

Organic Chemistry

→ Theory on Organic chemistry -

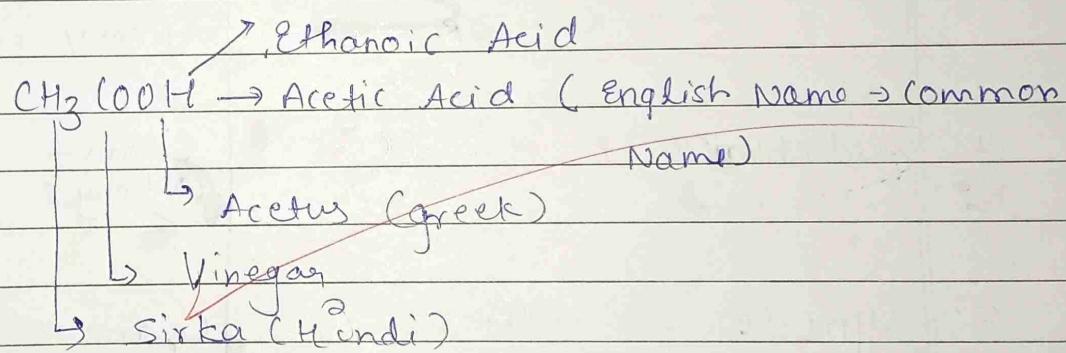
- Vital force Theory - Berzelius - (Religion Belief)

Other → Friedrich Wohler → Urea $\{ \text{NH}_2 - (\text{O} - \text{N})\text{H}_2 \}$
 ↗ first organic compound

What is Organic Chemistry - Chemistry related to carbons and its derivatives

Why IUPAC Needed - Many names for one compound because of many regional languages.

Ex -



Word - Organic compound - (C-H) Hydrocarbons
 ↗ new → functional groups

→ Why all compounds have carbon -

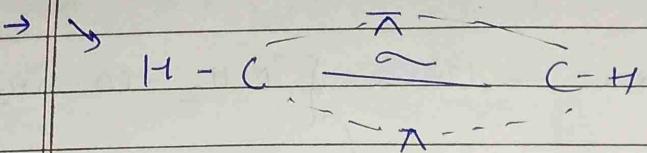
↳ Tetravalency

↳ Catenation.

Types of Bond -

→ Ionic Bond (sigma bond)

→ π (pie) bond



Functional Groups - (15-16) (Priority)

Prefix

Suffix

1.	Carboxylic Acid - COOH	carboxy -	oic acid
2.	Sulphonyl - SO ₃ +	Sulpho -	sulphonic acid
3.	Ester	Carbonyl Alkoxy	yl, -oak
4.	Acid chloride \rightarrow -C(=O)-Cl	Chloro - carbonyl	oyl chloride
5.	Cyano \rightarrow -CN	Cyano	-Cynide -nitroide
6.	Aldehyde \rightarrow -CHO	Formyl	-al
7.	Ketone \rightarrow -CO-	OxO	-one
8.	Alcohol \rightarrow -OH	Hydroxy -	-ol
9.	Thiol \rightarrow -SH	Mercapto	-thiol =amine

10. Amino $\rightarrow -\text{NH}_2$		amino	-amine
11. Alkane $\rightarrow -\text{C}=\text{C}-$	x		-one
12. Alkyne $\rightarrow -\text{C}\equiv\text{C}-$	x		-yne
13. Ether $\rightarrow -\text{O}-$		alk alk oxygen	

IUPAC

1. Selection of P.G \rightarrow (Side Chain)
2. Numbering \rightarrow lowest sum Rule.
3. Alphabetical Order.

Parent Chain

Chain containing (main functional group)

and having max no. of carbon atom (highest priority)

Classification of Organic Compounds.

Acyclic Comp. (Aliphatic)
(open)

Straight chain

Branched Chain.

Cyclic Comp.
(closed)

Homocyclic
(Carbo cyclic)

Alicyclic

Aromatic

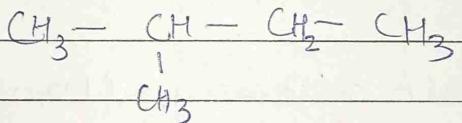
Heterocyclic

Examples -

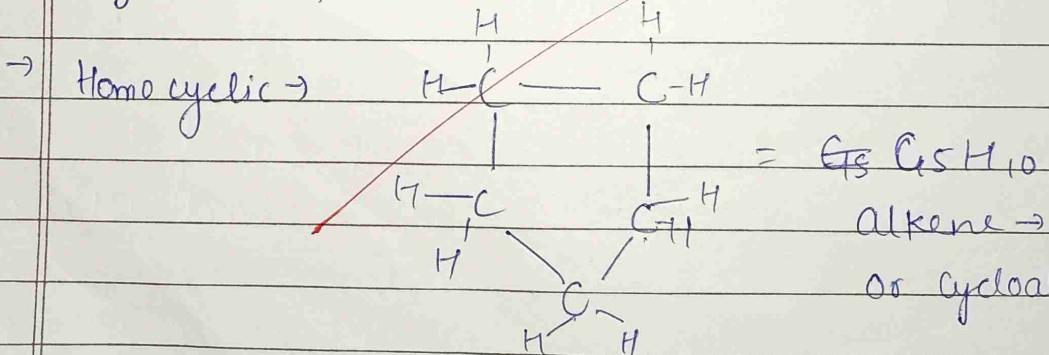
① Acyclic → (Open chain compound)

→ straight Chain $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 -$

② Branched Chain - 2-methylButane

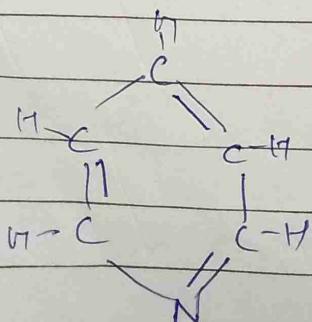


(2) Cyclic compound -



① Name → Cyclopentane

→ Heterocyclic →



$\text{C}_5\text{H}_5\text{N}$ (Pyridine)

Both cyclic & Acyclic
Aliphatic
↳ Alkanes
↳ Alkenes
↳ Alkyne.

Classification of Homocyclic ^{Acylic}

→ Aromatic Compounds -

↳ good smell

→ Ex- Naphthalene Napthelene

→ Benzene

Representation of Organic Compound.

1. Molecular formula -

- Give information about no. of atoms.

(Dis) → Doesn't tell about the nature of Bonding.

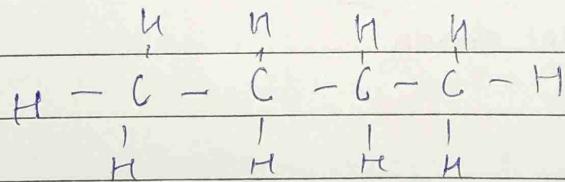
Ex- Butane C_4H_{10}

Butene = C_4H_8

2. Graphical formula -

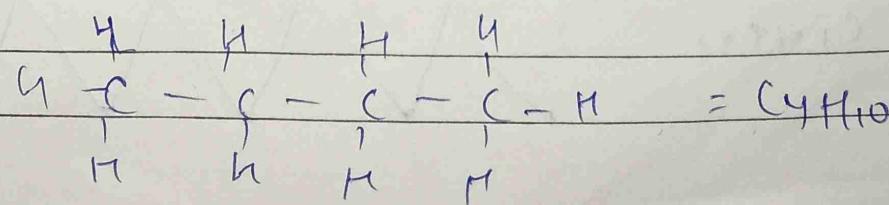
- It shows clear picture of no. of atoms means gives wide information
- It shows bonding
- It is time consuming (Dis)

Ex- Butene



3. Structural formula - It shows C-C bond

- Doesn't show C-H bond.

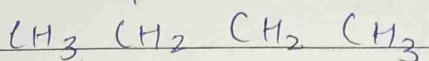


Condensed formula -

- It doesn't show (C-C) single bond
- Doesn't show (C-H) bond
- It shows C=C, C≡C

Ex -

• Butane (C₄H₁₀)



• Butene CH₃ CH CH CH₃

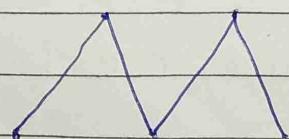
• Pentyne (C₅H₈)



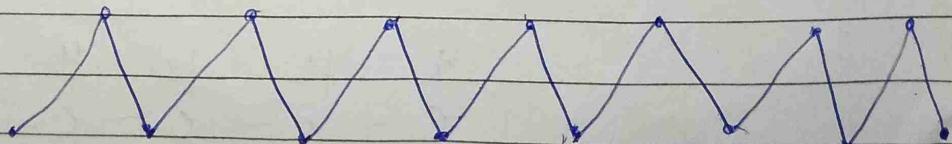
Bond line formula / structure :-

- Only bonds are shown
- Carbon atoms are not shown.
- (C-C) → —
- (C=C) → =
- (C≡C) → ≡
- End & bending point comprise of carbon atom.
- (CH) bond is also not shown.

