STEREOCHEMISTRY

1 Mark

Easy

1. For n – butane which type of conformation is the least stable?
   Fully eclipsed.
2. How many stereo isomer are possible for 2, 3 – pentanediol?
   Four.
3. Give one example of ionization isomerism.
   $[Co(NH_3)_5(SO_4)]Br$ and $[Co(NH_3)_5\ Br]\ (SO_4)$
4. Which isomerism is shown by alkenes but not by alkanes?
   Geometrical isomerism.

Moderate

1. Give one example of Coordination isomerism.
   $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$
2. How many number of ions generated when potassium ferrocyanide dissolved in water?
   5
3. How many Chiral centres are present in meso – tartaric acid?
   Two.

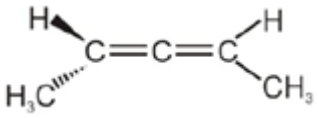
Hard

1. Give one example of ambidentate ligand.
   NO_2^-

5Mark

Easy

1. (a) Define specific rotation for an optically active molecule.
   (b) What is the necessary and sufficient condition for a molecule to be optically active?
   (c) The following compound not have a chiral center still it shows optical activity---- comment



(a) Specific rotation is the degree of a rotation of plane polarized light by an optically active compound when the light is passed through one decimeter (10 cm) of a solution having a concentration one gram per cm^3.
The specific rotation of a compound is representated as $[\alpha]_D^t$ where t stands for temperature and D for D- lines of sodium light.
$[\alpha]_D^t = \alpha_{obs}/l \times C$, where l represents the length of the solution column in decimeters and C represents the concentration of the substance.

(b) The necessary and sufficient condition for a molecule to be optically active is that its should be chiral i.e., the molecule and its mirror imag should be non super imposable.

(c) There exist same molecules which possess no asymetric carbon or chiral centre, yet they exibit optical activity. This is because they have chirality in them as a whole.
2,3 pentadiene exibits optical activity due to the reason that two – CH_3 groups that are singly bonded to the terminal carbon atoms of the allene system are lying perpendicularly to one another in two separate planes. As a consequence this compound exist in two non superimposable mirror images.

Modarate

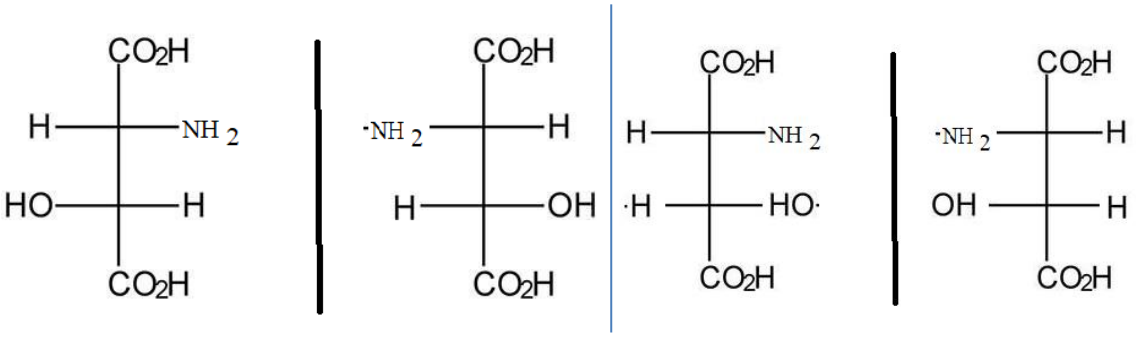
1. (a) Distinguish between constitutional isomers and stereo isomers.
   (b) What is chirality?
   (c) Does presence of two chiral carbon atoms always make the molecule optically active? Explain.
   (a)

Constitutional Isomers	Stereo Isomers
They have same molecular formula but different chemical structure	They have same molecular formula and same chemical structure
They may possess different functional group	They may possess same functional group
They have different connectivity of atoms in different structure.	They have same connectivity of atoms but different orientation of groups in space
They have different physical as well as chemical properties.	They have same physical and chemical properties but different optical properties.

(b) Chiral objects are those which possess no element of symmetry and is not superimposable to its mirror image. This phenomenon is called chirality.
(c) Not necessarily. The presence of two similar chiral carbon atoms may or may not make the molecule optically active. If the molecule as a whole is achiral, it is optically inactive. For example, (+) tartaric acid and (-) tartaric acid are optically active because their molecules are chiral. On the other hand meso – tartaric acid is optically inactive because its molecule is achiral. i.e., the molecule and its mirror image are superimposable due to the presence of a plane of symmetry in it.

