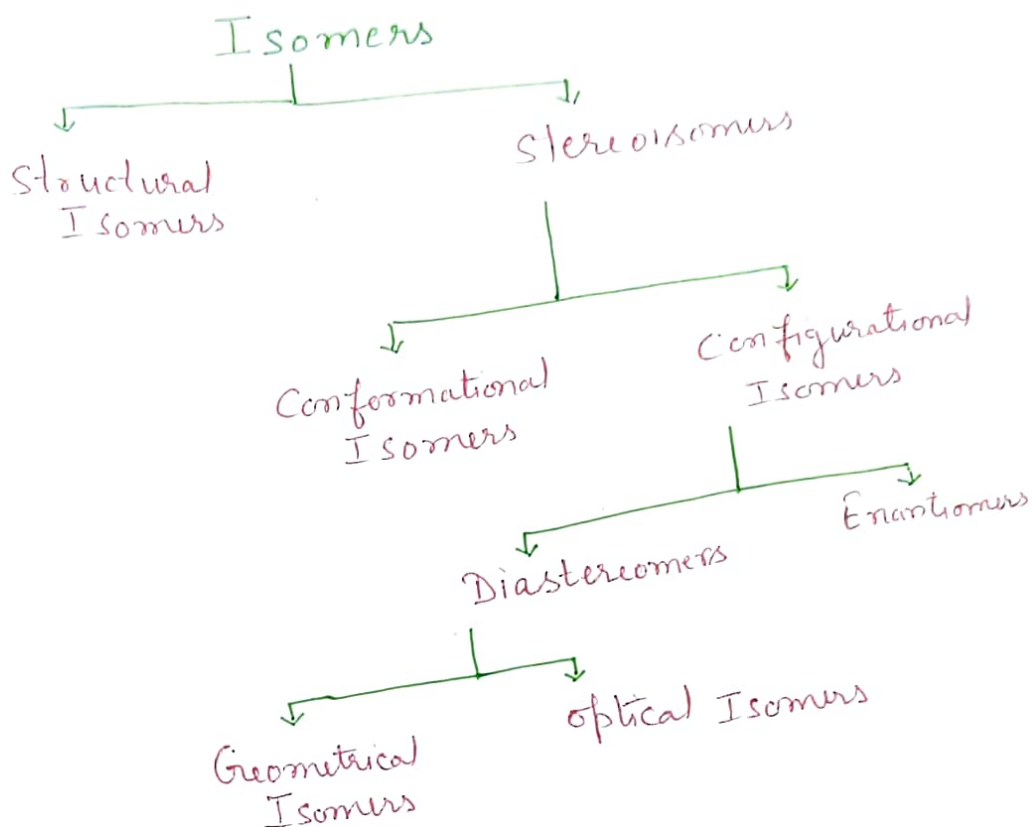
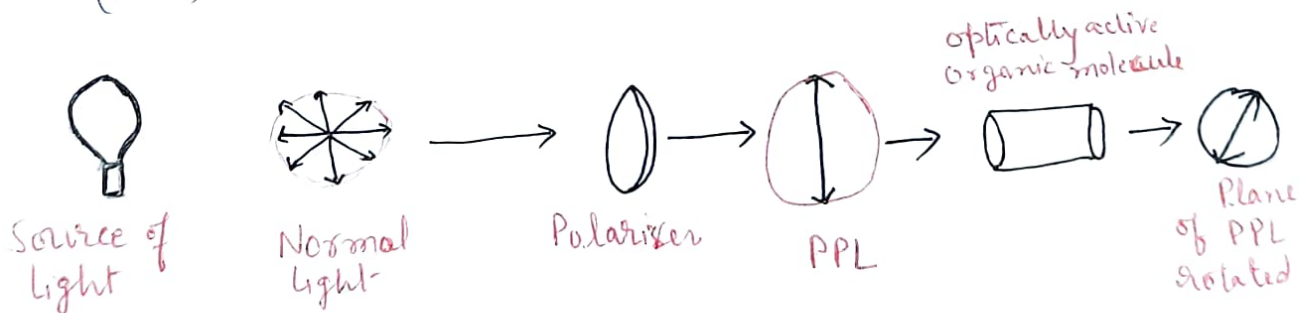


STEREOCHEMISTRY

The 3-dimensional study of a molecule is known as stereochemistry.



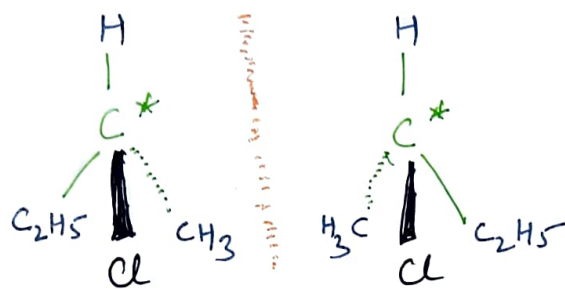
Optical Activity:- Optically activity is the phenomenon in which molecule rotates ^{plane of} polarised light (PPL) in either clockwise or anticlockwise direction.



