

Date 16/07/25



Sub. = chemistry = Theory CREDIT = 4.0

LAB = 1.5

5.5

Book: Jain & Jain engineering chemistry [A]

DAS mahapatra engg. chemistry [B]

(1-7 modules) (Books are to be taken from library)

mod 1) → Atomic and molecular structure [B]

mod 2) → Spectroscopic techniques & applications [B]

mod 3) → Inter-molecular forces (&) potential energy surfaces [B]

mod 4) → Use of free energy in chemical equilibrium [A] (thermo)

mod 5) → Periodic properties [B]

mod 6) → Stereochemistry [A]

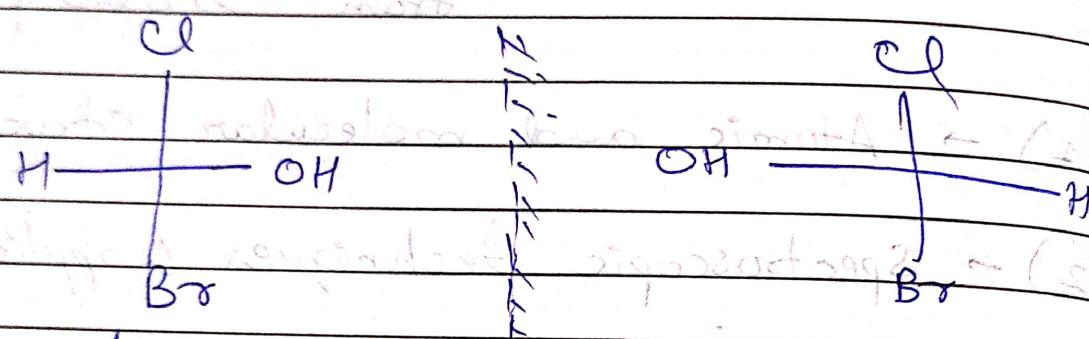
mod 7) → organic reactions & synthesis of a drug molecule [A]

STEREOCHEMISTRY (M-6)

Date 17/07/25

① CHIRALITY → Chirality is handedness for any object which is chiral you can't divide it in two equal halves. mirror image is non superimposable.

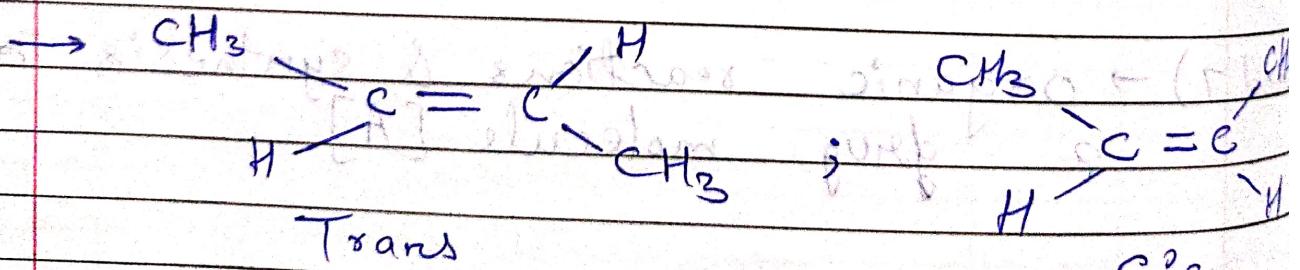
• Enantiomers → ~~isomer~~



(I) & (II) are mirror image but non-superimposable.

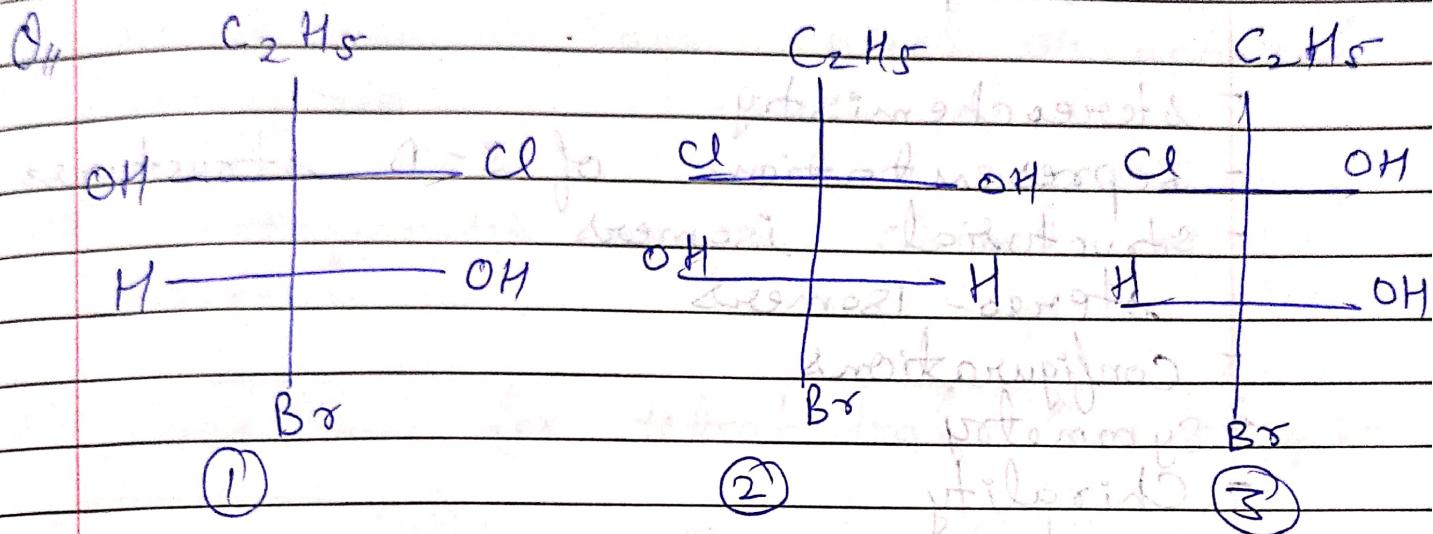
• What are Distereomers?

Same molecular formula but no mirror image relationship.



- These are Distereomers -

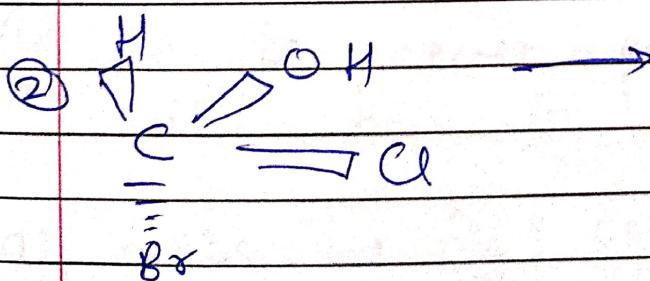
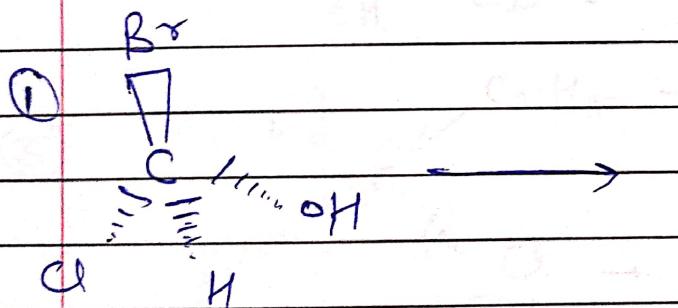
Chloraxanthus 3d at Sigot (3-11)



① & ② → customers

① & ③ - ~~zwitpolypillen~~ abdoel A +
 ~~Dia Pillen~~

(2) & (3) (because same formula
no mirror relation.)



Date / /



(M-6) Topics to be covered:

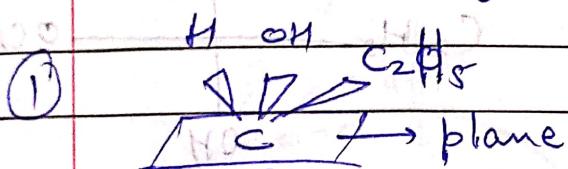
- Stereochemistry
- Representation of 3-D structures
- structural isomers
- stereo-isomers
- configurations
- Symmetry
- Chirality
- Enantiomers
- Diastereomers
- Optical Activity
- Absolute configurations
- Conformational Analysis
- isomerism in transition metal compounds

Q) Diastereomers are chiral or achiral.

Ans - Explain with suitable examples.

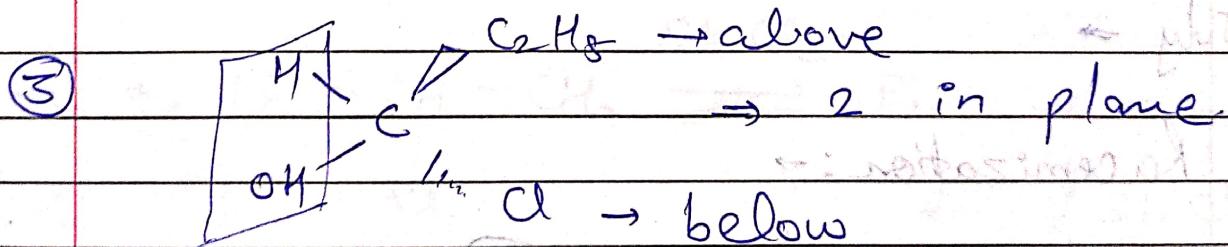
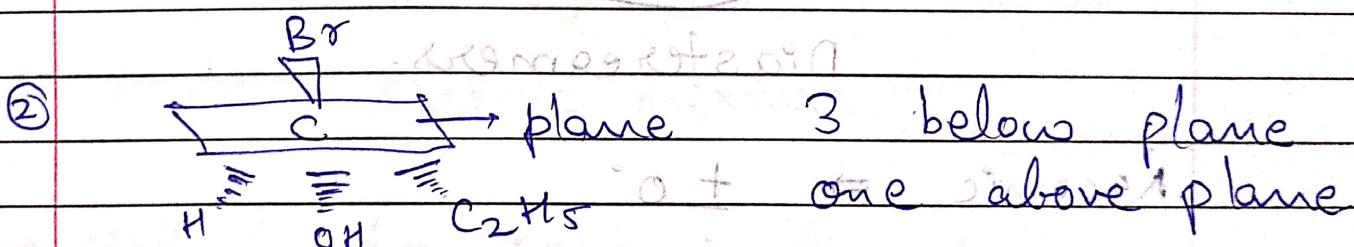
⇒ Diastereomers maybe chiral or achiral.

