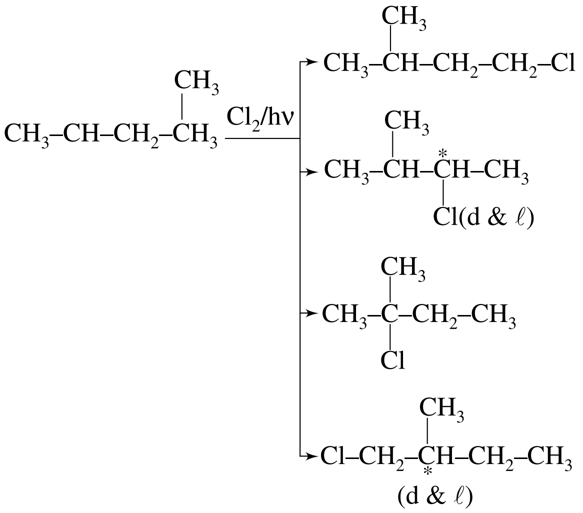
Keto Enol



Keto Enol in phenol

Thus, (3) 2-pentanone and (4) Phenol exhibit tautomerism.

20. [2]



$CH_3-\overset{CH_3}{CH}-CH_2-CH_3 \xrightarrow{Cl_2/h\nu}$

$CH_3-\overset{CH_3}{CH}-CH_2-CH_2-Cl$

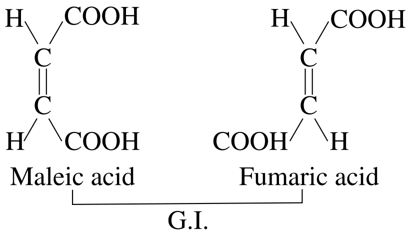
$CH_3-\overset{CH_3}{CH}-\underset{Cl(d\ \&\ \ell)}{\overset{*}{CH}}-CH_3$

$CH_3-\underset{Cl}{\overset{CH_3}{C}}-CH_2-CH_3$

$Cl-CH_2-\underset{*}{\overset{CH_3}{CH}}-CH_2-CH_3$
(d & ℓ)

- Each chiral carbon ($\overset{*}{C}$) cantaining substance have two chiral molecule
- Total chiral molecule

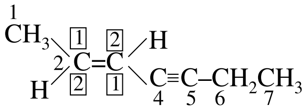
21. [3]



Maleic acid Fumaric acid

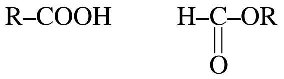
G.I.

22. [4]



(E) – 2 – heptene – 4 – yne

23. [3]



$R-COOH \qquad H-\underset{O}{\underset{\|}{C}}-OR$

Carboxylic acid and ester have same M.F

- Hence mono carboxylic acid in functional group isomer of ester.

24. [3]

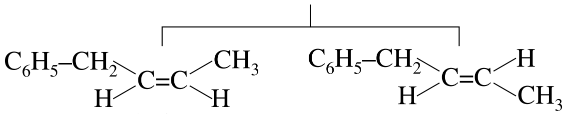
25. [3]

All other have at least one chiral C so they will show optical isomerism only maleic acid have no chiral carbon, thus it do not show optical isomerism

26. [1]

For G.I. each double bonded carbons have pair of different group/atom

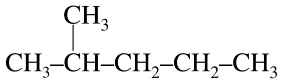
$C_6H_5-CH_2-CH=CH-CH_3$
1-phenyl-2-butene



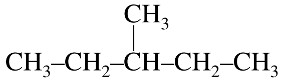
Cis form Trans form

27. [4]

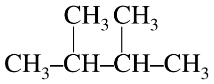
$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$



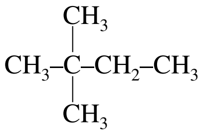
$CH_3-\overset{CH_3}{CH}-CH_2-CH_2-CH_3$



