

ISOMERS

Compound having same M.F

but diff physical & chemical prop.

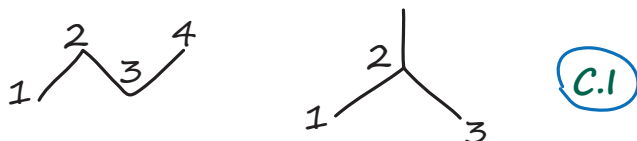
Types of Isomerism

1. Structural isomerism ✓ Mf = same, structure diff, IUPAC name diff
2. Stereoisomerism ✓ Mf = same, diff orientation of groups in space, IUPAC name same

Types of Structural Isomerism

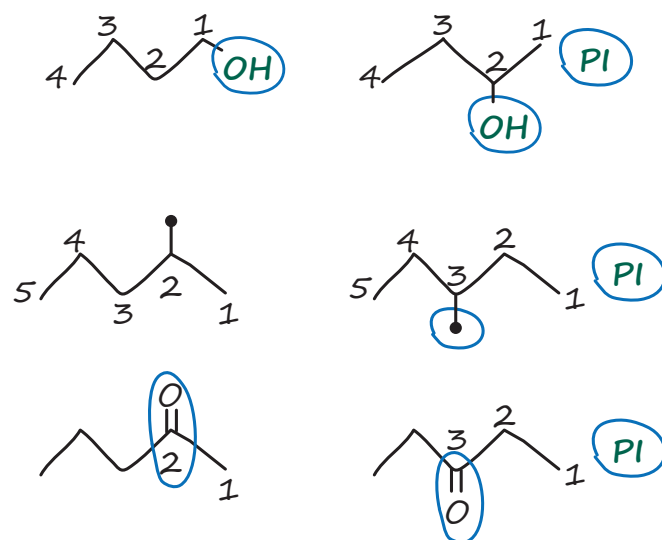
1. Chain Isomerism

Compound having same MF. but different parent chain.



2. Position Isomerism

MF = same, different position of branch like R or F.G. like OH, NH₂, OR, SH

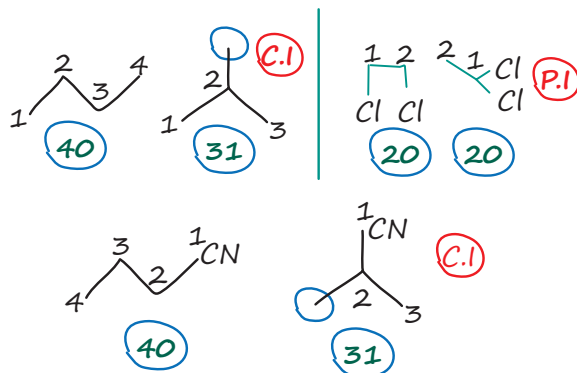


P.S.S.
Magic no. trick
for CI & P.I.
(XY)

x = no. of 'c' in parent chain

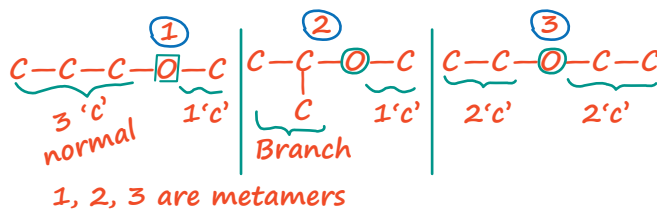
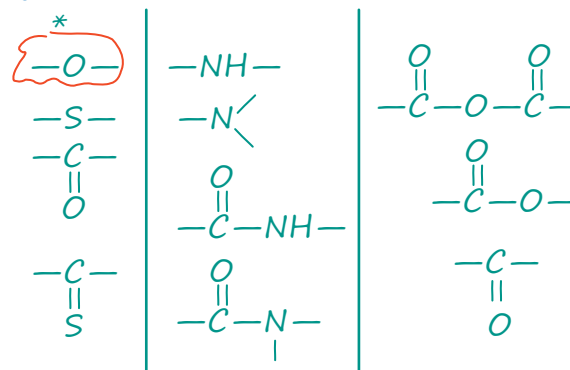
y = no. of branches of 'c'

Magic no $\Rightarrow$ diff $\Rightarrow$ C.I.
same $\Rightarrow$ P.I.