⇒ Conditions for tetrahedral Geometry :-



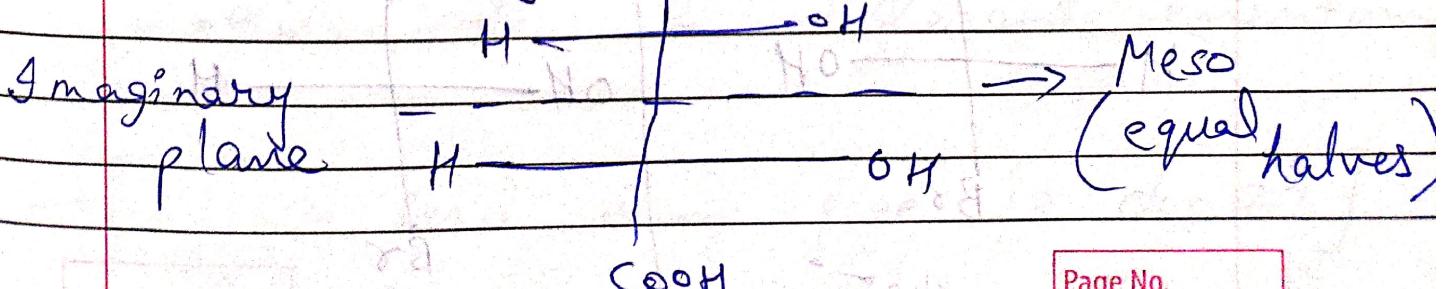
Three above plane

one below plane

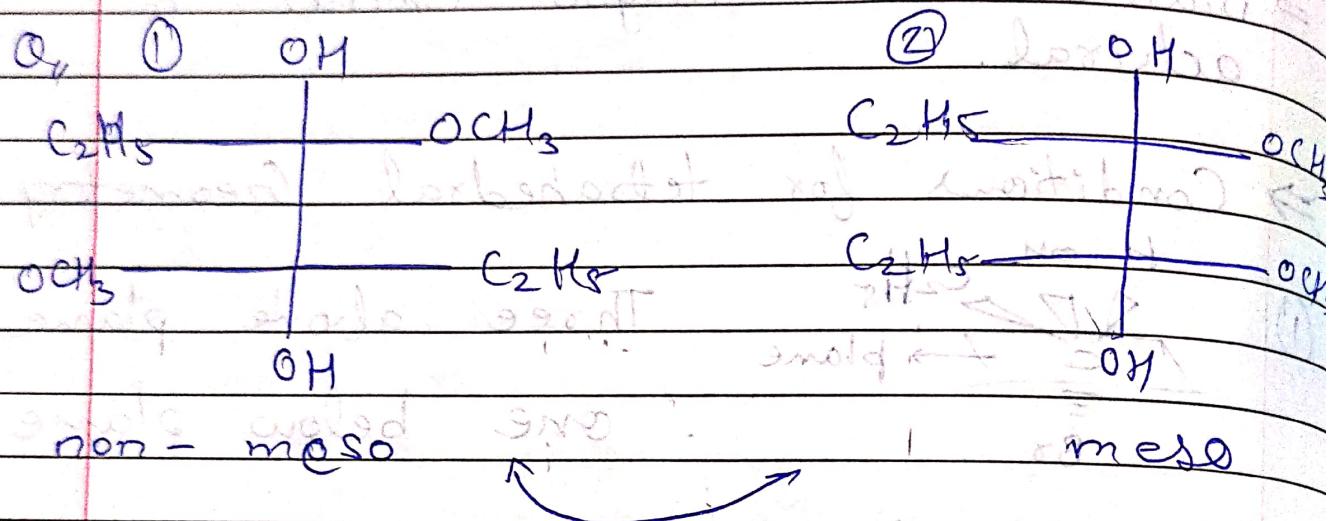


④ It is never possible that 4 bonds will be in plane.

(a) meso → (e.g.) COOH



(a) for meso compound, the molecule can be divided into two equal halves.

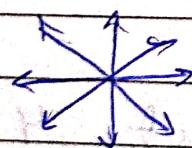


Diastereomers.

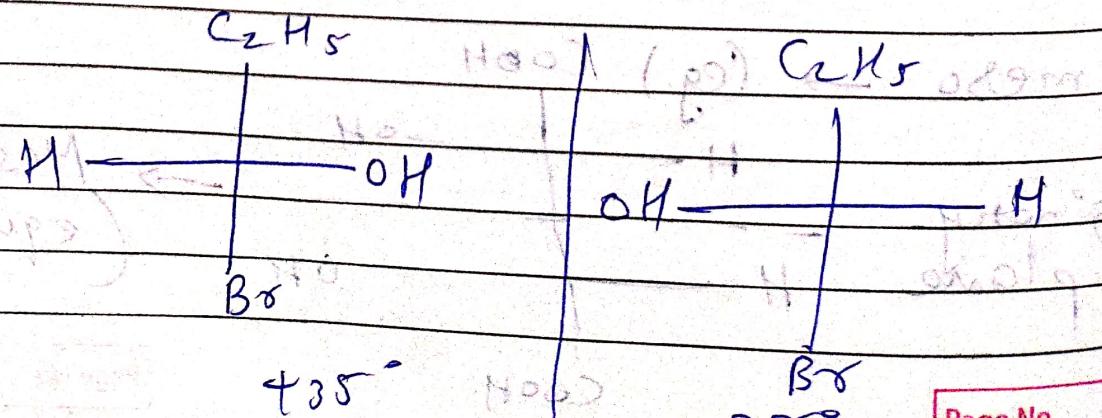
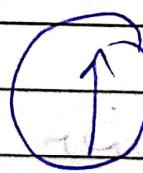
Racemic $\Rightarrow + \text{ } 0^\circ$

22nd July \Rightarrow

Racemization: -



normal light



(50% : 50%)

 $+35^\circ - 35^\circ$

110° HO

0°

→ Some special character of racemic compound.

melting point \propto purity

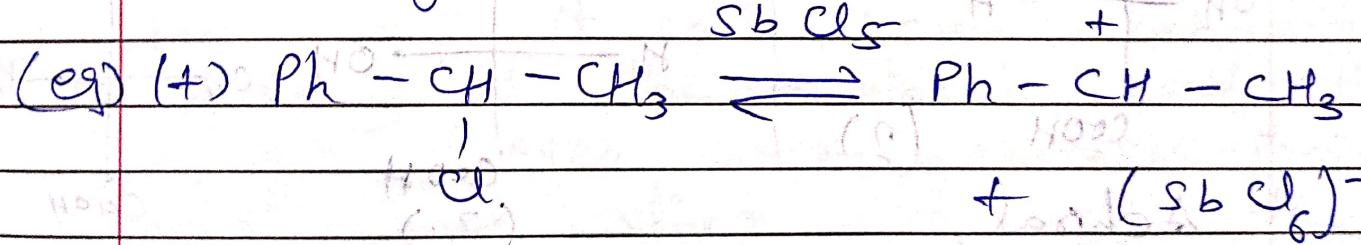
Pure (M.P)
Conc

(M.P) Pure
Conc

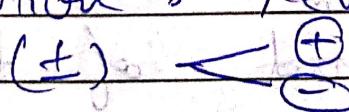
(M.P)

Racemic mixture.

→ Method for Racemization :-



→ Resolution : Reverse of Racemization.



the process to convert a racemic mixture to 2 different enantiomers.

→ H.W - Read from page 973 ch-27

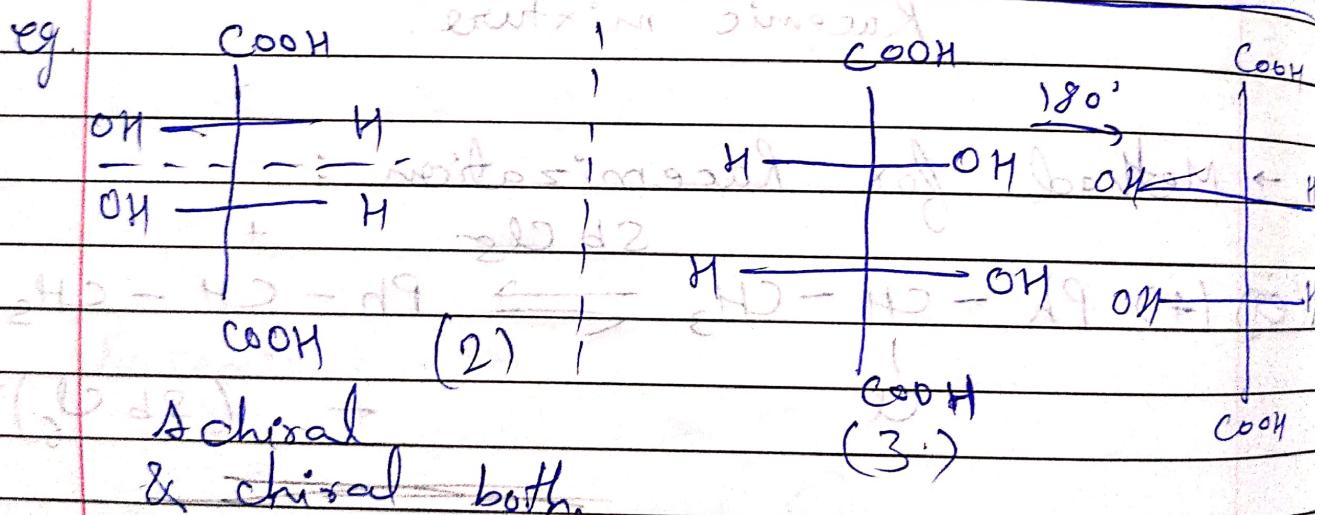
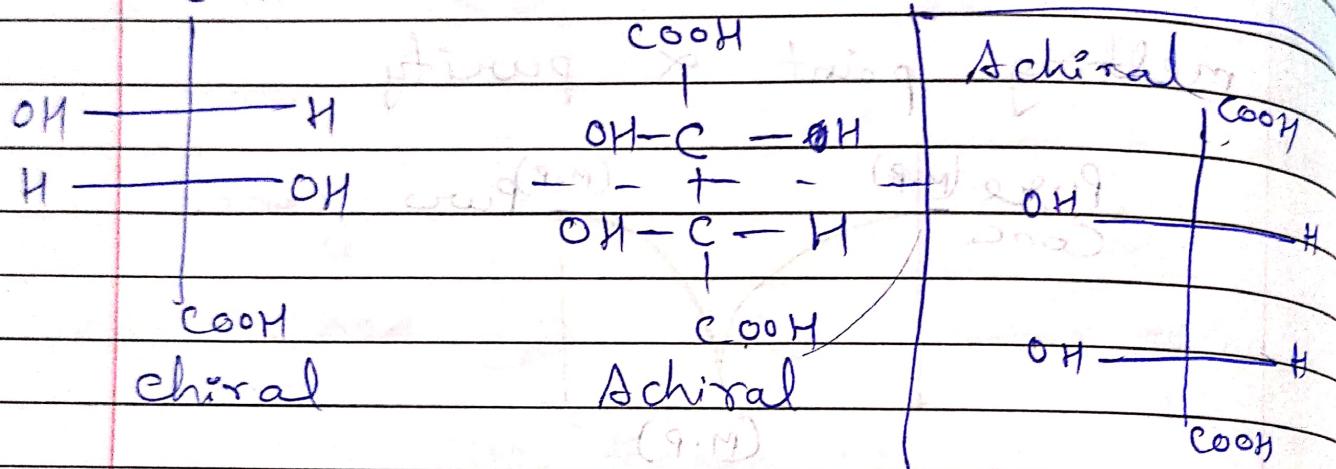
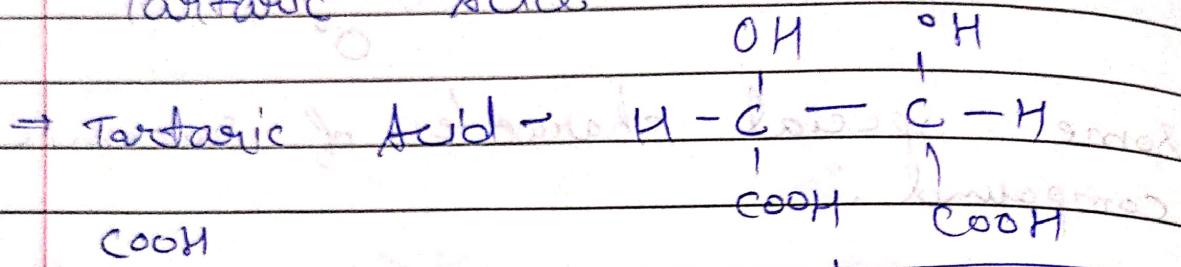
J&J

Achiral \rightarrow which has a plane of symmetry.

Date 24/07/25



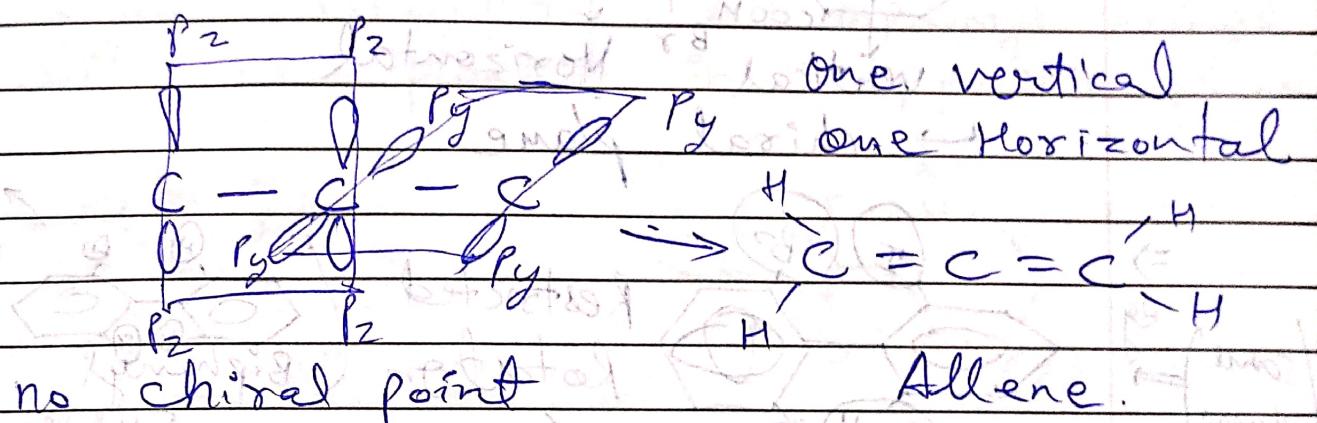
Q Draw the achiral form of Tartaric Acid.