$CH_3-CH_2-\overset{CH_3}{CH}-CH_2-CH_3$



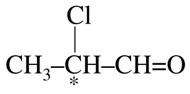
$CH_3-\overset{CH_3}{CH}-\overset{CH_3}{CH}-CH_3$



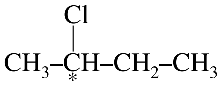
$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-CH_2-CH_3$

Total structural. isomer = 5

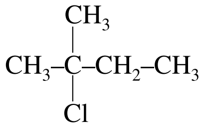
28. [3]



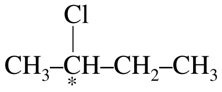
$CH_3-\overset{Cl}{\underset{*}{C}}H-CH=O$



$CH_3-\overset{Cl}{\underset{*}{C}}H-CH_2-CH_3$



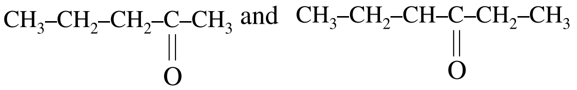
$CH_3-\overset{CH_3}{\underset{Cl}{C}}-CH_2-CH_3$



$CH_3-\overset{Cl}{\underset{*}{C}}H-CH_2-CH_3$

No chiral carbon
op. inactive

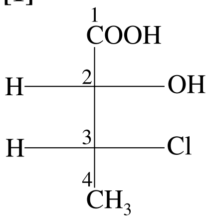
29. [1]



$CH_3-CH_2-CH_2-\underset{O}{\underset{\|}{C}}-CH_3$ and $CH_3-CH_2-CH-\underset{O}{\underset{\|}{C}}-CH_2-CH_3$

Same MF, but locant number of functional group will differ along same parcent carbon chain so it is pair of position isomer

30. [1]



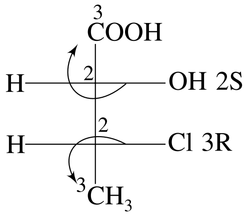
For C-2, order of priority of substituents is

OH > CH(Cl)(CH_3) > COOH (According to CIP rules)

For C-3, order of priority of substituents is

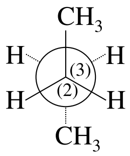
Cl > CH(OH)(COOH) > CH_3 (According to CIP rules)

Hence

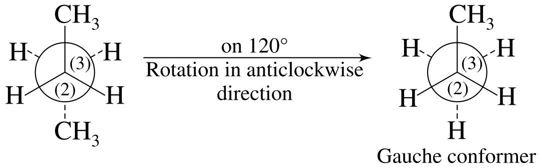


31. [4]

Here, when C_2 is rotated anticlockwise 120° about C_2–C_3 bond the resulting conformer is gauche conformer.

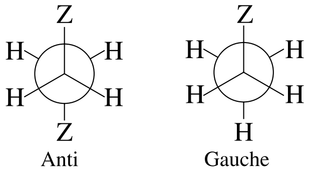


Hence



Gauche conformer

32. [1]



Mole-fractin of anti form = 0.82

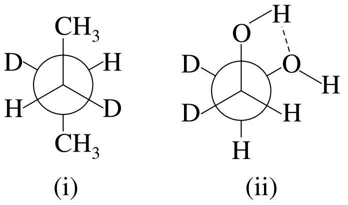
Mole-fraction of gauche form = 0.18

$$\mu_{obs} = 1\ D \Rightarrow 1 = \mu_{anti} \times 0.82 + \mu_{gauche} \times 0.18$$