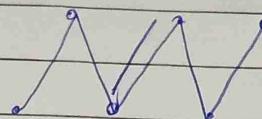
→ Ex - C₅H₂



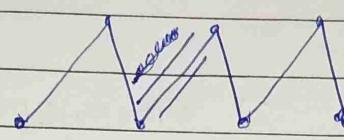
→ C₁₅H₃₂



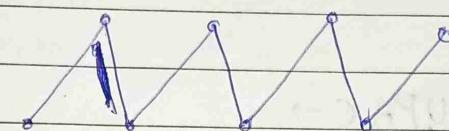
→ Hex-3-ene



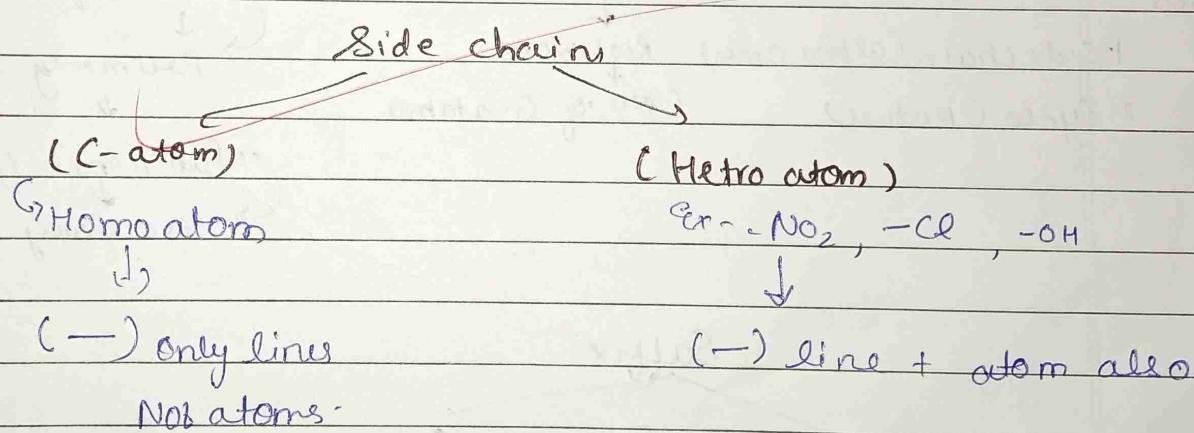
→ Hept-3-yne



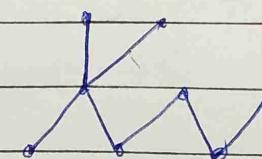
→ Oct-2-ene



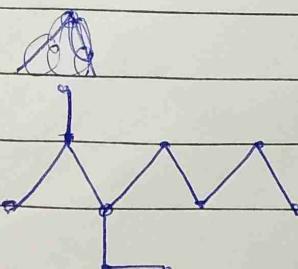
→ NOTE - If side chains are given



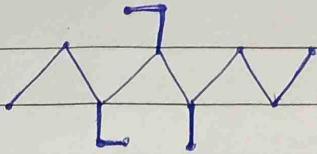
e.g. → 2,2-dimethyl hexane



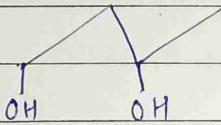
3-ethyl-2-methyl heptane



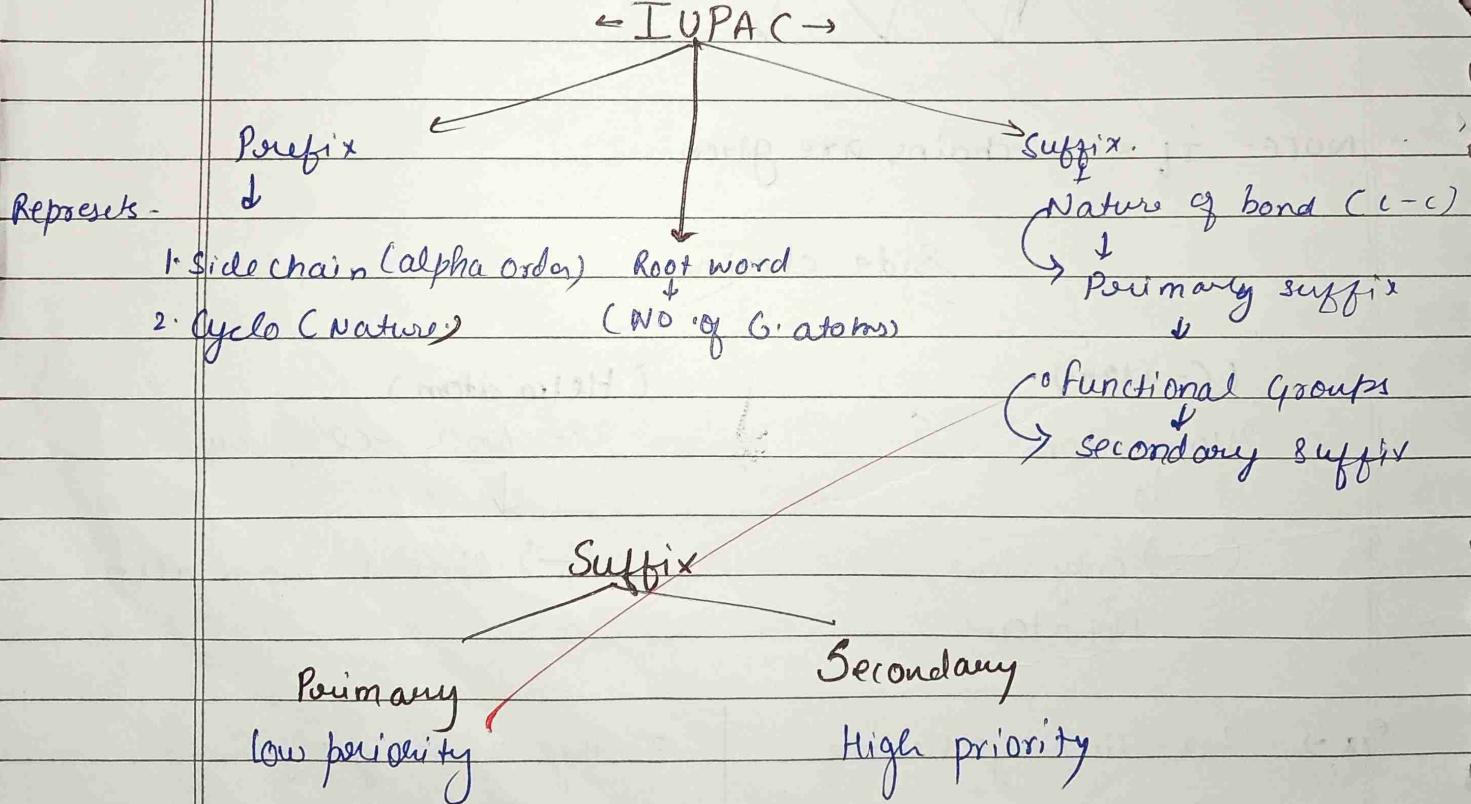
(3) 3,4-diethyl-5-methyloctane



(4) Butan - 1,3-diol



(5) 3-Methyl Hexanoic acid.



Priority Table of Functional Groups.

Functional groups

Prefix

Suffix

1. Carboxylic acid - COOH	Carboxy-	oic acid
2. Sulphonyl - SO ₃ F	Sulpho-	sulphoic acid
3. Ester CH ₃ -C(=O)-O-CH ₃ ↓ -C(=O)-OR	Carbonyl Alkoxy	yl, -oak
4. Acid chloride → -C(=O)-Cl	Chloro- carbonyl	oylechloride
5. Cyanide → -CN -C≡N	Cyano	-cyanide -ni+sid
6. Aldehyde → -CHO	Formyl	-al
7. Ketone → -C(=O)-	Axo	-One
8. Alcohol → -OH	Hydroxy-	-ol
9. Thiol → -SH	Mercapto	-thiol
10. Amine → -NH ₂	Amino	-amine
11. Alkene → -C=C-	X	-ene
12. Alkyne → -C≡C-	X	-yne
13. Ether → -O-	Alkoxyalkan	

(I) Aliphatic Compounds - (Straight chain compounds)
↳ ~~Alkane~~ Alkane

↳ Alkane Alkane

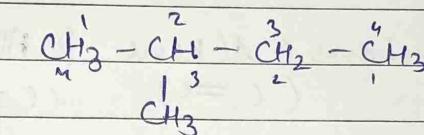
Example → $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2$

Rule-1 \rightarrow Selection of parent chain

Rule - 2 → Numbering

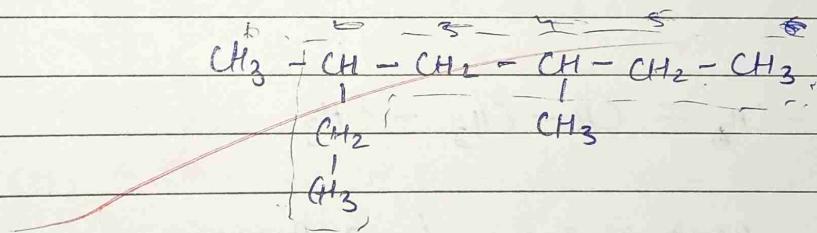
Name → Pentane

Example-2 → Alkane with side chain.