Optical Isomerism:- Compounds which have similar physical and chemical properties and differ only in their optical activity are known as optical isomers.

Examples:-

2-chlorobutane



Clock wise

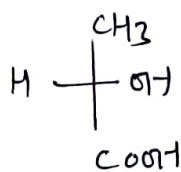
Dextro (d)

Anticlock wise

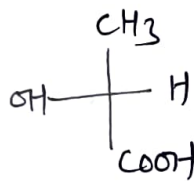
Laevo (l)

Optically active compound (Non-superimposable mirror image)

Lactic acid



Clock wise
(d)



Anticlockwise
(l)

Non-superimposable mirror image

Enantiomers

Enantiomers are optical isomers which are non-superimposable mirror images of each other

Enantiomers have identical physical properties except for the rotation of plane polarised light

Enantiomers have identical chemical properties

They are optically active

Enantiomers can be separated by resolution

Diastereomers

Diastereomers are optical isomers that are not mirror images of each other.

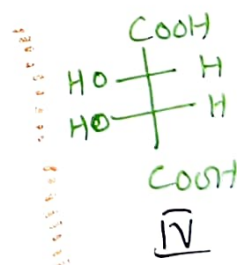
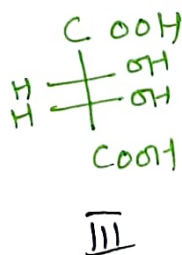
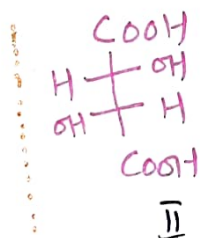
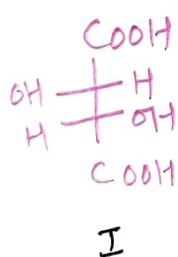
Diastereomers have different physical properties

Diastereomers have different chemical properties

They may or may not be optically active

Diastereomers can be separated by physical methods like Fractional distillation, chromatography

Example :- Tartaric acid



I and II — Enantiomers

I and III, II and III — Diastereomers

I and IV, II and IV — Diastereomers

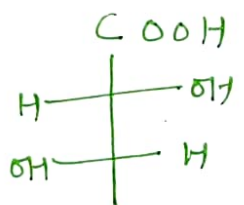
Racemic mixture

Racemic mixture contains equimolar amount of enantiomers

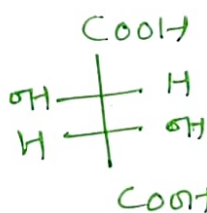
Racemic mixture is optically inactive due to external compensation

It can be resolved into optically active forms
Racemic mixture are dissymmetric in nature

Example ∴ Tartaric acid



d-form



l-form

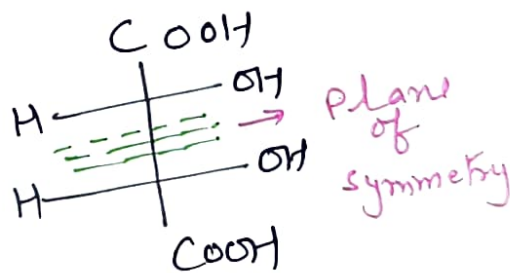
Meso-Compound

Meso-Compounds having two or more asymmetric centres which is superimposable on its mirror image.

Meso-Compound is optically inactive due to internal compensation

It can not be resolved into optically active forms molecule as a whole is not dissymmetric, as it has plane of symmetry

Example ∴ Tartaric acid



Meso-form

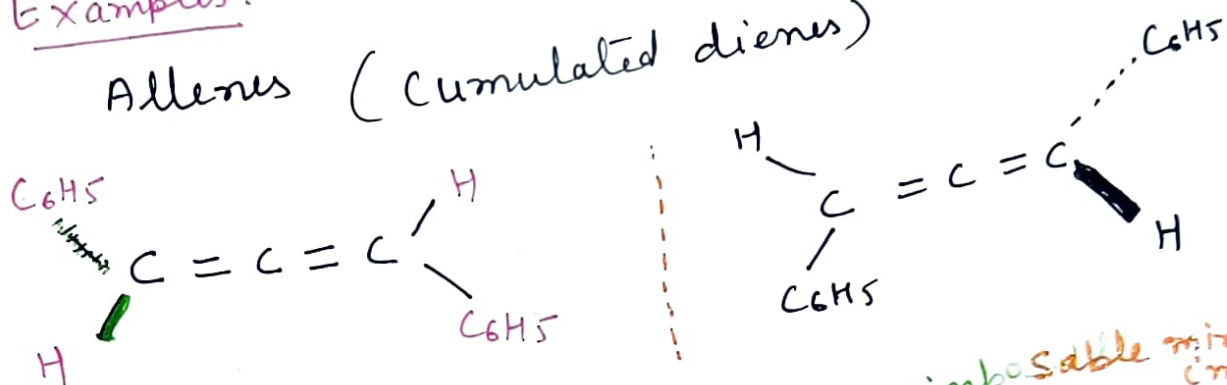
Atropisomerism:

(Optical activity without chirality)