$$\because\ \mu_{anti} = 0 \Rightarrow 1 = \mu_{gauche} \times 0.8$$

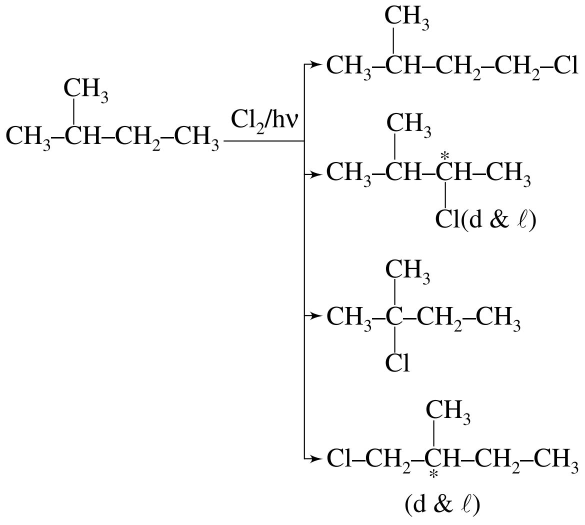
$$\mu_{gauche} = \frac{1}{0.18} = 5.55\ D$$

(b)



Structure (ii) is more stable than its anti-conformer because of intramolecular H-bonding

33. [1]



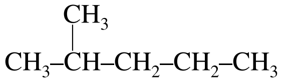
$$N \xrightarrow[\text{distillation}]{\text{Fractional}} F = 4$$

Separation of d and ℓ isomers do not takes place by fractional distillation

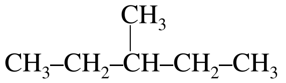
- Total number of structural isomers (N) = 6

34. [3]

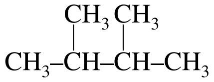
$CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$



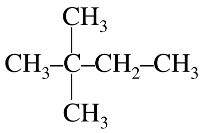
$CH_3–CH(CH_3)–CH_2–CH_2–CH_3$



$CH_3–CH_2–CH(CH_3)–CH_2–CH_3$



$CH_3–CH(CH_3)–CH(CH_3)–CH_3$



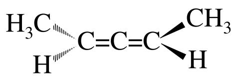
$CH_3–C(CH_3)_2–CH_2–CH_3$

Total structural isomer = 5

35. [3]

Molecules that are non-superimposable on its mirror image are optically active and known as chiral molecule. However, for chirality of molecule, presence of chiral centre is not essential

e.g.,



Molecule is chiral but does not possesses any chiral carbon

36. [1,4]

The compound is optically active as well as it possesses a two-fold axis of symmetry

37. [2,3,4]

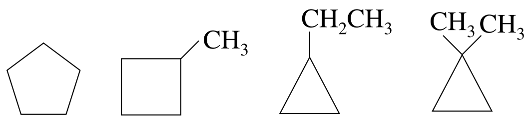
E, F and G are not resonance structures because movement of hydrogen between E and F are involved.

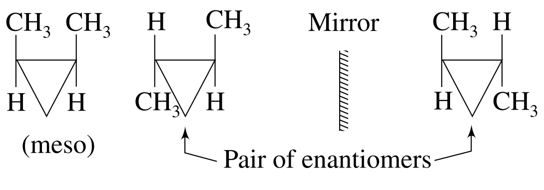
E, F and E, G are tautomers in which E is keto form and both F and G are enol form of the same E.

F and G are geometrical isomers.

F and G are diastereomers as they are stereoisomers but not related by mirror image relationship.

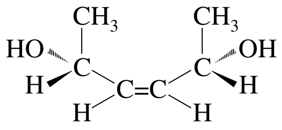
38. [7]



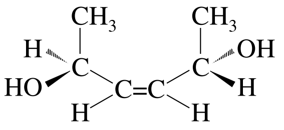


Total seven isomers.