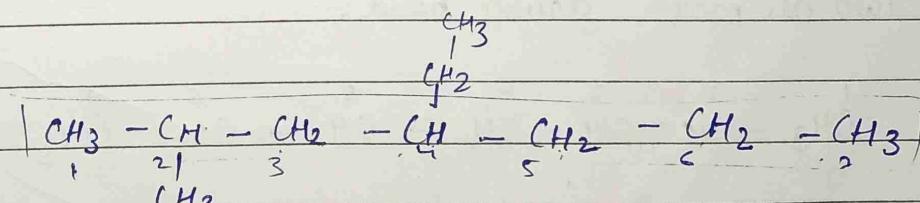


Name → 2-methyl Butane

Example - 3 alkanes with multiple side chain.



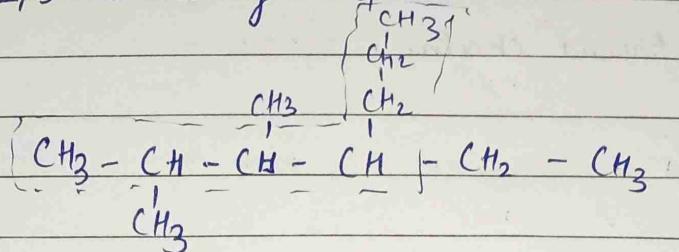
Name - 2-ethyl Heptane Pg) 3,5-dimethyl Heptane



Name - ~~2-methyl~~, ⁴₂-methyl-¹₁-ethyl-³₂-butane

Example - $\text{CH}_3 - \overset{7}{\underset{\text{CH}_3}{\text{CH}}} - \overset{5}{\underset{3)}{\text{CH}}} - \overset{1}{\underset{4)}{\text{CH}}} - \overset{2}{\underset{6)}{\text{CH}_2}} - \overset{3}{\underset{5)}{\text{CH}_2}} - \overset{2}{\underset{6)}{\text{CH}_2}} - \overset{1}{\underset{7)}{\text{CH}_3}}$

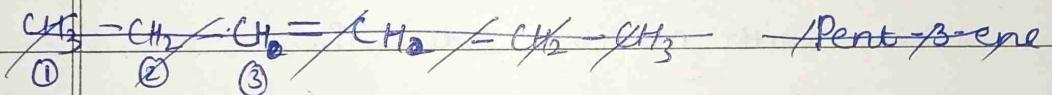
4-ethyl - 2,3-dimethyl Heptane



4-ethyl - 2,3-dimethylheptane

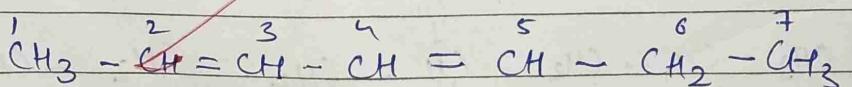
II Unsaturated Hydrocarbons (Alkene & Alkyne)

I ~~(X)~~ 1 double bond



Name → Pent - 2 - ene / 2 - Pentene

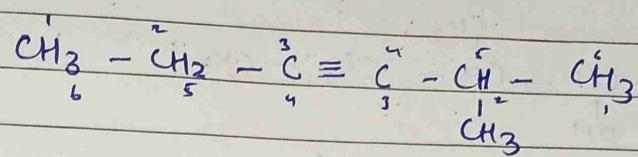
II Two or more double bonds:-



Hept - 2,4-diene / 2,4-Heptadiene

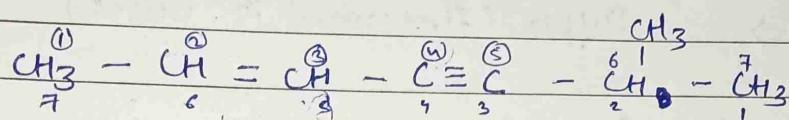
III (4) Multiple bond with side chains -

(1)

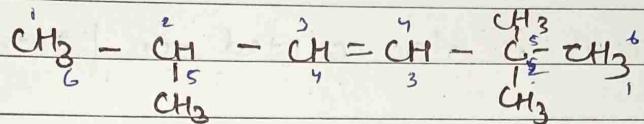


2-methyl Hex-3-yne

(2)



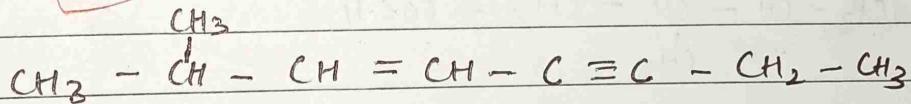
(3)



2,2,5-Triethyl Hex-3-ene

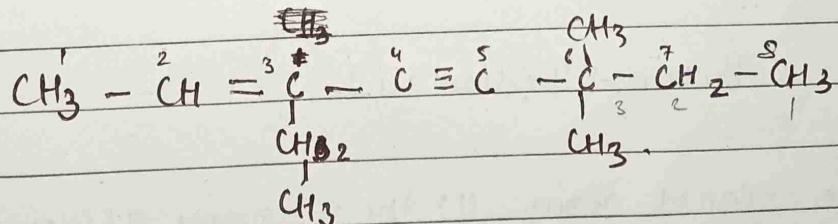
NOTE → Priority of Double bond is more than triple bond

(4)



2-Methyl ^{Oct}Hept-3-ene - 5-yne

(5)

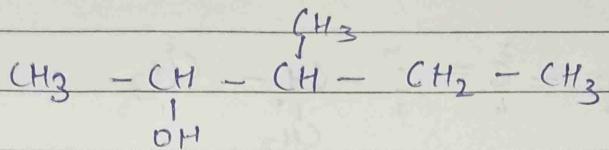


3-Ethyl-6-dimethyl Oct-2-ene-4-yne

III

Compound containing functional groups-

Ex-



3-methyl Pentan-2-ol

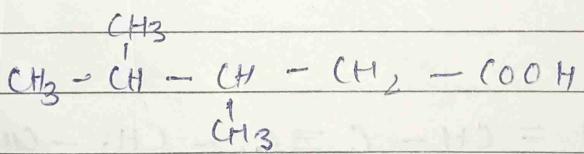
NOTE @ $\text{ane}-\text{C} \rightarrow$ suffix (first word is vowel)

Ex④

Carboxylic acid- (-COOH)

- The carbon of (-COOH) is also counted in parent chain
- It is the senior most member
- It is always present on end of parent chain
- Counting is also done from end of (-COOH)

{Ex-1}



W

3,4-dimethyl Pentanoic acid

Ex-2

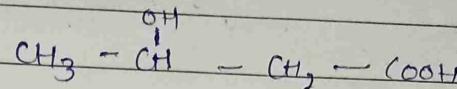


Butane-1,4-dioic acid

NOTE In case of multiple -COOH group, (i) try to cover all COOH in the parent chain - in addition to this try to get max. no. of carbon atoms

{(1) When two different functional groups are present }
 ↳ Senior → Suffix → only 1
 ↳ Junior → Prefix → More than 1

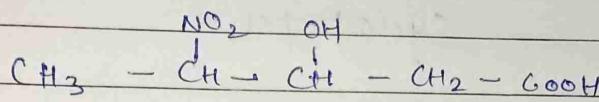
Ques. ex - ?



3-HydroxyButan-1-oic acid

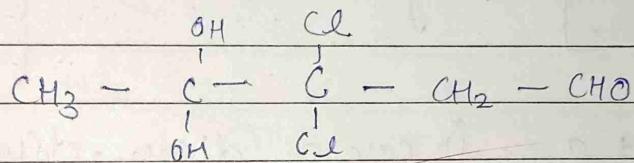
} when two F.G.
are present in
parent chain.

