GOC

1. Classification and Name (2M)
   - → Classification
   - → Common name
   - → Trivial name
   - → Derived name
   - → IUPAC name
2. Isomers
   - Structural
     - Chain
     - Position
     - functional
     - metamerism
     - Tautomerism
   - Stereoisomer
     - Geometrical
       - cis
       - trans.
     - Optical
       - x
3. Rxn & Mechanism

Type of Bond fission	Type of Attacking Rxn	Type of Rxn intermediate	Factor	Type of organic Rxn
Homolytic	Electrophiles	Carbocation	I Effect	substitution
Heterolytic	Nucleophiles	Carbanion	M Effect	Elimination
		CFK	E Effect	Addition
			Hyperconjugation	Removal.

4. Purification of organic compound.
   - → Sublimation
   - → Distillation
   - → Chromatographic
   - → Crystallisation.
5. Quantitative & Qualitative Analysis –
   - ↓
   - P, S, C, N, O
   - → Lasigne test, Dumas method, Kjeldal Test.

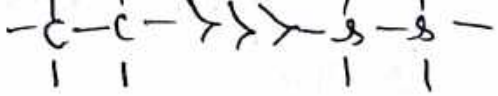
* Introduction

organic chemistry ⟶ compounds of carbon.

* C → 10 lakh bond.

↓ reason?

- → small size of carbon
- → high EN
- → Covalent Nature
- → Tetravalency
- → Catenation .. self bonding.



	σ bond	π bond	Hyb.	shape	Angle	%
$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-$	4σ	0π	sp3	Tetrahedral	109.5°	25%
$\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}}$	3σ	1π	sp2	Trigonal	120°	33.3%
$-C\equiv C-$	2σ	2π	sp	linear Trigonal	180°	50%
$-\overset{|}{\underset{|}{C}}=C=\overset{|}{\underset{|}{C}}-$	2σ	2π	sp	linear	180°	50%

Qu:- How many no. of σ & π bond are there = 10 σ, 3 π

$$\underset{\substack{2\sigma\\2\pi}}{CH}\equiv\underset{\substack{2\sigma\\2\pi}}{C}-\underset{3\sigma}{CH}=\underset{\substack{3\sigma\\1\pi}}{CH}-\underset{4\sigma}{CH_3}$$

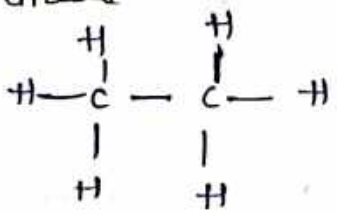
sp sp sp2 sp2 sp3

* REPRESENTATION OF CARBON :-

1) Structural
2) Molecular
3) Condense formula
4) Bond line.