3. Metamerism

MF Same but difference in arrangement of atoms or groups from either side of Bridging funcⁿ group (Polyvalent)



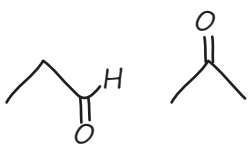
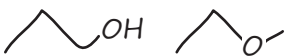
1, 2, 3 are metamers

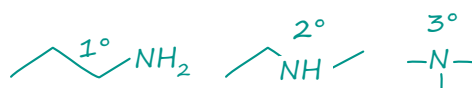
4. Functional isomerism

MF $\rightarrow$ same, different F.G.

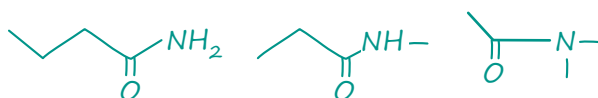


Some examples of F.I.

- a. Aldehyde & ketone: 
- b. Carboxylic acid & ester: CH_3COOH , HCOOCH_3
- c. Alcohol & ether: 
- d. Cyanide & isocyanide: RCN , RNC
- e. 1° , 2° , 3° amines:



- f. 1° , 2° , 3° amides:



- g. diene, yne: 

5. Ring Chain Isomerism

MF $\Rightarrow$ same

1^{st} $\rightarrow$ Ring

2^{nd} $\rightarrow$ Chain



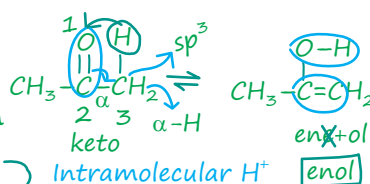
6. Tautomerism

Keto-enol system

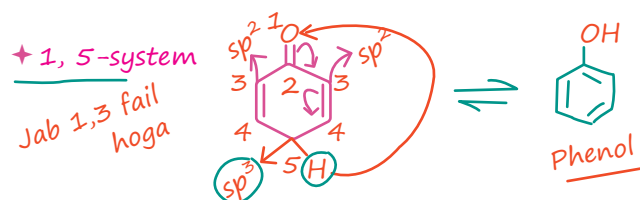
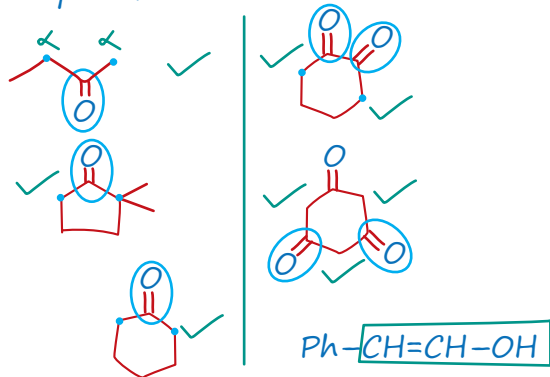
1, 3-system

Condⁿ for exhibition of tauto.

- ① α -C should be sp^3
- ② Presence of α -H



Examples of Tautomerism:



1,2-system



CALCULATION OF NUMBER OF STRUCTURAL ISOMERS

Degree of unsaturation (D.U)

or, double bond equivalent (D.B.E)