Ex. (2)



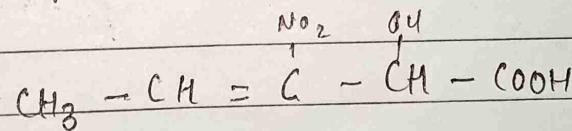
3-Hydroxy-4-nitro Pentanoic acid

Ex. (3)



3, 3-dichloro → 3, 3-dihydroxy Pentanal

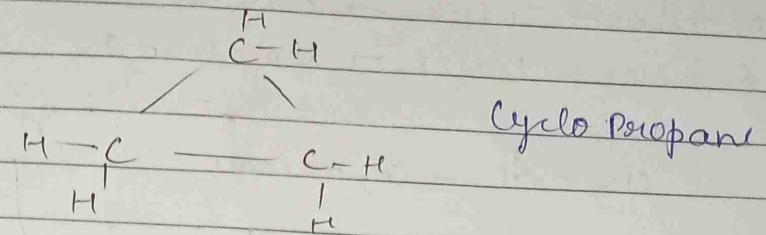
→ when multiple bond + F.G. →



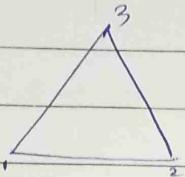
2-Hydroxy-3-Nitro Pent-3-en-1-oic acid

→ Cyclic compounds -

→

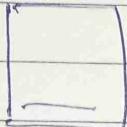


→



cyclo propene

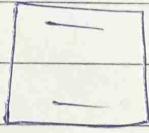
→



cyclo Butene

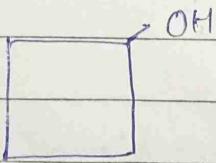
NOTE → Word Root + a In case of diene, diyne.

→



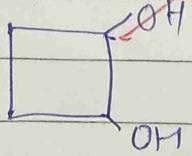
cyclo Butadiene

→



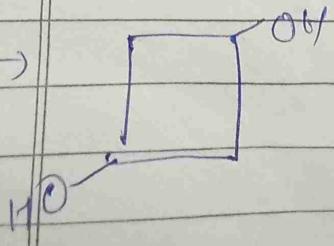
cyclo Butanol

→

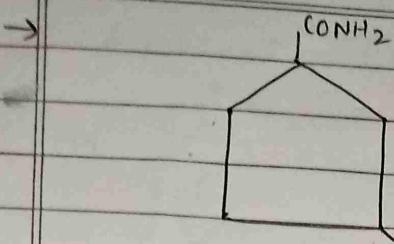


cyclo Butanediol
-1,2-

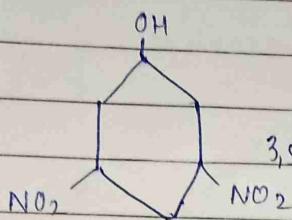
→



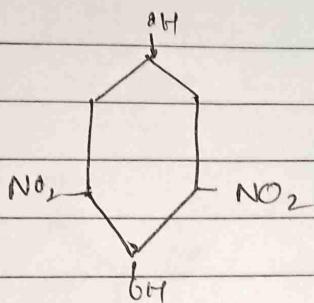
cyclobutane-1,3-diol
-1,3-



3-Nitro Cyclo Pentan-1-amide

NO₂

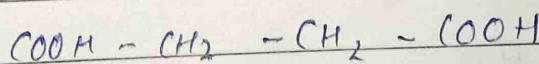
3,5-dinitro Cyclo Hexanol



3,5-Dinitro Cyclohexan -1,4-diol

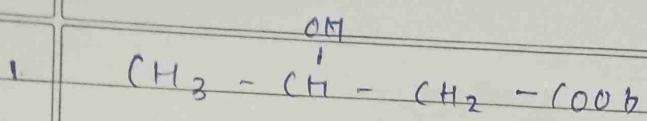
- # In case of multiple COOH group. try to cover all COOH in parent chain, + in addition to this try to get max. no. of carbon atoms.

Carboxylic acid

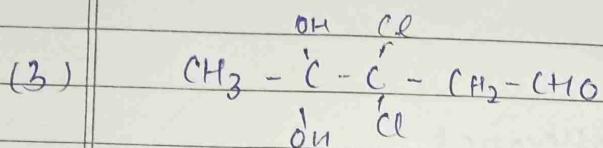
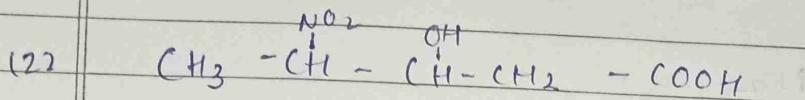


Butane-1,4-dioic acid.

- (*) When two diff functional groups are present.
 ⇒ senior - (suffix) only 1
 ⇒ junior (prefix) many.



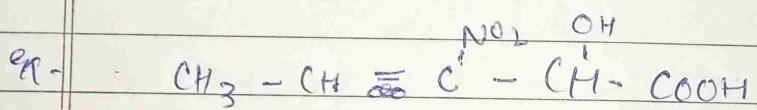
3-Hydroxy Butan-1-oic acid



3,3-dichloro-4,4-di hydroxy Pentanal.

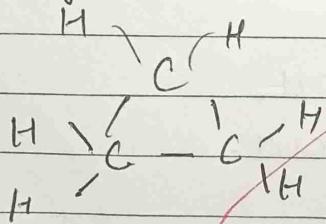


When multiple bond + f.c.:



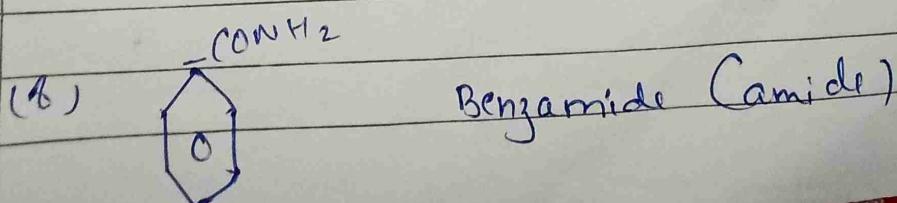
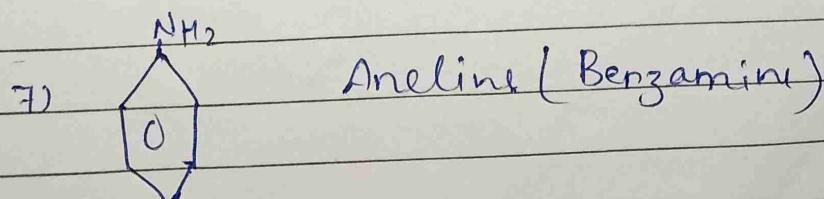
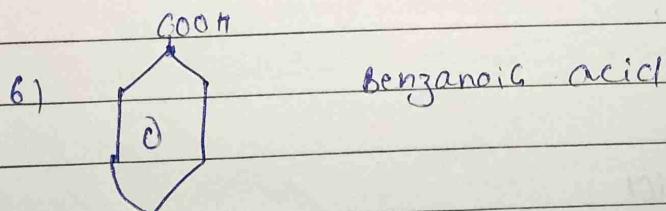
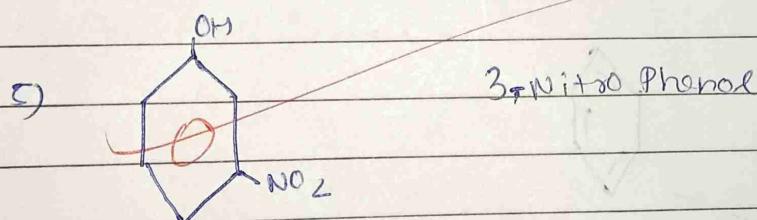
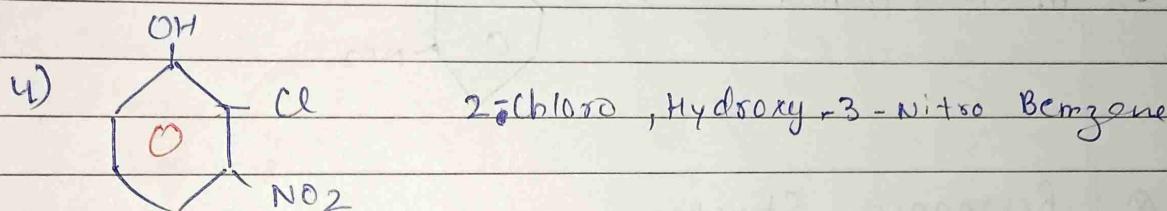
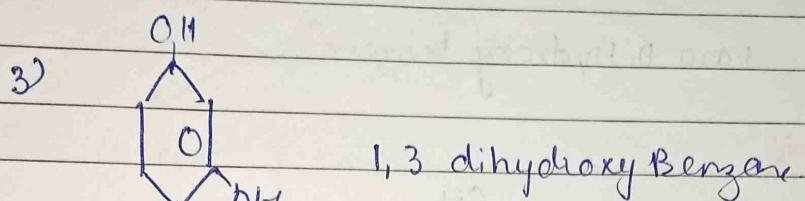
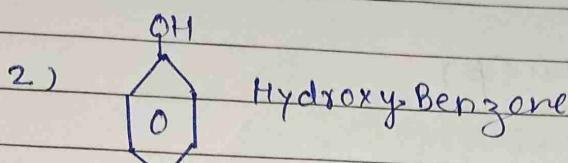
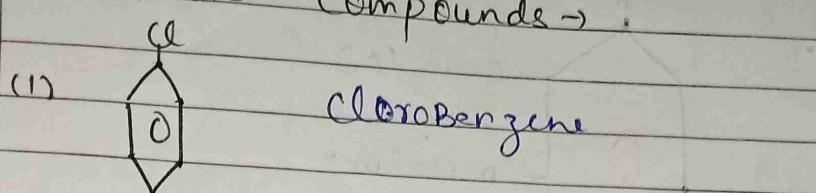
2-Hydroxy-3-Nitro-Pent-3-ene-1-oic acid

