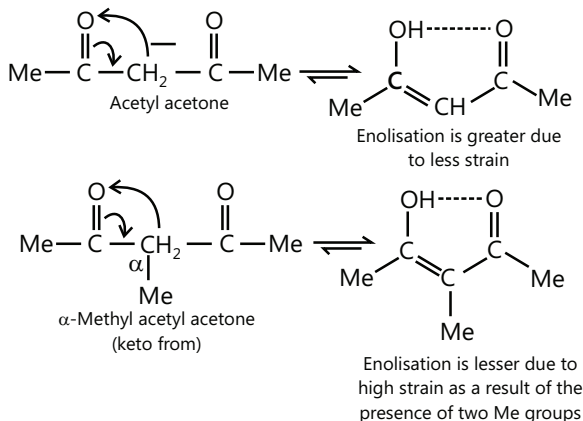


## Solved Examples

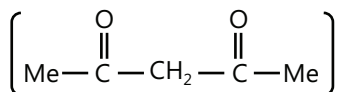
### JEE Main/Boards

**Example 1:** Explain why  $\alpha$ -methyl acetone enolises to a smaller extent than acetylacetone.

**Sol:**

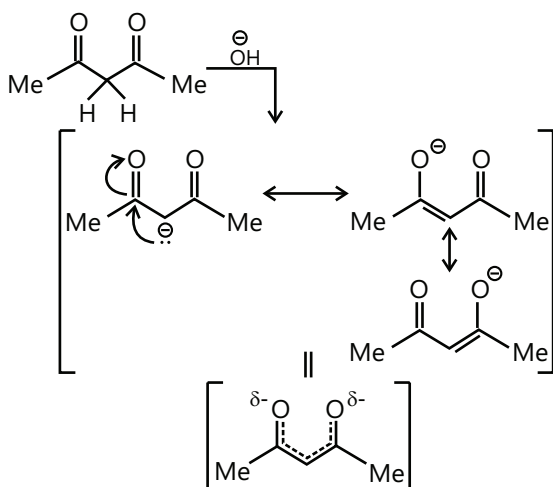


**Example 2:** Why is the  $(-\text{CH}_2-)$  group in acetyl acetone called active methylene group?

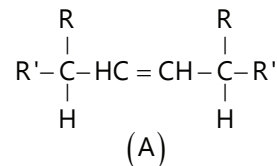


**Sol:** The  $(-\text{CH}_2-)$  group is acidic in nature because these H atoms can be easily lost as  $\text{H}^\ominus$  with base, as the resulting carbanion is resonance stabilized.

The  $(-\text{CH}_2-)$  group is acidic in nature because these H atoms can be easily lost as  $\text{H}^\ominus$  with base, as the resulting carbanion is resonance stabilised.



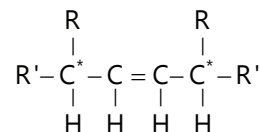
**Example 3:** Consider the compound (A) given as:



a. Give the total number of stereoisomers possible for (A).

b. If the stereochemistry about the double bond in (A) is cis, give the number of enantiomers possible for (A).

**Sol:** The compound (A) contains two asymmetric C atoms with the same terminal group.



Number of optically active isomers (O.I.A.) =  $2^{n-1} = 2^{2-1} = 2$  (where, n is the number of asymmetric C atoms).

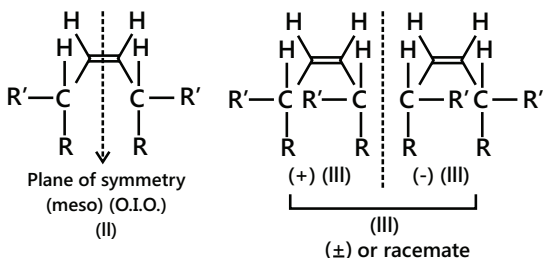
Number of meso form =  $2^{(n-2)/2} = 2^0 = 1$

Total optical isomers =  $2+1=3$

Due to one double bond, the number of geometrical isomers = 2

Total number of stereoisomers =  $3 \times 2 = 6$

If the stereochemistry about (C=C) bond is cis, Then two pairs of diastereomers (II) and (III) are possible. (II) is meso (O.I.A.) due to the presence of plane of symmetry. (III) is optically active (O.A) and two enantiomers are possible. Therefore, in total there are three diastereomers.

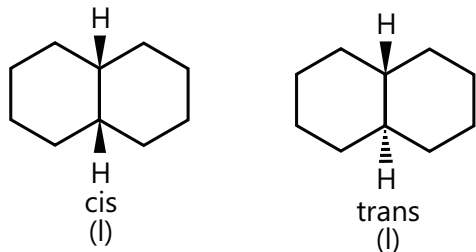


II and (+) III, II and (-) III are diastereomers, whereas (+) III and (-) III are enantiomers.

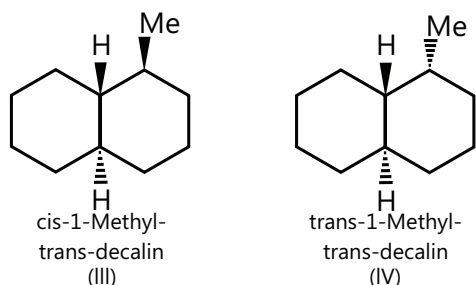
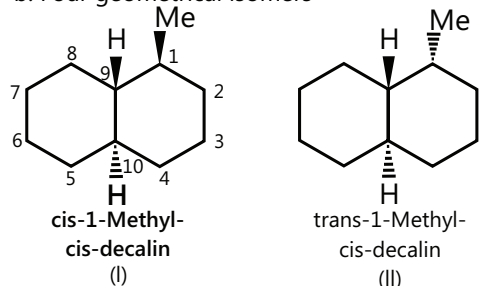
**Example 4:** How many geometrical isomers are possible for the following?

- a. Decalin    b. 1-Methyldecalin    c. 9-Methyldecalin

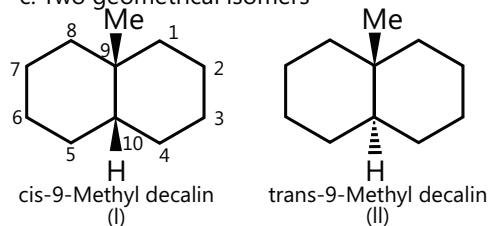
**Sol:** a. Two geometrical isomers: cis and trans



b. Four geometrical isomers



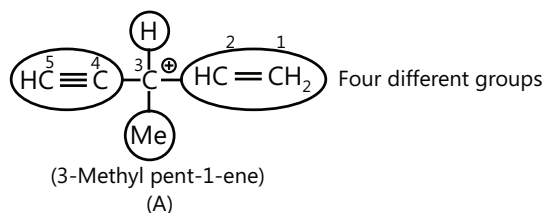
c. Two geometrical isomers



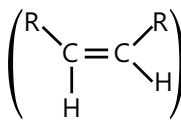
**Example 5:** Give the structural formula of an unsaturated hydrocarbon with the lowest number of C atoms (or with lowest molecular mass) which shows:

- a. Optical isomers    b. Geometrical isomers  
c. Both optical and geometrical isomers

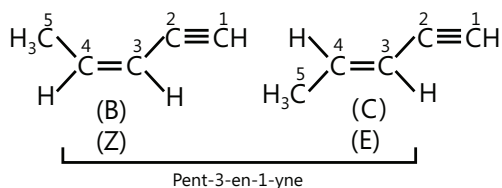
**Sol:** a. An unsaturated hydrocarbon with the lowest molecular mass should have one ( $C \equiv C$ ), one ( $C=C$ ), one H atom, and finally one Me group.



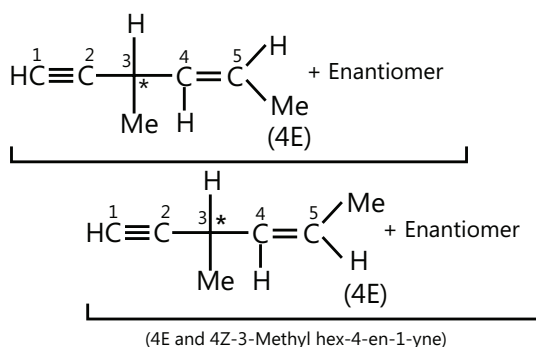
b. Geometrical isomerism is shown by the ( $C=C$ ) only and not by ( $C \equiv C$ ), so we have an alkene of the type



In this, one R group should have ( $C \equiv C$ ) and the other R should be a Me group so that the lowest number of C atoms is obtained.



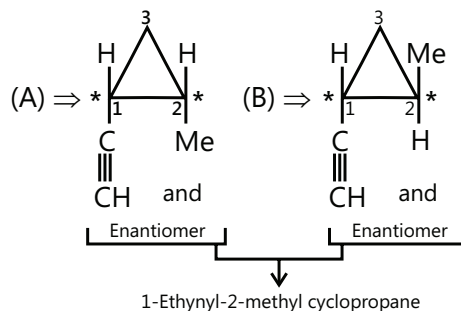
c. In compound (A) given in the solution to part (A), put one Me group at C-1 so that it can show both geometrical and optical isomerisms.



**Example 6:** Give the structural formula of a cyclic alkyne with the lowest number of C atoms and showing:

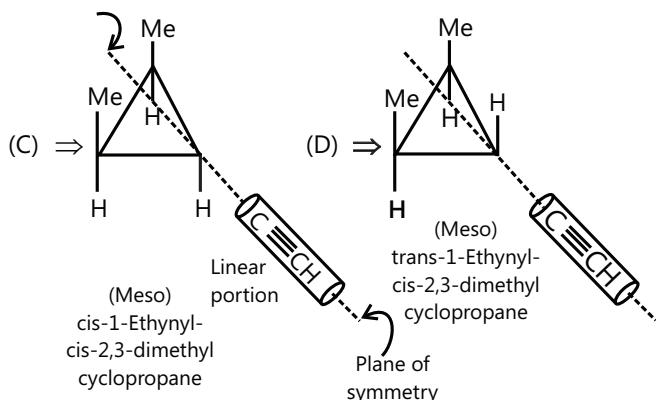
- a. Both geometrical and optical isomerisms.  
b. Geometrical isomerism with two meso stereoisomers.

**Sol:** a. For the lowest number of C atoms, take disubstituted cyclopropane ring in which one group is ( $HC \equiv C$ ) (ethynyl) and the other is ( $-Me$ ) group.



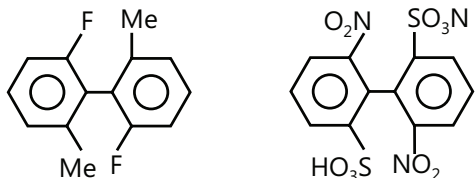
b. For the lowest number of C atoms, take the trisubstituted cyclopropane ring with one ( $HC \equiv C$ )

ethyne group and two (-Me) groups, so that meso compound can be obtained to have the plane of symmetry in the molecule.



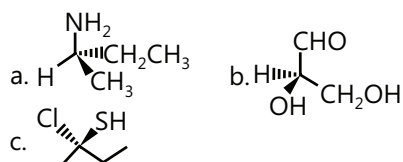
**Example 7:** 2, 2'-Difluoro-6,6'-dimethylbiphenyl is non-resolvable, whereas 2, 2'-dinitro-6, 6'-disulphonic acid biphenyl is resolvable. Account for this fact.

**Sol:** Presence of bulky group at ortho position causes ortho repulsion and due to this two ring becomes non planar and thus becomes resolvable.

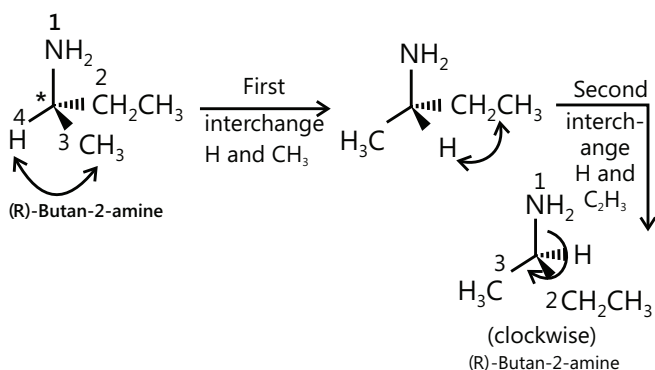


Steric crowding is not large enough to prevent free rotation about (C-C) single bond, so the energy of separation between various invertomers is low and consequently non-isoable. Due to the bulky group at ortho positions, free rotation is restricted as the two rings become nearly perpendicular and hence the energy of separation between the isomers is highly and consequently isolable.

**Example 8:** Assign the R and S designations to the following compounds:

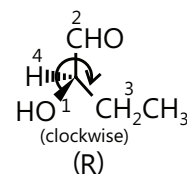


**Sol:** (A) The lowest priority ligand (H) is in the plane (i.e., not on the dotted line) so it makes two interchanges such that H is projected away from the observer.



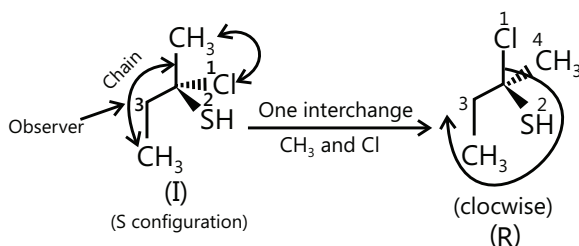
Priority order:  $-\text{NH}_2 > -\text{CH}_2\text{CH}_3 > -\text{CH}_3 > -\text{H}$

(B) The lowest priority ligand (H) is on the dotted line. R and S can be assigned directly from the priority rule.



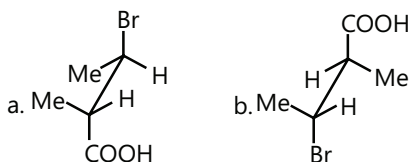
(-OH) > (-CHO) > (-CH<sub>2</sub>OH) > (-H).

(C) Lowest priority ligand ( $-\text{CH}_3$ ) is in the plane (i.e., not on the dotted line). So make one interchange so that ( $-\text{CH}_3$ ) is projected away from the observer. (Priority order.  $-\text{Cl} > -\text{SH} > -\text{CH}_2\text{CH}_3 > -\text{CH}_3$ )

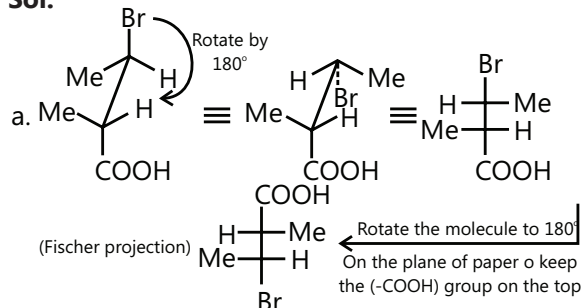


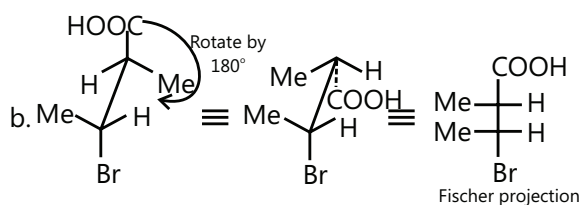
But with one interchange, the configuration changes from R to S.

**Example 9:** Convert Sawhorse formula to Fischer formula.

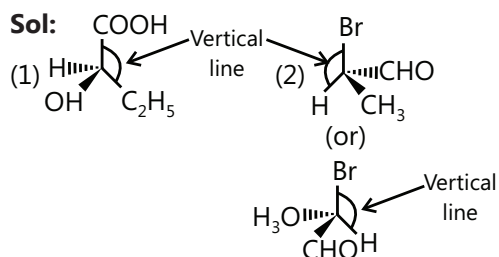
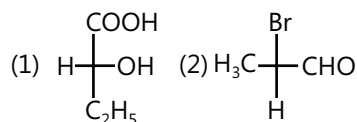


**Sol:**



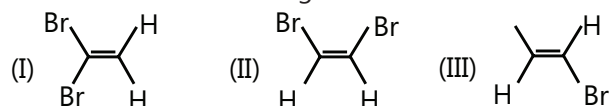


**Example 10:** Convert Fischer formula to Wedge formula.



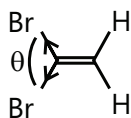
## JEE Advanced

**Example 1:** Give the decreasing order of net dipole moments of the following:

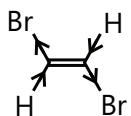


**Sol:** Dipole moment is inversely proportional to angle of separation. Thus smaller angle of separation will cause large dipole moment whereas large angle of separation causes less dipole moment. I > II > III

I. (I) has a smaller angle of separation between two Br atoms than in (II) and (III), resulting in more net dipole moment ( $\mu$ ).



II. (II) has a large angle of separation between two Br atoms; therefore, net ( $\mu$ ) is less than (I).



III. In (III), two Br atoms and two H atoms have equal and opposite bond moments; therefore, the net  $\mu$  is zero.

**Example 2:** Write down the number of asymmetric carbon atoms in each optically active compound and report the number of isomers.



**Sol:** Since  $n$  is even in both the case,

Number of O.I.A =  $2^n$

Number of meso forms =  $2^{(n-2)/2}$

Number of (O.I.A) racemic form =  $n/2$

Total optical isomers =  $2^{n-1} + 2^{(n-2)/2}$

i. Number of asymmetric C atoms = 2

Different terminal groups : ( $-\text{COOH}$ ) and (Me)

Number of O.I.A =  $2^n = 2^2 = 4$

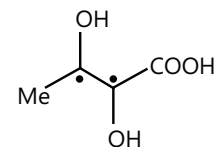
Number of meso forms = 0

Number of (O.I.A) racemic form =  $\frac{4}{2} = 2$

(racemate mixture)

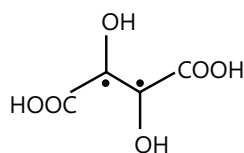
$\therefore$  Total optical isomers = 4

Optically inactive forms = 2.



ii. Number of asymmetric C atoms = 2.