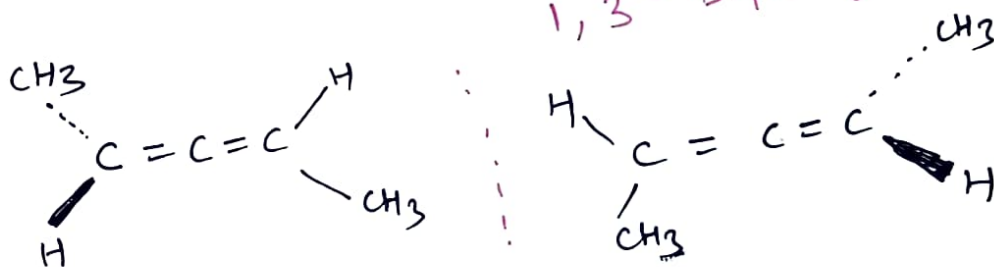
Atropisomerism arises due to restricted rotation around C-C bond and molecule become non-superimposable on its mirror image.

Examples:-

Allenes (Cumulated dienes)

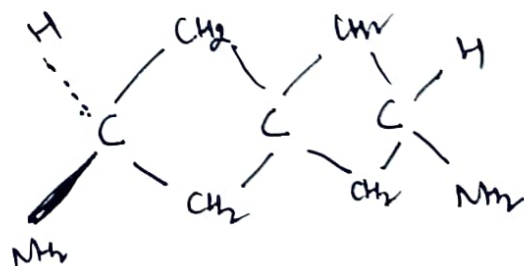
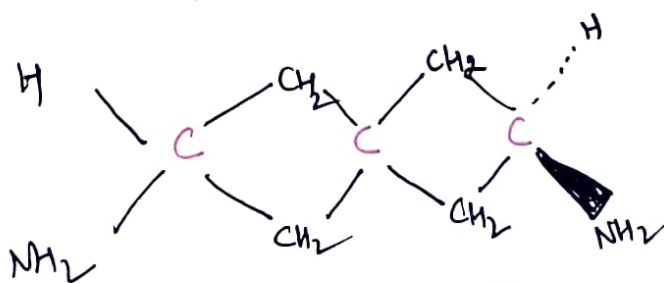


1,3 - Diphenyl propadiene



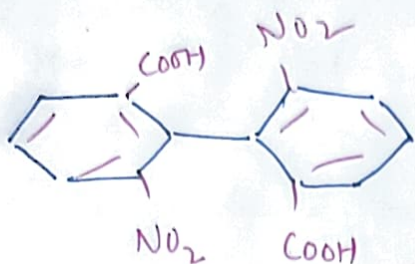
2,3 - Pentadiene

(Spiro compounds)
Spiranes

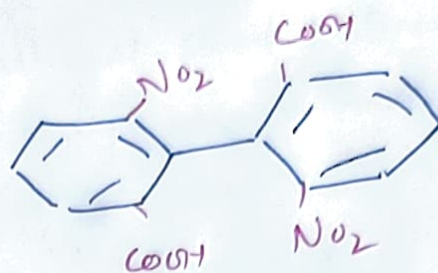


2,6-diamino cyclopentane (spiro)

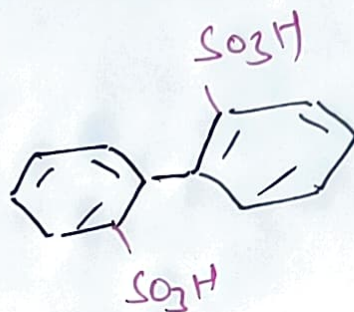
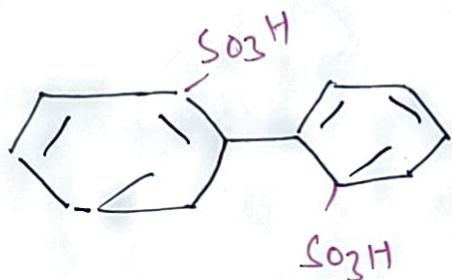
Biphenyls :-



Mirror

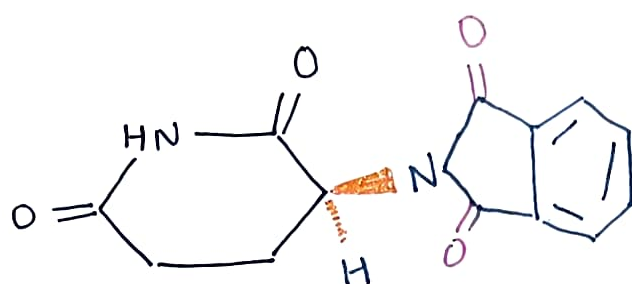


6, 6' Dinitro diphenic acid
(Non-superimposable mirror image)



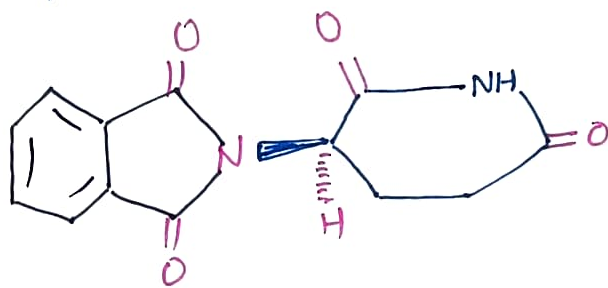
(Non-superimposable mirror image)
Biphenyl - 2, 2' disulphonic acid

Chiral Drugs: - Chiral stereoisomers have different physical and chemical properties of any drug is chiral then its different isomers will show entirely different pharmacological activities in the body because biological system responds differently for different enantiomers.