→ Alicyclic compound -

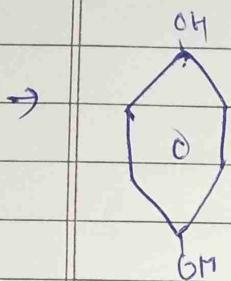
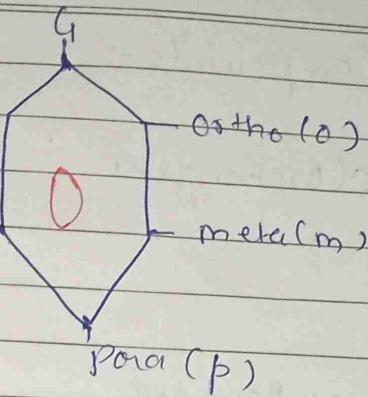


cyclopropane

Aromatic Compounds →

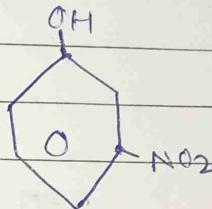


Depiction.

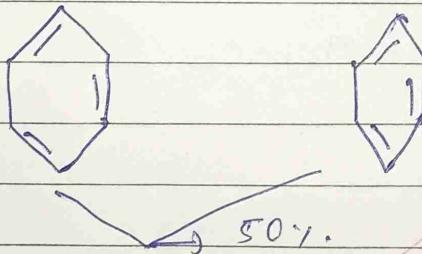


Para Di Hydroxy benzene.

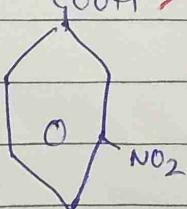
→ m - Nitrophenol →

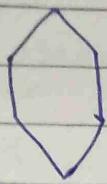


① Resonance Structure -

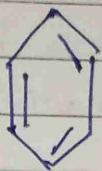


→ m - Nitrobenzoic acid

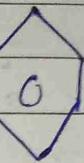




Cyclo Hexane .



Resonance Structure
of Benzene



Resonant Hybrid of Benzene

Isomers

Structural Isomers

- ↳ Position ,,
- ↳ Chain ,,
- ↳ Ring ,,
- ↳ Tautamers
- ↳ Metamers
- ↳ Functional Isomers -

Steric Isomers

- ↳ Optical
- ↳ Geometrical .

→ Tautomers → ② This isomers is observed in compounds which have a functional group which can connect with two diff. atoms.

Ex- (CN group) → cyanide-, Nitrile.

→ $\text{CH}_3\text{CN} \rightarrow$ acc to cyanide → Methyl cyanide

$\text{CH}_3\text{CN} \rightarrow$ acc to Nitrate → Ethanenitrile

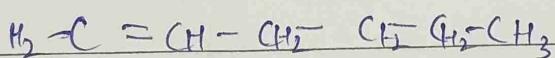
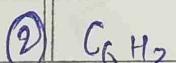
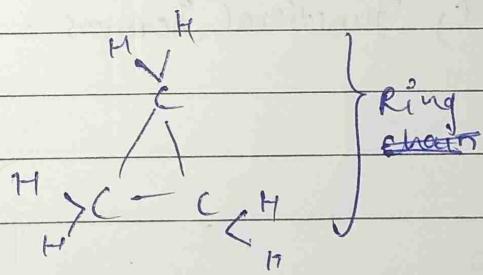
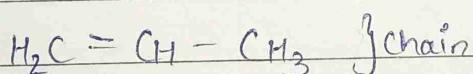
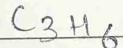
[-C≡N] CN group

Link^age with -C → Cynide

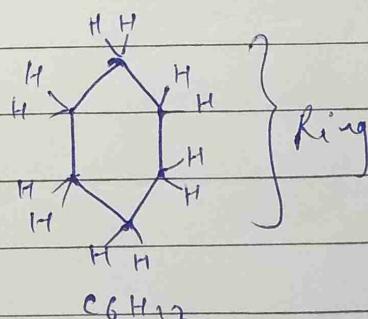
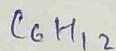
Linkage with -N → Isocyanide

In tautomere there is^a diff. of combining atoms only.

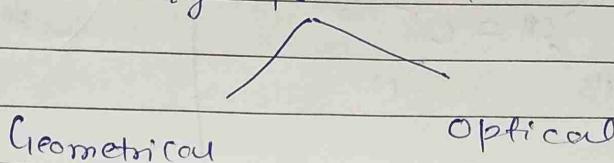
→ Ring chain isomers-



Chain



⑥ Stereo Isomers - Those compounds which have same mol. formula, same structure but have diff. arrangement of atoms / groups.



⑦ Geometrical Isomers →

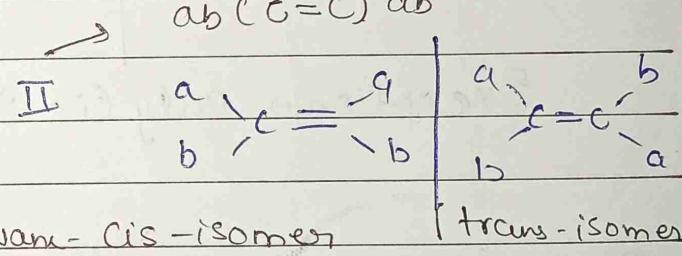
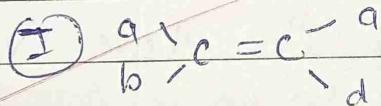
⑧ Found in alkenes only (only with Double bond)

Region - of Geo. Isomers

Because the (π) bond is formed by side wise overlapping of p. orbitals due to which the rotation of $(C=C)$ bond is restricted.

Types of Geo. Isomers -

Example

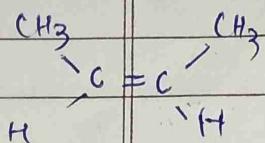


CIS ISOMER

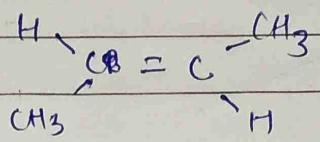
trans ISOMER -

cis isomer

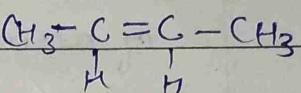
→ But-2-ene



Trans isomer

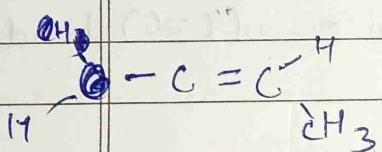


General structure

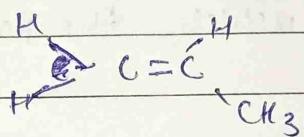


Draw: Geometrical isomer of propeno.

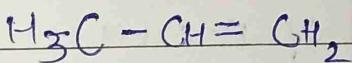
cis



trans



Gen. Structure

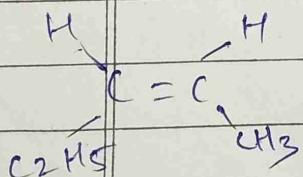


Exception → Only cis isomer in above Example -

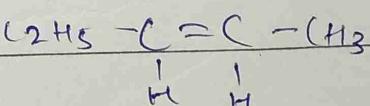
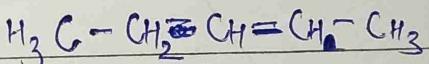
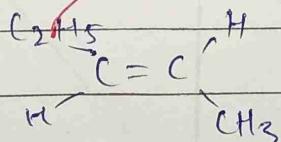
③