1) Molecular formula – C_2H_6, C_5H_{12}

2) Structural formula –



3) Condense – C_2H_6

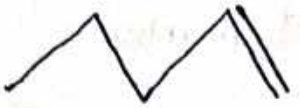
$CH_3 — CH_3$

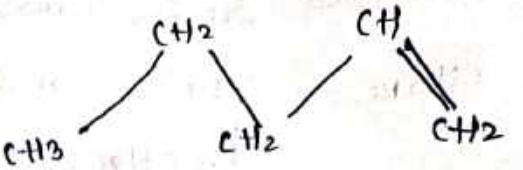
C_5H_{10}

$CH_3 — CH_2 — CH_2 — CH_2 = CH_2$

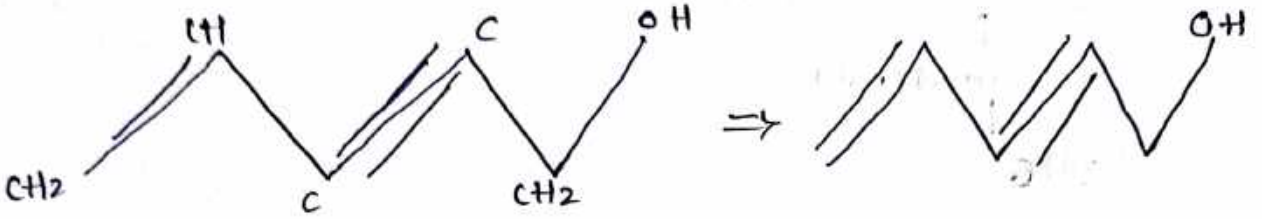
$CH_3CH_2CH_2CHCH_2$ //

4) Bond line – C_5H_{10}

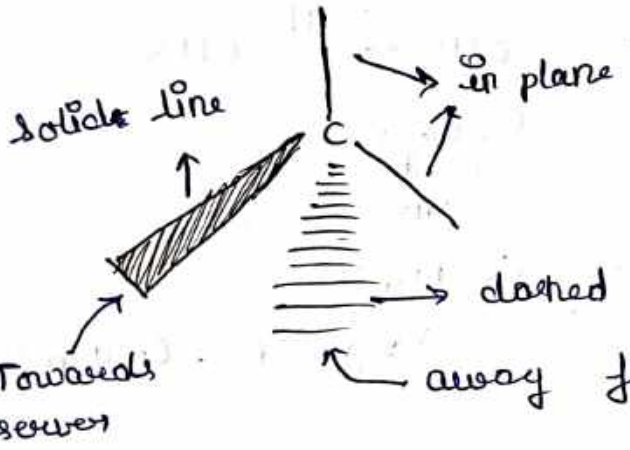




$CH_2 = CH - C \equiv C - CH_2 - OH$



3D Representation of CH_4 :-



* classification of organic compound -

- Acyclic / Aliphatic open chain
  - (paraffins) Alkanes — C_nH_{2n+2} — Saturated
  - (olifins) Alkenes — C_nH_{2n} — unsaturated
  - Alkynes — C_nH_{2n-2} — unsaturated
- Cyclic / Closed Chain
  - Homocyclic — All are Carbon
    - Aromatic
    - Anti Aromatic
  - Heterocyclic — others
    - Aromatic
    - Non aroma

Homologous Series – molecular weight = 14u difference.

Alkane → CH_4 ⟶ Methan 1st member

↓ + CH_2

CH_4 + C_2H_4 → C_3H_8 ← 3rd

↑

second (not)

↓

C_2H_6

* **Alkene** $H_2C = CH_2$

5th member $C_2H_4 + C_4H_8$

C_6H_{12}

1 C_2H_4
+ CH_2
3 C_3H_6
4 C_4H_8

} C_nH_{2n}.
↳ G.F

* **Ketone**

$CH_3 - \overset{\overset{O}{\|}}{C} - CH_3$

C_3H_6O
+ CH_2
+ CH_2

$C_5H_{10}O$

↳ gen. F = $C_nH_{2n}O$

* **Alcohol**

1st $CH_3 - OH = CH_4O$
+ CH_2

2 C_2H_6O
+ CH_2

3 C_3H_8O

$C_2H_{2n+2}O$

* **Aldehyde**

$H\,CHO = CH_2O$
+ CH_2

C_2H_4O

$C_nH_{2n}O$

* **Carboxylic Acid**

1st → $H-COOH$
CH_2O_2

2 + CH_2
3 + CH_2
4 + CH_2

G.F. = $C_nH_{2n}O_2$

$C_4H_8O_2$

$C_nH_{2n-2}O_2$

14th member

$C_{14}H_{32}O_2$

Aliphatic / Acyclic / open chain.

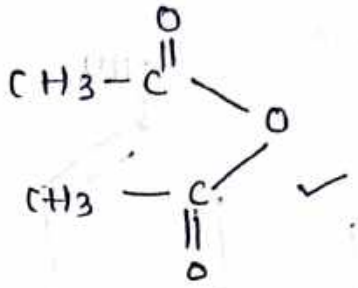
→ 1st carbon & last carbon NOT attach with any other C of the member.

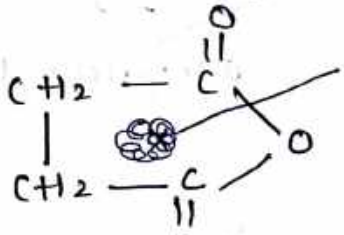
eg :- $CH_3 - CH_3$

$CH_3 - CH(CH_3) - CH_3$

$CH_3 - CHO$

$CH_3 - C(=O) - CH_3$



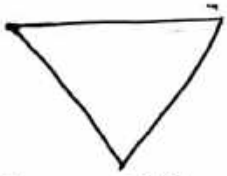


Chelate.

X

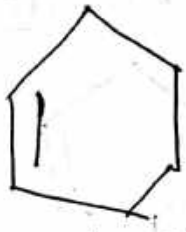
* Alicyclic / Close chain.

→ Homocyclic
↓
all C-atom



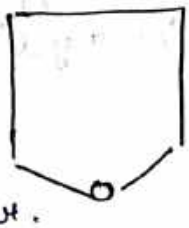
cyclopropane

cyclobutane.



cyclohexene.

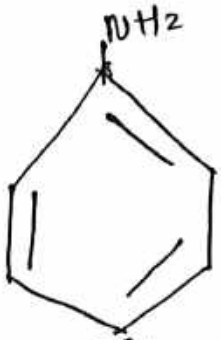
→ Heterocyclic
↓
in which one or more C-atom is replaced by other.