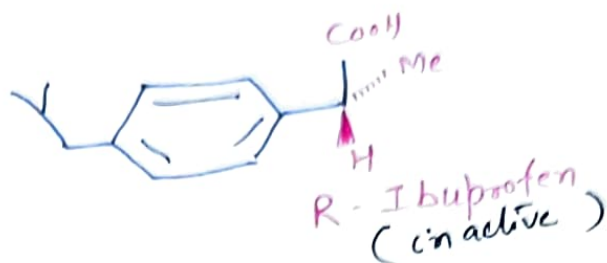
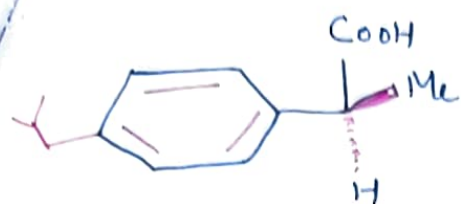
S-Thalidomide

The S-enantiomer is cause teratogenic of the patient. Teratogenic foetus has poorly developed body parts.



R-Thalidomide

The R-enantiomer is an effective sedative with a soothing effect that relieves anxiety of the patient and causes drowsiness.

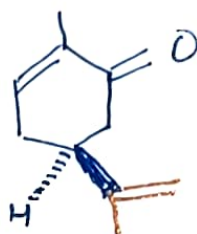


S-Ibuprofen (Pain killer drug)

S-enantiomer has the desired pharmacological activity whereas R-enantiomer is completely inactive



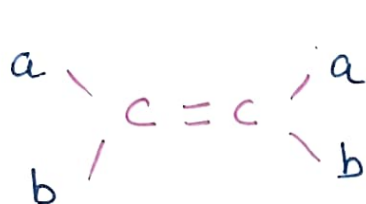
R-Carvone
spearmint
oil



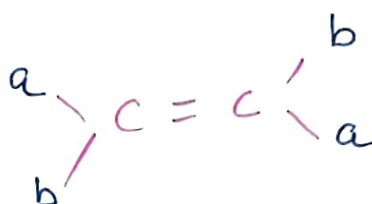
S-Carvone
Caraway oil

- * R-Carvone is used for air freshening products and like many essential oils, oil containing Carvones are used in aromatherapy
- * S-Carvone has shown suppressant effect against high-fat diet

Geometrical Isomerism:- Compounds having same molecular formula and same structural formula but differ in the arrangement of atoms or groups in space around the double bond are known as Geometrical Isomerism. It is also called as Cis - Trans Isomerism.

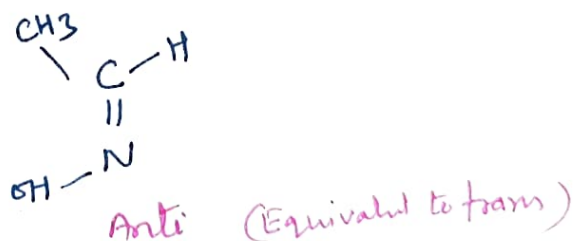
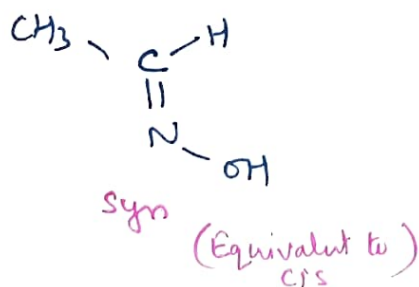
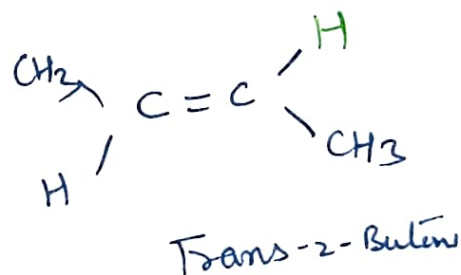
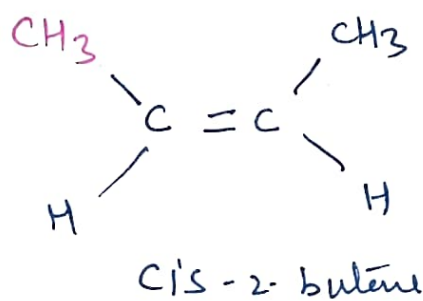


Cis-form
(Z)



trans-form
(E)

- * Similar atoms or groups are present on the same side of the double bond called as Cis form
- * Similar atoms or groups are present on the opposite side of the double bond called as Trans form