Pent-2-ene

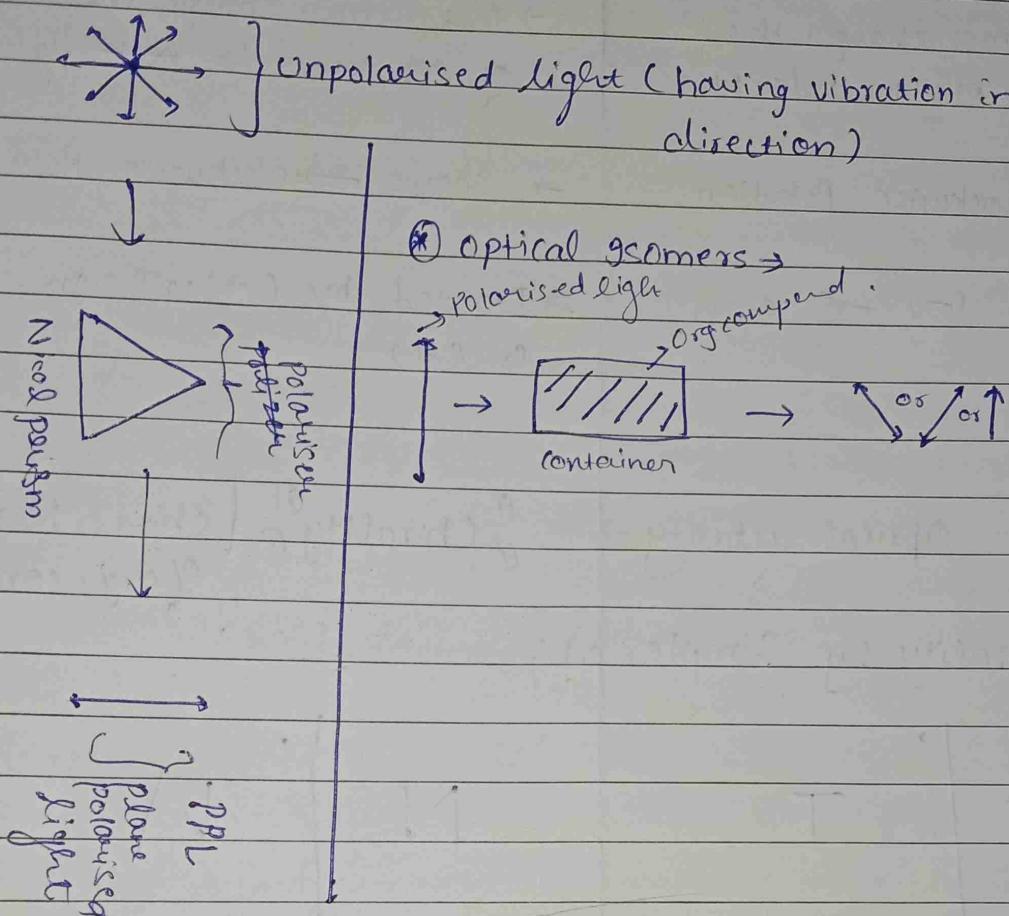
cis



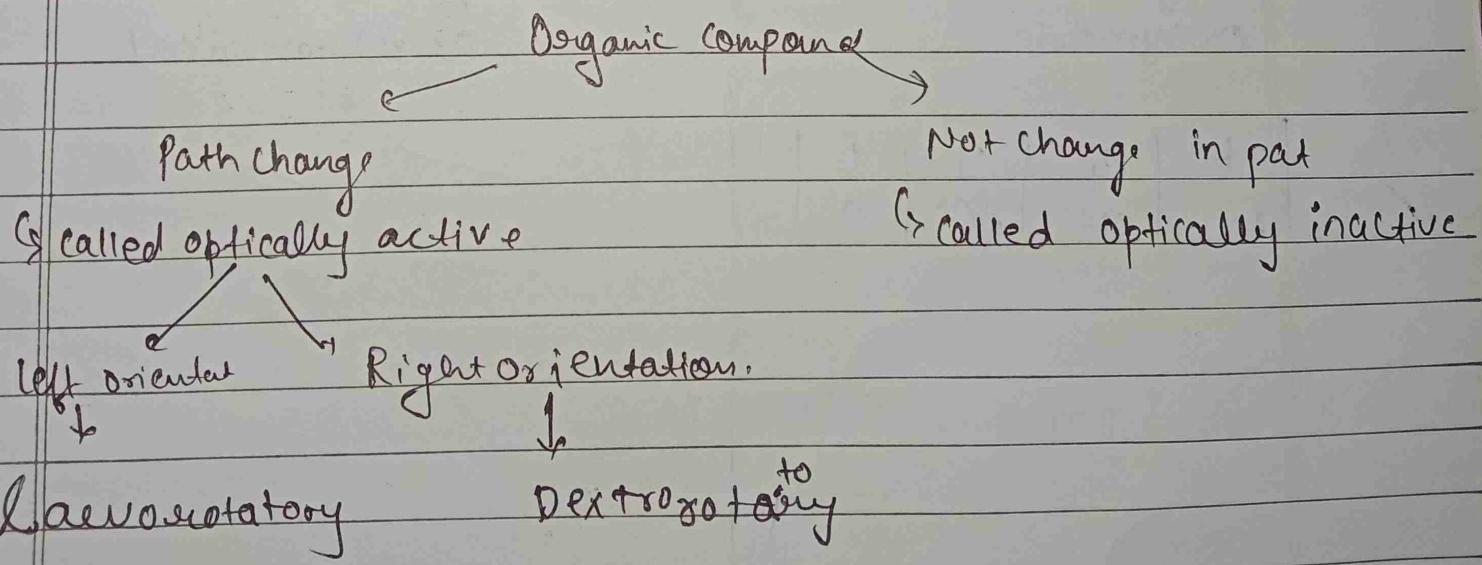
trans



Optical Isomers →



~~According to optical property.~~



Laevorotatory

1. → This isomer changes the direction of PPL towards LHS

→ This isomer changes the direction of PPL towards left eight H's

2. → Shows Anti-clockwise Rotation

→ Shows Anti-clockwise Rotation.

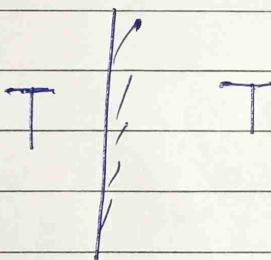
3. → Denoted by (-) -ve sign
↳ (l)

→ Denoted by (+) +ve sign.
↳ (d)

Reasons of Optical activity →

① Chirality ② Chiral Nature of org. compound.

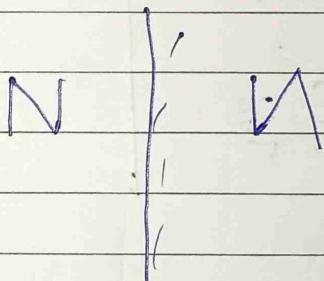
↳ Chirality by Simple obj



Superimposable Mirror

Image (Aehiral)

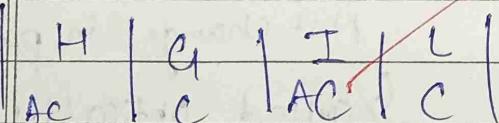
Or Symmetric



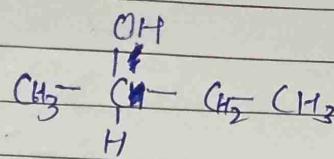
Non-Superimposable Mirror

Image (Chiral)

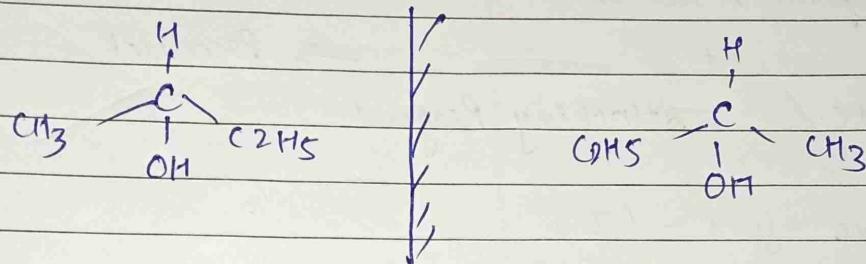
or Asymmetrical



→ Chiral nature of organic compound.



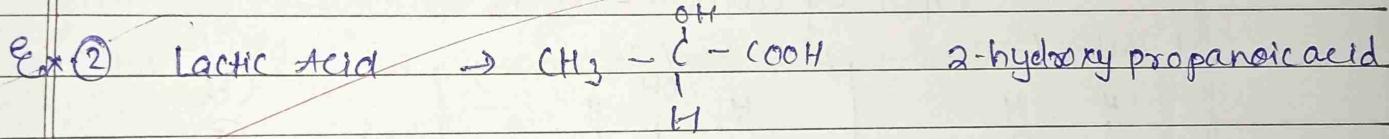
Tetrahedral Structure of Bonded carbon-



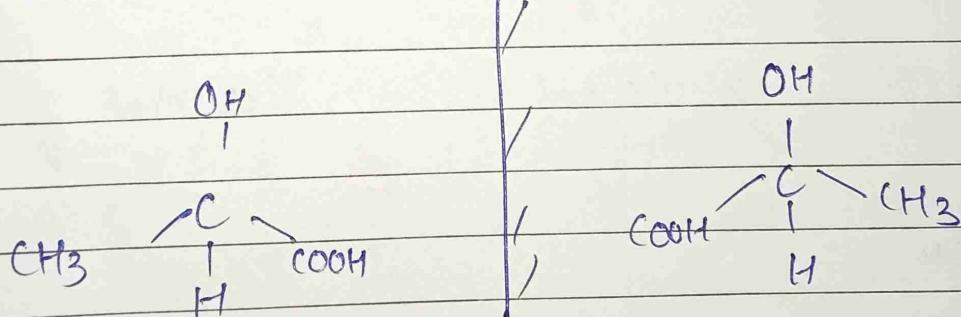
Non-superimposable mirror image

Chiral compound.