$$DU = (C + 1) - \left(\frac{H + X - N}{2} \right)$$

C = no of 'C' atoms

H = no of 'H' atoms

X = no of 'X' atoms

N = no of 'N' atoms

DU = 0 $\Rightarrow$ all single bond

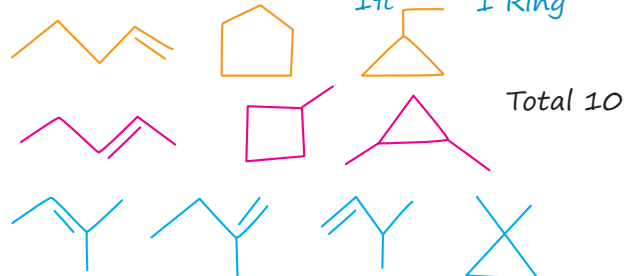
DU = 1
 $\swarrow \searrow$
1 π 1 Ring

DU = 2
 $\swarrow \searrow$
2 π 1 π + 1 Ring
2 Ring

Total structural isomers

① C_5H_{10} $DU = (5 + 1) - \left(\frac{10 + 0 - 0}{2} \right)$

$= 6 - 5 = 1$
 $\swarrow \searrow$
1 π 1 Ring



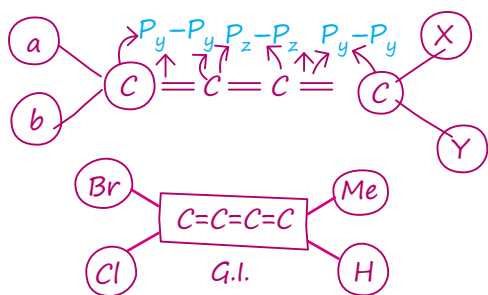
* Alkanes No. of structural isomers

C_4H_{10} 2

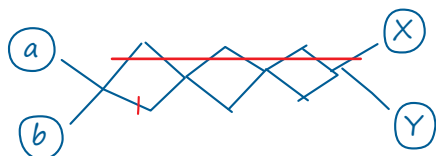
C_5H_{12} 3

SPECIAL CASES

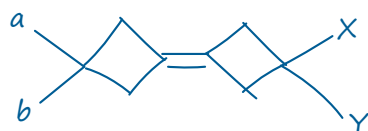
Case 1: Odd no. of cumulative double bond



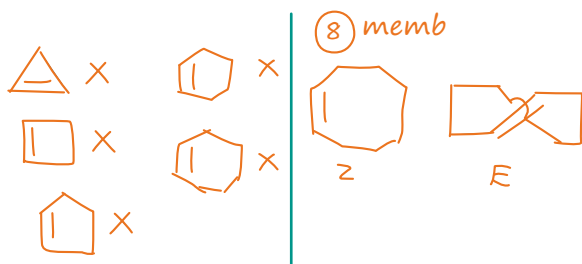
Case 2: Odd no. of Rings (spiro)



Case 3: Cumulative double bond + Ring = odd



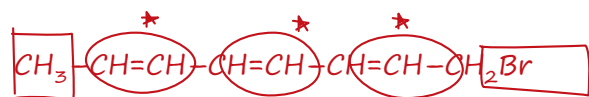
Case 4: Cycloalkene



CALCULATION OF G.I.

Case 1: If molecule is Unsymm

Total G.I. = 2^n , n = sites where G.I. exhibits



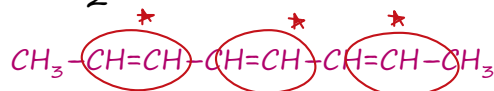
$n = 3$, Total G.I. = $2^3 = 8$.

Case 2: If molecule is symm.

Total G.I. = $2^{n-1} + 2^{p-1}$

$$P = \frac{n}{2} \quad (n = \text{even})$$

$$P = \frac{n+1}{2} \quad (n = \text{odd})$$



$$n = 3$$

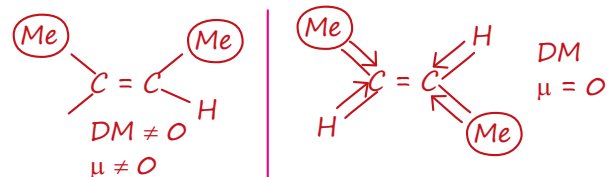
$$P = \frac{3+1}{2} = \frac{4}{2} = 2$$

$$\begin{aligned} \text{Total G.I.} &= 2^{3-1} + 2^{2-1} \\ &= 2^2 + 2^1 \\ &= 4 + 2 = 6 \end{aligned}$$

Properties of Geometrical Isomerism

a. BP: Cis > Trans

(BP $\propto$ DM)



b. MP: Cis < Trans

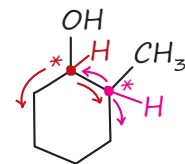
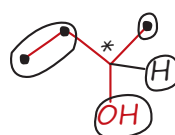
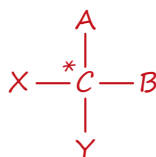
c. Stability: Cis < Trans

d. Solubility: Cis > Trans

2. Optical Isomerism

Chiral carbon

sp^3 'c' attached with 4 diff groups



★

If compound rotates PPL
(O.A)

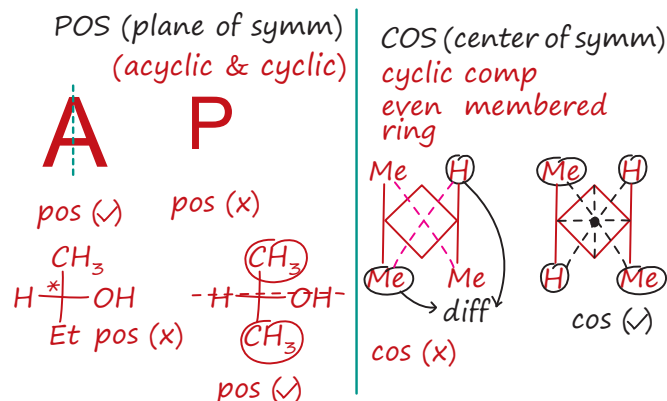
If compound does not rotate PPL
(O.I.A)