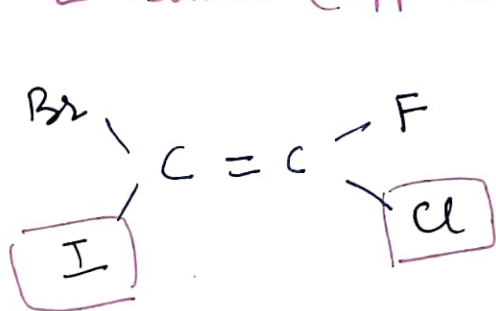


E, Z Nomenclature :-

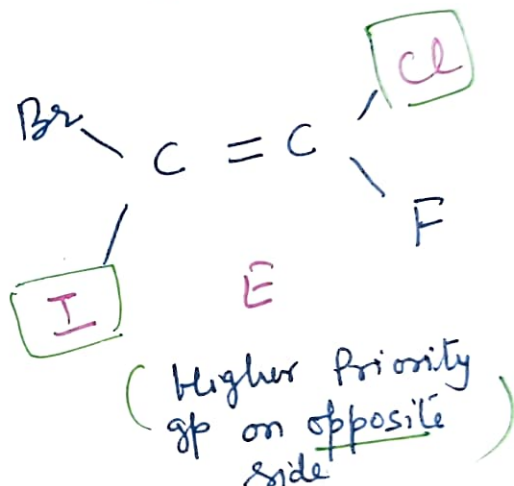
- Assign priority to groups according to atomic no.
- Higher priority to higher atomic no.
- Atoms of higher atomic number get higher priority
- In case of Isotopes, atom with higher mass number will have a higher priority.
- If Atomic no. of atoms attached to the double bonded Carbon atom is same, the priority is determined by comparing the atomic no. of second atom.

Z isomer (together (same sides of the double bond))

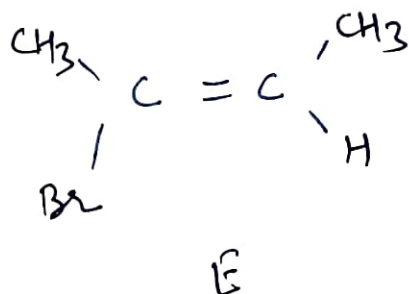
E isomer (opposite (opposite sides of the double bond))



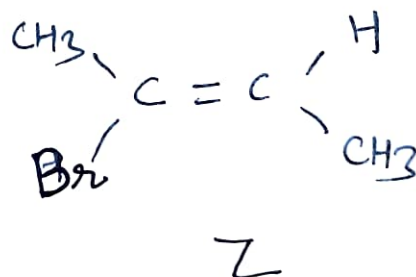
Z (Higher Priority grps on same side)



E (Higher Priority gr on opposite side)

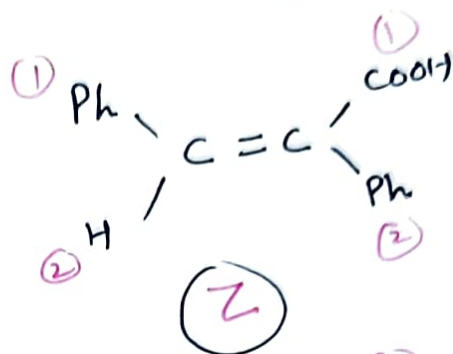
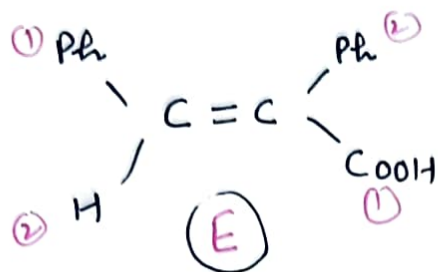
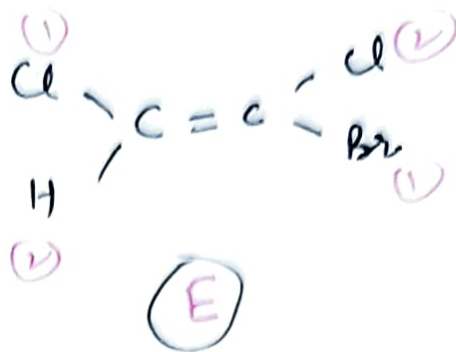
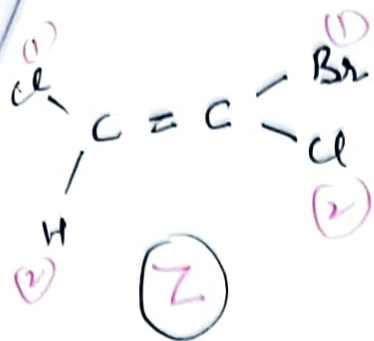