Same terminal groups: ( $-\text{COOH}$ )



Number of O.I.A =  $2^{n-1} = 2^{2-1} = 2$

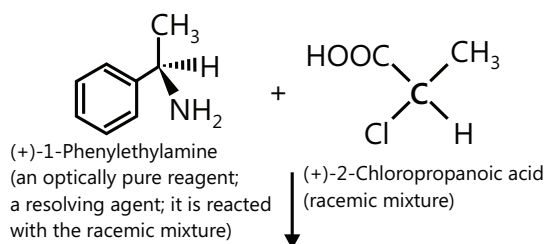
Number of meso forms =  $2^{(n-2)/2} = 2^0 = 1$

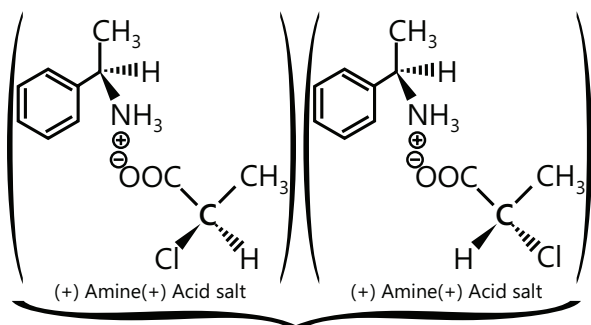
Number of (O.I.A) racemic form =  $\frac{2}{2} = 1$

Total optical isomers =  $2 + 1 = 3$

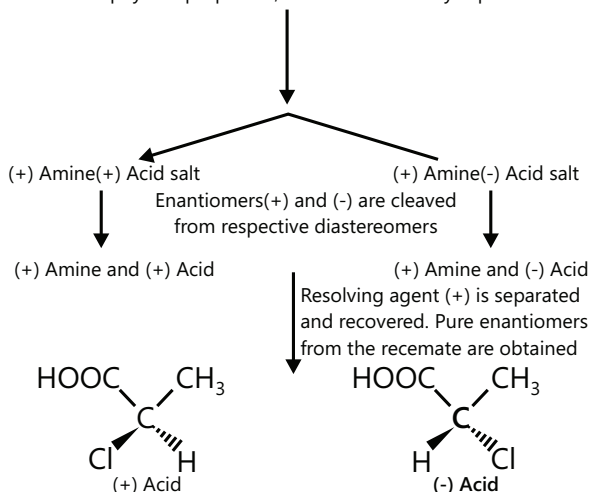
**Example 3:** Resolve the compounds from enantiomeric mixture

**Sol:** First convert the pair of enantiomers into diastereomers by using proper resolving agent. The two diastereomers have different physical properties like solubility. By using a proper solvent two diastereomers can be separated and they are converted back into enantiomer.





Mixture of diastereomers; Components of the mixture have different physical properties; hence can be easily separated.



**Example 4:** An aqueous solution containing 10gm of optically pure fructose was diluted to 500 mL with water and placed in a polarimeter tube 20 cm long. The measured rotation was  $-5.0^\circ$ . To this solution 500 mL of a solution containing 10 gm of racemic fructose is added. What will be the change in specific rotation?

**Sol:** Using the following equation, first calculate the specific rotation.

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

As we know, 20 cm = 2 dm.

$$[\alpha]_D = \frac{\theta}{l \times c} = \frac{-5.0^\circ}{2 \text{ dm} \times 10 \text{ gm} / 500 \text{ ml}} = -125^\circ$$

Total volume of solution = 500+500=1000mL

Mass per mL of pure fructose = 10/1000 = 0.01 gm/mL<sup>-1</sup>

Mass per mL of mixture = (10+10 = 20) / 1000  
= 0.02 gm/mL<sup>-1</sup>

OP (optical purity)

$$= \frac{[\alpha]_{\text{obs.}} \text{ of mixture}}{[\alpha]_D \text{ of pure form}} \alpha \frac{\text{Mass per ml of pure form}}{\text{Mass per ml of mixture}}$$

$$= \frac{0.01}{0.02} = 0.5 \quad (\because l \text{ is constant})$$

$$\text{New } [\alpha]_D = -125^\circ \times 0.5 = -62.5^\circ$$

$$\text{Change in specific rotation} = 62.5 - (-125) = +62.5^\circ$$

**Example 5:** What is the optical purity of a sample having an  $[\alpha]_{\text{obs.}} = +9.0$  if  $[\alpha]_D = +12^\circ$

$$\text{Sol Optical purity (OP) of sample} = \frac{+9.0}{+12^\circ} \times 100 = 75\%$$

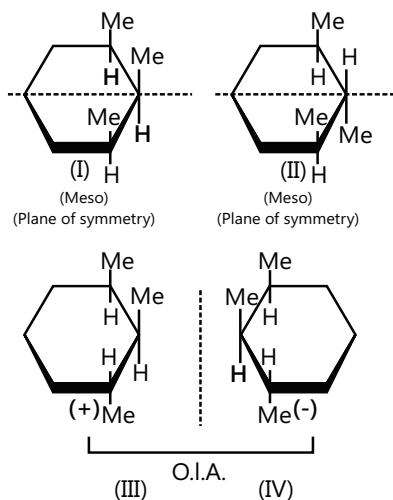
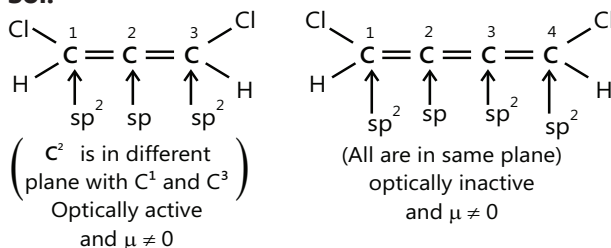
The mixture has 75% (+) and 25% racemic mixture [i.e.; 12.5%(+) and 12.5%(-) form.

$$\text{Total percentage of (+) form} = 75\% + \frac{25\%}{2} = 87.5\%$$

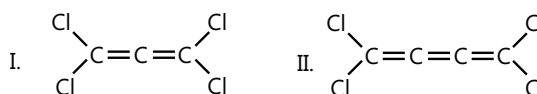
$$\text{Total percentage of (-) form} = 12.5\%$$

**Example 6:** How many optically active and inactive isomers of 1, 2, 3 trimethylcyclohexane are possible?

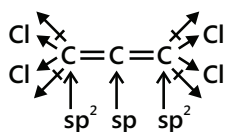
**Sol:**



**Example 7:** Which of the following will show dipole moment ( $\mu$ )?

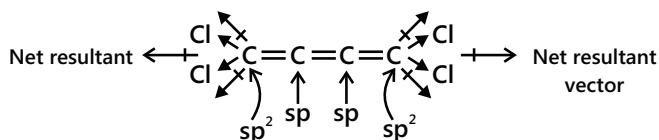


**Sol:** (i) Will show dipole moment ( $\mu$ ). The terminal C atoms are not in plane with middle C atom.



So they have net resultant dipole moment.

(ii) Has zero dipole moment. All the C atoms are in one plane, so the net resultant bond moment is cancelled.



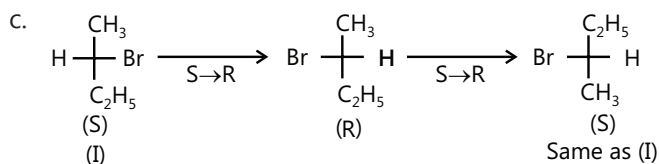
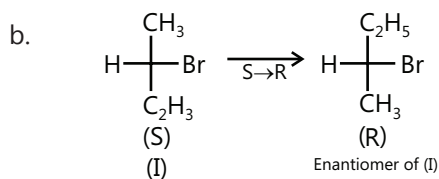
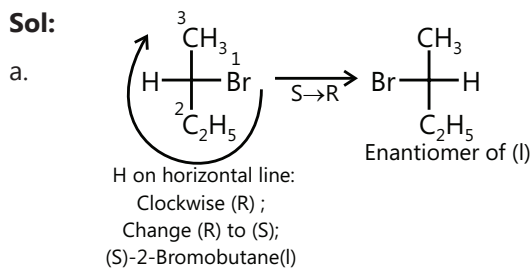
As a general rule, an even number of cumulative double bonds with all the same four groups will show a dipole moment and an odd number of cumulative double bonds with all the same four groups will not show dipole moment.

Similarly, an even number of cumulative double bonds with two different groups on terminal C atoms will be optically active and an odd number of cumulative double bonds with two different groups on terminal C atoms will be optically inactive.

**Example 8:** Give the effect of the configuration of (S)-2-bromo butane on performing the following operations:

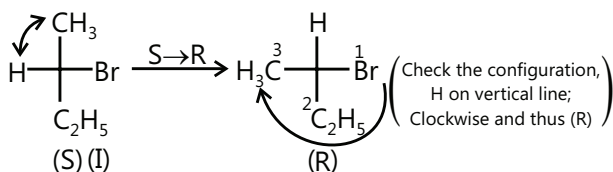
- Exchanging ligands across the horizontal bond.
- Exchanging ligands across the vertical bond.
- Making both switches (A) and (B).
- Exchanging a horizontal and vertical ligand.
- A 180° vertical or horizontal rotation outside the plane of paper.
- A 90° rotation on the plane of paper.

**Sol:**



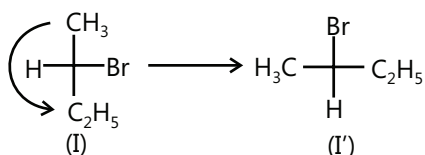
Thus, there is no change in the configuration when both switches (A) and (B) are made.

d.

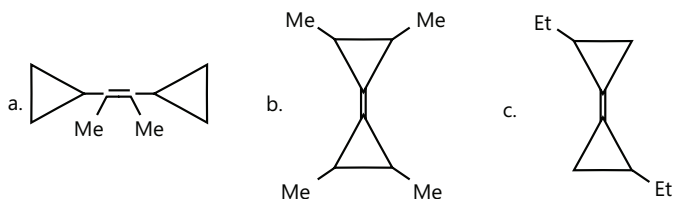


e. This type of operation is not allowed in Fischer projection because any flipping out of the plane of paper (side to side or top to bottom) would change the ligands formerly projecting behind the plane of paper to projecting towards the observer. Those ligands formerly pointing towards the observer would change to behind the paper.

f. This type of operation is also not allowed in Fischer projection. For example,



**Example 9:** Some possible structures of a compound A ( $C_{10}H_{16}$ ) are:

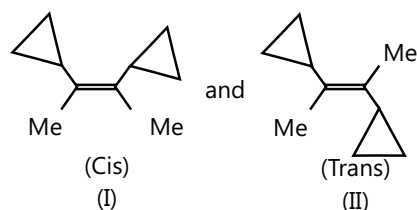


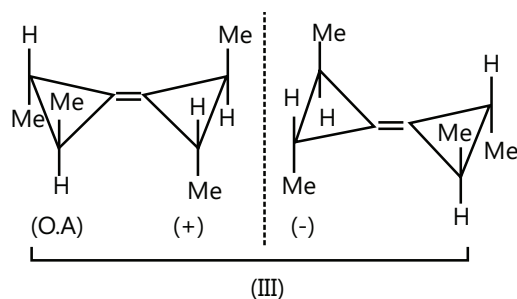
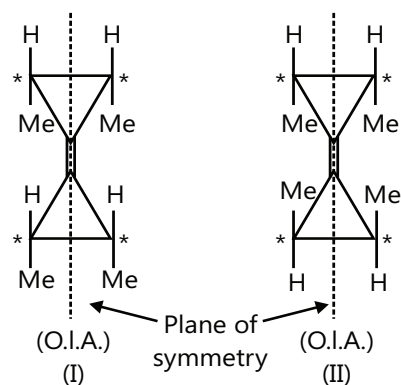
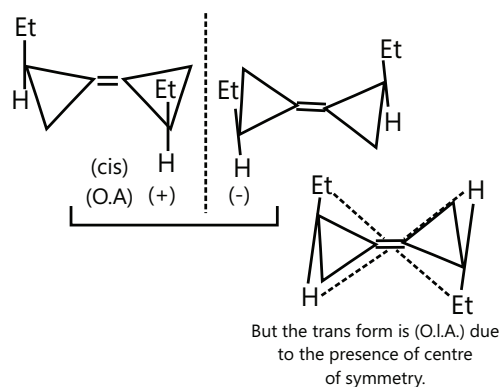
Write the possible stereoisomers of (A), (B), and (C).

**Sol:** (A) Representations of geometrical isomers (diastereomers).

(B) Three geometrical isomers are shown; out of them one is optically active.

(C) The cis form is optically active.





**Example 10:** What is the observed rotation when 0.1 M solution of (R)-2 butanol is mixed with an equal volume of 0.05M solution of racemic 2-butanol and the resulting solution is taken in a cell of 5 cm long tube in a polarimeter? The specific rotation of (R)-2-butanol is +13.9°.

**Sol:** The racemic 2-butanol has no contribution to optical activity. So, the observed rotation will be due to (R)-2 butanol only. Racemic butanol helps in diluting after dilution is 0.05M. Molecular weight of 2-butanol is 74.

$$l = 5 \text{ cm} = 0.5 \text{ dm}$$

$$\therefore \text{Concentration} = \frac{74 \times 0.05}{1000} = 3.7 \times 10^{-3} \text{ gm ml}^{-1}$$

$$\therefore [\alpha]_{\text{obs.}} = [\alpha]_{\text{pure}} \times l \times c = 13.9 \times 0.5 \times 3.7 \times 10^{-3} = 0.26^\circ$$

## JEE Main/Boards

### Exercise 1

**Q.1** 0.90 gm of an organic compound  $\text{C}_4\text{H}_{10}\text{O}_2$  (A) when treated with sodium gives 224 mL of hydrogen at NTP. Compound (A) can be separated into fractions (B) and (C), by crystallisation of which the fraction (B) is resolved into optical isomers (D) and (E). Write down the structural formula of (A) to (E) with proper reasoning.

**Q.2** Write down the structures of close homologues of heptane having one quaternary C atom in their molecule and the other having two tertiary carbon atoms.

**Q.3** An alkaline (A)  $\text{C}_5\text{H}_{12}$  on chlorination at  $300^\circ\text{C}$  gives a mixture of four different monochlorinated derivatives, (B), (C), (D), and (E). Two of these derivatives give the same stable alkene (F) on dehydrohalogenation. On oxidation with hot alkaline  $\text{KMnO}_4$  followed by acidification, (F) gives two products (G) and (H). Give the structures of (A) to (H) with proper reasoning.

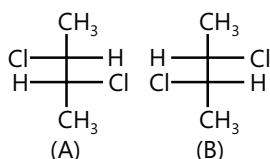
**Q.4** Which alkane, having a molecular weight of 86, will form only two monobromo alkanes?

**Q.5** A hydrocarbon (A) was found to have vapour density 36. It forms only a single monochloro substitution product. Suggest (A).

**Q.6** Which of the following will not be able to show optical isomerism (enantiomerism)?

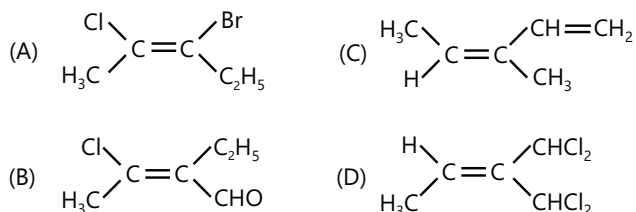
- (A) 1,2-Propadiene      (B) 2,3-Pentadiene  
(C) Sec-Butyl alcohol      (D) All exhibit enantiomerism

**Q.7** If optical rotation produced by the compound (A) is  $+52^\circ$ , the one produced by compound (B) is:

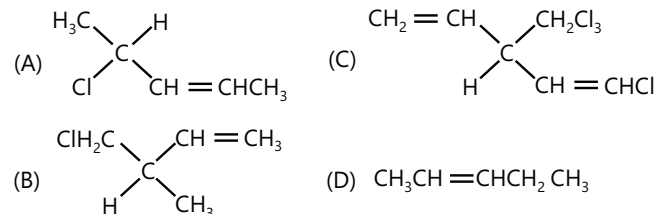




**Q.8** The E-isomer among the following is:



**Q.9** Which of the following will not show geometrical isomerism?



**Q.10** The dihedral angle between the hydrogen atoms of two methyl groups in staggered conformation of ethane is:

- (A)  $120^\circ$  (B)  $180^\circ$  (C)  $90^\circ$  (D)  $60^\circ$

**Q.11** Which of the following objects is chiral?

- (A) Nail (B) Blade  
(C) Tennis racket (D) Laced football

**Q.12** Predict the number of stereoisomers for 2,5-heptadiene.

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

**Q.13** Symbol D stands for:

- (A) Dextrorotatory, which rotates P.P.L. towards right.  
(B) Dextrorotary, which rotates P.P.L. towards left.  
(C) Relative configuration with respect to lactic acid taken as standard.  
(D) Relative configuration with respect to glyceraldehyde taken as standard and (OH) group is on the right side.