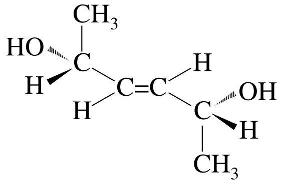
39. [1,4]



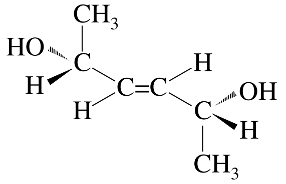
(I)
Meso



(II + III)
(Enantiomeric)

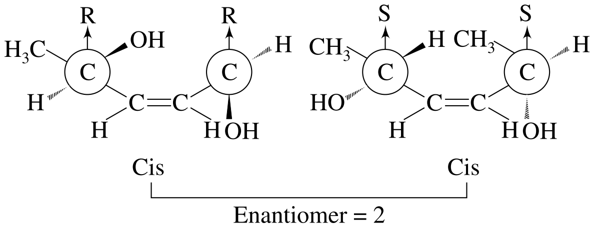


(IV + V)
(Enantiomeric)

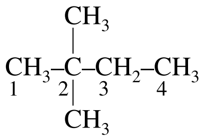


(VI)
(Meso)

Total six isomers, in both *cis* and *trans* forms, there are two enantiomers each.



40. [2,4]

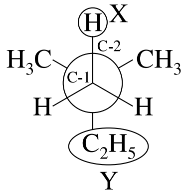


$\underset{1}{CH_3}–\underset{2}{C}(CH_3)_2–\underset{3}{CH_2}–\underset{4}{CH_3}$

Conformation projection along $C_1–C_2$

C_1 contains all three Hs

So, X = H



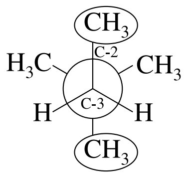
C_2 contains two methyl and one ethyl group

So, Y = C_2H_5

Conformational projection along $C_2–C_3$

C_2 contains three methyl groups (C_2 from the back carbon in the given structure)

So, Y = CH_3



C_3 contains two Hs and one methyl group

[C_3 form front carbon in the given structure]

So, X = CH_3

C_3 contains two Hs and one methyl group

(C_3 form front carbon in the given structure)

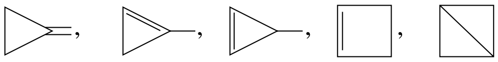
So, X = CH_3

Isomerism (Stereochemistry)

Conceptual (Structural visualisation) III

41. **[1]**

C_4H_6 can have five cyclic isomers

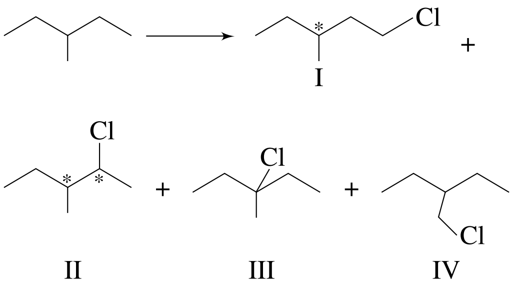


Isomerism (organic)

Structural manipulation

III

42. **[4]**



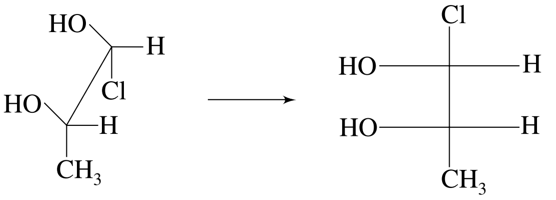
I has one chiral carbon = two isomers

II has two chiral carbons and no symmetry = four isomers.

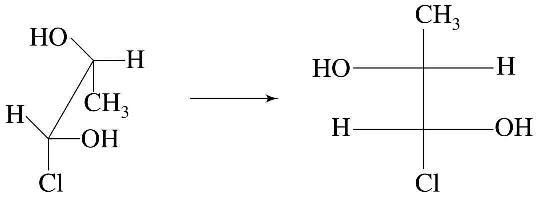
III and IV have not chiral carbon, no stereoisomers.

43. **[1,2,3]**

Converting all of them into Fischer projection.