E

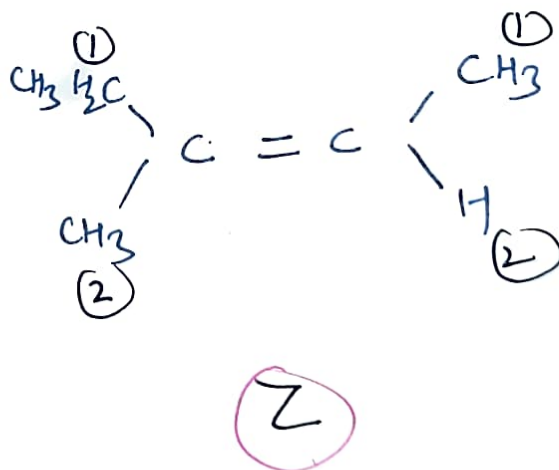
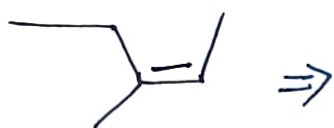
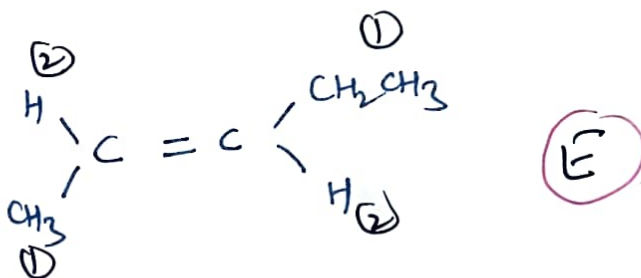
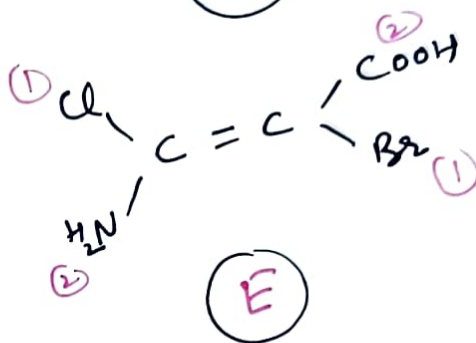
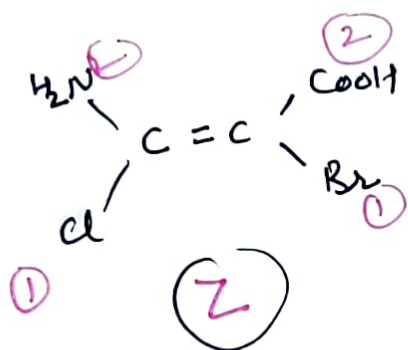


Z

Examples

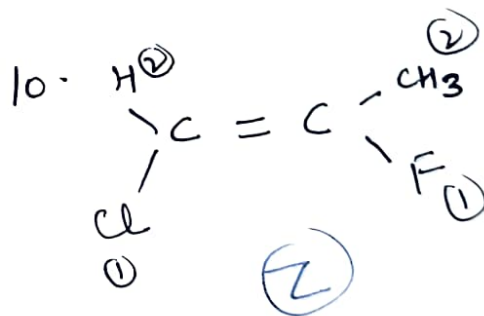
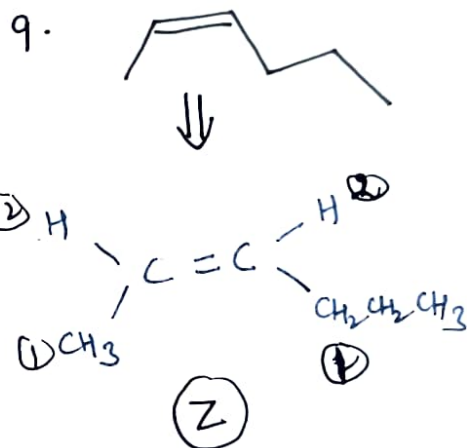
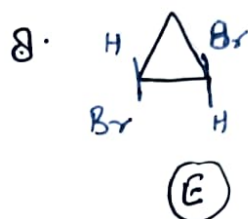
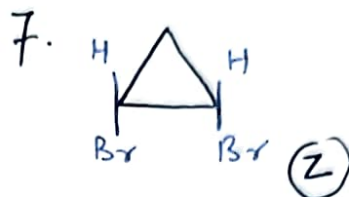
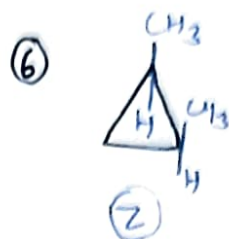
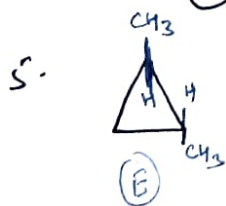
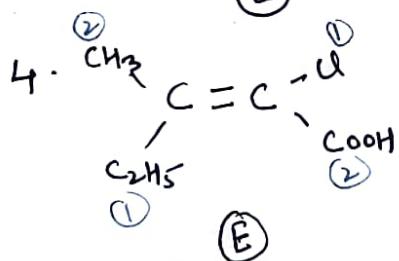
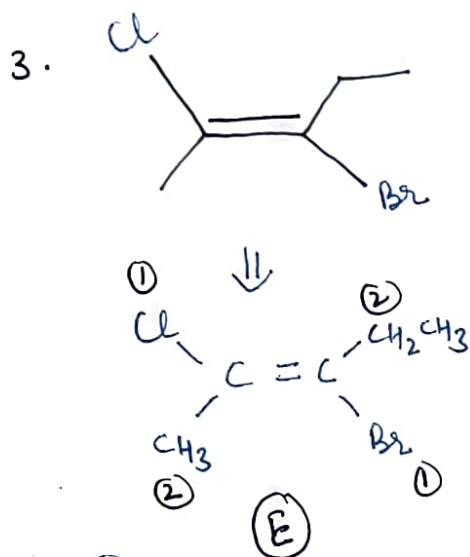
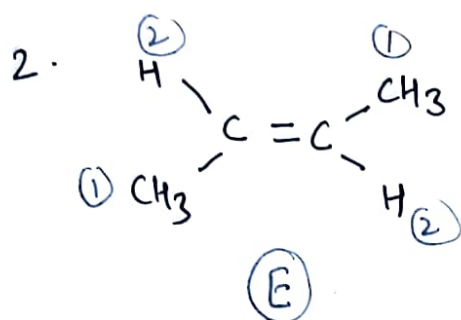
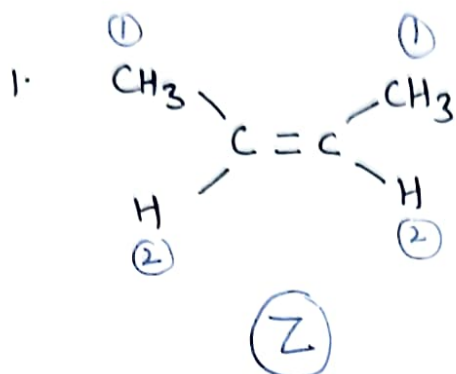