→ dextrorotatory
'd' or +
'l' or -
laevorotatory

- ★ condⁿ for exhibition of opti Iso:
assymetry(chirality).

pos	cos	comp
✓	✓	OIA
✓	x	OIA
x	✓	OIA
x	x	O.A ←

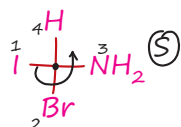
★



- ★ R/S nomenclature

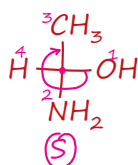
In fischer projection formula

Case ① if ④ is on vertical then check direction of movement from 1→2→3



R → Rectus (CW)
S → Sinister (ACW)

Case ② if ④ is on horizontal make a switch

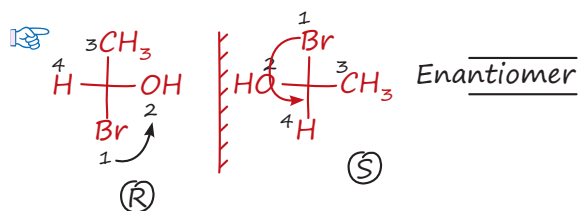
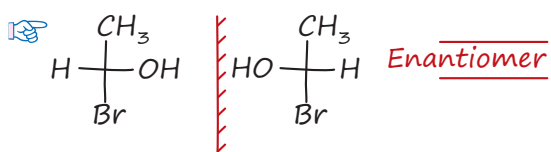


- ★ Relation b/w compounds

Case ① If only 1 chiral carbon is present

Answer : Enantiomer or Identical

Enan: 1) non super imposable mirror images
2) phy & chem prop same



P.S.S.

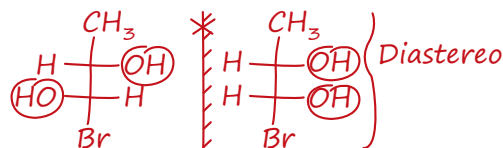
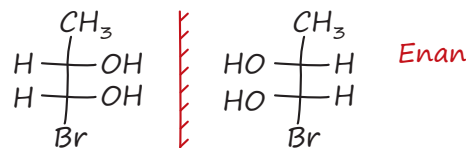
Jab Aankhon se na dikhe

Comp 1	Comp 2
R	S
S	R
R	R
S	S

E

I

Case ② If two chiral carbons are present

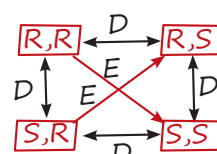


Answer

Enan
or
Iden
or
Diastereomer

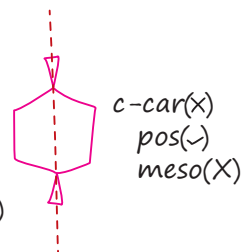
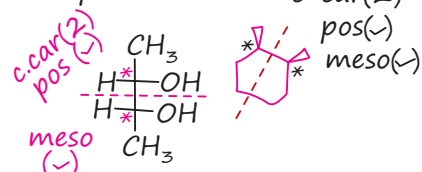
(1) not mirror images
(2) phy & chem prop diff