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

- (A) 3-Phenyl-2-propenoic acid  
(B) 2-Butene  
(C) 3-Methyl-2-butenoic acid  
(D) 3-Methyl-2-pentenoic acid

**Q.15** The enolic form of acetone contains:

- (A)  $9\sigma$ -bonds,  $1\pi$ -bond, and 2 lone pairs

- (B)  $8\sigma$ -bonds,  $2\pi$ -bond, and 2 lone pairs

- (C)  $10\sigma$ -bonds,  $2\pi$ -bond, and 1 lone pairs

- (D)  $9\sigma$ -bonds,  $2\pi$ -bond, and 2 lone pairs

**Q.16** Arrange the following in the increasing order of expected enol content.

- i.  $\text{CH}_3\text{COCH}_2\text{CHO}$  ii.  $\text{CH}_3\text{COCH}_3$   
iii.  $\text{CH}_3\text{CHO}$  iv.  $\text{CH}_3\text{COCH}_2\text{COCH}_3$   
(A)  $\text{iii} < \text{i} < \text{ii} < \text{iv}$  (B)  $\text{iii} < \text{ii} < \text{i} < \text{iv}$   
(C)  $\text{i} < \text{iv} < \text{ii} < \text{iii}$  (D)  $\text{iv} < \text{i} < \text{ii} < \text{iii}$

**Q.17** Hydrocarbon with formula  $\text{C}_8\text{H}_{18}$  gives one chloro derivative. The hydrocarbon can be:

- (A) n-octane  
(B) 2-methylheptane  
(C) 2,2,4-trimethylpentane  
(D) 2,2,3,3-tetramethylbutane

**Q.18** The minimum number of carbon atoms an alkane should contain in order to exhibit optical activity is:

- (A) 5 (B) 6 (C) 7 (D) 8

**Q.19** A compound whose molecule is superimposable on its mirror image despite containing chiral carbon atoms is called:

- (A) Threo isomer (B) Meso compound  
(C) Enantiomer (D) No special name

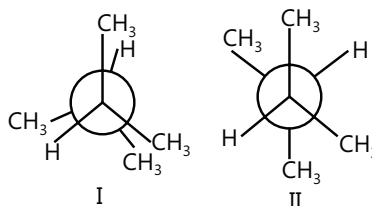
**Q.20** The IUPAC name of the compound with formula  $\text{C}_n\text{H}_{2n+2}$ , having the lowest possible molecular mass and capable of showing enantiomerism is:

- (A) 3-Methyl hexane (B) 2,3-Dimethyl pentane  
(C) Methane (D) Both (A) and (B)

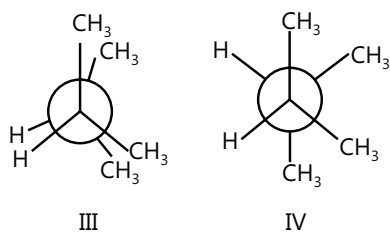
## Exercise 2

### Single Correct Choice Type

**Q.1** In which of the following has minimum torsional strain and minimum Vander waal strain.

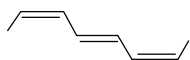






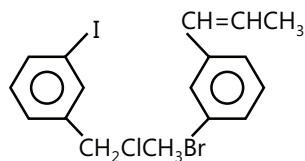
- (A) I                      (B) II                      (C) III                      (D) IV

**Q.2** The IUPAC name of the compound:



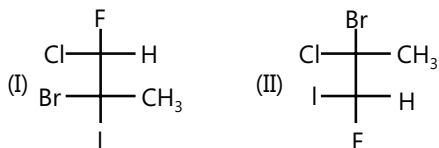
- (A) (2E,4E,6Z)-octa-2,4,6-triene  
 (B) (2E,4E,6E)-octa-2,4,6-triene  
 (C) (2Z,4E,6Z)-octa-2,4,6-triene  
 (D) (2Z,4Z,6Z)-octa-2,4,6-triene

**Q.3** How many spatial orientations are possible in the following compound?



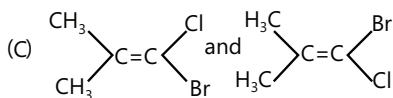
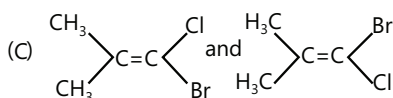
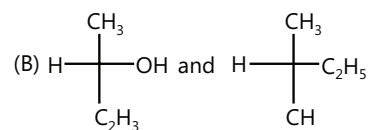
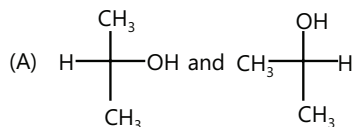
- (A) 2                      (B) 4                      (C) 6                      (D) 8

**Q.4** How are compounds I and II are related?

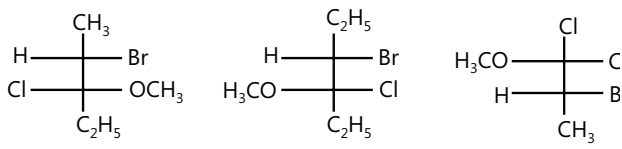


- (A) Enantiomers                      (B) Diastereomers  
 (C) Constitutional                      (D) Identical

**Q.5** The non identical species are:

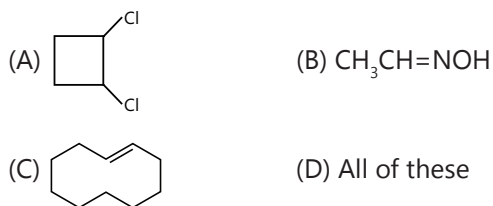


**Q.6** Which statement is correct about the following structures

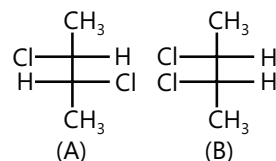


- (A) I and II are structural isomers  
 (B) I and II, I and III are enantiomers  
 (C) I, III are enantiomers and I, II are structural isomers  
 (D) I, II and III are stereoisomers.

**Q.7** Which will form geometrical isomers?

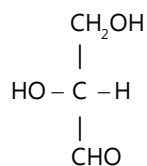


**Q.8** If optical rotation produced by (A) is  $+36^\circ$  then optical rotation produced by (B) will be ?



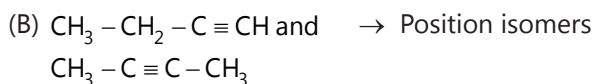
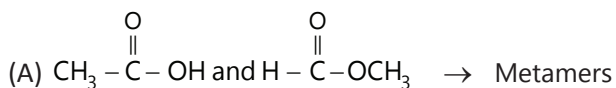
- (A)  $+36^\circ$                       (B)  $0^\circ$                       (C)  $+26^\circ$                       (D) Unpredictable

**Q.9** What is the configuration of the given molecule?



- (A) D                      (B) L                      (C) d                      (D) l

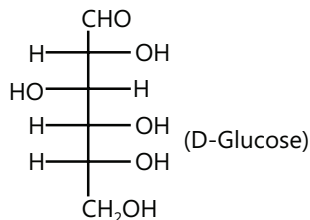
**Q.10** Which of the following is/are correct matchings?



(C)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$  and  $\text{CH}_3 - \underset{\text{NH}_2}{\text{CH}} - \text{CH}_3 \rightarrow$  Tautomers

(D) Anisole and o-cresol  $\rightarrow$  Metamers

**Q.11** The correct IUPAC name of D-Glucose is:



(A) (2D,3D,4L,5D) 2,3,4,5,6-pentahydroxyhexanal.

(B) D-2,3,4,5,6-pentahydroxyhexanal

(C) 6-oxo-(2D,3L,4D,5D)-2,3,4,5,6-pentahydroxyhexane.

(D) (2D,3L,4D,5D)-2,3,4,5,6-pentahydroxyhexanal.

**Q.12** Total number of geometrical isomer of following compound.



(A) 2      (B) 4      (C) 8      (D) 16

## Previous Years' Questions

**Q.1** How many optically active stereoisomers are possible for butane-2,3-diol? **(1997)**

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

**Q.2** The optically active tartaric acid is named as D-(+)-tartaric acid because it has a positive **(1999)**

(A) Optical rotation and is derived from D-glucose

(B) pH in organic solvent

(C) Optical rotation and is derived from D-(+)-glyceraldehydes

(D) Optical rotation when substituted by deuterium

**Q.3** Which of the following compounds will exhibit geometrical isomerism? **(2000)**

(A) 1-phenyl-2-butene      (B) 3-phenyl-1-butene

(C) 2-phenyl-1-butene      (D) 1,1-diphenyl-1-propene

**Q.4** The number of isomers for the compound with molecular formula  $\text{C}_2\text{BrClFI}$  is **(2001)**

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

**Q.5** Which of the following compounds exhibits stereoisomerism? **(2002)**

(A) 2-methylbutene-1

(B) 3-methylbutyne-1

(C) 3-methylbutanoic acid

(D) 2-methylbutanoic acid

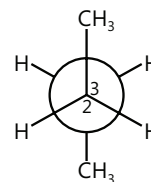
**Q.6**  $\text{C}_2$  is rotated anti-clockwise  $120^\circ$  about  $\text{C}_2-\text{C}_3$  bond. The resulting conformer is **(200)**

(A) Partially eclipsed

(B) Eclipsed

(C) Gauche

(D) Staggered



**Q.7** The number of stereoisomers obtained by bromination of trans-2-butene is **(2007)**

(A) 1

(B) 2

(C) 3

(D) 4

**Q.8** Read the following questions and answer as per the direction given below: **(2007)**

(A) Statement-I is true; statement-II is true; statement II is the correct explanation of statement-II.

(B) Statement: I is true; statement-II is true; statement-II is not the correct explanation of statement-I.

(C) Statement-I is true; statement-II is false

(D) Statement-I is false; statement-II is true

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

**Statement-II** : All chiral molecules have chiral centres.

**Q.9** Isomers which are ..... mirror images are known as .....(superimposable, non-superimposable, enantiomers, diastereomers, epimers) **(1988)**

**Q.10** A solution of (-) 1-chloro-1-phenylethane in toluene racemises slowly in the presence of a small amount of  $\text{SbCl}_5$ , due to the formation of: **(2013)**

(A) Carbanion

(B) Carbene

(C) Carbocation

(D) Free radical

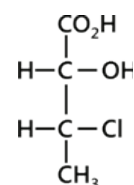
**Q.11** The absolute configuration of (figure) is **(2016)**

(A) (2S, 3R)

(B) (2S, 3S)

(C) (2R, 3R)

(D) (2R, 3S)



## JEE Advanced/Boards

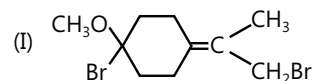
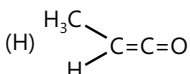
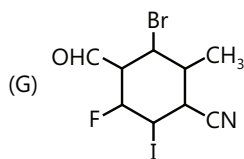
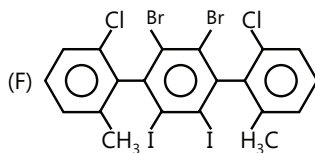
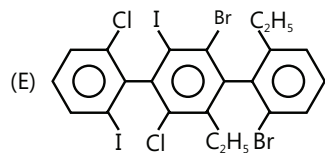
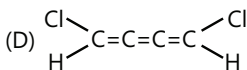
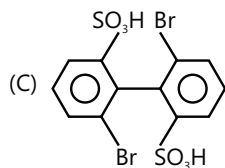
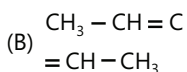
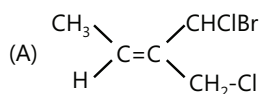
### Exercise 1

**Q.1** How many benzenoid isomer are possible for cresol?

**Q.2** Find out the total number of cyclic structural isomers of  $C_6H_{12}$

**Q.3** How many pair(s) of geometrical isomers are possible with  $C_6H_{12}$  (with in open chain structures)

**Q.4** Which of the following compounds can be optically active?



**Q.5** Calculate the number of Benzenoid isomers possible for  $C_6H_3ClBrI$ .

**Q.6** Calculate the total number of structural isomers of 3°- amines for the molecular formula  $C_6H_{15}N$  are?

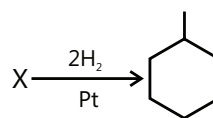
**Q.7** Write the number of acyclic, optically active structural isomers having following molecular formula and write their structural formula also.

(A)  $C_7H_{16}$       (B)  $C_7H_{12}$       (C)  $C_7H_9Cl$

(D)  $C_3H_4ClBr$       (E)  $C_2H_2Cl_2F_2$

**Q.8** How many cyclopentane structures (excluding stereo isomer) are possible for  $C_7H_{14}$ .

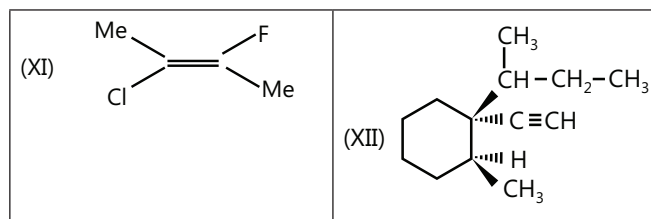
**Q.9** Find out total number of structures of X.



**Q.10** Calculate the total number of cyclic isomeric compounds of molecular formula  $C_5H_8O$  which can't show geometrical isomerism.

**Q.11.** Assign E and Z configuration

(I)	(II)
(III)	(IV)
(V)	(VI)
(VII)	(VIII)
(IIX)	(X)



**Q.12** Write the number of all possible acyclic compounds having molecular formula. Give their structural formula also.

- (A)  $C_2H_2Cl_2F_2$       (B)  $C_2HClBrIF$       (C)  $C_2ClBrIF$

**Q.13** Mention the specific type of isomerism exhibited by each of the following pairs

- (A) 1,2-dichloro ethane and 1,1-dichloro ethane  
 (B) Propanoic acid and methyl acetate  
 (C) Methyl acetate and ethyl formate  
 (D) o-Nitrophenol and p-Nitrophenol.  
 (E) Anisole and o-cresol  
 (F) Phenol and Cyclohexa-2,4-dien-1-one.

**Q.14** Draw the two chair conformers of each compound and indicate which conformer is more stable.

- (A) Cis 1-ethyl-3-methylcyclohexane  
 (B) Trans-1-ethyl-3-isopropylcyclohexane  
 (C) Trans-1-ethyl-2-methylcyclohexane  
 (D) Trans-1-ethyl-3-methylcyclohexane  
 (E) Cis 1-ethyl-3- isopropylcyclohexane  
 (F) Cis 1-ethyl-4- isopropylcyclohexane

**Q.15** Write stereochemical formula of the following compounds.

- (A) D-2-Hexanol  
 (B) L-Lactic acid       $(CH_3 - CHOH - COOH)$   
 (C) D-Glyceric acid  $\begin{pmatrix} CH_2 - CH - COOH \\ | \quad | \\ OH \quad OH \end{pmatrix}$   
 (D) D-Alaninc  $\begin{pmatrix} CH_3 - CH - COOH \\ | \\ NH_2 \end{pmatrix}$

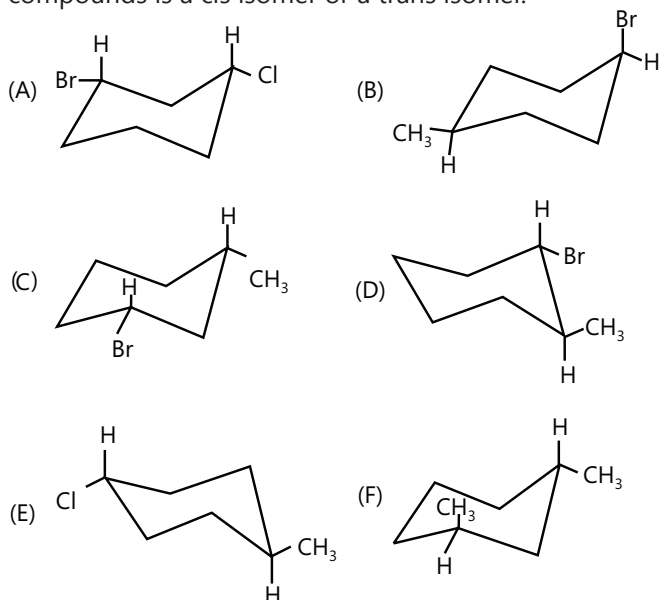
**Q.16** Draw the most stable conformer of N-methylpiperidine.

**Q.17** Considering rotation about the C-3-C-4 bond of 2-methylhexane:

(A) Draw the Newman projection of the most stable conformer.

(B) Draw the Newman projection of the least stable conformer.

**Q.18** Determine whether each of the following compounds is a cis isomer or a trans isomer.

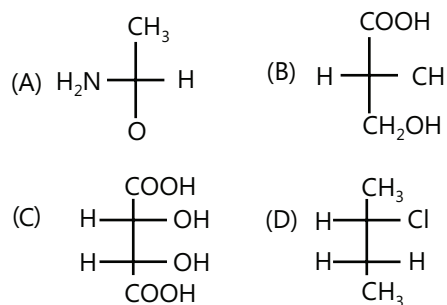


**Q.19** Write down all the isomers of formula  $C_7H_7O_2N$ . What type of isomerism they show?

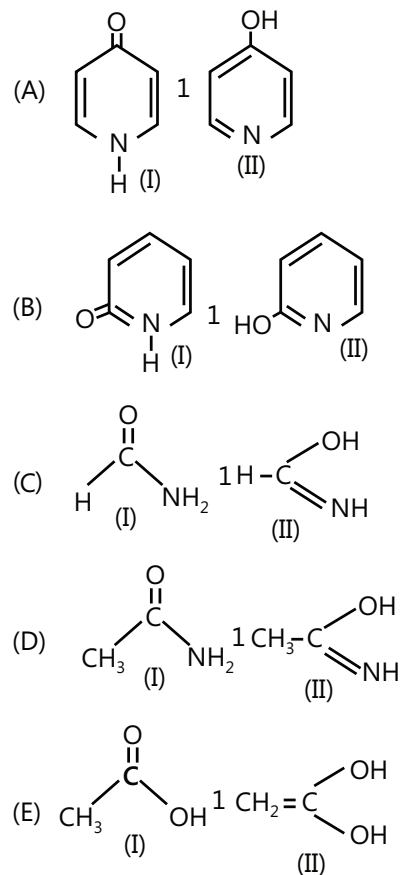
**Q.20** Assign the priority order number to the following atoms or groups.

- (A)  $-CHO, -CH_2OH, -CH_3, -OH$   
 (B)  $-Ph, -CH(Me)_2, -H, -NH_2$   
 (C)  $-COOH, -Ph, -CHO, -CH=CH_2$   
 (D)  $-CH(Me)_2, -CH=CH_2, -C\equiv CH_3 - Ph$   
 (E)  $-CH_3, -CH_2Br, -CH_2OH, -CH_2Cl$   
 (F)  $-H, -N(Me)_2, -Me, -OMe$   
 (G)  $-CH=CH_2, -Me, -Ph, -Et$   
 (H)  $-CH-CH_2 - Br, -Cl, -CH_2 - CH_2$   
 $-CH_2 - Br, (Me)_2CH -$   
 (I)  $-Cl, -Br, -I, -NH_2$   
 (J)  $NH_2, NO_2, CH_2NH_2, C\equiv N$

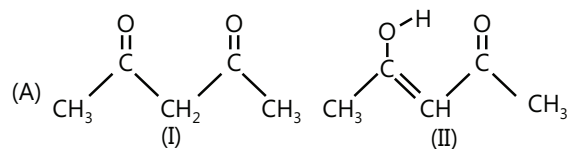
**Q.21** Allot R/S configurations to the following optical isomers.