Ph \rightarrow C₆H₅



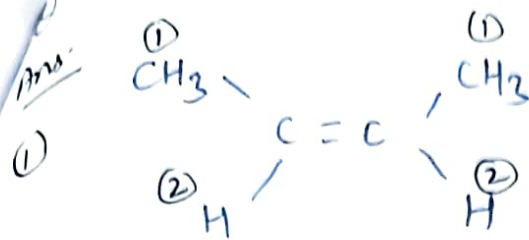
Short Questions & Answers

Assign E and Z configuration to the following compounds.

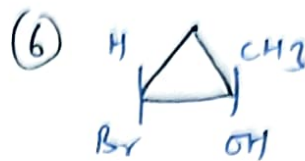


Short Questions & Answers

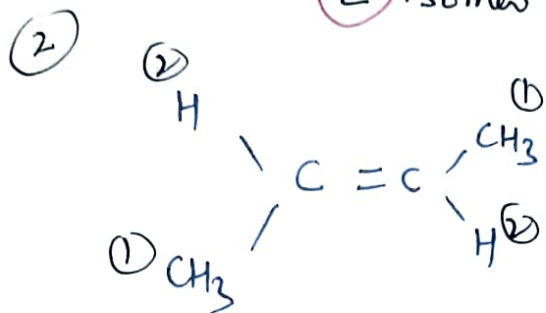
Assign E and Z configuration to the following compounds.



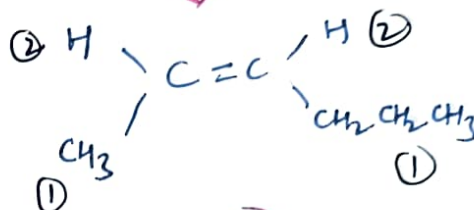
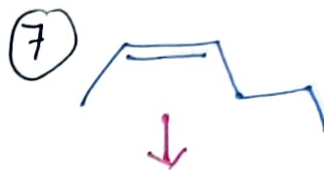
(Z)-isomer



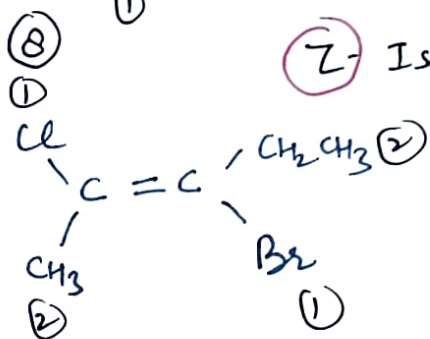
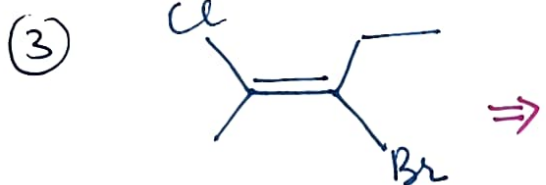
(Z)-form
cis-Isomer