\therefore for Achiral compound of Tartaric acid 2 mirror images are actually same molecule, because when we give 180° rotation of molecule (3), we get the molecule (2).

* CHIRALITY (without) CHIRAL centre :

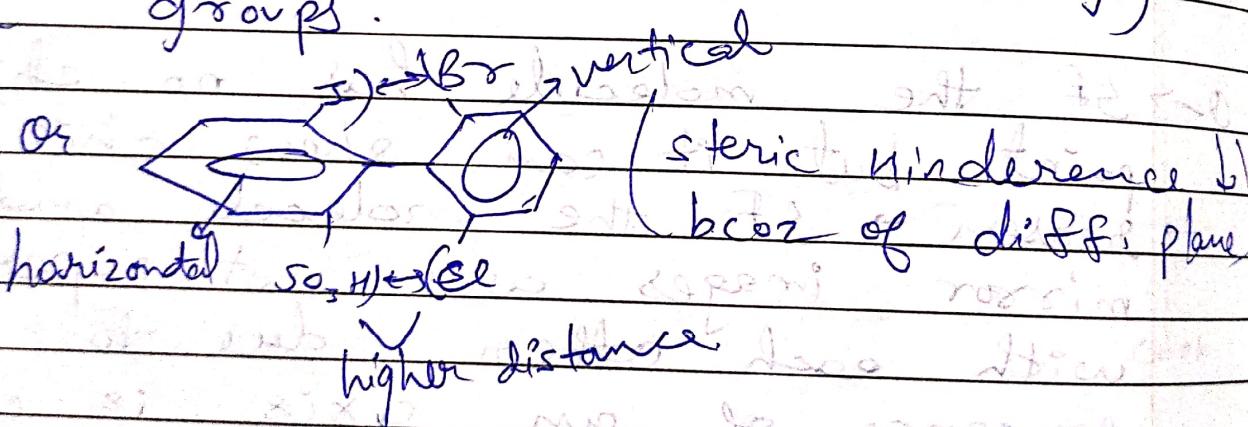
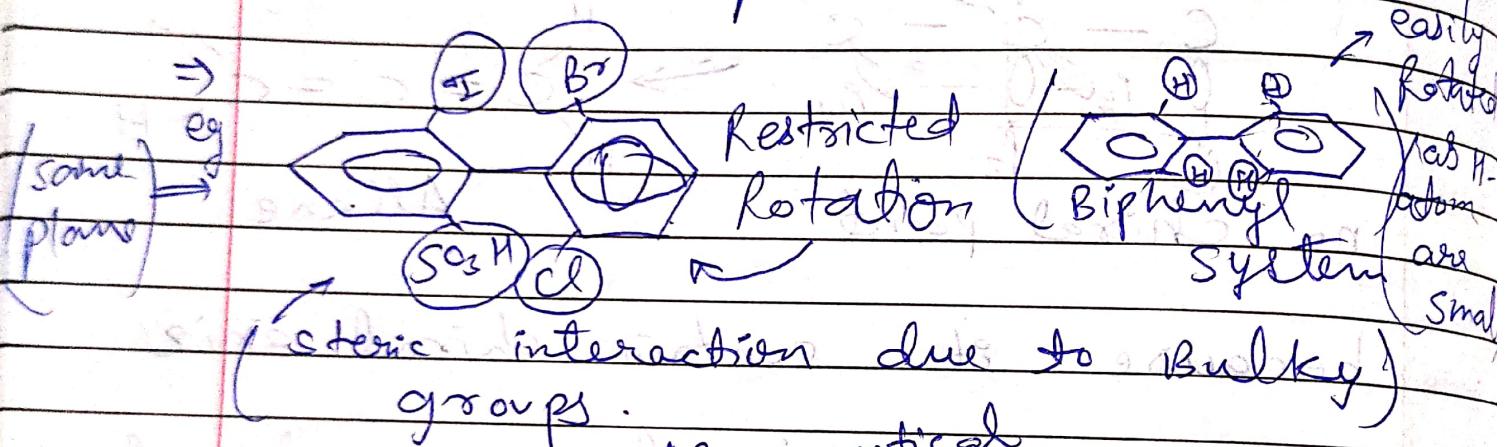
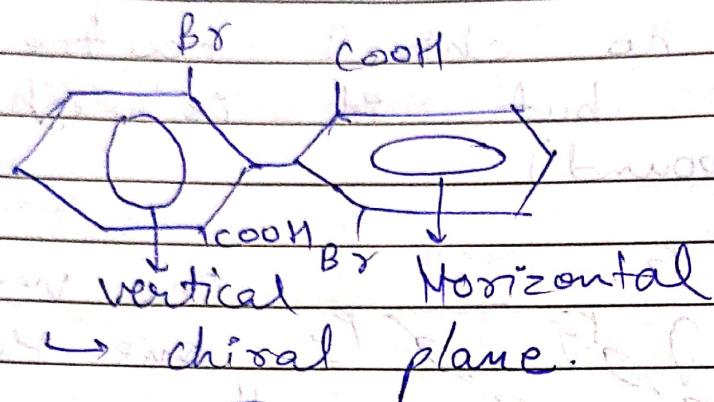
(newman) (Axial chirality)
there is no chiral centre in compound but it is chiral.
(it = compound)



because it contains chiral axis

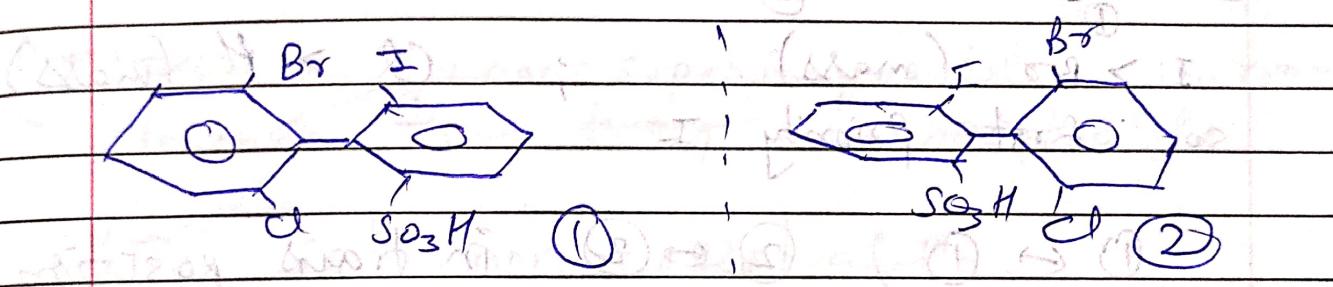
\rightarrow If the molecule has no chiral point but it can show chirality.
 \rightarrow reason \rightarrow If the molecule and its mirror images are not superimposable with each other due to the presence of an axis is called the axial chirality and the axis is called chiral axis which is passing through the 3 carbons.

* Atropisomerism (no bond rotation (Atrop) isomerism)



\Rightarrow Atrop isomerism is called no bond rotation isomerism when the two benzene rings are attached with each other by singly bond. So this system is called the biphenyl system.

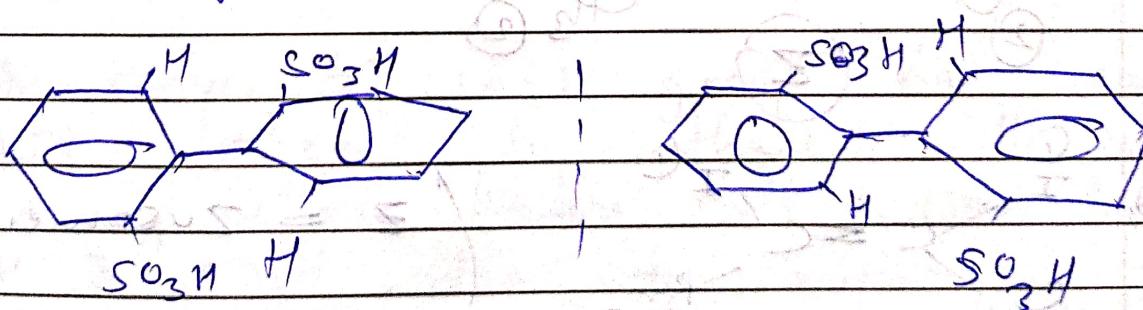
so this system has 4 ortho-position then if the 4 positions are substituted by 4 bulky groups then there will be strong steric interaction. So, to minimize the steric interaction, 2 Biphenyl rings will be placed in opposite planes



so ① & ② are non superimposable mirror image but ① & ② have no chiral point but they will show chirality.

this type of chirality is called 'Chirality due to axial plane'.

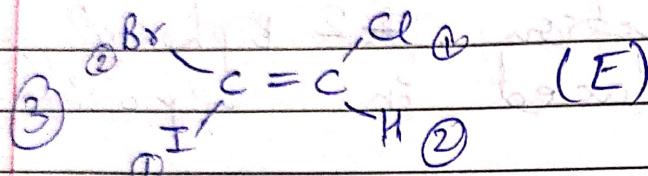
e.g.



E-Z

E → Entgegen (opposite)

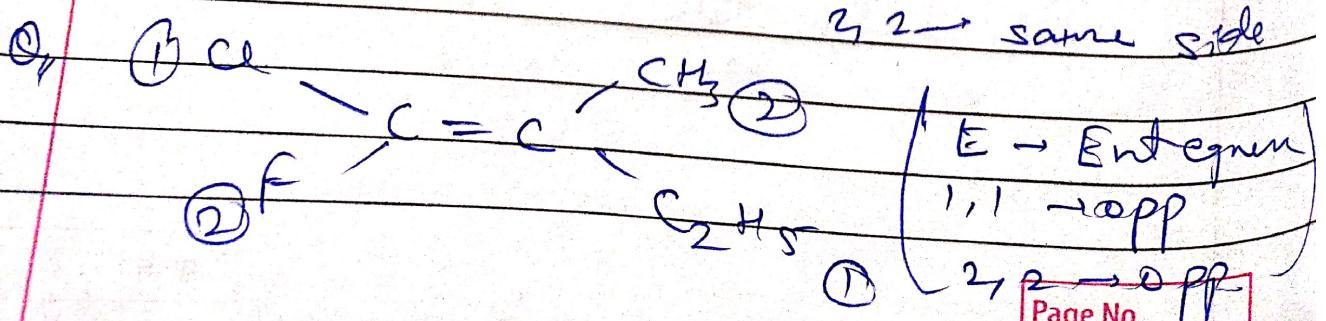
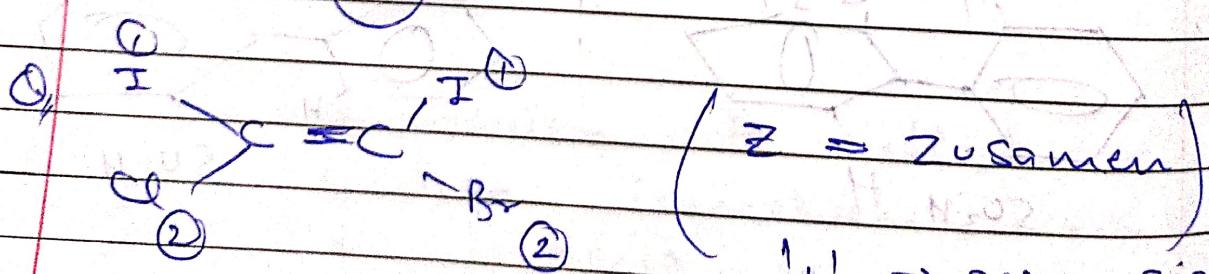
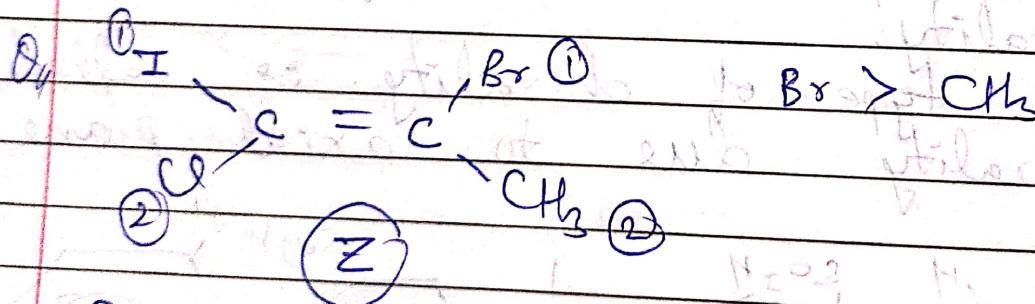
Z → Zusammen (same side)