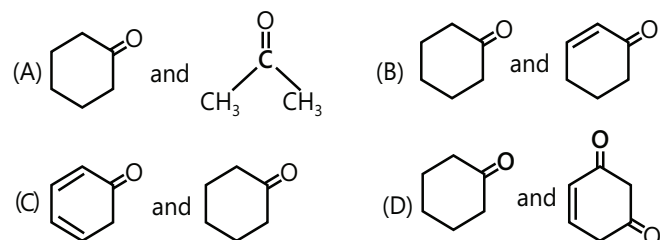
**Q.22** In each of the following pairs which is more stable:



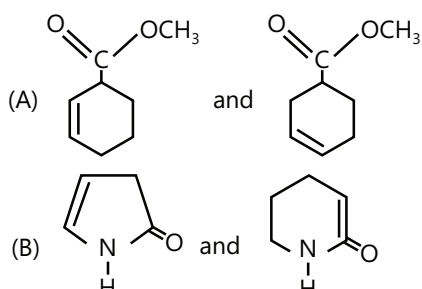
**Q.23** In each of the following pairs which is more stable:



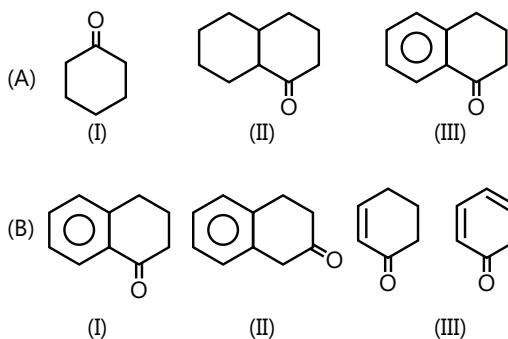
**Q.24** In each of the following pairs which will have less enol content:



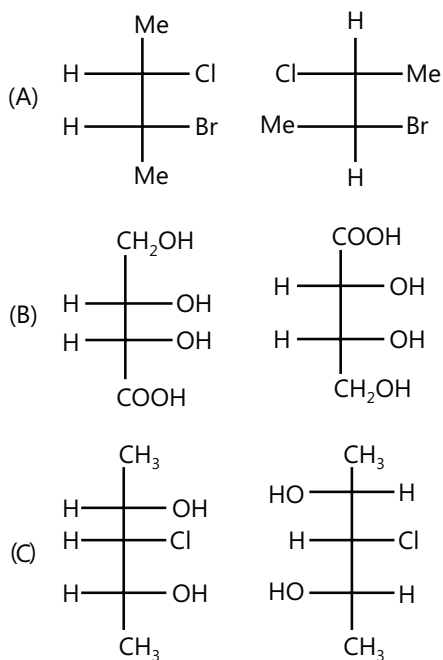
**Q.25** In each of the following pairs which will have less enol content:



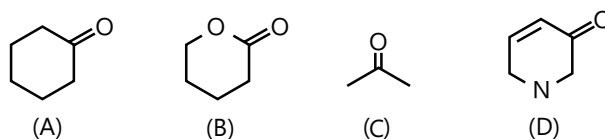
**Q.26** In each of the following sets of compounds write the decreasing order of % enol content.



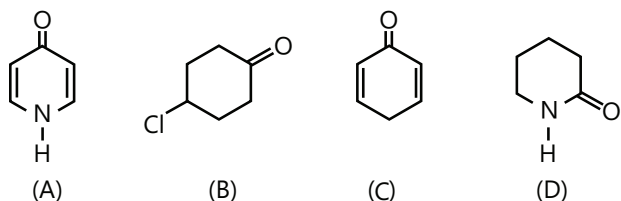
**Q.27** Identify the following pairs as enantiomers, diastereomers or identicals.



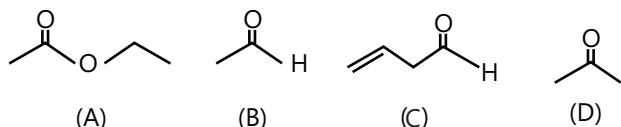
**Q.28** In each of the following sets of compounds write the decreasing order of % enol content.



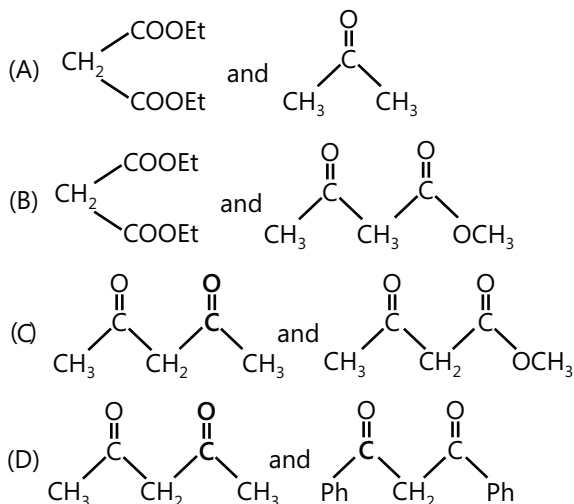
**Q.29** In each of the following sets of compounds write the decreasing order of % enol content.



**Q.30** In each of the following sets of compounds write the decreasing order of % enol content.



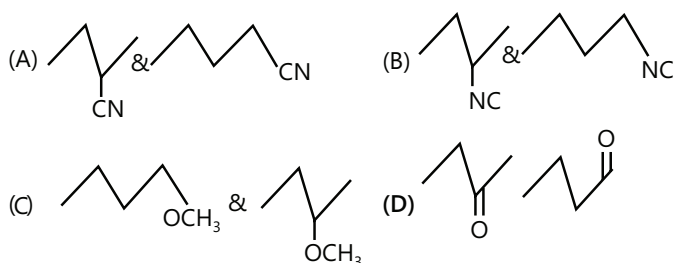
**Q.4** In which of the following pairs first will have higher enol content than second:



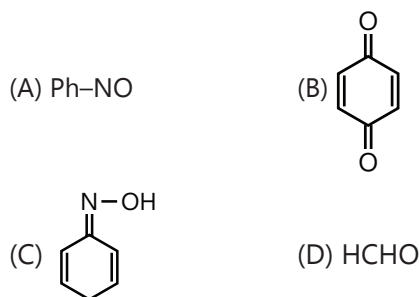
## Exercise 2

### Single Correct Choice Type

**Q.1** Identify the position isomer.

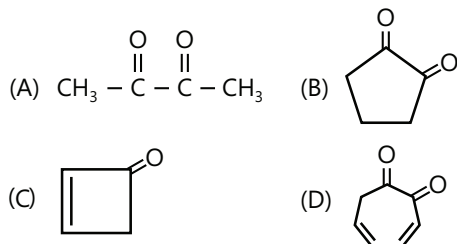


**Q.2** Which compound show tautomerism



### Multiple Correct Choice Type

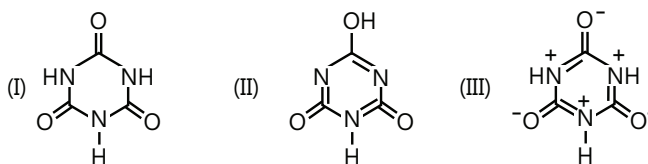
**Q.3** Which of the following compounds have higher enolic content than Keto content:



**Q.5** What statement is correct for Keto – enol tautomerism?

- (A) Tautomerism is catalysed by acid and base.  
 (B) Tautomers are present in dynamic equilibrium state.  
 (C) Generally keto is more stable than enol form in mono Ketones  
 (D) Atomic arrangements are same in tautomerism.

**Q.6** What is the relation between (I), (II) and (III)?



- (A) I and II are tautomers  
 (B) III is conjugate base of II  
 (C) III is resonance structure of I  
 (D) No relation exists.

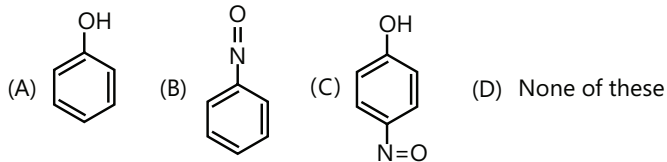
**Q.7** Which of the following have zero dipole moment?

- (A) p-Dichlorobenzene (B) Benzene-1,4-diol  
 (C) Fumaric acid (D) Maleic acid

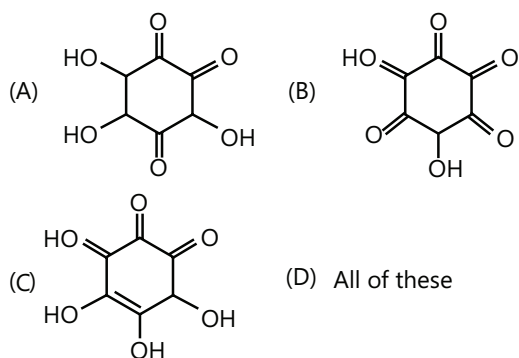
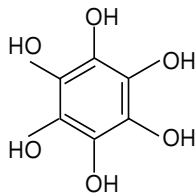
**Q.8** Which of the following statements is/are not correct?

- (A) Metamerism belongs to the category of structural isomerism  
 (B) Tautomeric structures are the resonating structures of a molecule.  
 (C) Keto form is always more stable than the enol form  
 (D) Geometrical isomerism is shown only by alkanes

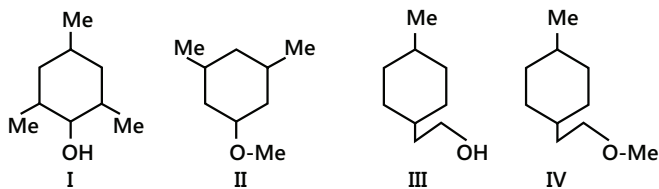
**Q.9** Which compound show tautomerism:



**Q.10** Tautomeric form of this compound is/are:

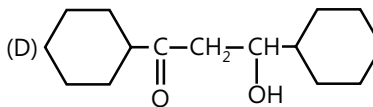
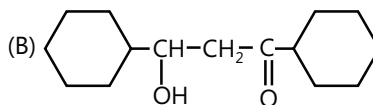
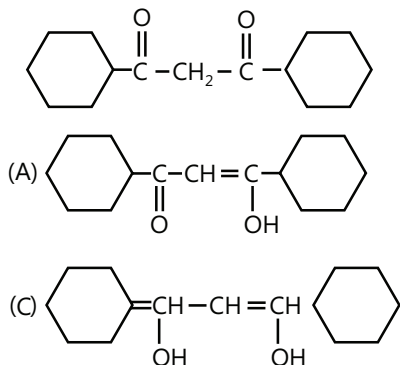


**Q.11** Which of the following is not the correct relationship.

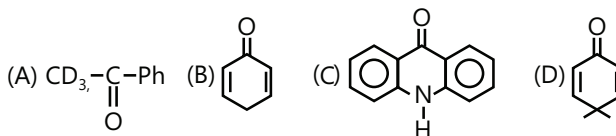


- (A) II and IV are metamers  
 (B) I and II are functional isomers  
 (C) I and III are chain isomers  
 (D) I and IV are positional isomers. [as q 8]

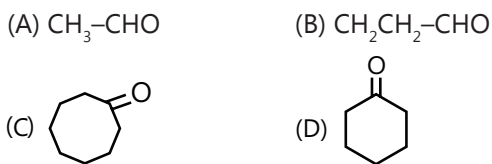
**Q.12** Tautomer of following compound is:



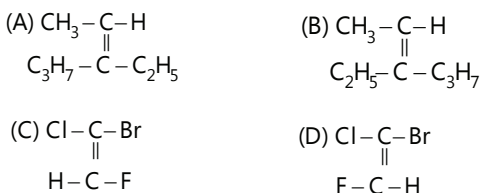
**Q.13** Which of the following can tautomerise:



**Q.14** Tautomer of which of the following can show geometrical isomerism



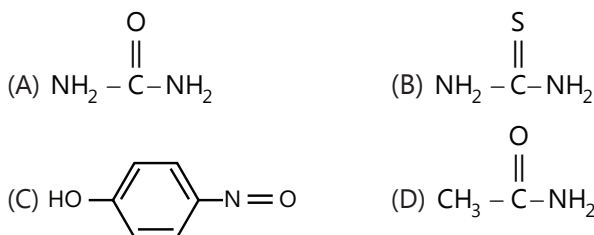
**Q.15** The Z-isomer among the following are:



**Q.16** Which of the following is correctly matched?

- (A)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{C}_2\text{H}_5 \rightarrow 4$   
 (B)  $\text{CH}_3-(\text{CH}=\text{CH})_4-\text{CH}_3 \rightarrow 2$   
 (C)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_2 \rightarrow 2^3 + 2^1 = 10$   
 (D)  $\text{CH}_3-(\text{CH}=\text{CH})_5-\text{CH}_3 \rightarrow 2^4 + 2^2 = 20$

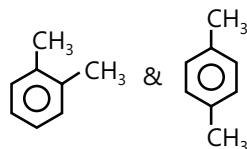
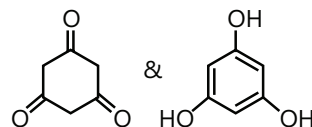
**Q.17** Which of the following compounds show tautomerism?




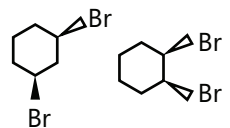
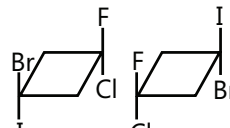


## Match the Columns

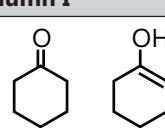
Q.18 Match Column I with Column II

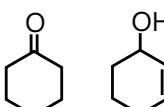
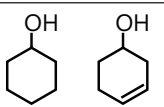
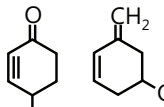
Column I	Column II
(A) $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{C}_3\text{H}_7$ & $\text{Et} - \overset{\text{O}}{\parallel}{\text{C}} - \text{O} - \text{Et}$	(p) Chain isomer
(B) 	(q) Positional isomers
(C) 	(r) Metamers
(D) $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{O} - \text{CH}_3$ & $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{O} - \text{CH}_3$	(s) Tautomers

Q.19 Match Column I with Column II

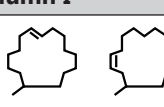
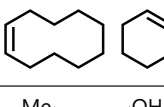
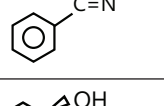
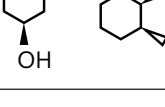
Column I	Column II
(A) 	(p) Geometrical isomers
(B) 	(q) Structural isomer
(C) 	(r) Number of Geometrical isomer of first compound is even number
	(s) Number of geometrical isomer of second compound is even number

Q.20 Match Column I with Column II


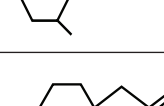
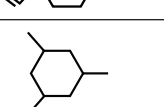

Column I	Column II
(A) 	(p) Tautomers

(B) 	(q) Structural isomer
(C) 	(r) Positional isomers
(D) 	(s) At least one of the two structures is enol

Q.21 Match Column I with Column II

Column I	Column II
(A) 	(p) Positional isomers
(B) 	(q) Geometrical isomers
(C) 	(r) First is E and second is Z form
(D) 	(s) Structural isomer

Q.22 Match Column I with Column II

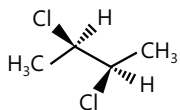
Column I Compound	Column II Number of geometrical isomers
(A) 	(p) 2
(B) 	(q) 4
(C) 	(r) 6
(D) 	(s) 8

## Previous Years' Questions

**Q.1** Which of the following compounds will show geometrical isomerism? **(1998)**

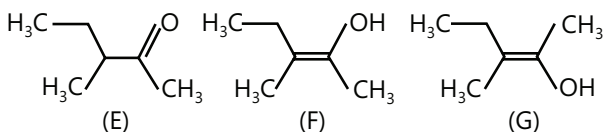
- (A) 2-butene (B) Propene  
(C) 1-phenyl propene (D) 2-methyl-2-butene

**Q.2** The correct statement(s) about the compound given below is (are) **(2008)**



- (A) The compound is optically active  
(B) The compound possess centre of symmetry  
(C) The compound possess plane of symmetry  
(D) The compound possess axis of symmetry

**Q.3** The correct statement(s) concerning the structures E, F and G is (are) **(2008)**



- (A) E, F and G are resonance structures  
(B) E, F and G are tautomers  
(C) F and G are geometrical isomers  
(D) F and G are diastereomers

**Q.4** The correct statement(s) about the compound  $\text{H}_3\text{C}-\underset{\text{OH}}{\text{C}}-\text{CH}=\text{CH}-\underset{\text{OH}}{\text{C}}-\text{H}-\text{CH}_3$  (X) is (are) **(2009)**

- (A) The total number of stereoisomers possible for X is 6.  
(B) The total number of diastereomers possible for X is 3.  
(C) If the stereochemistry about the double bond in X is trans, the number of enantiomers possible for X is 4.  
(D) If the stereochemistry about the double bond in X is cis, the number of enantiomers possible for x is 2.

**Q.5** M-chlorobromobenzene is an isomer of m-bromo-chlorobenzene. **(1985)**

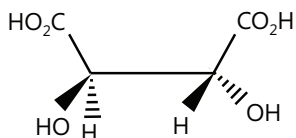
**Q.6** 2,3,4-trichloropentane has three asymmetric carbon atoms. **(1990)**

**Q.7** The organic chloro compound, which shows complete stereochemical inversion during a  $\text{S}_{\text{N}}2$

reaction, is **(2008)**

- (A)  $(\text{C}_2\text{H}_5)_2\text{CHCl}$  (B)  $(\text{CH}_3)_3\text{CCl}$   
(C)  $(\text{CH}_3)_2\text{CHCl}$  (D)  $\text{CH}_3\text{Cl}$

**Q.8** The absolute configuration of is **(2008)**



- (A) S, S (B) R, R (C) R, S (D) S, R

**Q.9**  $\alpha\text{-D-(+)}$  glucose and  $\beta\text{-D(+)}$  – glucose are **(2013)**

- (A) Conformers (B) Epimers  
(C) Anomers (D) Enantiomers

**Q.10** Glycerine contain one .....hydroxy group. **(2004)**

**Q.11** (A) Draw Newman's projection for the less stable staggered form of butane.

- (B) Relatively less stability of the staggered form is due to  
(i) Torsional strain  
(ii) van der waals' strain  
(iii) Combination of the above two **(2004)**

**Q.12**  $\mu_{\text{obs}} = \sum \mu_i x_i$  Where  $\mu_i$  is the dipole moment of stable conformer and  $X_i$  is the mole fraction of that conformer.

(A) Write stable conformer for  $\text{Z-CH}_2-\text{CH}_2-\text{Z}$  in Newman's projection.