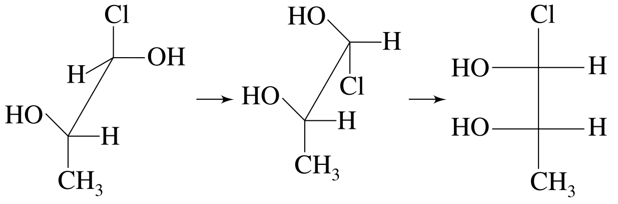


(M) (M)



(N) (N)

Since, M and N have –OH on same side and opposite side respectively, they cannot be mirror image, they are diastereomers.

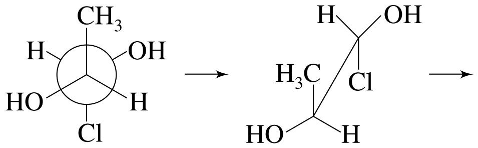


(O) (O) (O)

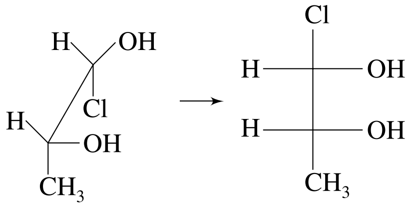
M and O are identical.

Note: Fischer projection represents eclipsed form of Sawhorse projection.

For comparison purpose, similar types of eclipsed conformers must be drawn, i.e., both vertically up or both vertically down.

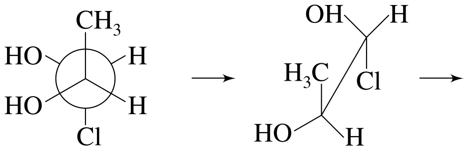


(P)

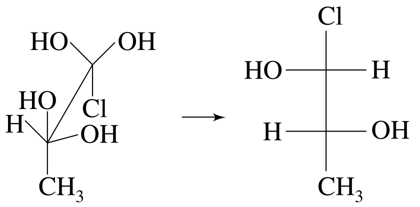


(P)

M and P are non-superimposable mirror images, hence, enantiomers.



(Q)



(Q)

M and Q are non-identical they are diastereomers.

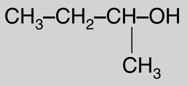
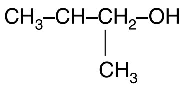
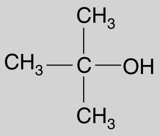
44. [1,3,4]

Plan this problem is based on structure and nomenclature of organic compound.

Draw structure of each compound and write IUPAC name of the given compound.

Match the molecular formula of given compound with molecular formula of compound given in choices.

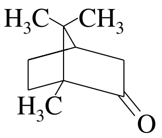
The combination of names for possible isomeric alcohols with molecular formula $C_4H_{10}O$ is/are

Formula	Names
$CH_3CH_2CH_2CH_2OH$	n-butyl alcohol/n-butanol/butan-1-ol
 $CH_3{-}CH_2{-}\underset{\substack{\vert\\CH_3}}{CH}{-}OH$	Isobutyl alcohol/2-methyl propan-1-ol
 $CH_3{-}\underset{\substack{\vert\\CH_3}}{CH}{-}CH_2{-}OH$	Secondary butyl alcohol/butan-2-ol
 $CH_3{-}\overset{\substack{CH_3\\\vert}}{\underset{\substack{\vert\\CH_3}}{C}}{-}OH$	Tertiary butyl alcohol/2-methyl propan-2-ol

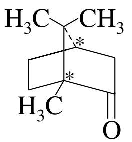
Hence, choices (1), (3) and (4) are correct

45. [2]

Although the compound has two chiral carbons (indicated by stars), it does not has four optically active isomers as expected. It is due to its existence in *cis*-form only



cis-form



Trans-form
(only hypothetical)

The above shown transformation does not exist due to restricted rotation about the bridge head carbons, hence only *cis*-form and its mirror image exist.

46. [1]

L-(–)-glucose is enantiomer of D-(+)-glucose with hydroxyl group on left of vertical at C-5 (L-configuration).