Comp 1 Comp 2



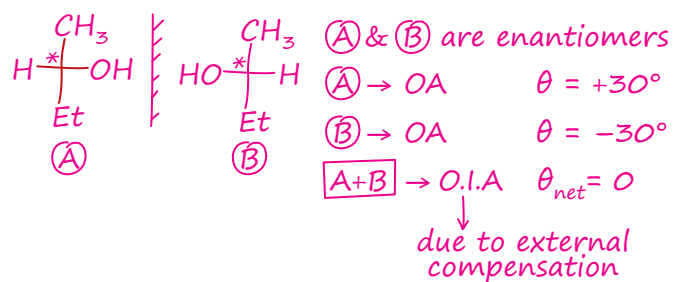
Meso Compounds

atleast 2 chiral carbon
with pos or cos



Racemic Mixture

equimolar mix of two enantiomers



Resolution

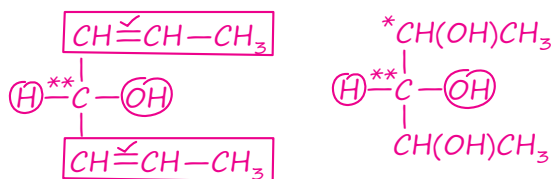
Sep of pure enantiomers from R.M



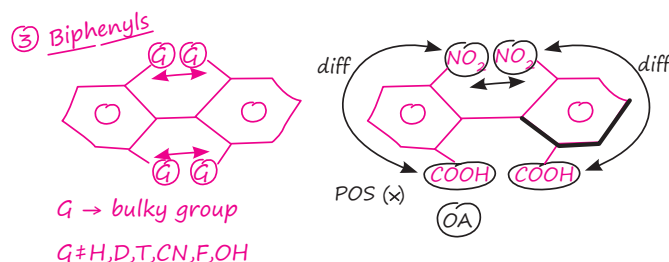
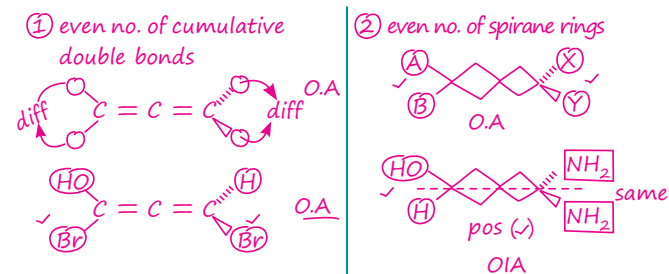
Pseudo Chiral Centres

a) 'c' attached with two diff group

b) other two groups are same bsut exhibit G.I or have chiral carbons



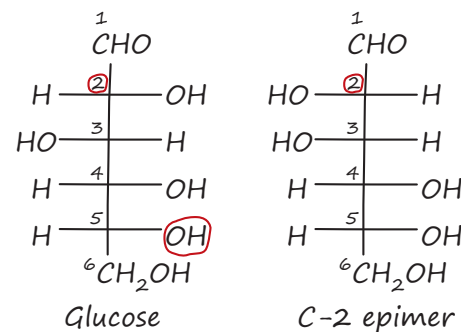
Special Cases



Epimers

P.S.S.

Diastereo
but 1 chiral
carbon
par he
config
change
hoga



Calculation of Optical Isomers

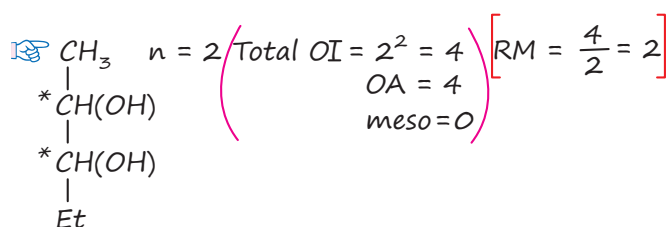
Case (1) if molecule is unsym

Total O.I = 2^n n = chiral carbon

O.A = 2^n

meso = 0

R.M = $\frac{\text{O.A}}{2}$



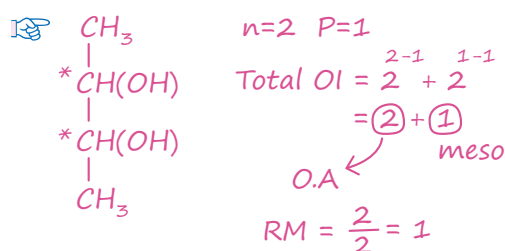
Case (2) If molecule is sym

(a) n = even $P = \frac{n}{2}$

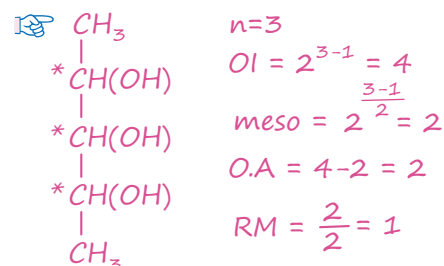
Total OI = $2^{n-1} + 2^{p-1}$

OA $\leftarrow$ meso

R.M = $\frac{\text{O.A}}{2}$

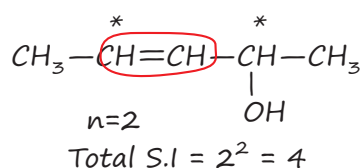


(b) $n = \text{odd}$
 Total OI = 2^{n-1}
 $\text{meso} = 2^{\frac{n-1}{2}}$
 $\text{OA} = \text{OI} - \text{meso}$
 $\text{R.M} = \frac{\text{OA}}{2}$