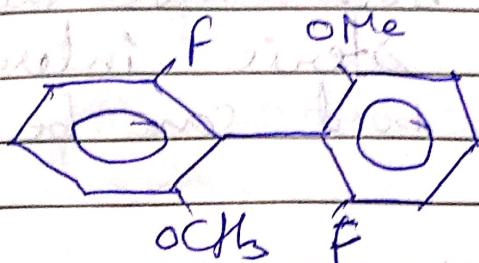
$\text{I} > \text{Br}$ (mass) ; $\text{Cl} > \text{H}$ (mass)
so, first priority I.

$\text{①} \leftrightarrow \text{①}$, $\text{②} \leftrightarrow \text{②}$ in trans position
then compound is E (Entgegen).

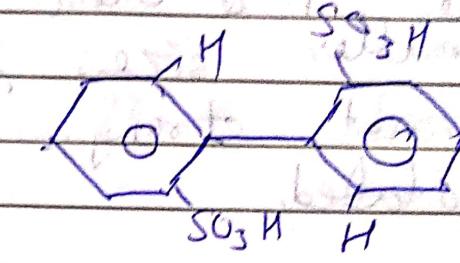
About the Z structure ② highest priority group is $\text{J} > \text{Br}$.



Explain the following:



(I)



(II)

(II) both have non-superimposable mirror images, they are resolvable.

(I) is non-resolvable.

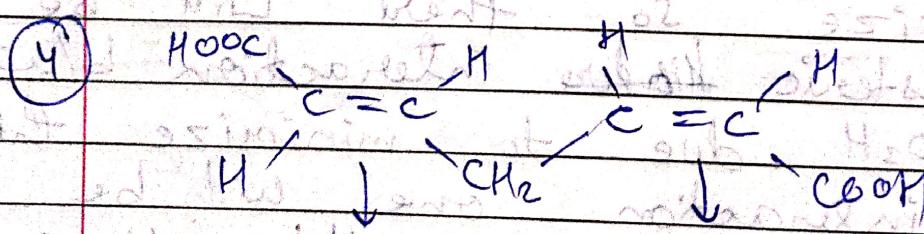
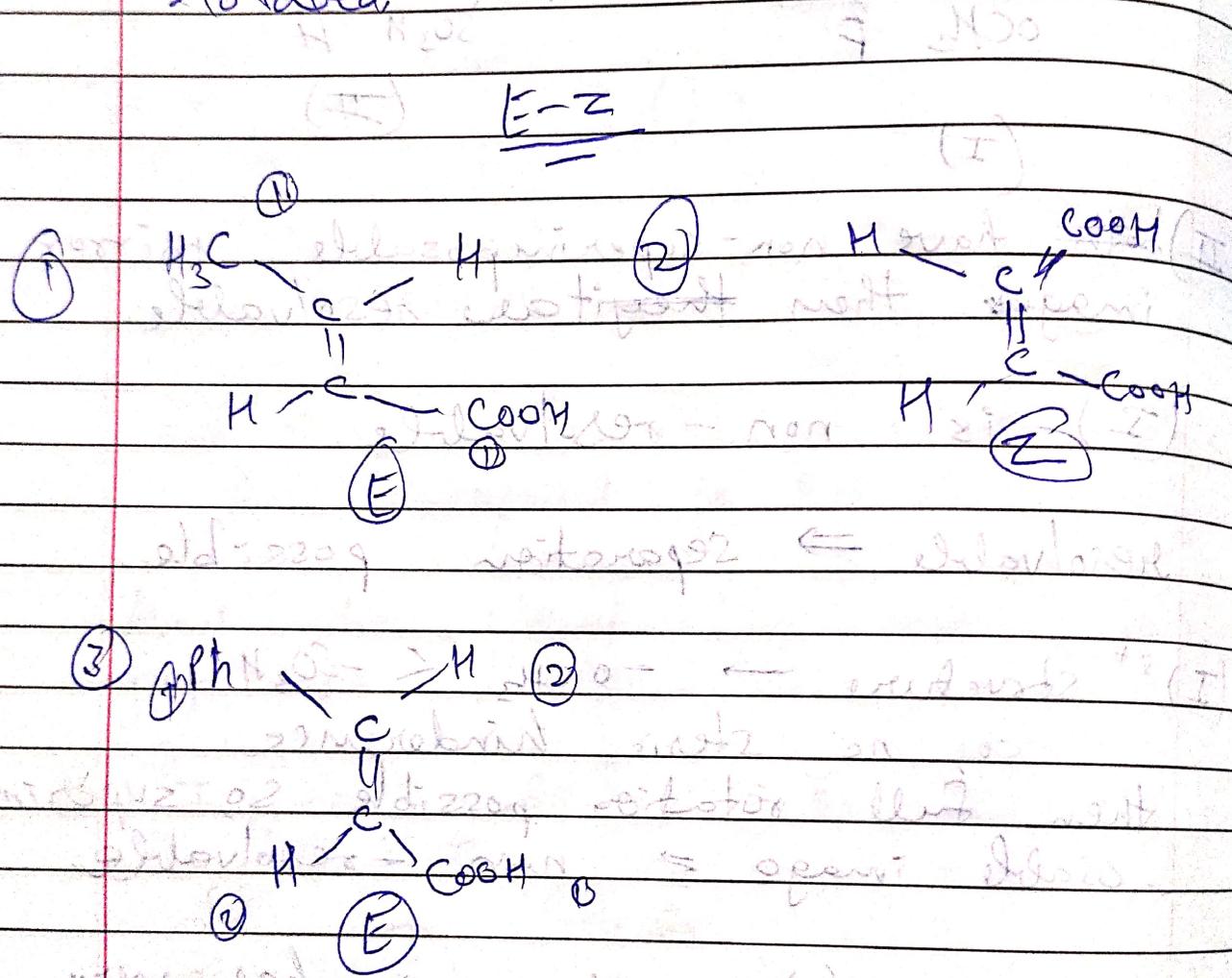
resolvable \Rightarrow separation possible.

(I)st structure \rightarrow $-OCH_3 < -SO_3H$
so, no steric hindrance.

then full rotation possible so, superimposable image = non-resolvable.

In comp. (II) SO_3H group has very big size so there will be strong steric ~~hindrance~~ interaction b/w H & SO_3H . Due to minimize these steric interaction one will be vertical and another will be horizontal so, when you put the mirror, the mirror image will be non-superimposable, so these two mirror images can easily be separable.

In compounds, the two groups are f & octs, both have the smaller size. So, steric interaction is not strong. So, bond can be rotated.



Q give 2 examples of the following compounds.

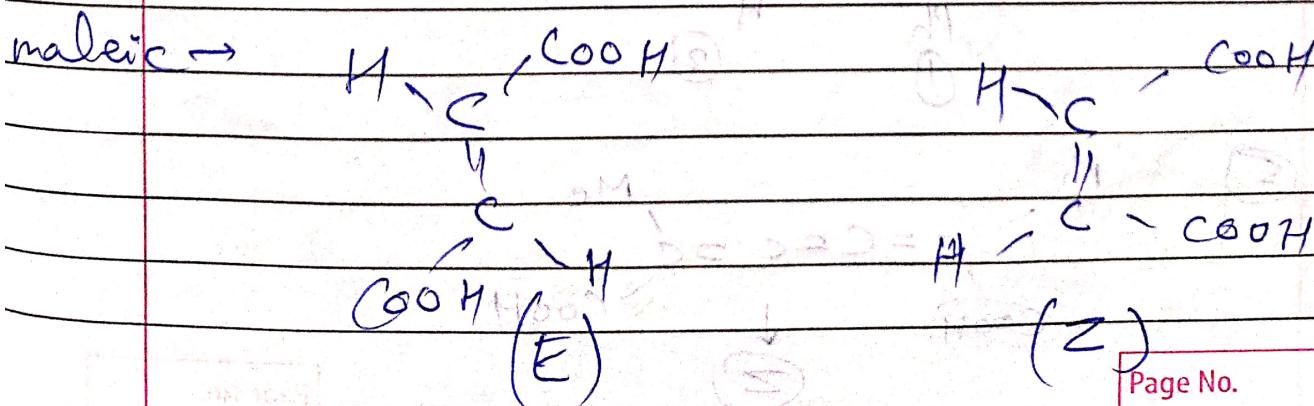
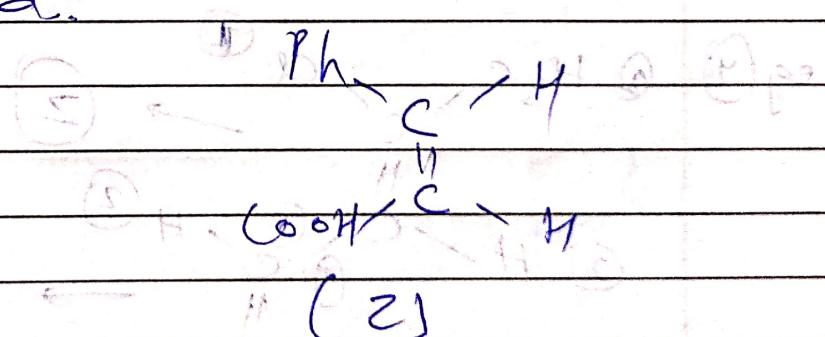
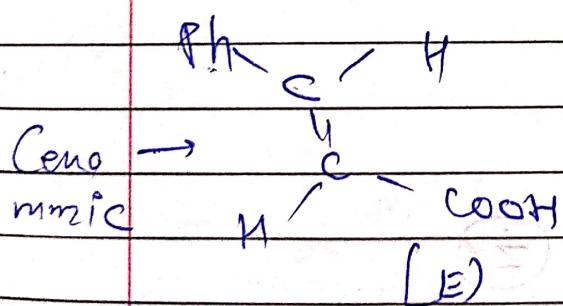
① optical activity without Assymetric carbon.

② Chirality without chiral point
(same question & diff. language).

③ Write down the two forms of Maleic Acid. Identify them with proper E-Z nomenclature.