If  $\mu_{\text{solution}} = 1.0\text{D}$  and mole fraction of anti form = 0.82, find  $\mu_{\text{gauche}}$

(B) Write most stable meso conformer of  $(\text{CHDY})_2$  If

- (i)  $\text{Y} = \text{CH}_3$  about C2-C3 rotation and  
(ii)  $\text{Y} = \text{OH}$  about C1-C2 rotation. **(2005)**

**Q.13** Give the total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula  $\text{C}_5\text{H}_{10}$  **(2009)**

# MASTERJEE Essential Questions

## JEE Main/Boards

### Exercise 1

Q.1            Q.3            Q.11

### Exercise 2

Q.2            Q.7            Q.11  
Q.18          Q.22          Q.23

### Previous Years' Questions

Q.4

## JEE Advanced/Boards

### Exercise 1

Q.4            Q.5            Q.11 (3,8,12)  
Q.13 (E,B)    Q.21 (C,D)    Q.23 (D,E)    Q.27

### Exercise 2

Q.1            Q.3            Q.8            Q.20

### Previous Years' Questions

Q.2            Q.4            Q.9

## Answer Key

## JEE Main/Boards

### Exercise 1

Q.6 A            Q.7  $-52^\circ$             Q.8 B            Q.9 B            Q.10 D            Q.11 D            Q.12 B  
Q.13 B            Q.14 C            Q.15 A            Q.16 B            Q.17 A            Q.18 C            Q.19 B  
Q.20 D

### Exercise 2

#### Single Correct Choice Type

Q.1 B            Q.2 C            Q.3 D            Q.4 C            Q.5 B            Q.6 C            Q.7 D  
Q.8 C            Q.9 B            Q.10 A            Q.11 D            Q.12 B

### Previous Years' Questions

Q.1 B            Q.2 C            Q.3 A            Q.4 D            Q.5 D            Q.6 C            Q.7 A  
Q.8 C            Q.9 Non-superimposable; enantiomers            Q.10 C            Q.11 A

## JEE Advanced/Boards

### Exercise 1

Q.1 3

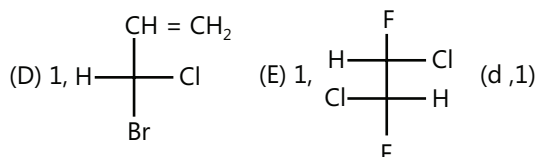
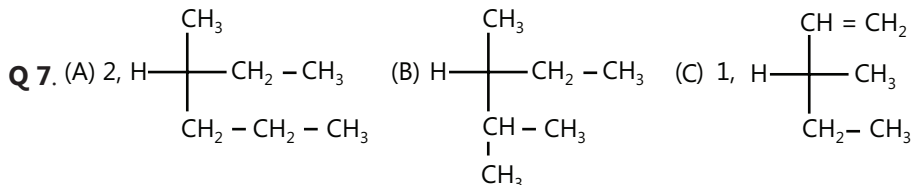
Q.2 6

Q.3 4

Q.4 A,B,C,E,G

Q.5. 10

Q.6. 7



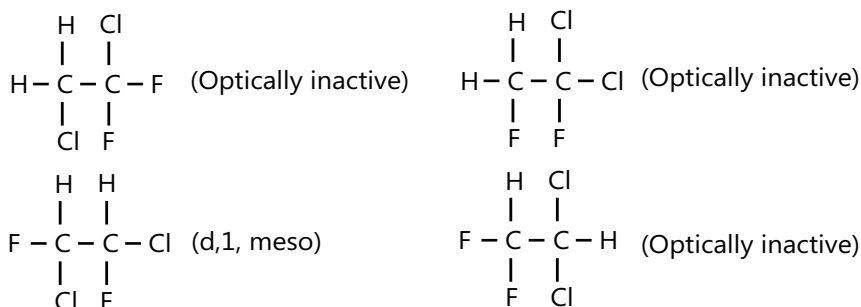
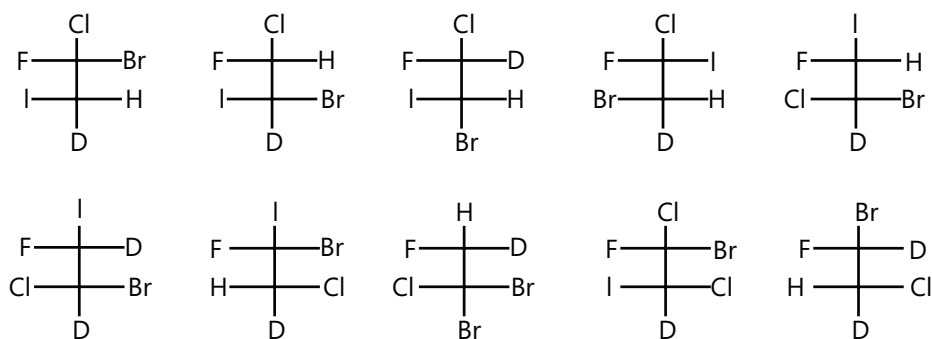
Q.8 4

Q.9 7

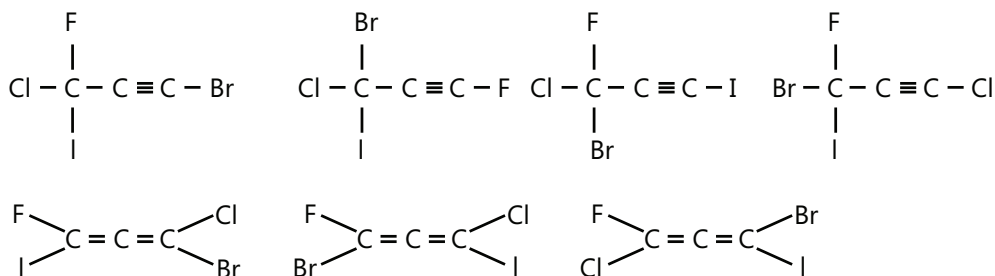
Q.10 10

Q.11 Z-I,II,III,VI, VII; E-IV,V,VIII,IX,X,XI,XII

Q.12 (A) 6, structural isomers = 4, stereoisomers = 3

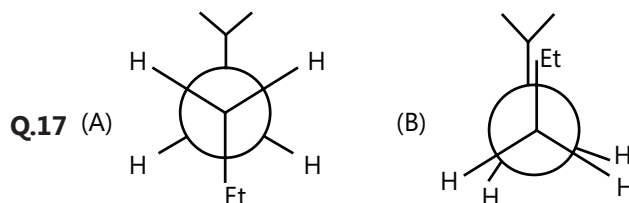
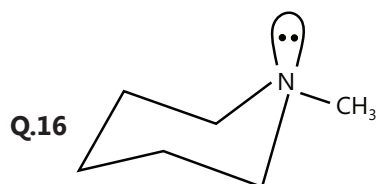
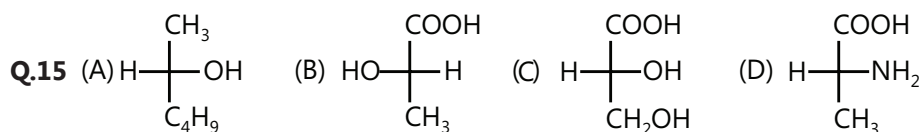
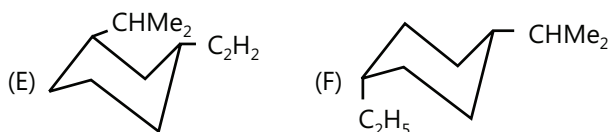
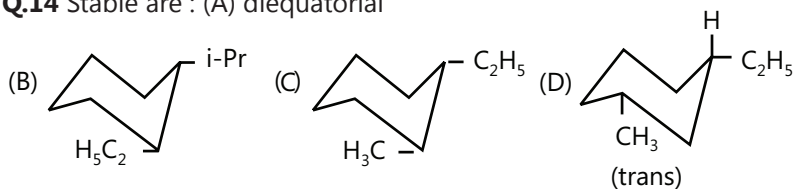
(B)  $10 \times 4 = 40$ , structural (positional) isomers = 10, stereoisomers = 40

(C) 14, structural isomers = 7, Stereoisomers = 14



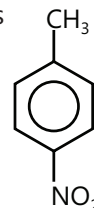
**Q.13** (A) Positional (B) Functional (C) Metamerism (D) Positional  
 (E) Functional (F) Tautomerism

**Q.14** Stable are : (A) diequatorial



**Q.18** (A) Cis (B) Cis (C) Cis (D) Trans (E) Trans (F) Trans

**Q.19** Position isomers, Functional isomers, Tautomers, Geometrical isomers



**Q.20** (A) 4,1,2,3 (B) 4,1,2,3 (C) 1,3,2,4 (D) 4,3,2,1 (E) 2,4,3,1 (F) 4,2,3,1  
 (G) 3,1,4,2 (H) 2,4,1,3 (I) 3,2,1,4 (J) 2,1,4,3

**Q.21** (A) S (B) R (C) R, S (D) S, S

**Q.22** (A) 1; (B) 1; (C) 1; (D) 1; (E) 1;

**Q.23** (A) 2; (B) 2; (C) 1; (D) 2; (E) 1

**Q.24** (A) 2; (B) 1; (C) 2; (D) 1; (E) 2

**Q.25** (A) 2; (B) 2

**Q.26** (A) 3>1>2 (B) 4>2>1>3

**Q.27** (A) Diastereomer, (B) Enantiomer, (C) Diastereomer

**Q.28** (D)>(B)>(A)>(C)

**Q.29** (C)>(A)>(D)>(B)

**Q.30** (C)>(D)>(B)>(A)

## Exercise 2

### Single Correct Choice Type

Q.1 C                    Q.2 C

### Multiple Correct Choice Type

Q.3 B, D                    Q.4 A, C                    Q.5 A, B, C                    Q.6 A, C                    Q.7 A, B                    Q.8 C, D  
 Q.9 (A) P, R, S (B) Q (C) Q                    Q.10 A, B                    Q.11 A, D                    Q.12 A, C, D                    Q.13 A, B, C                    Q.14 B, C  
 Q.15 A, C                    Q.16 A, B                    Q.17 A, B, C, D

### Match the Columns

Q.18 A → r; B → q; C → s; D → q                    Q.19 A → q, r, s; B → q, r, s; C → p, r, s  
 Q.20 A → p, q, s; B → q, s, C → s; D → q, s                    Q.21 A → p, r, s; B → q; C → q, r; D → p, r, s  
 Q.22 A → p; B → p; C → s; D → p

### Previous Years' Questions

Q.1 A, C                    Q.2 A, D                    Q.3 B, C, D                    Q.4 A, D                    Q.7 D                    Q.8 B                    Q.9 C

## Solutions

### JEE Main/Boards

#### Exercise 1

**Sol 1: i.** (A) reacts with Na to give  $H_2$  and thus it contains (–OH) group.

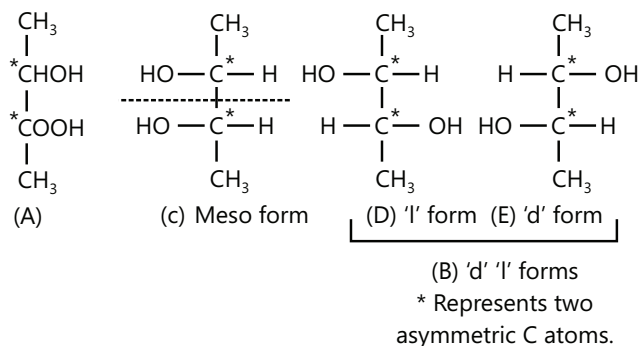
**ii.** The molecular weight of (A) ( $C_4H_{10}O_2$ ) is 90. If one (OH) group, then 90 gm (A) with Na gives 11200 mL  $H_2$  (i.e., half mole  $H_2$ ).

0.90 gm of (A) gives  $\frac{11200 \times 0.90}{90} = 112$  ml of  $H_2$  at STP.

Since 0.90 Na gives 224 mL  $H_2$  at STP, it contains two (–OH) groups.

**iii.** keeping in view the above facts, (A) is  $C_4H_8$   $\begin{matrix} \text{OH} \\ \diagdown \\ \text{C} \\ \diagup \\ \text{OH} \end{matrix}$

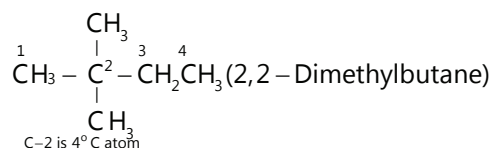
**iv.** (A) shows optical isomerism of which (B) form is optically active having two isomers (D) and (E); (C) being the inactive form; therefore, (A), (B), (C), and (D) are:



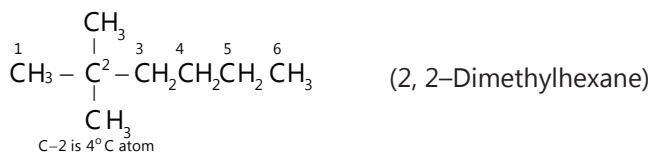
**Sol 2:** Heptane is  $C_7H_{16}$ .

The homologues of heptane are  $C_7H_{14}$  and  $C_8H_{18}$ .

**i.** Molecule of hexane having one quaternary C atom:



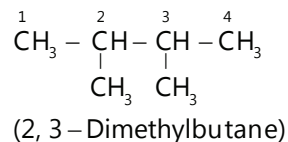
**ii.** Molecule of octane having one quaternary C atom:



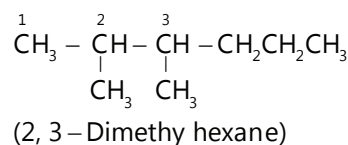
**Note:** Other structures with one quaternary may also be formed with octane.

ii. Molecule of hexane having two tertiary c atoms:

Where C-2 and C-3 are  $3^\circ\text{C}$  atoms.

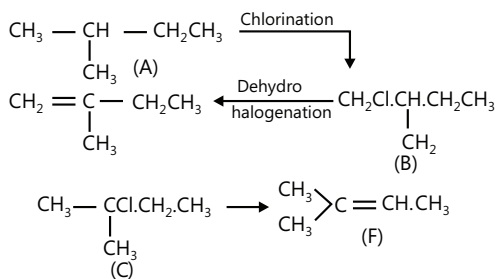


Molecule of octane having two tertiary C atoms:



C-2 and C-3 are  $3^\circ\text{C}$  atoms.

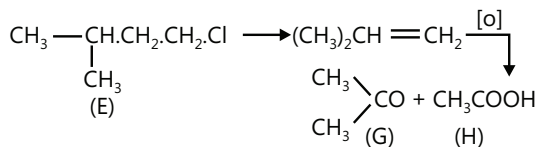
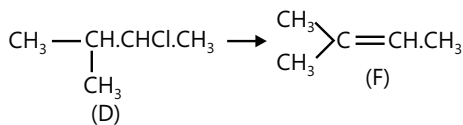
**Sol 3: i.** Alkane (A)  $\text{C}_5\text{H}_{12}$  on chlorination gives four monochloro products and thus (A) is isopentane.



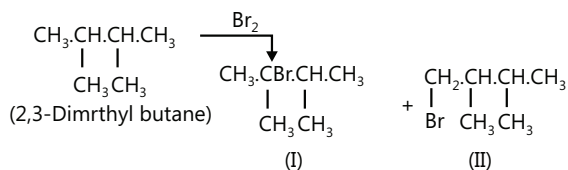
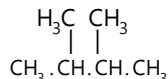
**Sol 4:** Alkane is  $\text{C}_n\text{H}_{2n+2}$  Molecular weight = 86

$$\therefore 12n + 2n + 2 = 86 \Rightarrow n = 6$$

Therefore, alkane is  $\text{C}_6\text{H}_{14}$ .



The alkane with this formula on bromination giving two product may be written as



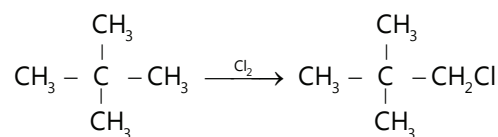
**Sol 5:** Vapour density = 36; Molecular weight =  $2 \times 36 = 72$

Examination of molecular weight suggests it to be an alkane, i.e.  $\text{C}_n\text{H}_{2n+2}$ .

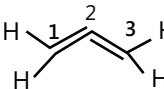
$$12n + 2n + 2 = 72 \Rightarrow n = 5$$

Therefore, alkane (A) is  $\text{C}_5\text{H}_{12}$ .

(A) Gives only one product on substitution, thus (A) is:

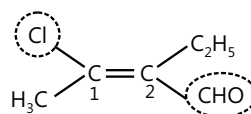


(A) is  $(\text{CH}_3)_4\text{C}$ , i.e. 2, 2-dimethyl propane ( neopentane).

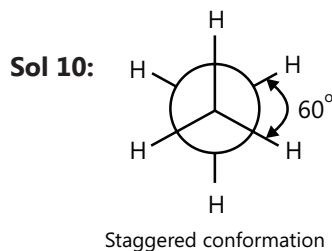
**Sol 6:**  Allenes of the type

**Sol 7:** Since (A) and (B) are enantiomers, so specific rotation of B is  $-52^\circ$  (because enantiomers have equal and opposite specific rotation).

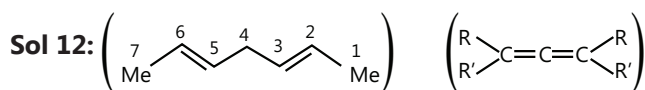
**Sol 8:** Two higher priority groups (Cl and CHO) on C-1 and C-2 are in the opposite directions; so the and C-2 are in the opposite directions; so the configuration is E.



**Sol 9:** In (B), the two groups (two H atoms) are same around the double bond.



**Sol 11:** The mirror image of placed football is non-superimposable.



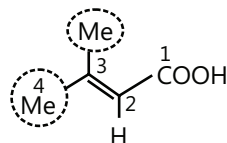


Terminal groups are same. The number of double bonds is two (even number).

$$\therefore \text{Number of GI} = 2^{n-1} + 2^{(n-2)/2} = 2^1 + 2^0 = 2 + 1 = 3$$

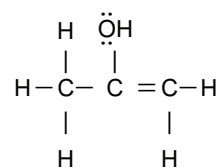
Where n is the number of double bonds.

**Sol 14:**



Two same groups (Me) on C-3; hence, do not show G.I.

**Sol 15:**  $9\sigma$  Bonds,  $1\pi$  and 2 lone pairs.

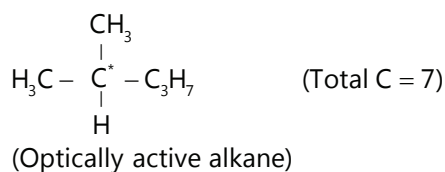


**Sol 16:** Order of enol content:

Aldehyde < Ketone < Keto-aldehyde < Diketone.