Calculation of Stereo Isomers

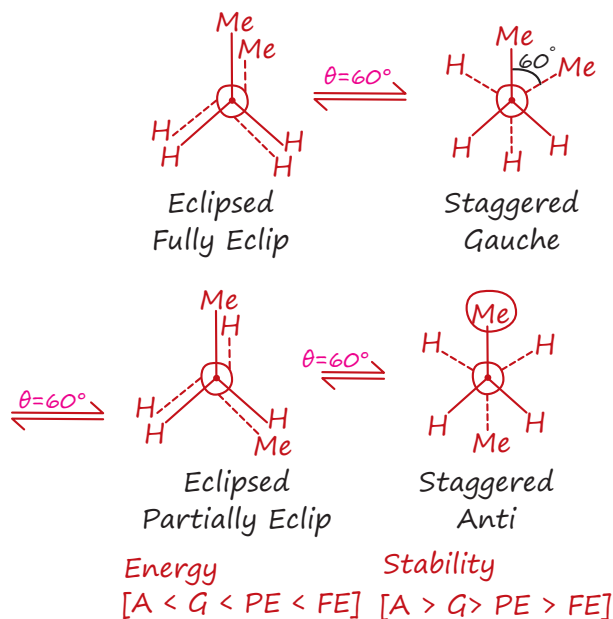
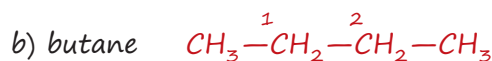
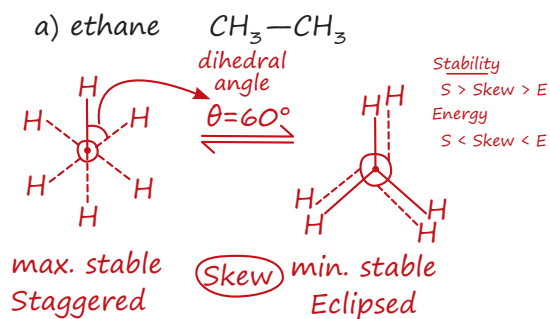
$n = \text{chiral carbon} + \text{site of GI exhibition}$
 $\text{Total S.I} = 2^n$
 stereogenic area



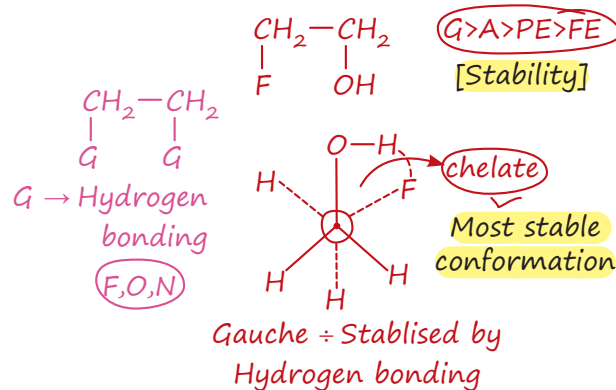
Conformational Isomerism

- 1) free rotation around σ bonds
- 2) C—C σ bond ✓
- 3) Total Conformers = ∞

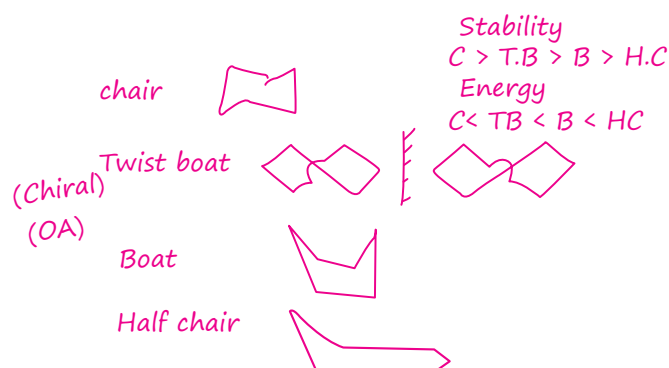
Conformers of Alkanes



Gauche Effect



Conformers of Cyclohexane



Jo kahi geere nahi, unhe kha asmaan ki uchaiyo ka pata hota hai.