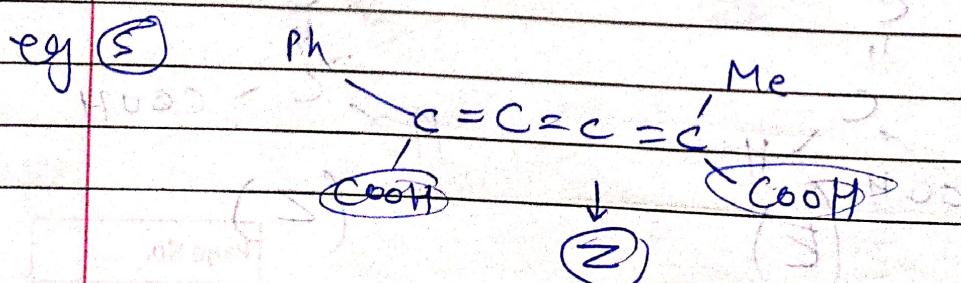
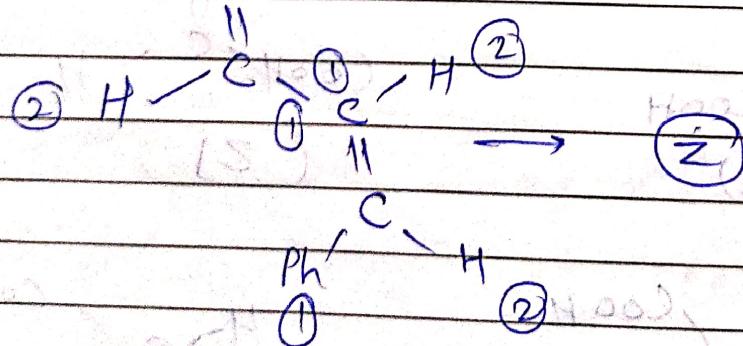
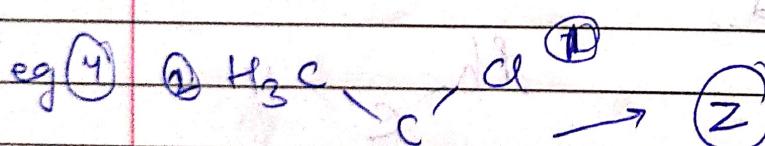
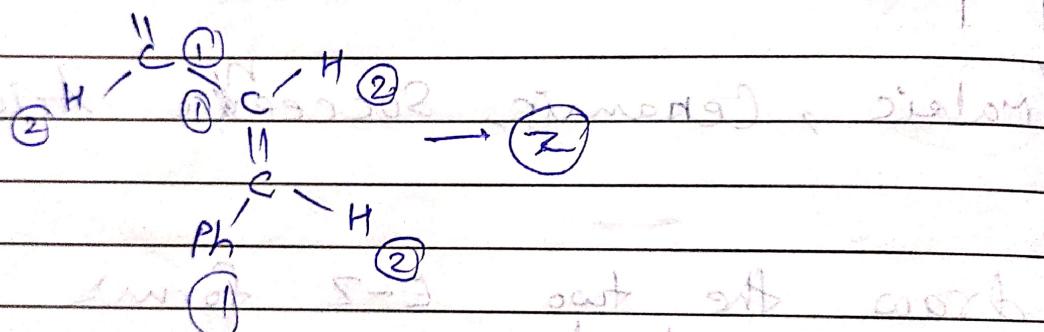
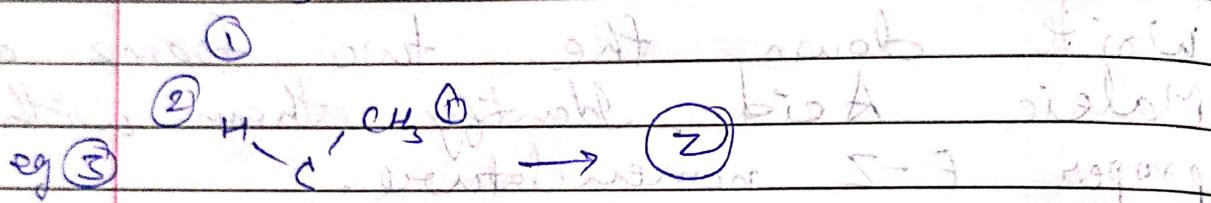
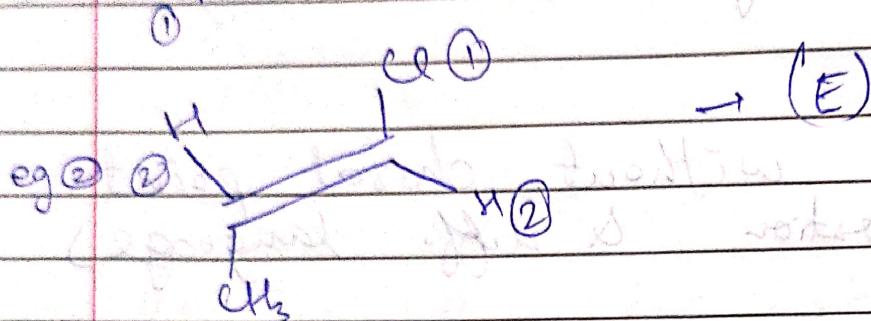
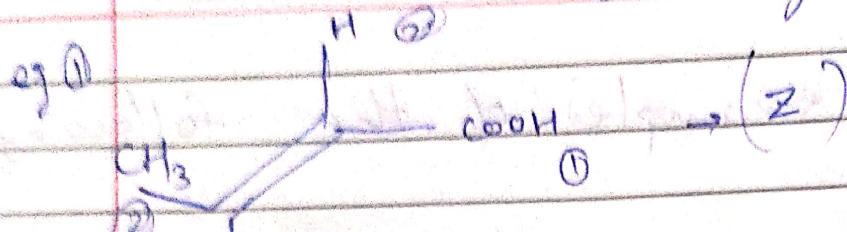
[Maleic, Cetamic, Succedie acids]

Or draw the two E-Z forms of Cetamic Acid.

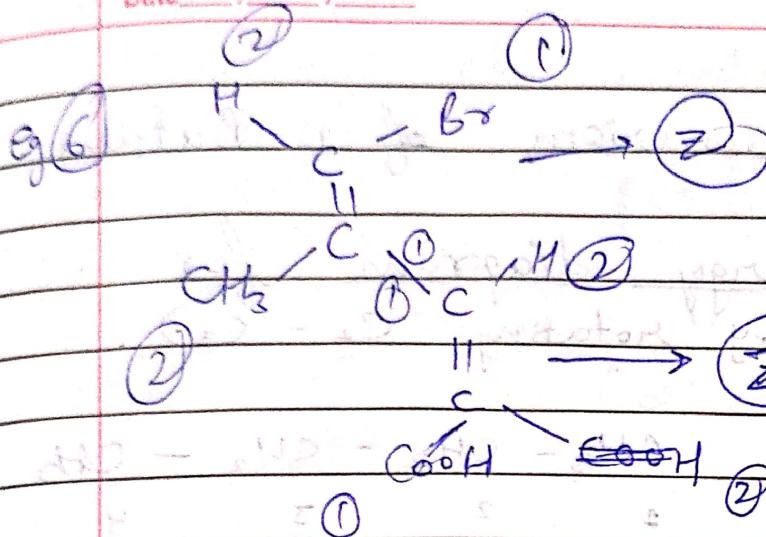


Date 17/8/25

E-Z eg. →



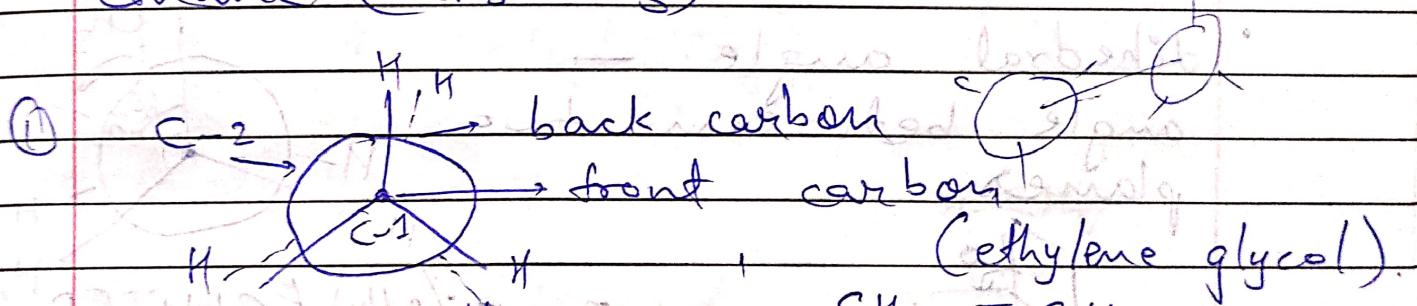
Date / /

22/07/2023
Page No. 993

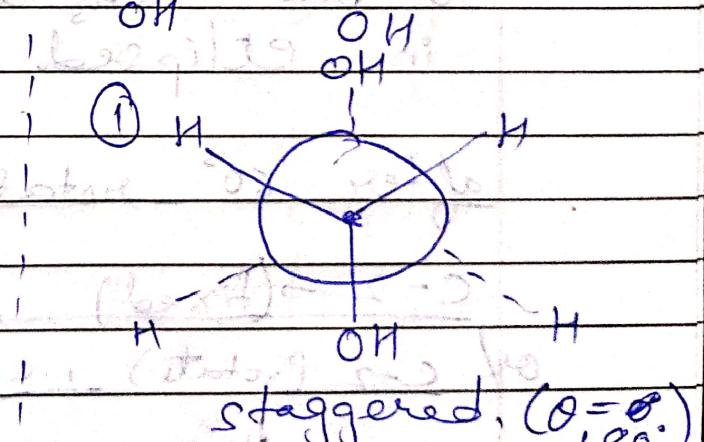
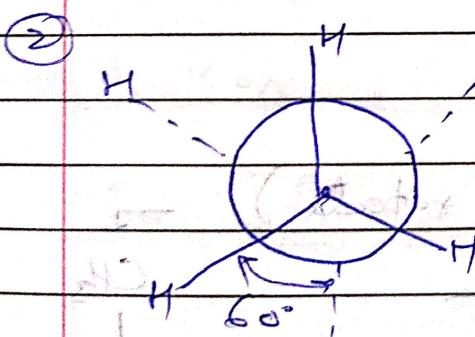
- ★ n-Butane
- ★ Energy profile diagram.
- ★ newman projection formula.

★ newman projection formula

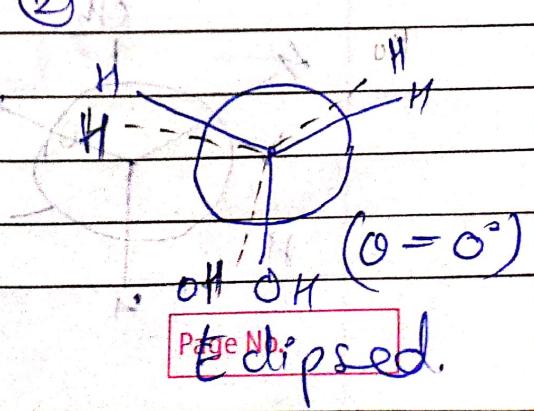
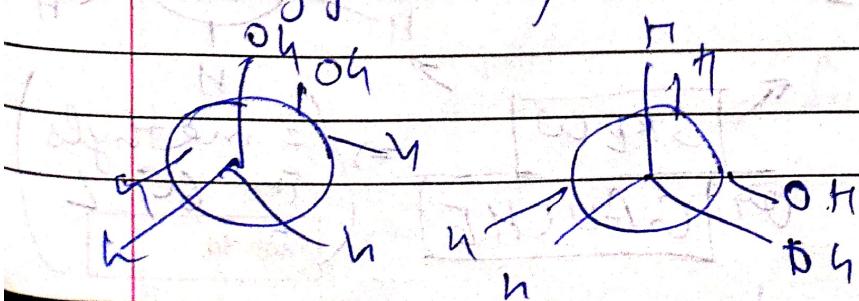
→ ethane ($\text{CH}_3 - \text{CH}_3$)



Eclipsed form



Staggered / Anti form.

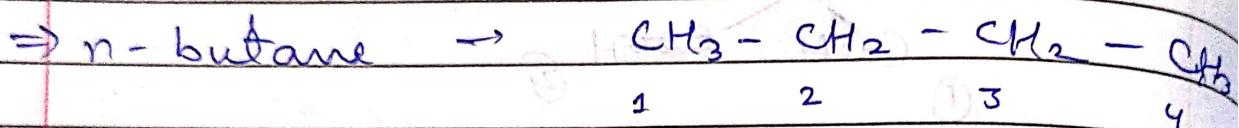


Eclipsed.

Date 4th Aug 25.