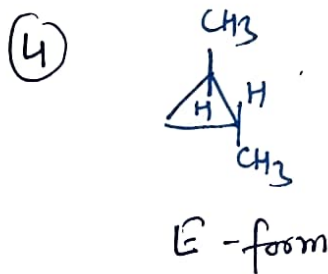
(E)-isomer



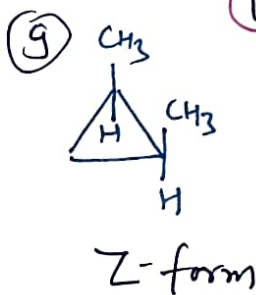
(Z)-Isomer



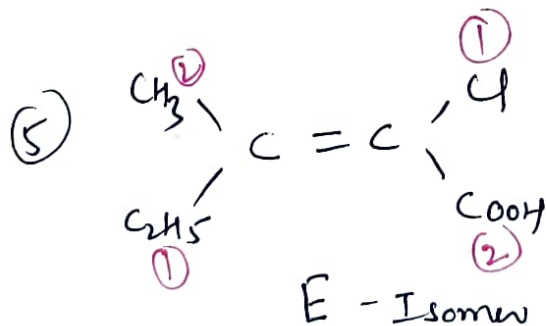
(E)-Isomer



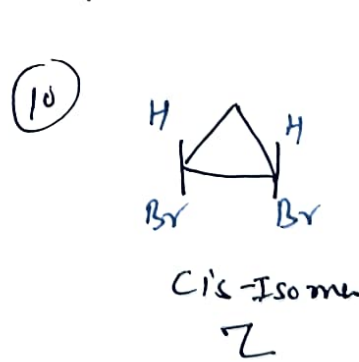
E-form



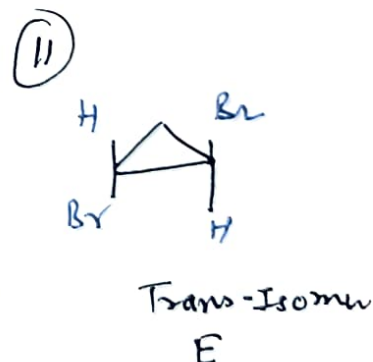
Z-form



E-Isomer



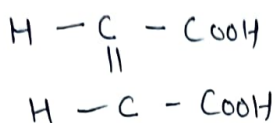
Cis-Isomer
Z



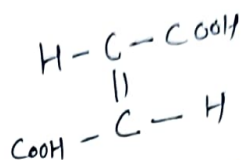
Trans-Isomer
E

Draw the stereoisomers of Maleic acid and Fumaric acid.

Ans. Maleic acid and fumaric acid show Geometrical Isomerism.



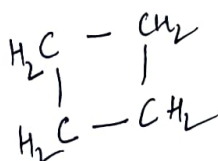
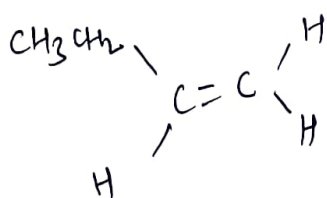
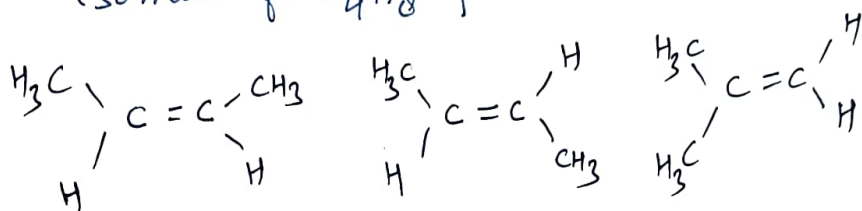
Cis form
Maleic acid



Trans form
Fumaric acid

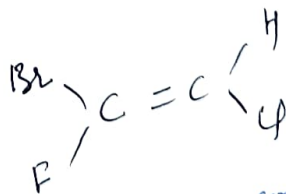
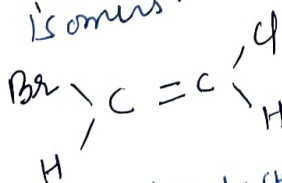
Q. Write formulas for all the structural and geometrical isomers of C_4H_8 ?

Ans.



Q. Which of the following compounds can exist as geometric isomers?
 CH_2Cl_2 , $\text{CH}_2\text{Cl} - \text{CH}_2\text{Cl} - \text{CH}_2\text{Cl}$, $\text{CHBr} = \text{CHCl}$, $\text{CH}_2\text{Cl} - \text{CH}_2\text{Br}$

Ans. Only $\text{CHBr} = \text{CHCl}$ can exist as geometric isomers.



In $\text{CH}_2\text{Cl} - \text{CH}_2\text{Cl}$ and $\text{CH}_2\text{Cl} - \text{CH}_2\text{Br}$, the carbon atoms are connected by a single bond about which the groups can rotate relatively freely.

more wave

Long answer Questions

- Q. Explain optically active compounds that do not have chiral centre. Refer —
- Q. Explain Geometrical Isomerism with suitable examples. Refer
- Q. What are chiral drugs? Give examples of chiral drugs. Refer —
- Q. What is Atropisomerism? Give five examples of compounds showing optical isomerism in the absence of chiral carbons. Refer —
- Q. Differentiate between Enantiomers and Diastereomers. Refer
- Q. Differentiate between Racemic mixture and meso compound. Refer