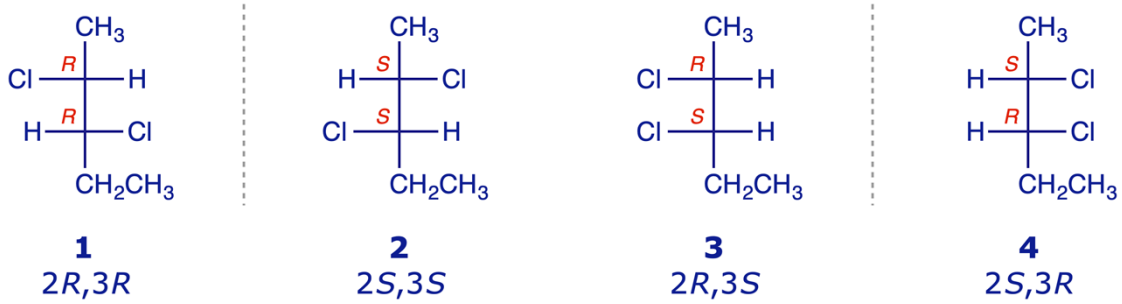
Hard

1. (a) What will happen if one of the OH group of tartaric acid is replaced by NH_2 Group?
   (b) How many pairs of enantiomers are possible for the compound, 2, 3 dichloropentane?



If one of the OH groups of tartaric acid is replaced by NH_2 group, possible configuration will be above. Thus , number of optically active forms will increase. Beside the above four forms there are diasteriods.

(b)Two pairs of enantiomers, i.e., four optically active forms of 2, 3 – dichloropentane are possible.



15 Mark

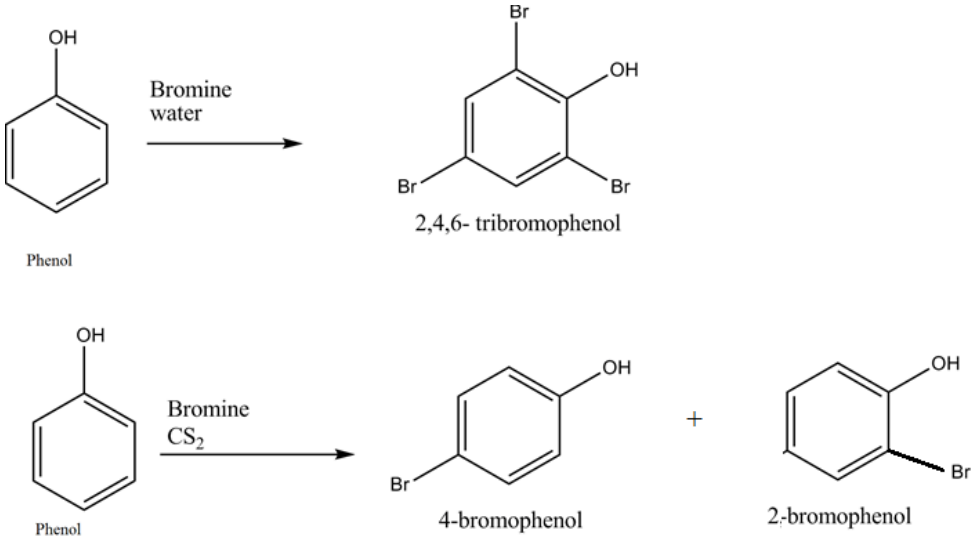
Easy

1. (a) Phenol on treatment with Br_2 in CS_2 at low temperature gives two isomeric monobromophenols X and Y. But phenol on treatment with bromine water gives a white precipitate Z. Identify the products X, Y and Z with chemical reactions. 6

   (b) What do you mean by enantiomer and diastereomer? Differentiate them with examples. 4

   (c) Explain the difference between a meso – isomer and a recimic mixture. What characteristics do they have in compound? 5

   (a)



(b) Enantiomers: The stereoisomers which are non – superimposable mirror images of each other are known as enantiomers. Chirality is the most fundamental condition of enantiomerism.

Characteristics:

1. Enantiomers have similarities in their physical properties such as melting and boiling points, solubilities, refractive index etc. although they have difference in their optical properties like direction of rotation of plane polarized light.
2. They have identical chemical properties except the rate of reaction.
3. Enantiomers differ in their biological properties.

Diastereomerism: Stereoisomers of a compound which are neither mirror images of each other non superimposable are known as diastereomers.

Characteristics:

1. Diastereomers have different physical as well as chemical properties.
2. Diastereomers possess similar chemical properties although the rate at which they react with other optically active substance may vary.
3. Stereoscopic characterization , specially the NMR and mass spectra od diastereomers may have difference.