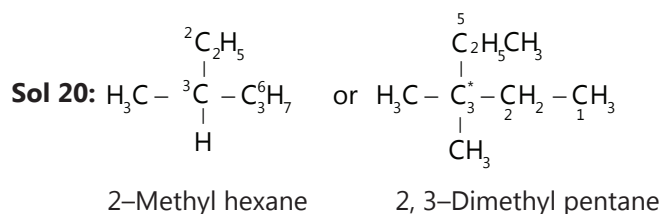
(iii < ii < i < iv)

**Sol 17:**



**Sol 18:** Although the meso compounds contain asymmetric C atoms, but they are optically inactive due to superimposable mirror image or due to the presence of any element of symmetry.

**Sol 19:** Meso compound



Both (I) and (II) are optically active alkanes.

## Exercise 2

### Single Correct Choice Type

**Sol 1: (B)** All groups are as far apart as possible.

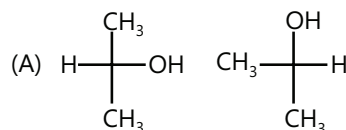
**Sol 2: (C)** (2Z,4E,6Z)-octa-2,4,6-triene

**Sol 3: (D)** 3- stereo centers and no POS in any compound

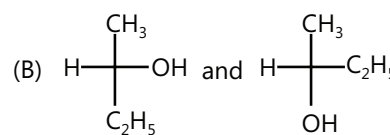
$$\therefore \text{Stereo isomers} = 2^3 = 8$$

**Sol 4: (C)** Compounds are (C) constitutional isomers

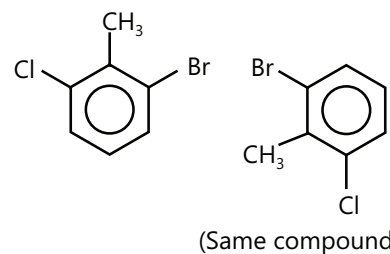
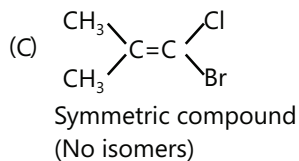
**Sol 5: (B)**



Achiral compounds hence identical



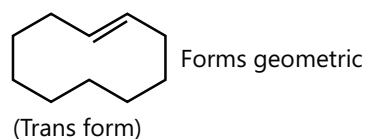
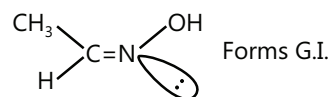
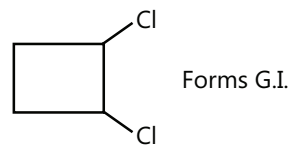
Enantiomers



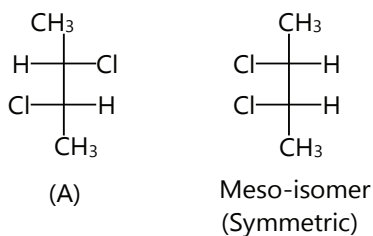
**Sol 6: (C)** I and II are enantiomers as they are non-superimposable mirror image of each other.

I, II and are all structural isomer as they have same molecular formula.

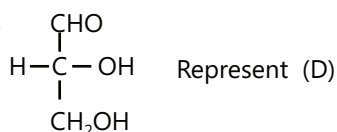
**Sol 7: (D)**



As form of ring is also formed. Ans (D)

**Sol 8: (C)**

$\therefore$  Optically inactive optical rotation = 0

**Sol 9: (B)**

Since OH is on right side of the carbon chain, molecule acquires D configuration.

**Sol 10: (A)**  $\text{CH}_3\text{-C(=O)-OH}$  &  $\text{H-C(=O)-OCH}_3$  Are functional isomers

(B)  $\text{CH}_3\text{-CH}_2\text{-C}\equiv\text{H}$  and  $\text{CH}_3\text{-C}\equiv\text{C-CH}_3$  Are positional

(C) Are positional isomer

(D) Are functional isomer

**Sol 11: (D)** Correct name

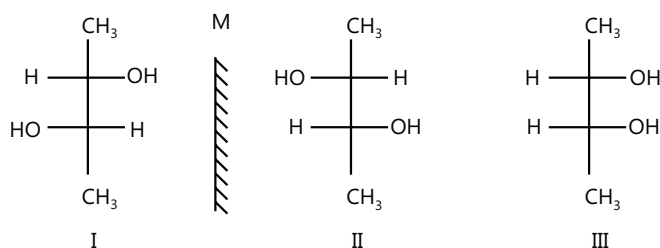
$\Rightarrow$  (2 D 3L 4D 5D) 2, 3, 4, 5, 6 – pentahydroxyhexanal

**Sol 12: (B)** 2 stereo centres and non symmetry

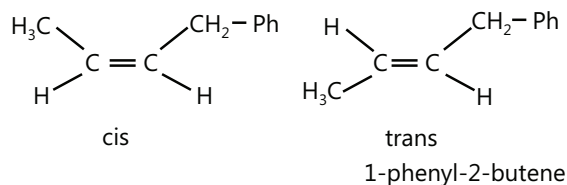
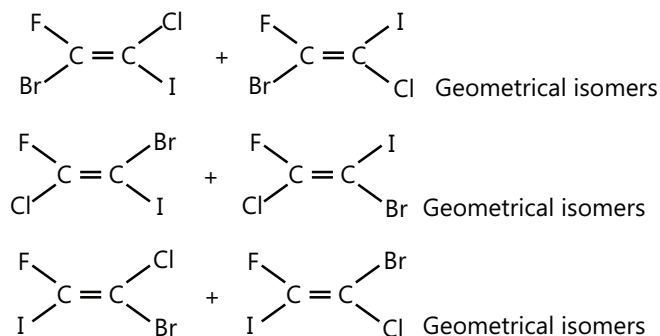
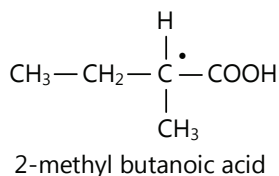
$\therefore 2^2 = 4$

## Previous Years' Questions

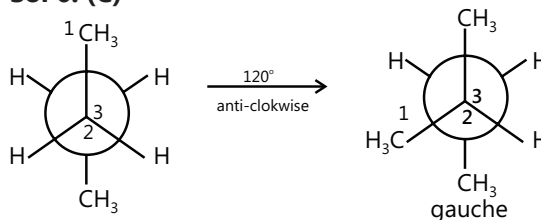
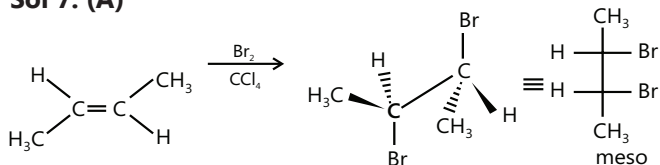
**Sol 1: (B)** I and II are optically active while III is optically inactive (meso form).



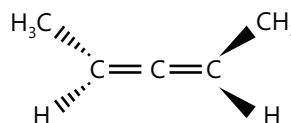
**Sol 2: (C)** The 'D' term in name is derived from D-glyceraldehyde.

**Sol 3: (A)****Sol 4: (D)****Sol 5: (D)**

Has a chiral carbon, optically active.

**Sol 6: (C)****Sol 7: (A)**

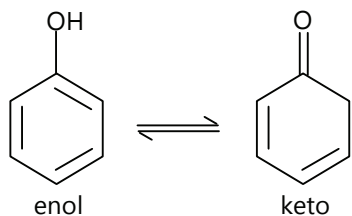
**Sol 8: (C)** Molecules that are non-super imposable on its mirror image are optically active and known as chiral molecule. However, for chirality of molecule, presence of chiral centre is not essential, eg.



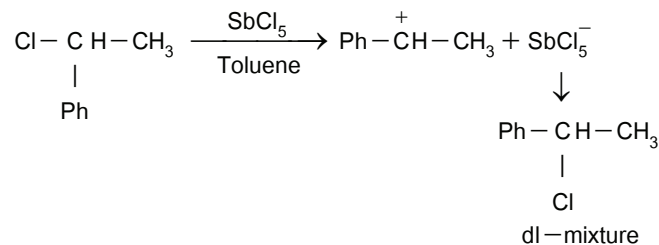
Molecule is chiral but does not possess any chiral carbon.

**Sol 9:** Non-superimposable, Enantiomers.

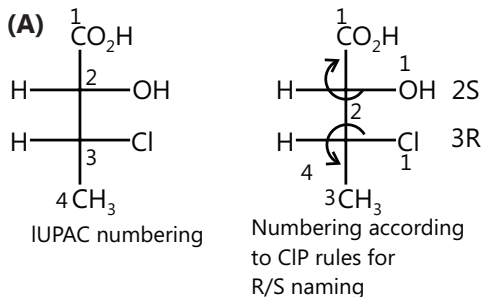
**Sol 10: (C)**



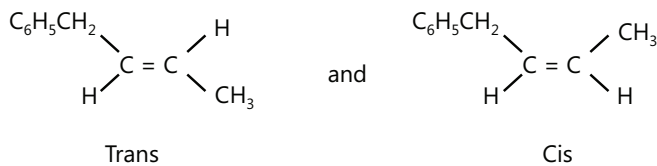
**Sol 11: (C)**



**Sol 12: (A)**



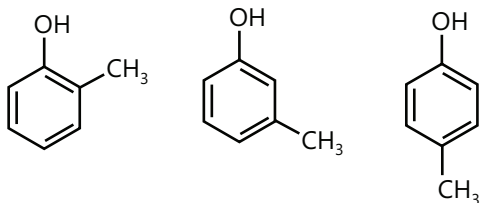
**Sol 13: (A)**  $\text{C}_6\text{H}_5\text{CH}_2\text{CH}=\text{CHCH}_3$  has two geometrical isomers as



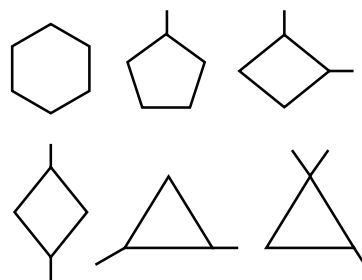
## JEE Advanced/Boards

### Exercise 1

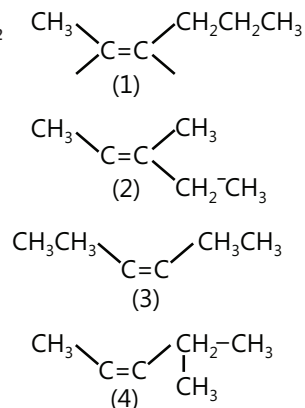
**Sol 1:** Three isomers are possible



**Sol 2:**



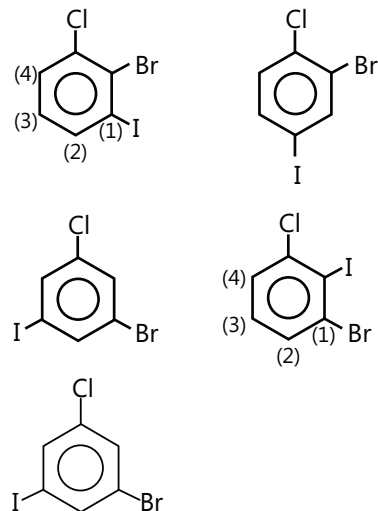
**Sol 3:**  $\text{C}_6\text{H}_{12}$  Total = 4 pair



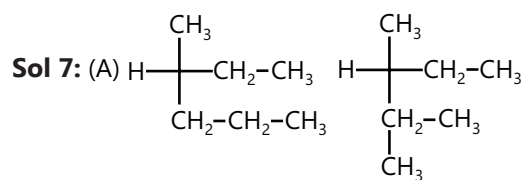
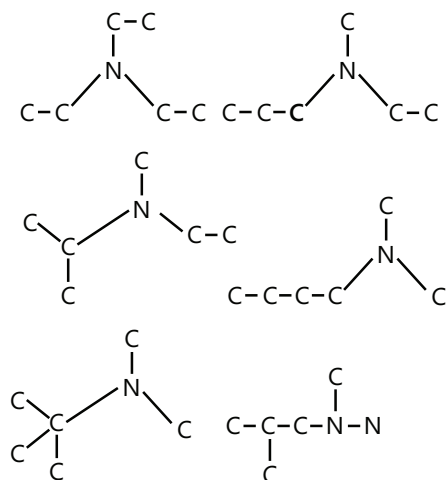
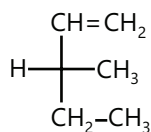
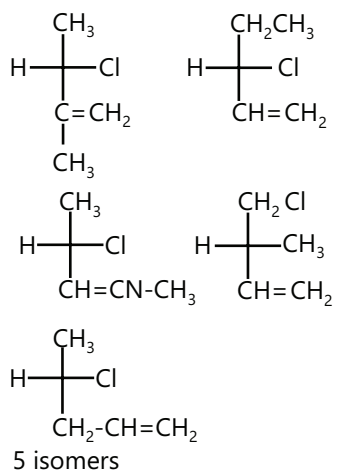
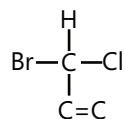
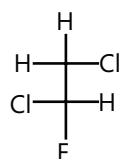
**Sol 4:**

	Compound	Optical activity
(A)	Planar compound but $\text{CHClBr}$ (group active)	Active due to $\text{CHCl-Br}$
(B)	Non-planar	Active
(C)	Non-planar	Active
(D)	Planar non symmetric	Inactive
(E)	Non-planar & asymmetric	Active
(F)	Non-symmetric but planar	Inactive
(G)	Non-planar (chain form)	Active
(H)	Planar	Inactive
(I)	Planar (no-chiral) side groups	Inactive

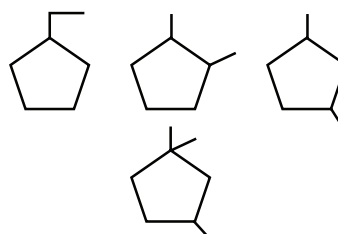
**Sol 5:**



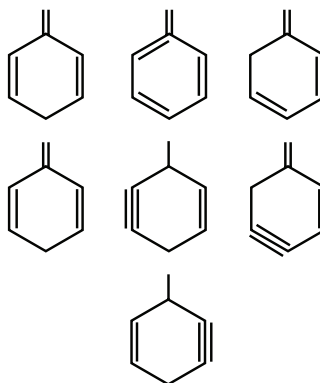
$$= 4 + 4 + 1 + 2 - 1 = 10 \text{ isomers}$$

**Sol 6:** 7 isomers

 (B)  $\text{C}_6\text{H}_{12}$ 

 (C)  $\text{C}_5\text{H}_9\text{Cl}$ 

 (D)  $\text{C}_2\text{H}_4\text{ClBr}$ 

 (e)  $\text{C}_2\text{H}_2\text{Cl}_2\text{F}_2$ 


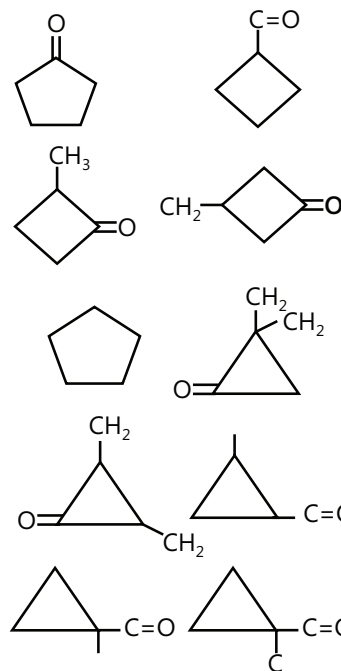
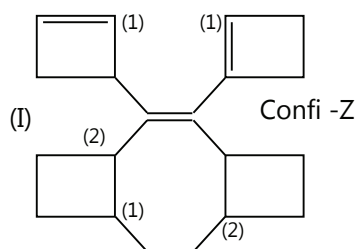
Optically active

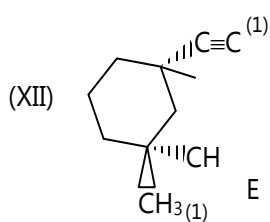
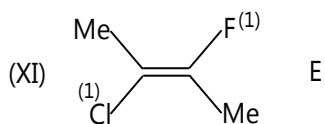
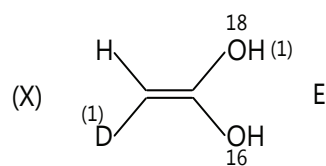
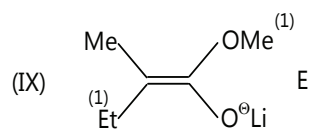
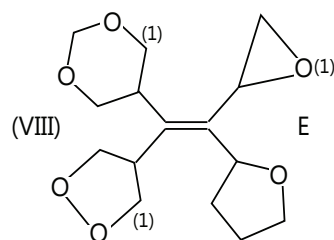
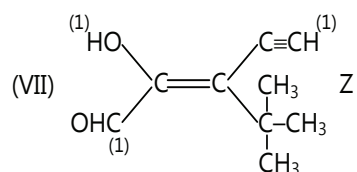
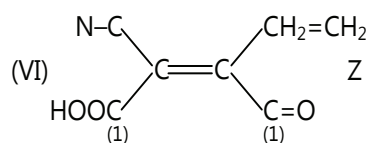
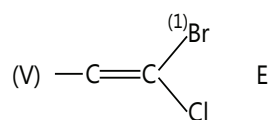
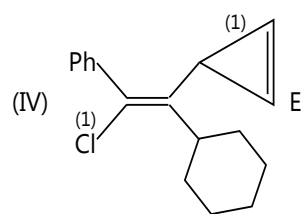
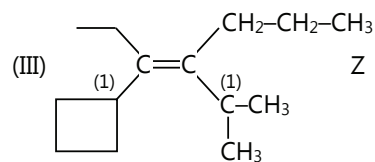
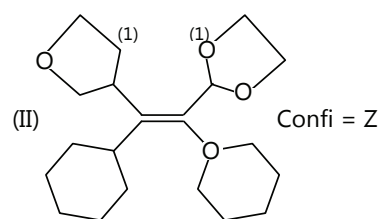
**Sol 8:**