Optical isomer is shown by Asymmetric Carbons -



Tetrahedral

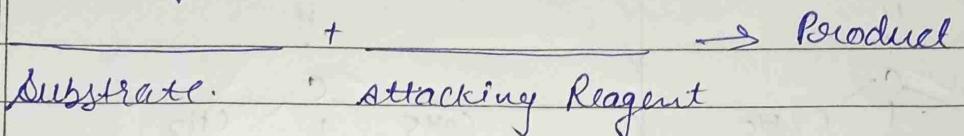


A.S.I.R.A. N.S.M.I (chiral)

Major Topics

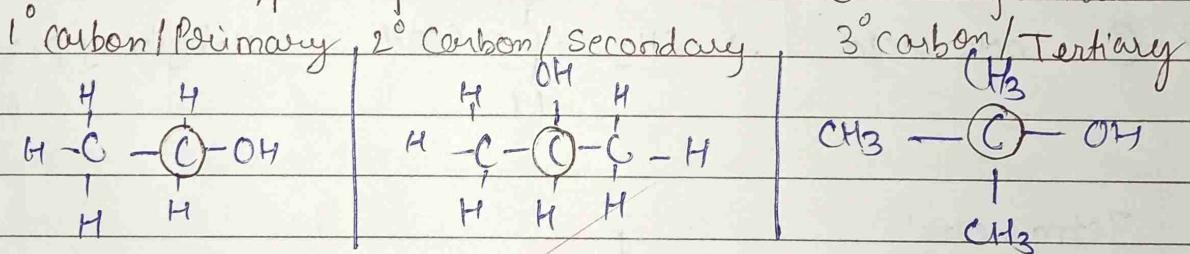
- IUPAC NOMENCLATURE
- ISOMERS
- ELECTRON DISPLACEMENT
- ORGANIC REACTION

(*) Electron Displacement → Organic Reaction



1. → Inductive effect - (I)
2. → Electromeric effect - [E]
3. → Resonance effect - (Mesomeric) [M, R]
4. → Hyperconjugation effect -

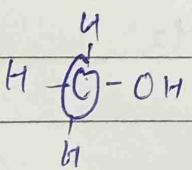
Types Of Carbon - in the structural formula



1° alcohol

2° alcohol

3° alcohol.



0° carbon / Super primary

0° alcohol -

Types of Group in the structural formula.

1. EWG

→ Stands for Electron Withdrawing Group.
↓

having highly electroneg. atoms.

↓

Ex - (-NO₂) etc

(2) EDG

Stands for Electron donating Group.
↓

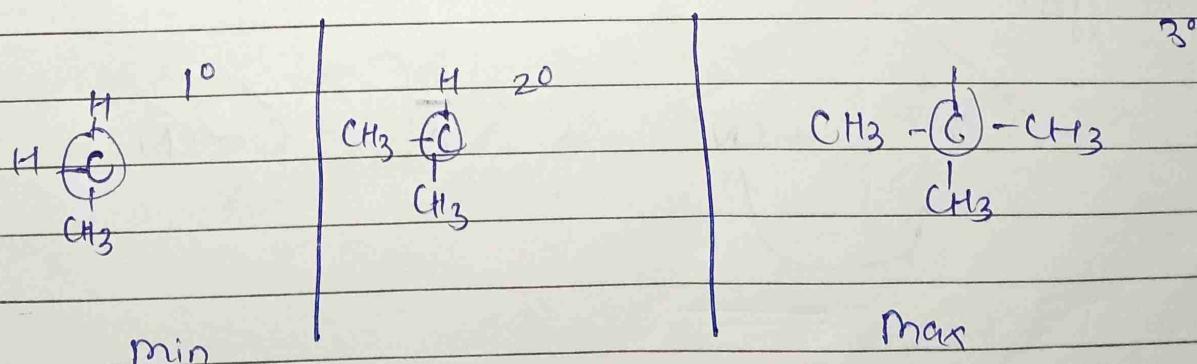
having highly. electro positive atoms

Ex - CH₃ - C₂H₅ - , alkyl group.

① Inductive effect -

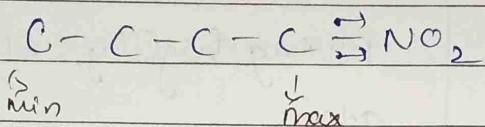
- This effect is observed when EWG & EDG are connected to carbon atom
- This effect is observed upto three carbons
- It is of two types
 - +I effect
 - I effect

→ + I effect :

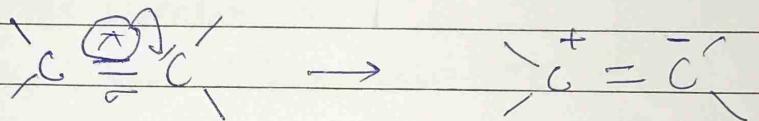


Due to increase in EDG.

- I effect - Observed when EWA is attached to Carbon atoms ,

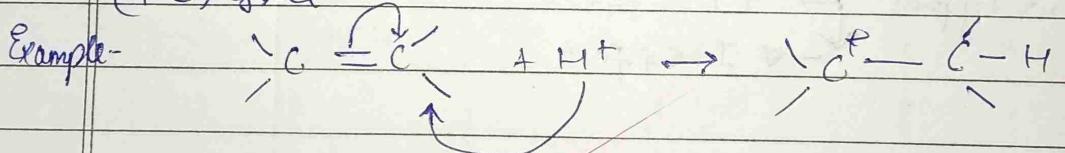


(2) Electromeric effect \rightarrow observed in ($\text{C}=\text{C}$) compound
 $\hookrightarrow \pi \text{ e}^{-1}\text{s}$ (displacement)

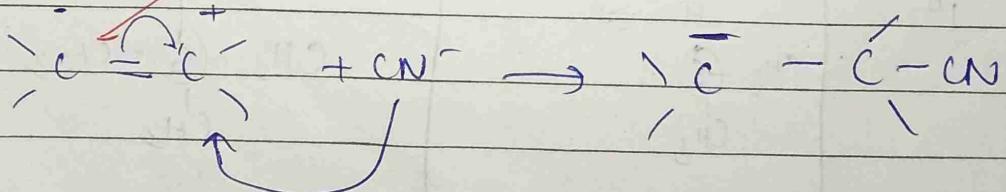


It is of two types (+e) effect and (-e) effect

(+e) effect

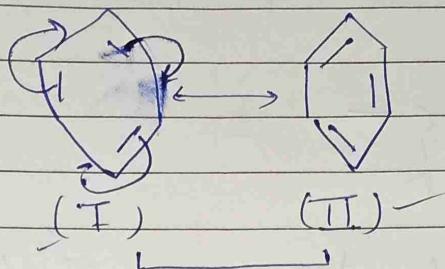


-e effect



⑨ Resonance effect \rightarrow Hybrid structure of two Resonating structures

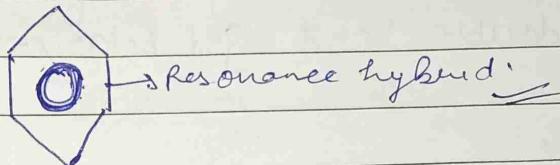
1) Benzene -



Resonating
Structures /
canoncial structures

Reactive Energy

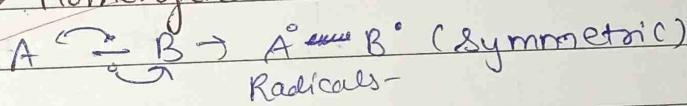
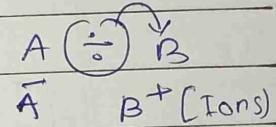
Real Benzene



difference energy
of R.H and

R. S having
min. energy

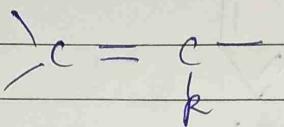
A) Bond fission - (Bond Breaking) \rightarrow Heterolytic
 \downarrow Homolytic



Homolytic - when the e- negativity is nearly same or neg. b/w two combined atoms.