Comparison of Enantiomers and Diastereomers:

Enantiomers	Diastereomers
Enantiomers have mirror image relationship.	Diastereomers do not have any mirror image relationship.
They have similarities in physical properties.	They possess difference in physical properties
Enantiomers can show optical rotation to the same	Diastereomers may show optical rotation in the same

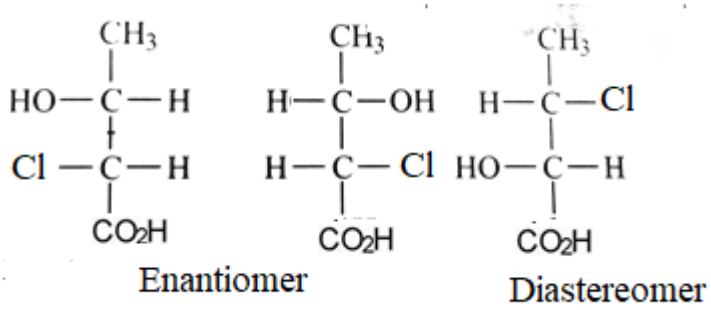
extent but in opposite direction	or opposite directions but to the same extent.
These cannot be separated by the methods like fractional distillation, absorption chromatography etc.	These can be separated by these methods

(c) A meso isomer is a single compound, a recimic mixture contains an equimolar mixture of two compounds. The meso isomer is inherently inactive because of internal compensation; the racimic mixture does not rotate the plane of polarized light because the effect of one of the isomers cancels the effect of the other. The recimic mixture can be separated into two optically active compounds by physical means. The meso isomer and the racimic mixture have in common their inability to rotate the plane of polarized light. Both have two centres of (opposite) chirality.

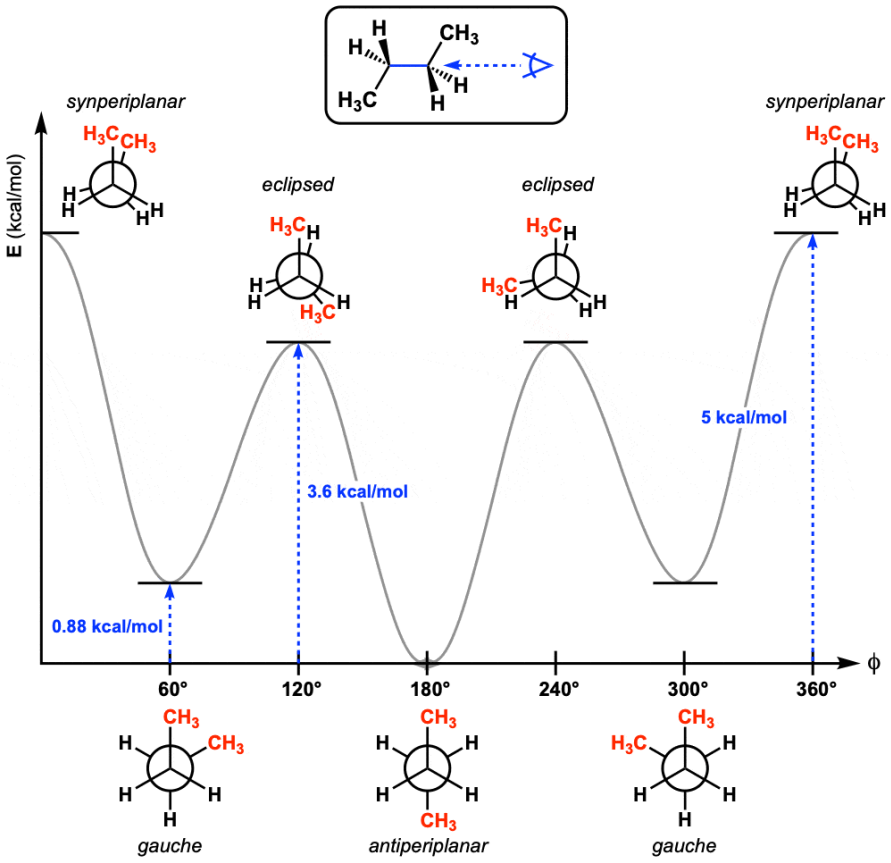
Moderate

1. (a) Draw all the stereo isomers for the following: 4
   $CH_3CH(OH) – CH (Cl) COOH$
   (b) Arrange the different conformations of n – butane in terms of their stability. 5
   (c) The following compounds are optically active or not: 6
   (i) n- propanol (ii) n – butanol (iii) 2 – chlorobutane.