→ Conformational Isomerism of n-Butane

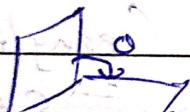
or potential energy diagram for
n-butane (by rotating C₂ - C₃)



C-2 → front $\Rightarrow (0^\circ)$

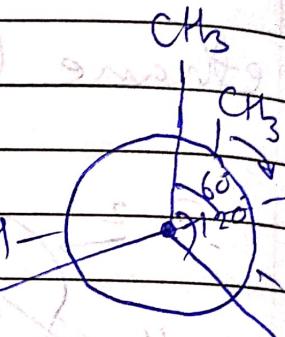
C-3 → back $\Rightarrow (180^\circ)$

• dihedral angle → angle between two planes



$0 = 0^\circ$ (fully) ECLIPSED.

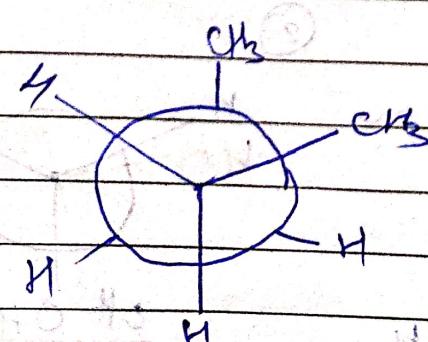
0 b/w CH₃ & CH₃, H & H, H & H = 0°
in eclipsed



after 60° rotation ⇒

C-2 → (fixed) C-3 (rotate) →

or C-2 (rotate) & C-3 (fix).

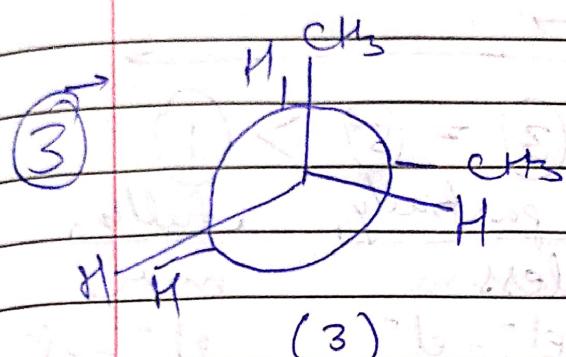


SKEW

or GAUCHE

\Rightarrow 1/2 methyls
in 60°

Another 60° rotation in skew :-



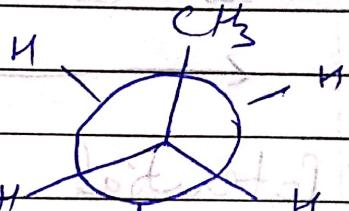
Partially Eclipsed

↳ not fully matched

(dihedral angle = 120°)

(3)

→ Another 60° →

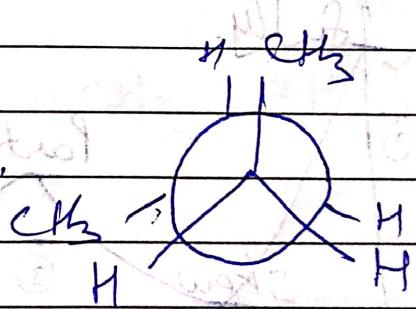


staggered

$$\theta = 18^\circ$$

(Highest stability)
& least P. E.)

Another $60^\circ \rightarrow$

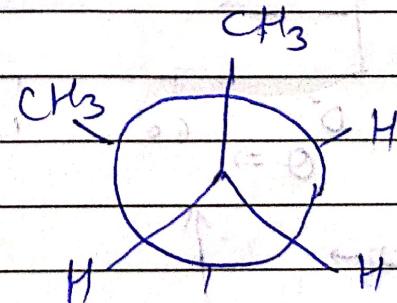


partially eclipsed.

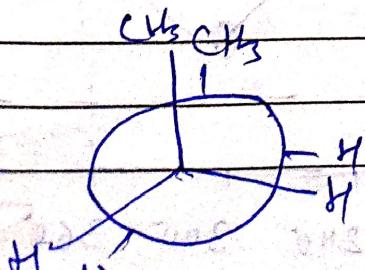
$$(O = 120^\circ)$$

⑥ → Another 60° →

SKEW/GAUCHE →



7) \rightarrow Another 60° (360° total)



fully eclipsed

$\theta = 360^\circ$ or 0° Page No. 4

Stability order :-

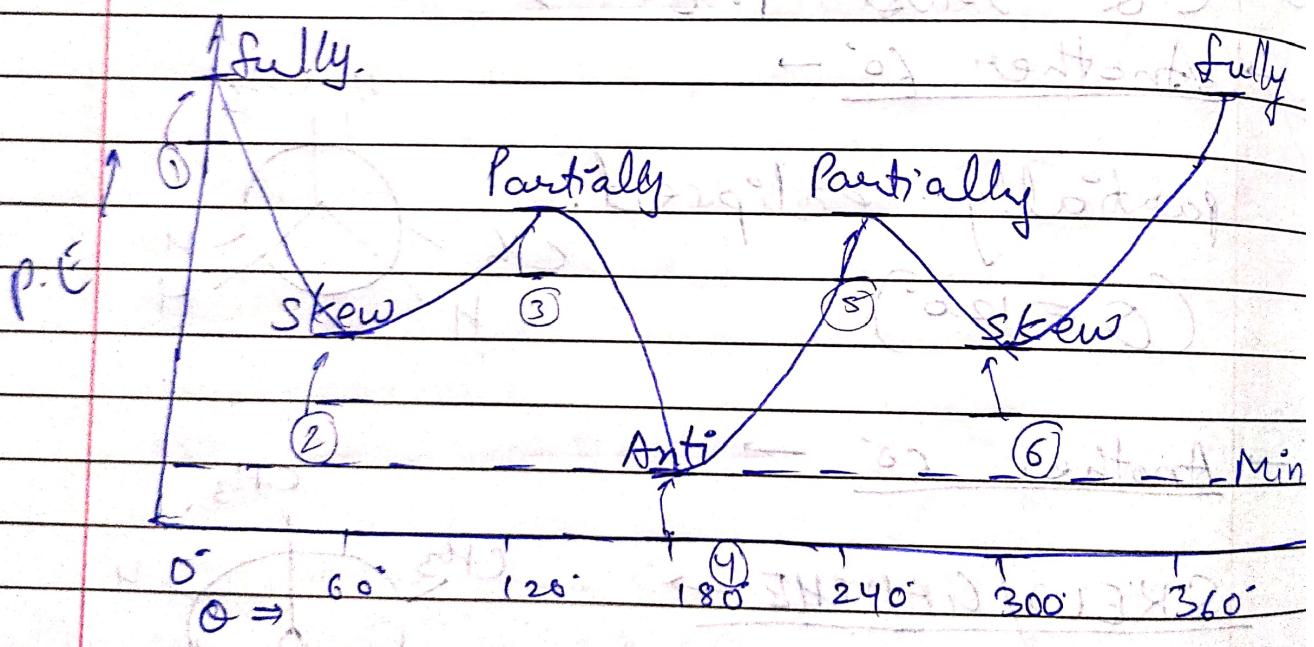
$$(4) > (2) = (6) > (3) = (5) > (1)$$

Anti, skew + partially, fully
Least steric hindrance less more
steric steric $\text{el}^- - \text{el}^-(\text{e})$ $\text{el}^- - \text{el}^-(\text{e})$
hindrance hind. repulsion repulsion

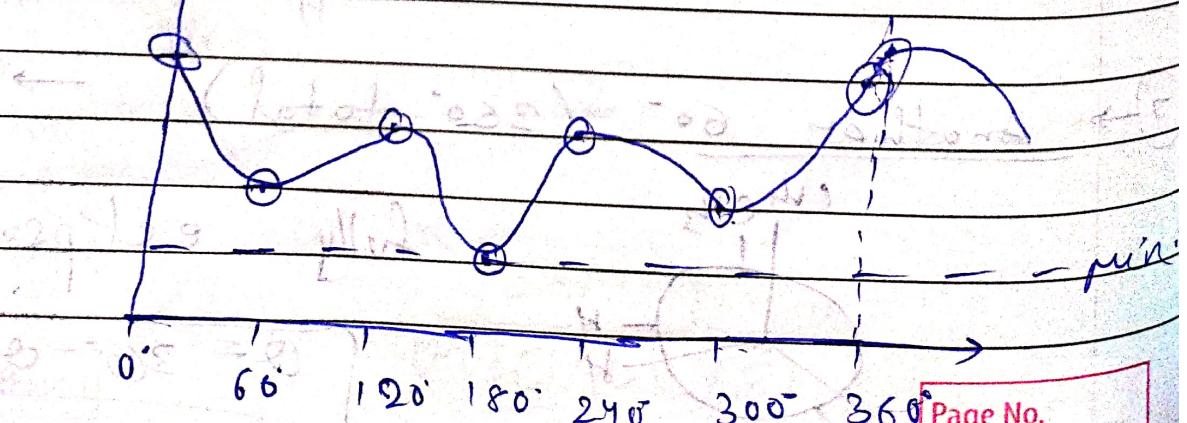
P.E.

→ Potential Energy diagram :-

for n-butane when you rotate
 $\text{C}_2 - \text{C}_3$ (solid to liquid)



redraw -



Date 8/7/25



for mid-term

n-butane

E
etc.

Stereoisomerism → [Page - 973]

real,

28 marks

18 from book

10 from class

Isomerism

Constitutional isomerism

Stereoisomerism

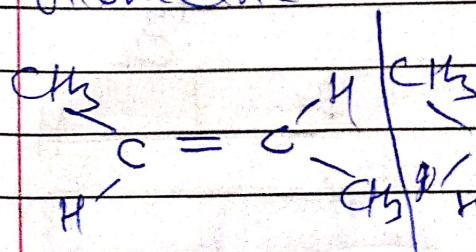
→ Constitutional → $\text{CH}_3-\text{O}-\text{CH}_3$ (I)

same molecular formula but different properties.

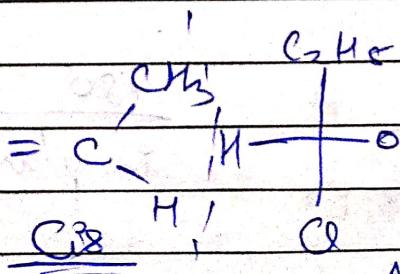
→ Stereoisomerism → (973)

(molecular formula same but structural formation different)