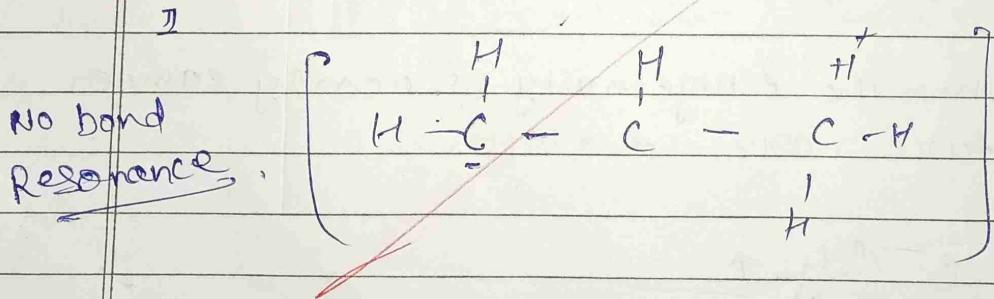
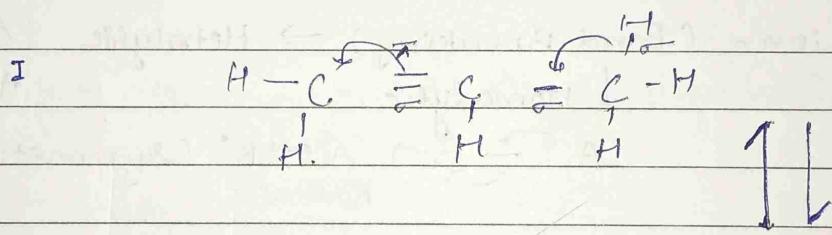
Heterolytic - e⁻ diff ↑

→ Hyperconjugation, when alkyl group is attached to unsaturated carbon chain the electron displacement takes place through hyperconjugation.



In this effect the sigma e- of C-H bond (C-H) interact with πe^- of (C=C) double bond. Due to this the e- displaced towards the double bond due to which e- releases from the α carbon And the double bond get polarized.

Ex- propene.



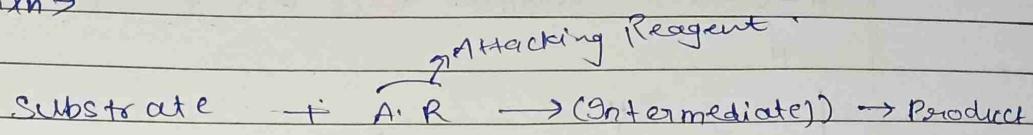
Why Hyperconjugation is called No bond Resonance.

In the II Structure there is no bond b/w C and H⁺ but still H⁺ is not free to move. Due to this it is (NBR) No bond Resonance.

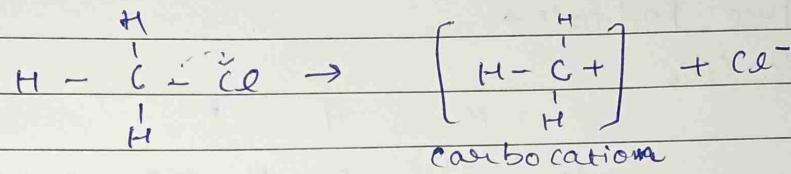
→ Reaction Intermediate →

↳ normal Rxn → Reactant → Product.

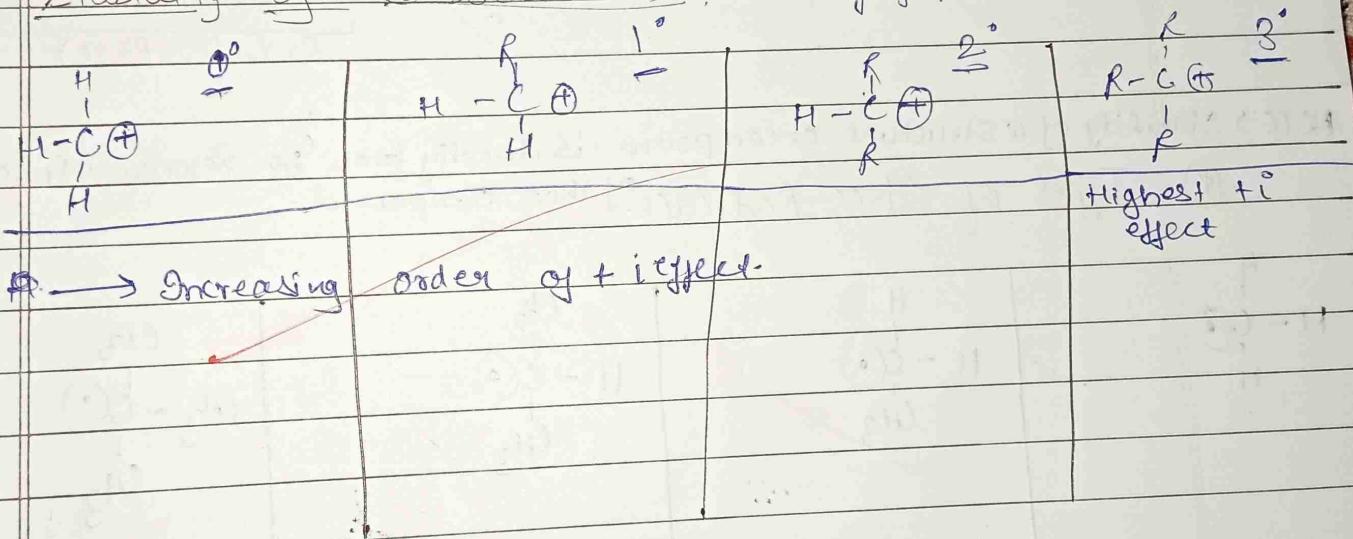
Organic Rxn →



→ Carbocation →

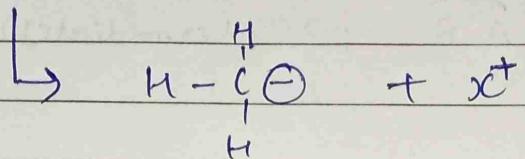
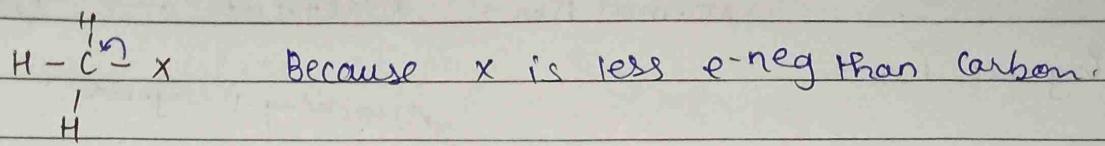


④ Stability of Carbocation → R-alkyl group - EDC.



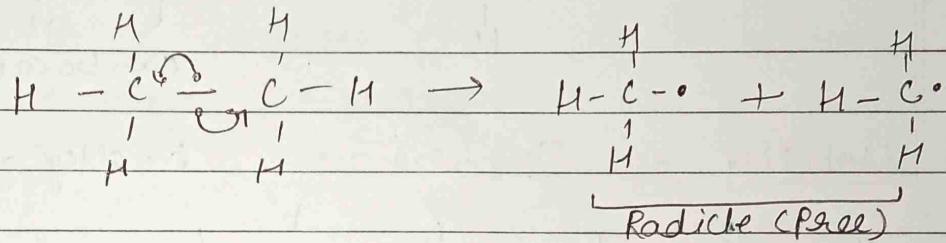
④ (+ve) charge ↓ = Stability ↑

→ Carbanion group →



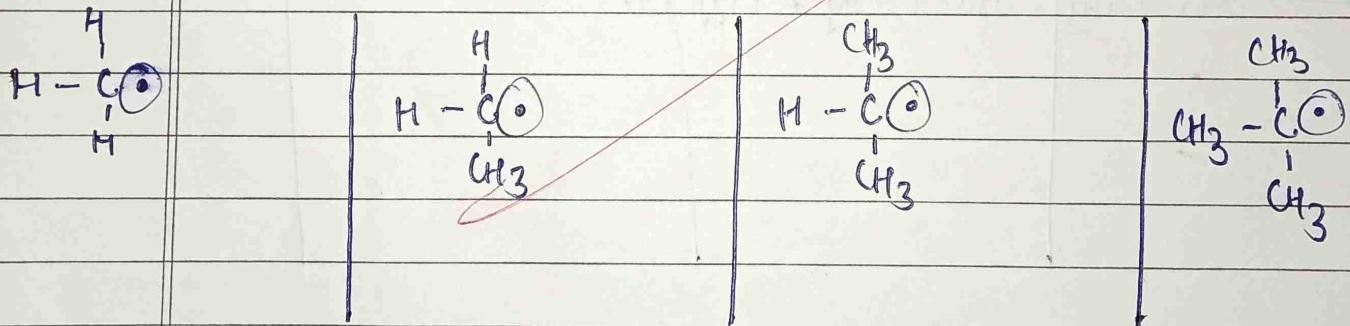
③ Free Radicals →

Ex - C_2H_6



NOTE → Stability of a structure or compound is directly prop ^{to} no. Resonance structure

✳ Types of Free Radicals of that compound.



→ Instability (bcz No. of R.s) increase.

3° Free Radical ⇒ Highest No. of Resonance structure.

→ Electrophile

(-ve) attract
→ Electron + phile

→ Type → ① Positive ^{Electro} Nucleophile

⇒ Carbocation, H^+

- ② Neutral

Ex. BH_3 , AlCl_3

Nucleophile.

(+ve) attract
→ Nucleus + phile.

→ Type - ① Neg. Nucleophile.

⇒ OH^- , I^- , NO_2^- , Br^- , carboanion

② Neutral

Ex. Lone pair \checkmark will work as

nucleophile.