   (a)



   (b)



(c) (i) n – propanol is optically inactive because it has no chiral carbon. $CH_3 – CH_2 – CH_2 OH$

(ii) n – butanol is optically inactive because it has no chiral carbon. $CH_3 – CH_2 – CH_2 – CH_2 OH$

(iii) 2 – chlorobutane is optically active because it has one chiral carbon. $CH_3 – CH (Cl) – CH_2CH_3$

Hard

1. (a) Define the following elements of symmetry with a suitable example in each case: 8

   (i) Rotational axis of symmetry

   (ii) Plane of symmetry

   (iii) Centre of symmetry

   (iv) Alternating axis of symmetry

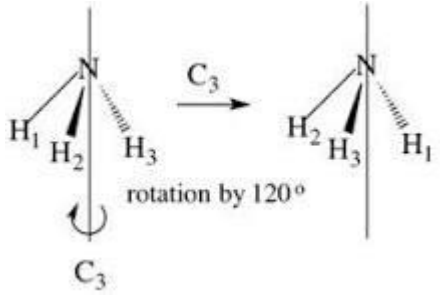
   (b) Draw all possible stereo isomers for butane – 2, 3 – diol. Are all of them optically active? 3

   (c) Draw all Fischer projection formula of following stereoisomers:

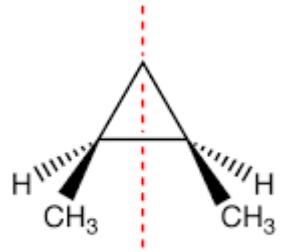
   (i) (2R, 3R) – 2, 3 – dibromobutanedioic acid.

   (ii) S – 2 – Hydroxy – 2 – phenylpropanoic acid.

   (a) (i) Proper Rotations - Rotation by 360º/n. This is simply rotation about an axis, which passes through the molecule by an angle of 360º/n (or 2π/n). When repeated n times, the molecule returns to the original orientation. The appearance of the molecule must be exactly the same after the operation.



(ii) Plane of symmetry: A plane of symmetry is an imaginary plane that bisects a molecule into halves that are mirror images of each other.



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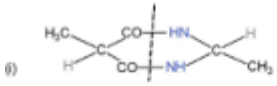
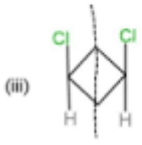
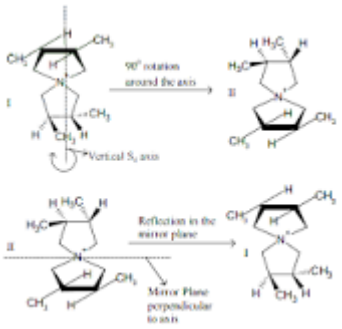
(iii) Centre of symmetry: Center of symmetry of a molecule is the center point from which the identical atoms exist on the opposite side from this center at equal distance.

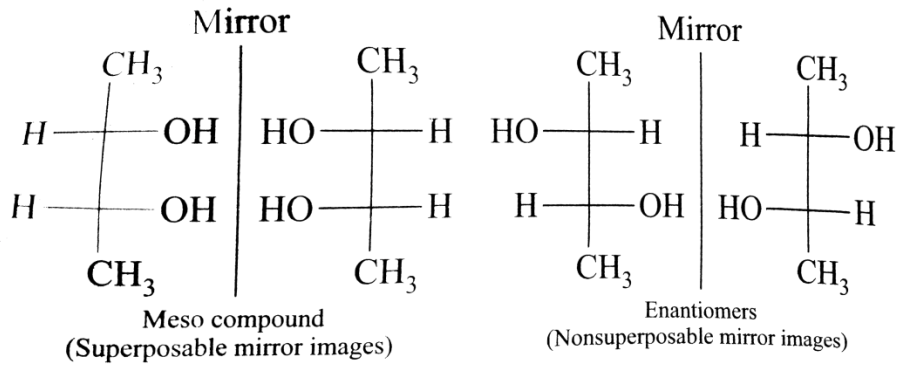




Alternating axis of symmetry: A molecule possess an n-fold alternating axis of symmetry if when rotated through an angle of 360º/n about this axis and then followed by reflection in plane perpendicular to the axis; the molecule is indistinguishable from the original molecule.

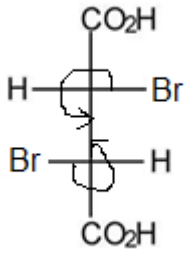


(b) Stereoisomers of butane 2, 3 – diol



Meso compounds are optically inactive as they possess plane of symmetry. But the two enantiomers are optically active.

(c) (i) (2R, 3R) – 2, 3 – dibromobutanedioic acid.



(ii) S – 2 – Hydroxy – 2 – phenylpropanoic acid