Geometrical

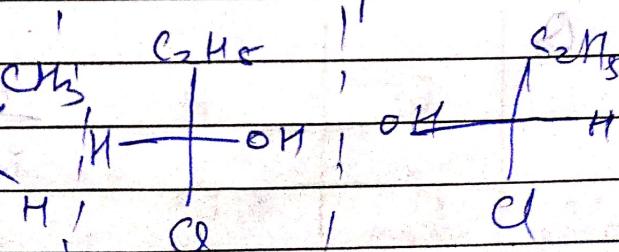


Trans



Cis

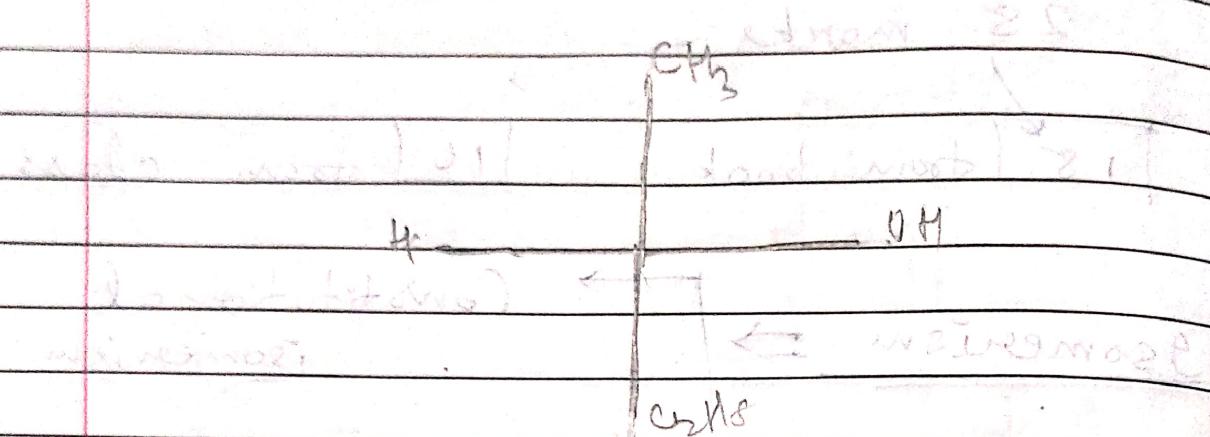
Optical



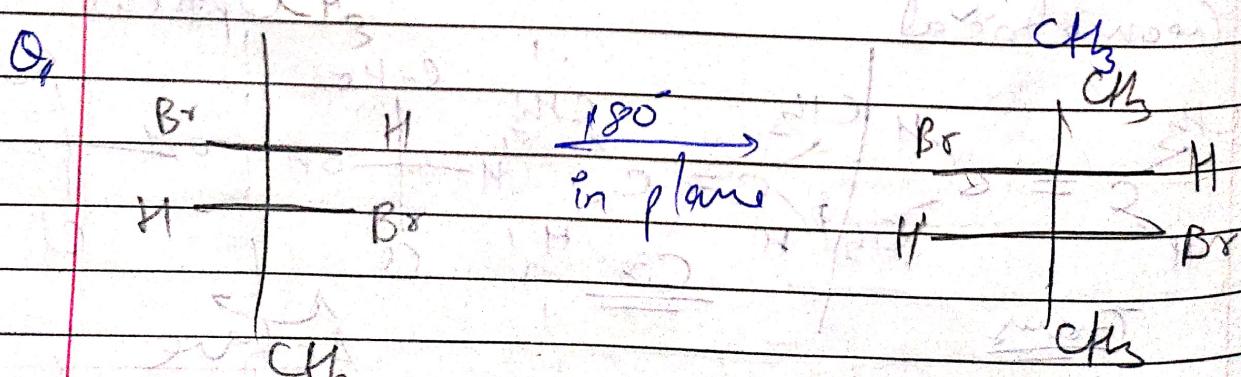
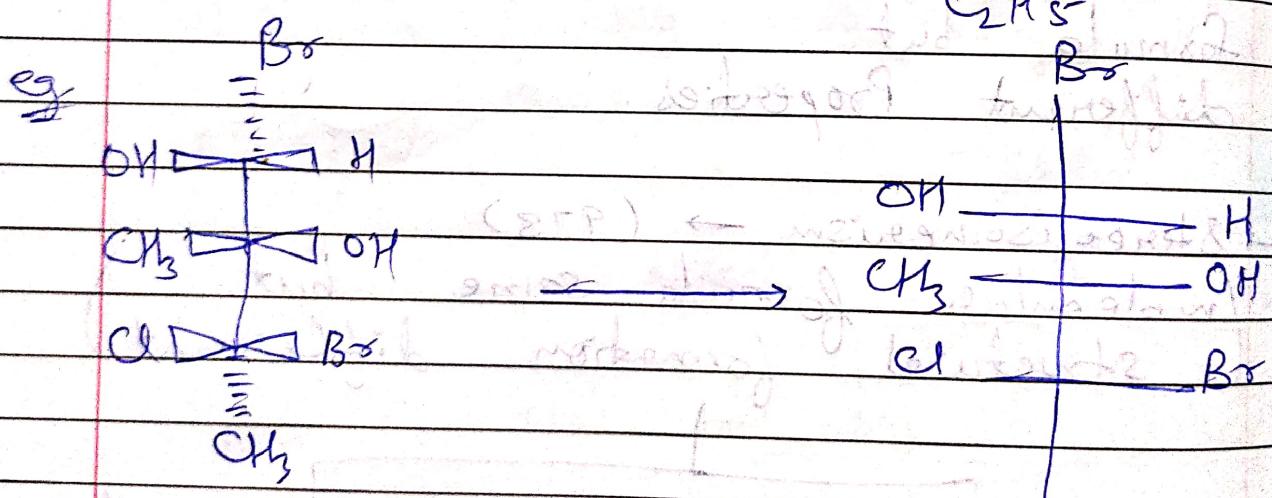
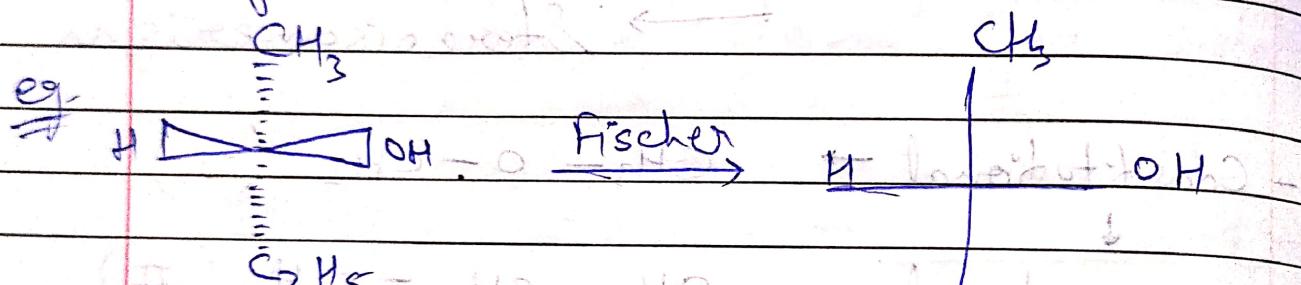
Active
(non-superimpose)

FISCHER PROJECTION

formula



→ Only 180° rotation allowed

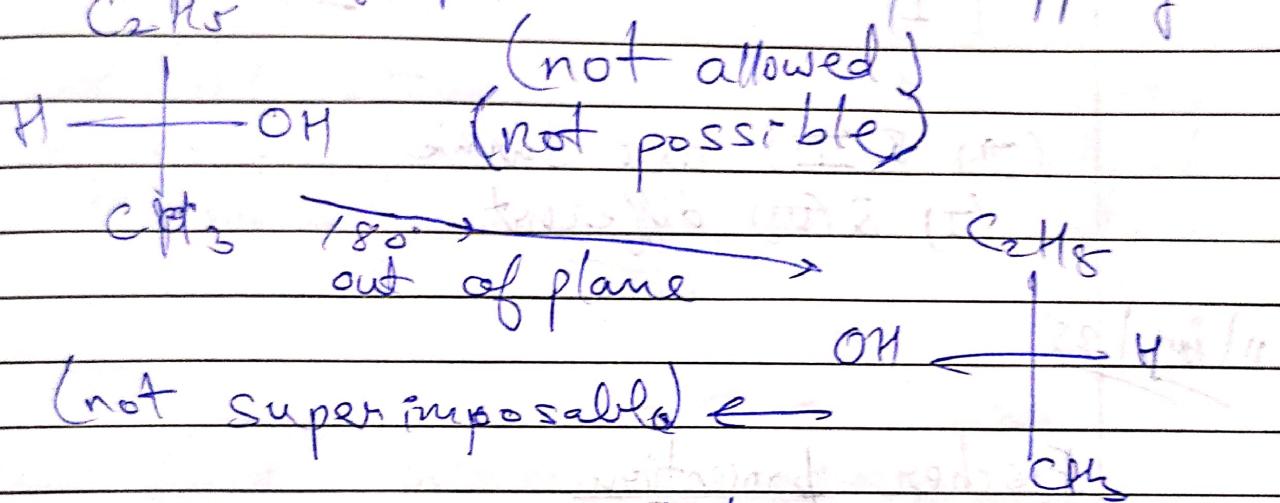




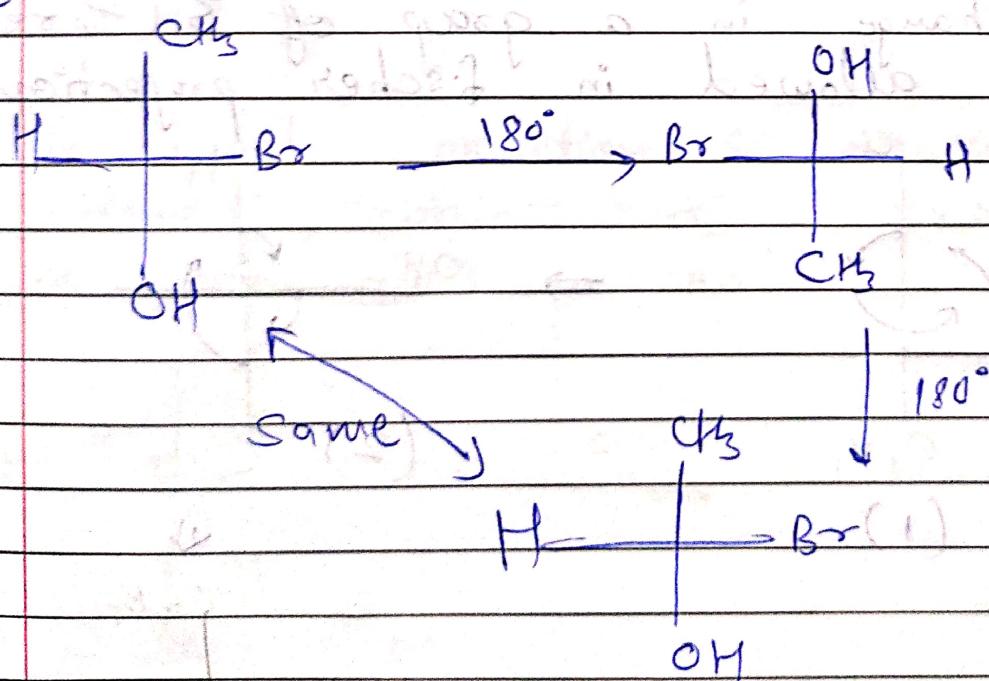
For Fischer projections, there are few rules:

① 180° in-plane rotation is allowed.

(x). 180° out of plane rotation / flipping

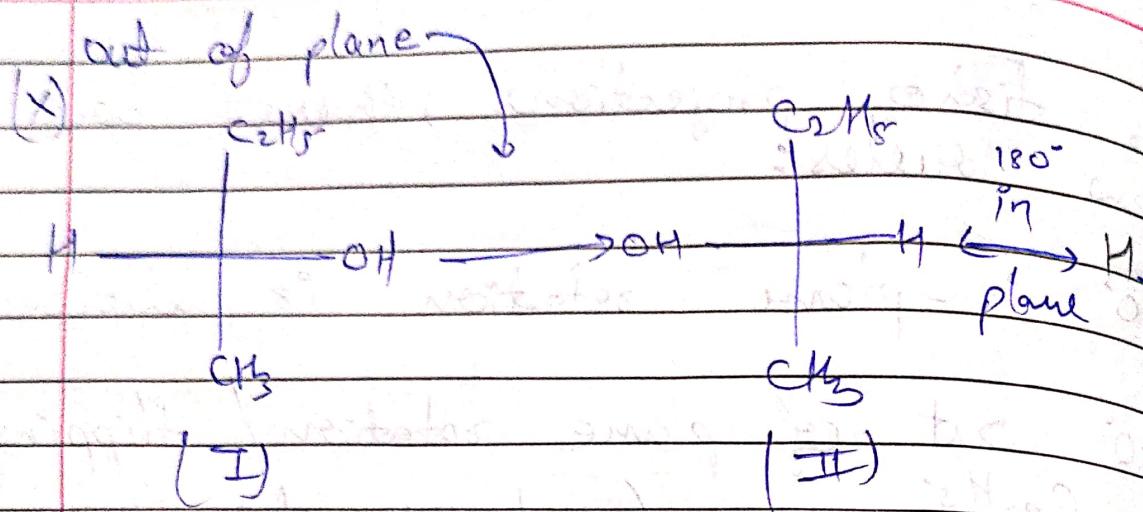


e.g. of in-plane 180° rotation \rightarrow



* out-of-plane rotation (for conical enantiomers). that is why it is not allowed

Date 18/8/



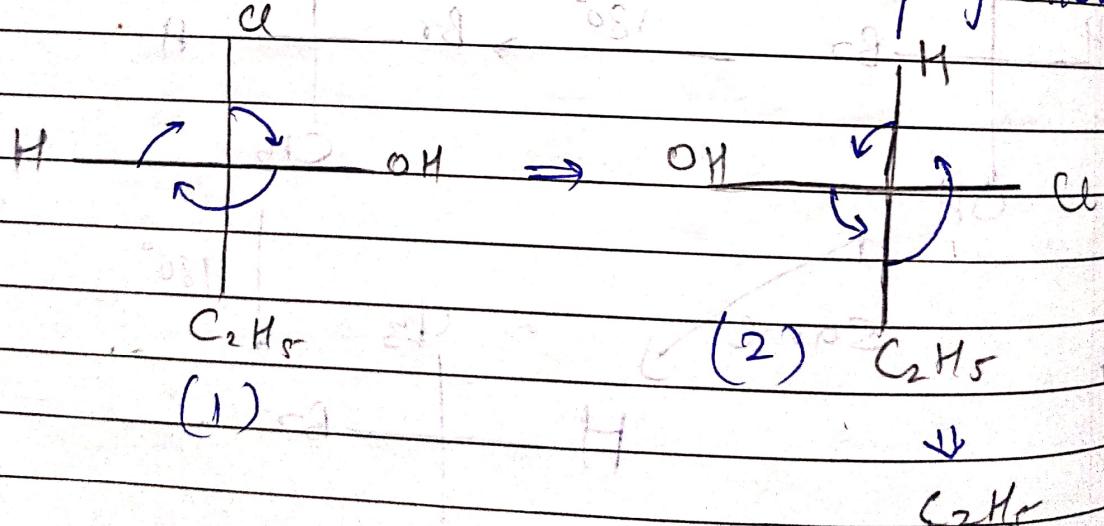
(II) & (III) are same

(I) & (III) different.