4 structure

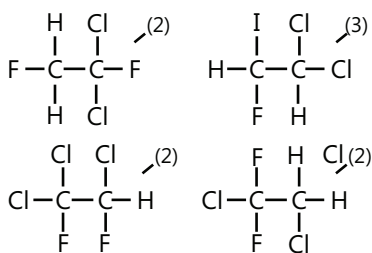
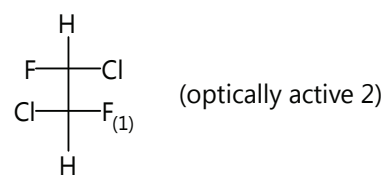
**Sol 9:**


7 isomers

**Sol 10:**  $\text{C}_5\text{H}_8\text{O}$ 

**Sol 11:**




**Sol 12: (A)  $C_2H_2Cl_2F_2$  (3)**

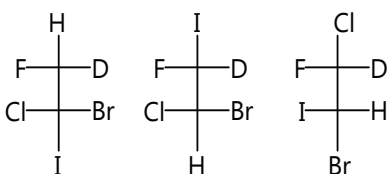
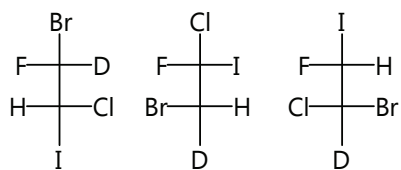
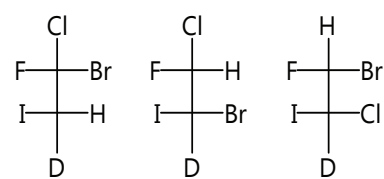


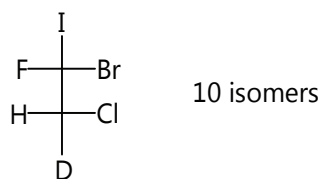
**(B)  $C_2HClBr$  IFD**

All isomers all active (no meso)

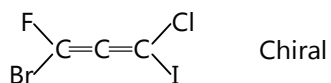
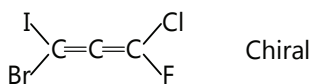
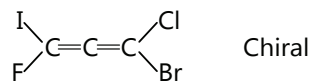
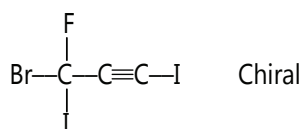
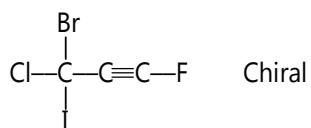
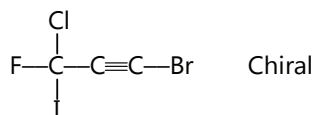
∴ Corresponding to each structural there all 4 stereo isomers

∴ Total number of isomers (structure all)

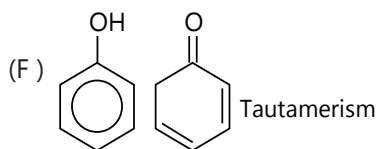
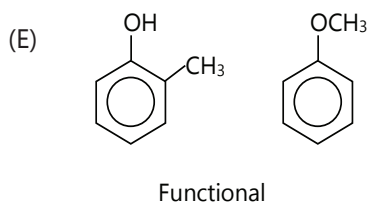
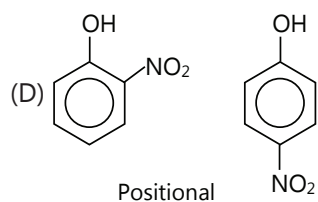
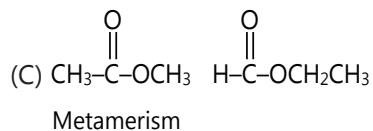
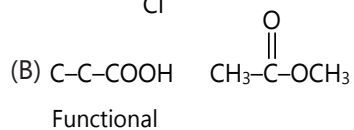
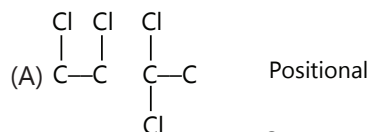




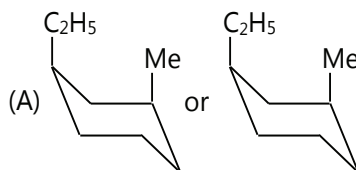
(C) Trans (2 isomers each)



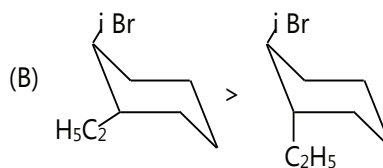
**Sol 13:**



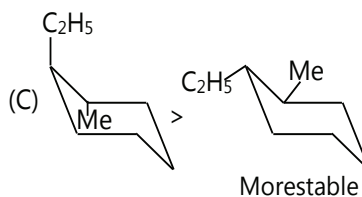
**Sol 14:**



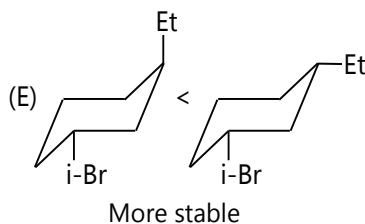
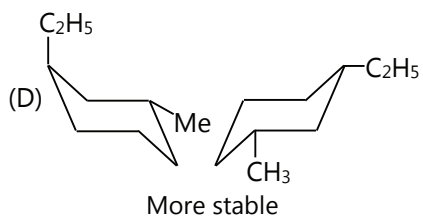
More stable (both in equatorial less repulsion)



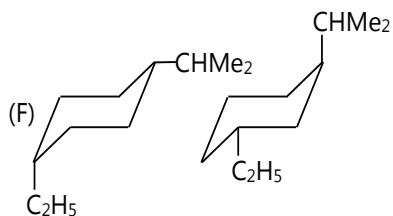
Both equatorial

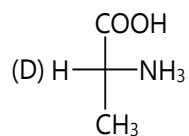
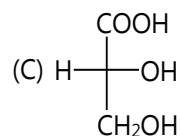
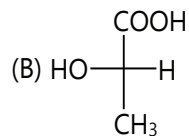
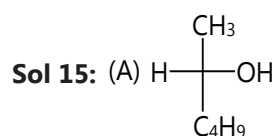


More stable

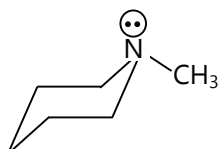


More stable

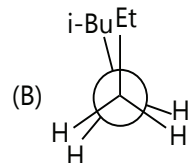
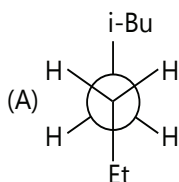




**Sol 16:**



**Sol 17:**



According to hydrogen

**Sol 18:** (A) 1-3 axial-axia cis

(B) 1-4 axial-equatorial cis

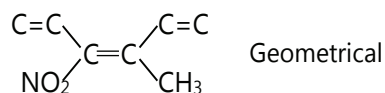
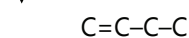
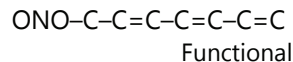
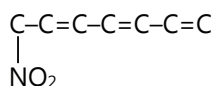
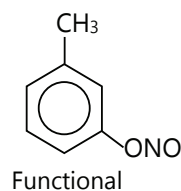
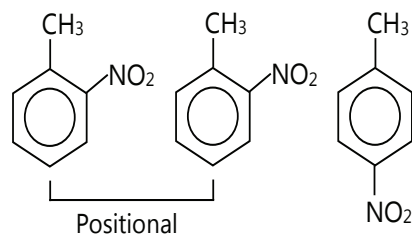
(C) 1-3 axial axial cis

(D) 1-2 axial axial trans

(E) 1-4 axial axial trans

(F) 1-3 axial equatorial trans

**Sol 19:**  $\text{C}_7\text{H}_7\text{O}_2\text{N}$



**Sol 20:** (A)  $\text{OH} > \text{CHO} > \text{CH}_2\text{OH} > \text{CH}_3$   
4 > 1 > 2 > 3

(B)  $\text{NH}_2 > -\text{Ph} > \text{CH}(\text{Me})_2 > \text{H}$   
4 > 1 > 2 > 3

(C)  $\text{COOH} > \text{CHO} > \text{Ph} > \text{C}=\text{CH}_2$   
1 > 3 > 2 > 4

(D)  $\text{Ph} > \text{C}\equiv\text{CH} > \text{CH}=\text{CH}_2 > \text{CHMe}_2$   
4 > 3 > 2 > 1

(E)  $\text{CH}_2\text{Br}_3 > \text{CH}_3\text{Cl} > \text{CH}_2\text{OH} > \text{CH}_3$   
2 > 4 > 3 > 1

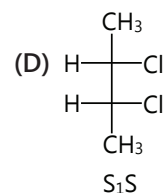
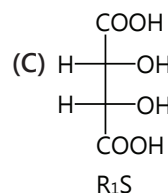
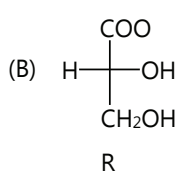
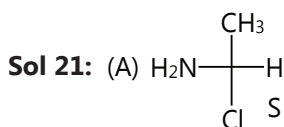
(F)  $\text{OMe} > -\text{NMe}_2 > \text{Me} > \text{H}$   
4 > 2 > 3 > 1

(G)  $\text{Ph} > \text{CH}=\text{CH}_2 > \text{Et} > \text{Me}$   
3 > 1 > 4 > 2

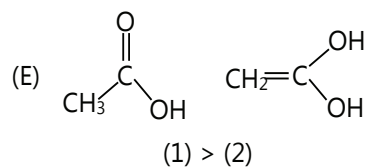
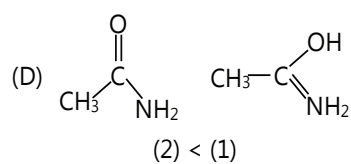
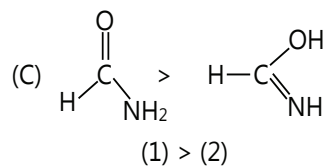
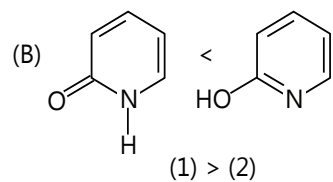
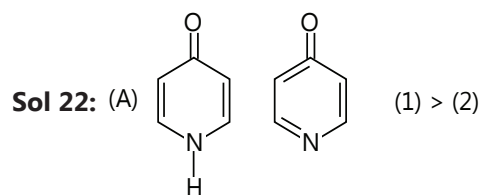
(H)  $\text{Cl} > \text{CH}(\text{Me})_2 > \text{CH}_2(\text{CH}_2-\text{Br}) > \text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br}$   
2 > 4 > 1 > 3

(I)  $\text{I} > \text{Br} > \text{Cl} > \text{NH}_2$   
3 > 2 > 1 > 4

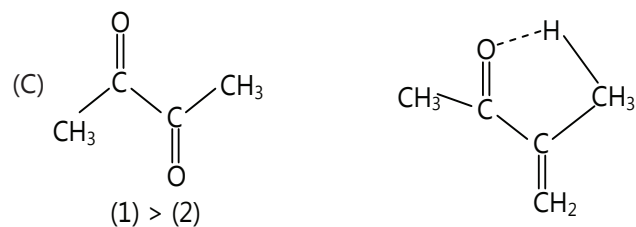
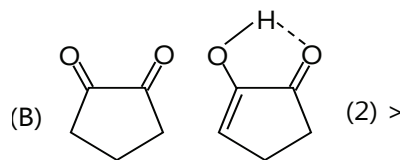
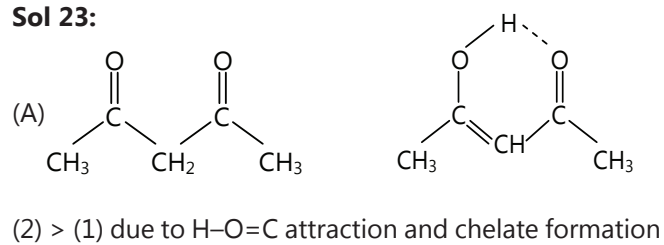
(J)  $\text{NO}_2 > \text{NH}_2 > \text{C}\equiv\text{N} > \text{CH}_2\text{NH}_2$   
2 > 1 > 4 > 3



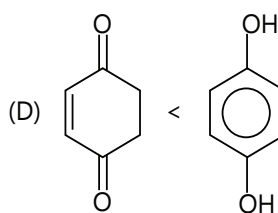




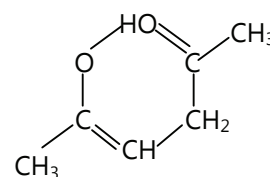
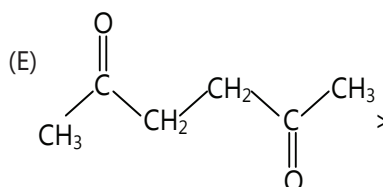
**Sol 23:**



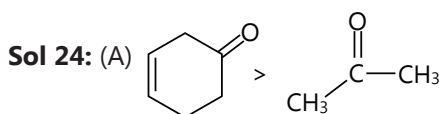
More e<sup>-</sup> density is far on higher electro negative element only



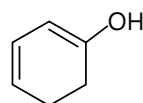
Disluted density but intramolecular attractive H-bonding



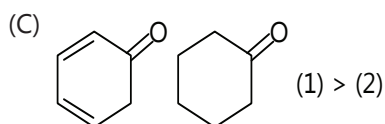
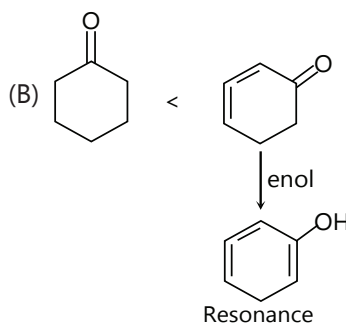
(7) membered chelates are very difficult



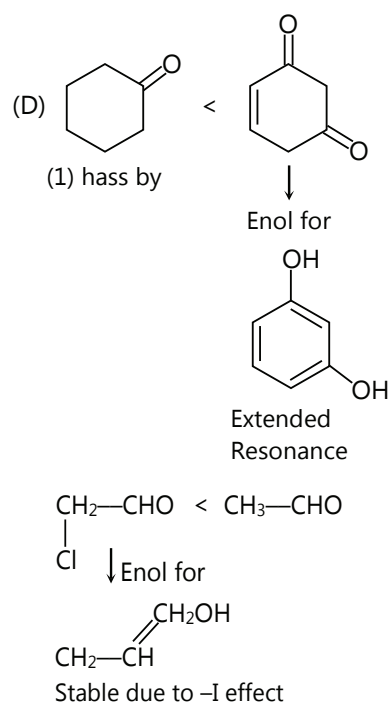
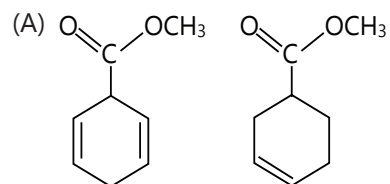
Enol for



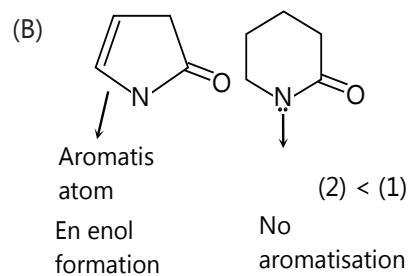
More stable due to resonance



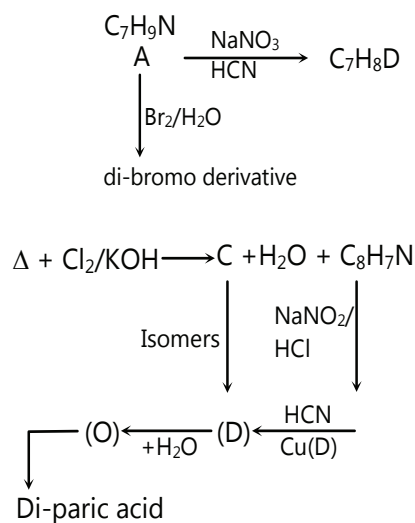
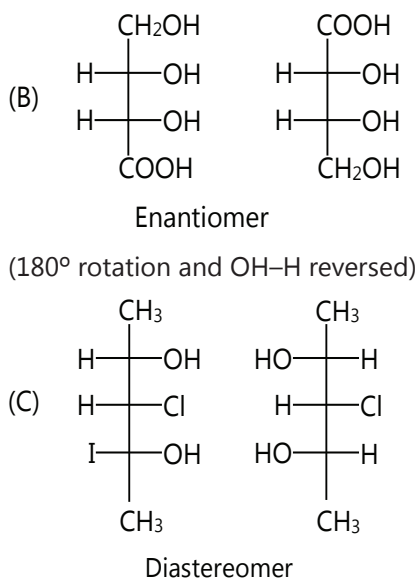
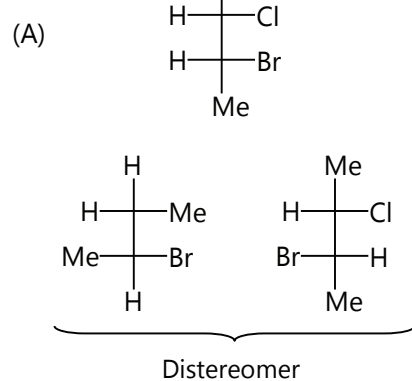
More stable due to extended resonance in enol-form

**Sol 25:**

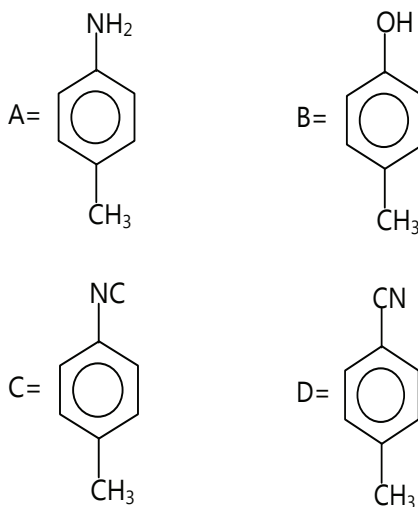
Less enol content as double bond not in conjugation

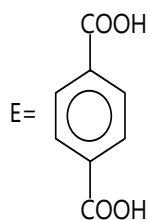


**Sol 26:** (A)  $3 > 1 > 2$  (B)  $4 > 2 > 1 > 3$

**Sol 27:**

On halogenative forms one molecule direvative according to the following reactions compounds are





Since D gives red colour with (A.N.)