11 Aug. 25

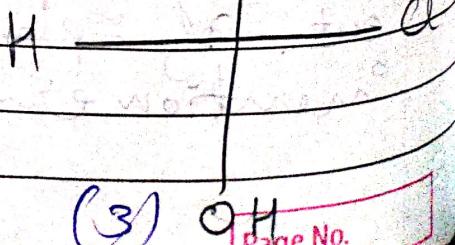
Fischer projection

↳ Exchange in a group of 3 (three) is allowed in Fischer projection.



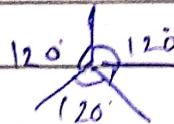
(1) ≡ (2) ≡ (3)

these all are equivalent structures



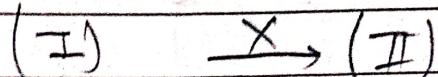
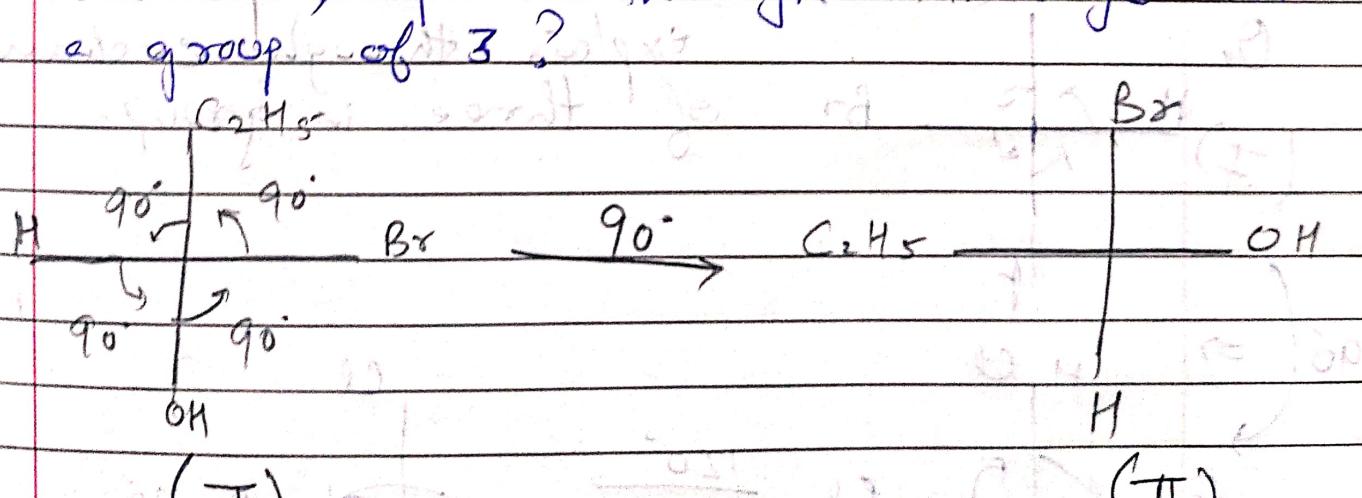
exchange in a group of three is allowed because this is nothing but the internal rotation.

- the operation is equivalent to an internal rotation.
- this will become clear that using the exchange in a group of three exact molecule will not be changed



- each 120° internal rotation is equivalent to 1 exchange in a group of 3.

- Q, in Fischer projection 90° rotation is not allowed, explain through exchange in a group of 3?

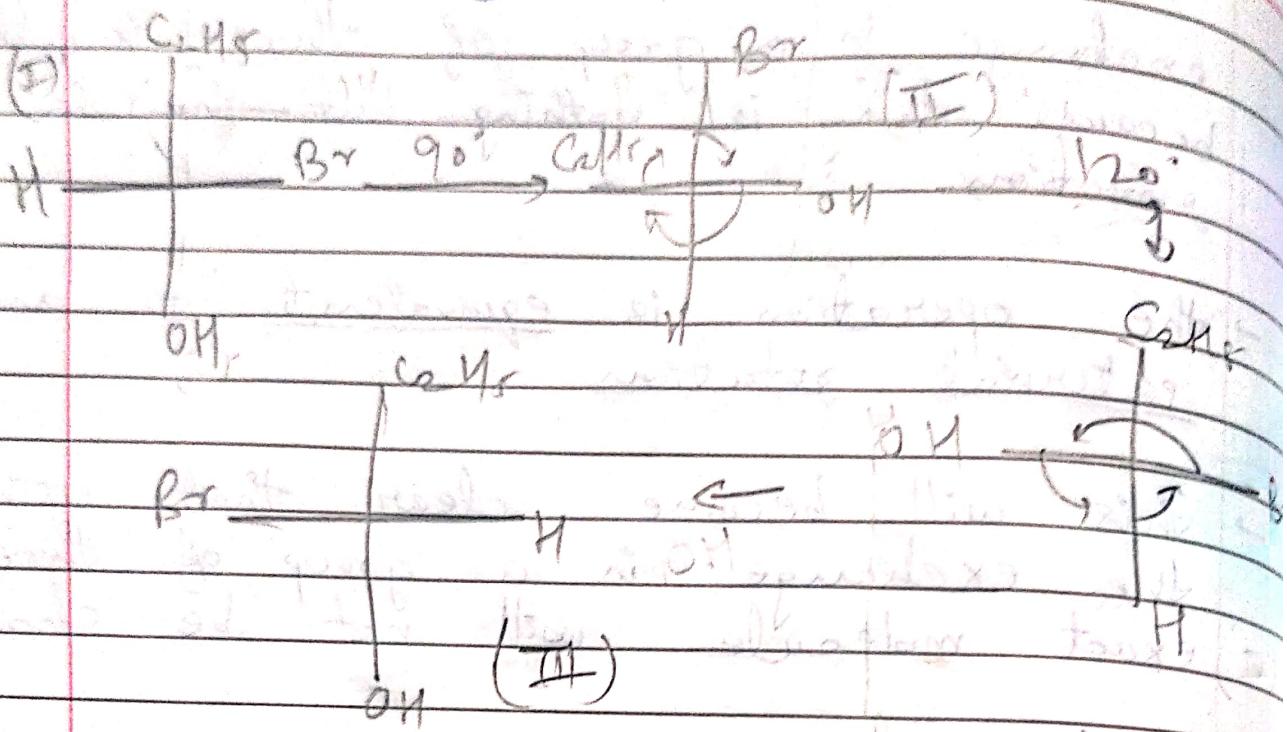


they both are not equivalent as...

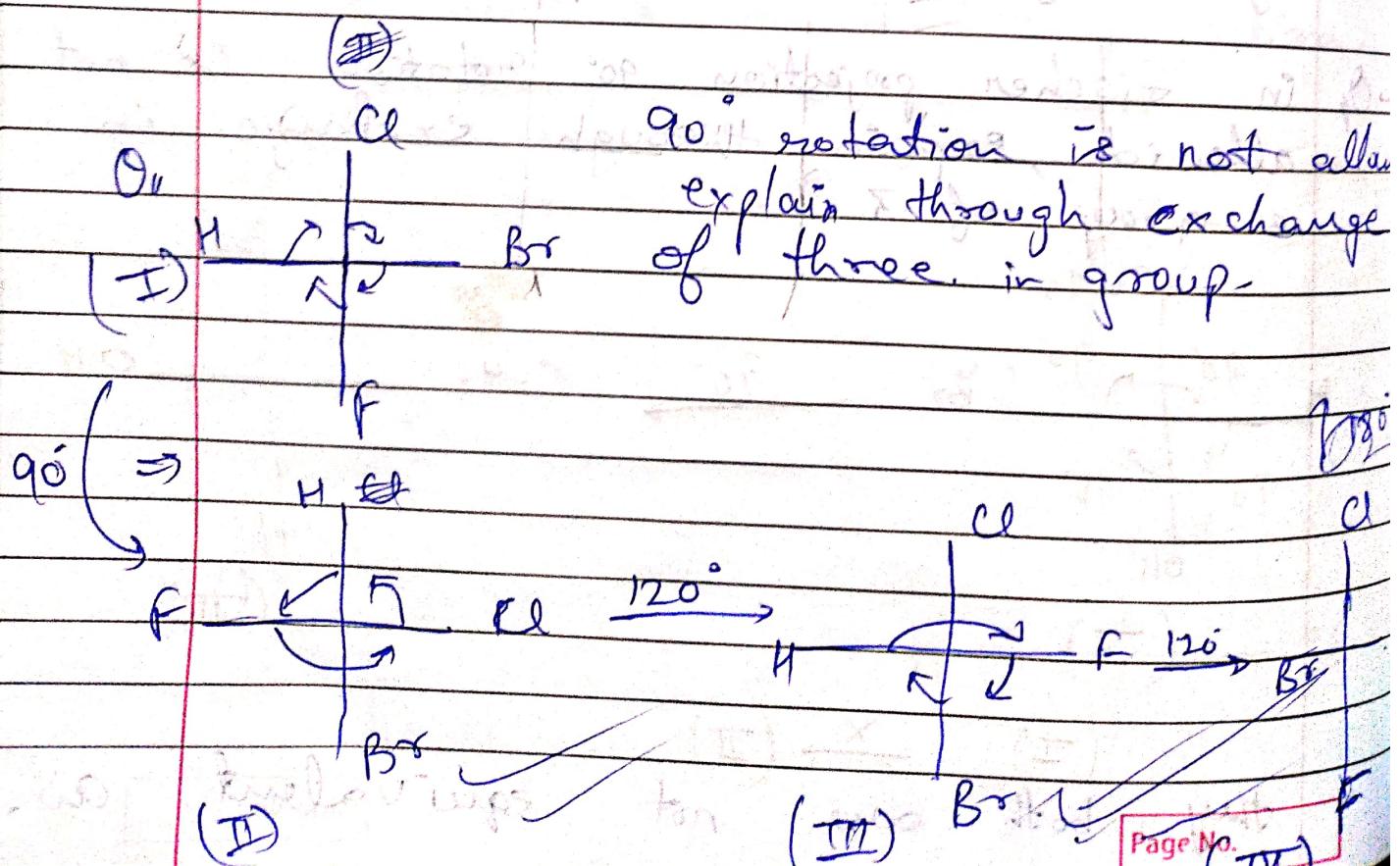
Date / /

2023

90°(X) ($I \neq II$)



now, (I) & (II) & (III) ~~are enantiomers~~
are enantiomers as they have
followed non-superimposable mirror image
property.



now, (I) & (IV) are enantiomers
as they are non-superimposable mirror
images so, 90° rotation is not allowed