∴ D is a primary alcohol  $R-CH_2-OH$

∴ C would be a primary amine

C =  $R-CH_2-NH_2$

and A would be a  $R-CH_2-CONH_2$

Mass of  $RCH_2CONH_2 = 135$

∴ Mass of R =  $135 - 2 \times 12 - 16 - 14 - 4$

$$= 135 - 24 - 16 - 18 = 77$$

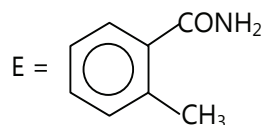
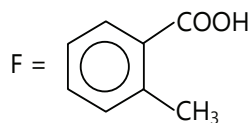
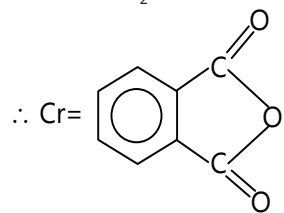
∴ R-Phenyl group

A =  $Ph-CH_2-CONH_2$

B =  $Ph-CH_2-COOH$

C =  $Ph-CH_2-NH_2$

D =  $Ph-CH_2-OH$



**Sol 28:** (D) > (B) > (A) > (C)

**Sol 29:** (C) > (A) > (D) > (B)

**Sol 30:** (C) > (D) > (B) > (A)

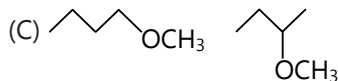
## Exercise 2

### Single Correct Choice Type

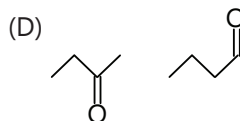
**Sol 1: (B)**

(A) are chain isomers

(B) position are isomers  $1^\circ$  ard.

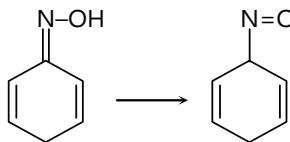
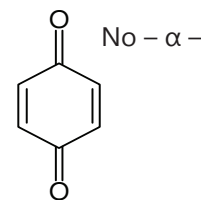


Positional isomers



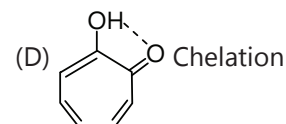
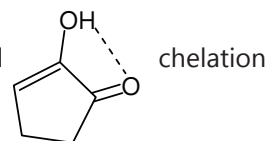
Functional isomers

**Sol 2: (C)** Ph-NO -No tautomerism

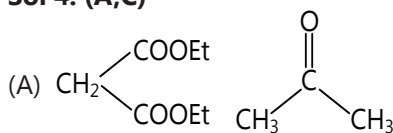


### Multiple Correct Choice Type

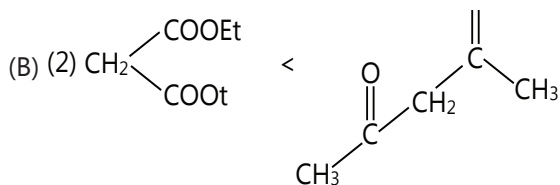
**Sol 3: (B,D)** B → enol



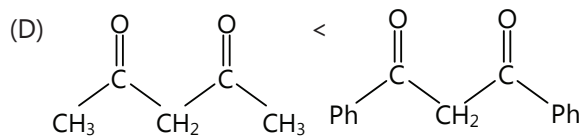
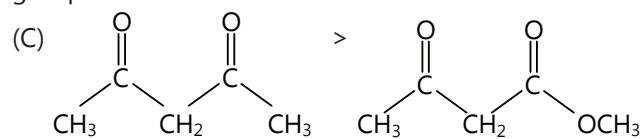
**Sol 4: (A,C)**



(1) > (2)



Carbanion in enol form more stable due to higher-I group.

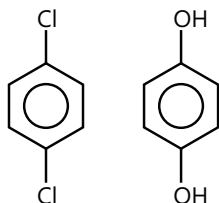
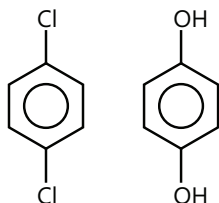
**Sol 5: (A,B,C)**

(A) Tautomers catalysed by acid/base

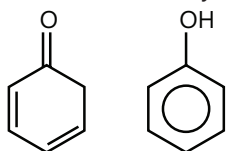
(B) Tautomers present in dynamic equilibrium continuous conversion form one form to other

(C) Generally mono ketones are more stable than enol.

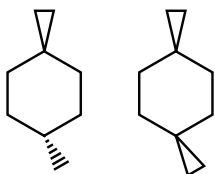
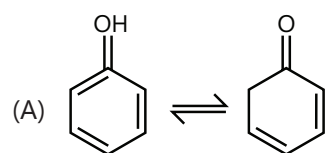
**Sol 6: (A,C)** I, II are tautomers and III and I are resonating structure

**Sol 7: (A,B)****Sol 8: (C,D)**

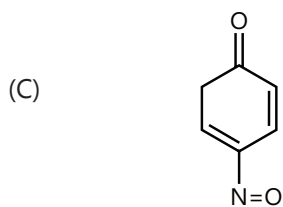
(D) Keto form is not always more stable than the



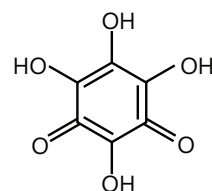
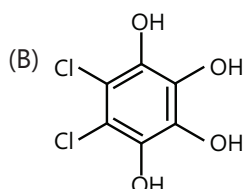
(D) For geometrical rotation can also be show in cyclic compound

**Sol 9: (A,C)**

(B) No alpha-H



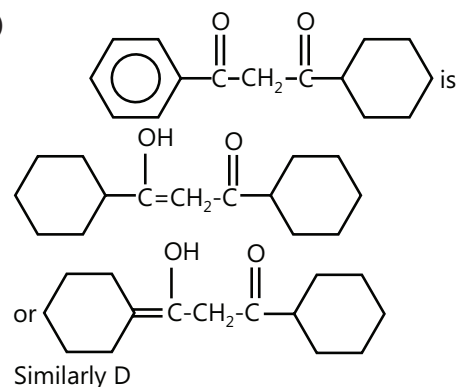
(enol form) tautomers

**Sol 10: (A,B)**

A can also be, but C is not possible

**Sol 11: (A,D)** (i) 2 and 4- are not metamers, they are chain isomer

(ii) I and V are not positional, they are structural isomers.

**Sol 12: (A,C,D)**

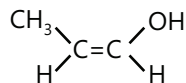
Similarly D

**Sol 13: (A,B,C)**  $\text{CD}_3\text{-C(=O)-Ph}$  3- $\alpha$ -H can

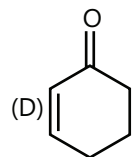
(B) 2- $\alpha$ -H can tautomerise

(C) 1- $\alpha$ -H can tautomerise

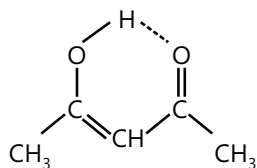
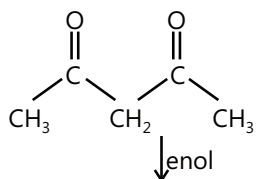
(D) No- $\alpha$ -H can not tautomerise

**Sol 14: (B,C)**(A)  $\text{CH}_3\text{-CHO}$   No isomers(B)  $\text{CH}_3\text{-CH}_2\text{-CHO}$  No isomerism in keto for

(C) In enol form 2 geometrical isomers



(D) No geometrical isomer

**Sol 15: (A,C)**

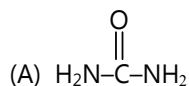
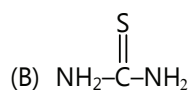
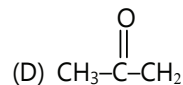
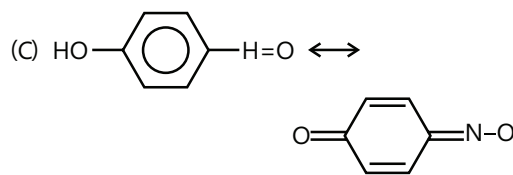
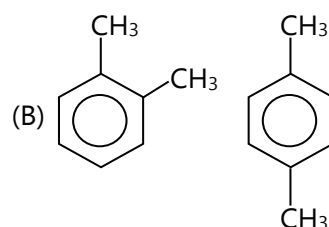
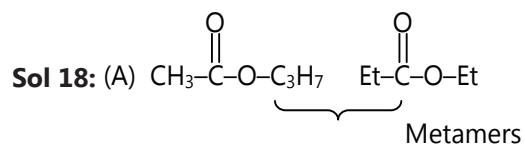
Resonance and chelate or due to a intramolecular H-bonds

**Sol 16: (A,B)**(A)  $\text{CH}_3\text{-CH=CH-CH=CH-C}_2\text{H}_5$ 2-stereo centres  $\Rightarrow 2 = 4$  $\text{CH}_2=\text{CH-CH-CH}_2$  (Planar symmetric compound)

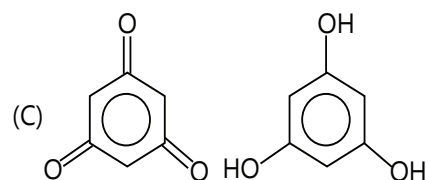
Isomer = 0

 $\text{CH}_3\text{-(CH=CH)}_5\text{-CH}_3$ 

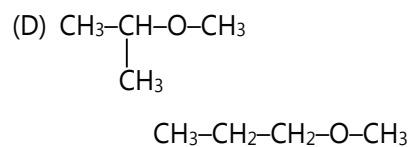
Total isomers

(B)  $\text{CH}_3\text{-(CH=CH)}_4\text{-CH}_3$  ; Total isomers = 4**Sol 17: (A,B,C,D)**4- $\alpha$ -H will tautomerism4- $\alpha$ -H will show tautomerism6- $\alpha$ -H will show tautomerism**Match the Columns**

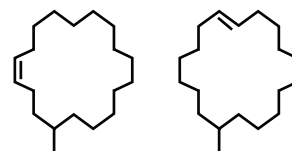
Positional isomers



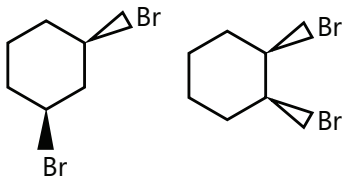
Tautomerism



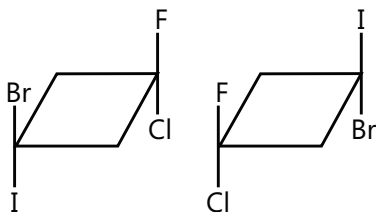
Chain isomers

**Sol 19** A  $\rightarrow$  P, R, S    B  $\rightarrow$  Q    C  $\rightarrow$  Q

(A) Both are structural isomers of each other and both have even number of geometrical isomers.

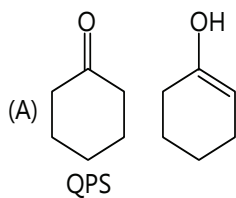


(B) Both are structural isomer of each other.

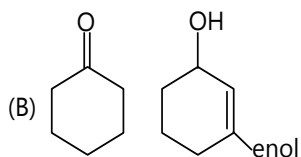


(C) Both are structural isomer of each other.

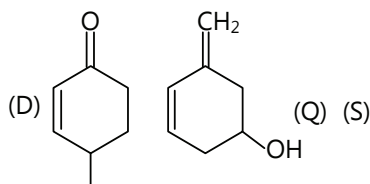
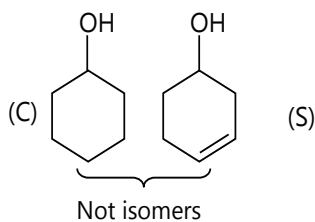
**Sol 20:**



Tautomers and one is enol



Structural isomers (s)

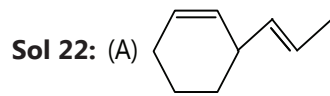


**Sol 21:** (A) Position isomers P, R, S structure

(B) Geometric Q

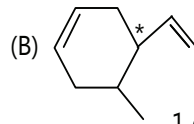
(C) Syn and anti Q, R

(D) Position, structural P, R, S



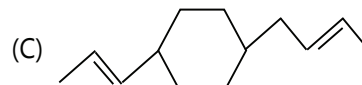
Isomer =  $2^1 = 2$

No. of isomer



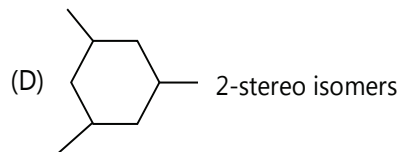
1 chiral  $2^1 = 2$

center



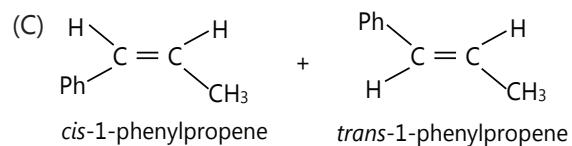
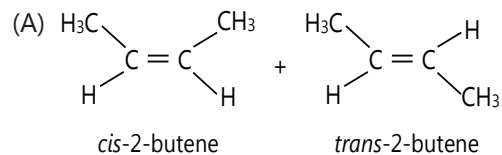
$2^3 = 8$

S-stereo centre



## Previous Years' Questions

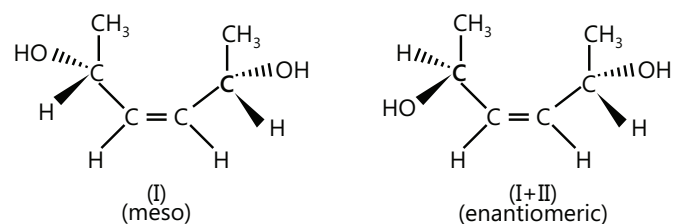
**Sol 1: (A,C)** a and c will show geometrical isomerism as follow:

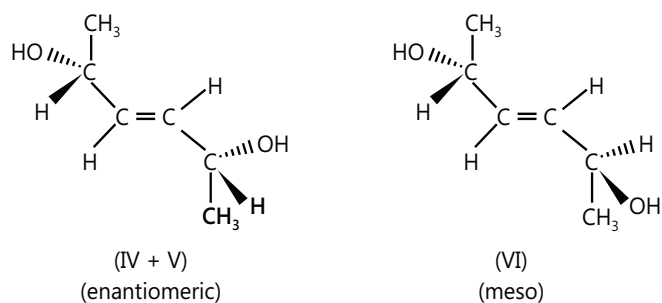


**Sol 2: (A,D)** The compound is optically active as well as it possesses a two-fold axis of symmetry.

**Sol 3: (B,C,D)** 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.

**Sol 4: (A,D)**

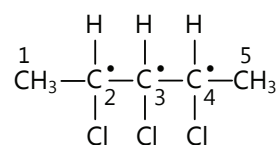




Total six isomers. In both *cis* and *trans* forms, there are two enantiomers each.

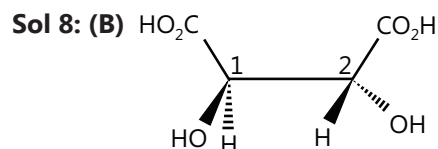
**Sol 5:** They are identical.

**Sol 6:** It has only two asymmetric carbon, carbon no.3 is not asymmetric.



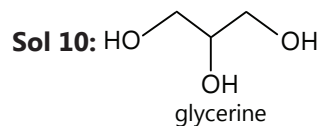
**Sol 7: (D)** For  $S_N2$  reaction, the C atom is least hindered towards the attack of nucleophile in the case of  $CH_3Cl$

Hence, (D) is the correct answer.

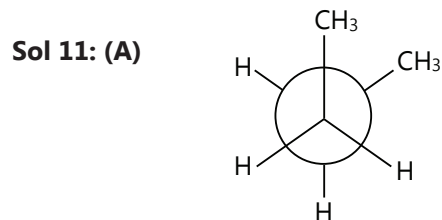


Both  $C_1$  and  $C_2$  have R – configuration.

**Sol 9: (C)**  $\alpha$ -D-(+) glucose and  $\beta$ -D (+) – glucose are anomers.



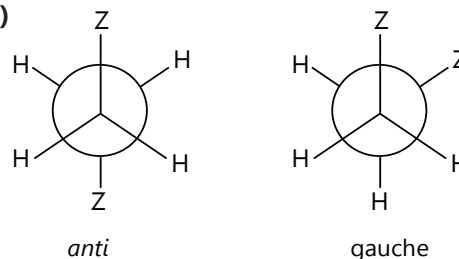
It contains a secondary ( $2^\circ$ ) hydroxy group.



less stable staggered form of butane

(B) The less stability of above mentioned conformer is due to vander Waal's repulsion between the adjacent methyl groups.

**Sol 12: (A)**



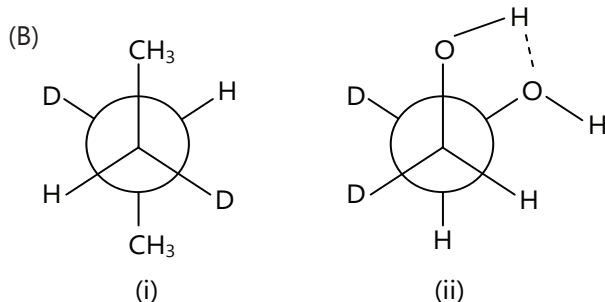
Mole-fraction of anti form = 0.82

Mole-fraction of gauche form = 0.18

$\mu_{obs} = 1D$

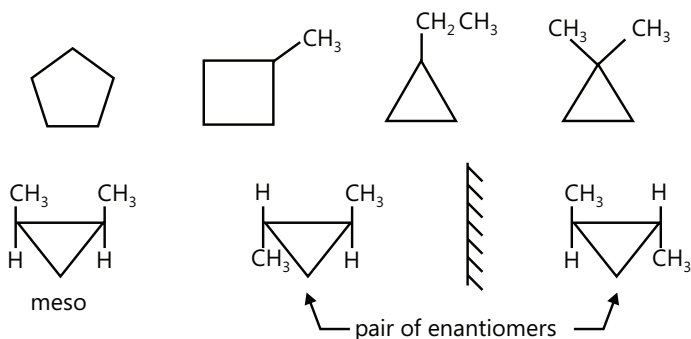
$$\Rightarrow 1 = \mu_{anti} \times 0.82 + \mu_{gauche} \times 0.18 \quad \therefore \mu_{anti} = 0$$

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



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

**Sol 13:**



$\Rightarrow$  Total seven isomers