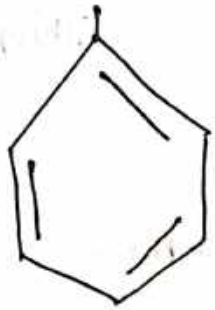
Tetrahydrofurane

* AROMATIC

Benzene

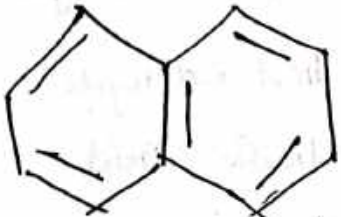


Aniline

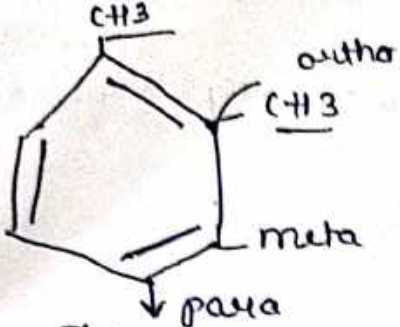


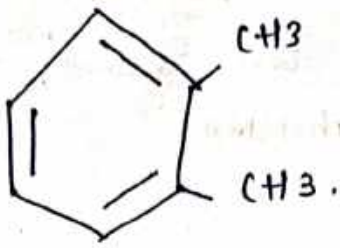
Anisole.

phenol



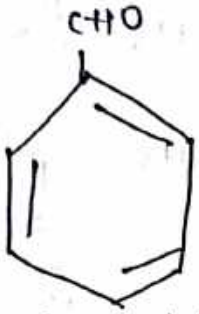
Napthalene.



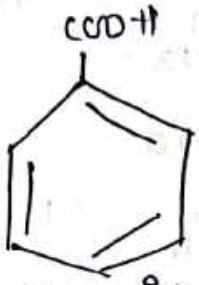


Xylene

Toluene

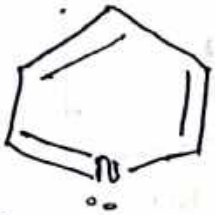


Benzaldehyde

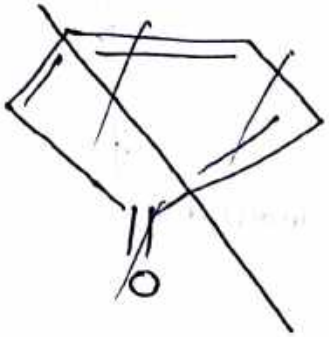


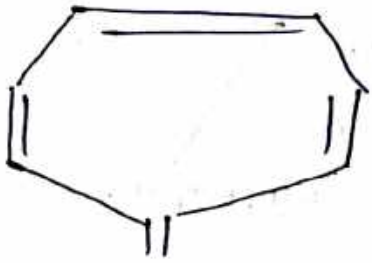
Benzoic acid.

* HETEROCYCLIC

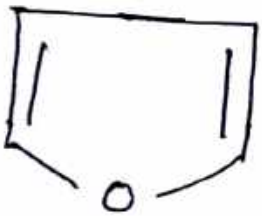


Pyradine

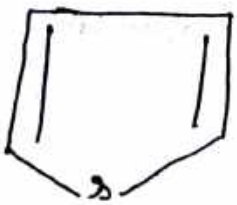




Homocyclic Tropone.



Furane



Thiophene.

* NAMING :-

1) Common name -

HCOOH → formic acid

H-CHO → formaldehyde

{1C → form, 2C → Acet}

→ CH_3-CHO → Acet aldehyde

3C → propion

→ CH_3-COOH → Acetic Acid.

4C → Butyr

5C → Valer

→ $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ → Acetone //

1) Iso groups - (I)

minimum 3 carbon required.

free 1 methy group in 2nd last C-atom.

1) $CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-$ isobutyl.

2) $\overset{5}{CH_3}-\overset{4}{\underset{CH_3}{\underset{|}{CH}}}-\overset{3}{CH_2}-\overset{2}{CH_2}-\overset{1}{CH_2}$ ← free radical.

isohexyl.

2) Neo group -

minimum 5 carbon atoms are required.

2 free methyl group in 2nd last carbon atom.

$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-$$ neopentyl.

→ Primary (P) or n group

$CH_2-CH_2-CH_2-CH_2-$

Pr butyl or n butyl.

→ secondary grp - 1 free methyl in 2nd carbon.

1) $CH_3-CH_2-\underset{CH_3}{\underset{|}{CH}}-$

2) $CH_3-\underset{CH_3}{\underset{|}{CH}}-$ sec/iso propy

→ ter° group (t) - 2 free methyl group in 1st carbon atom.

1) $CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-$ t° butyl

2) $CH_3-CH_2-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-$ t- pentyl.

* common Name of Alkanes.

1) n / primary
2) iso - 3
3) neo - 5
4) sec - C with 2C
5) ter° - C with 3C

} are the names.

* Common name of Alkenes :-

$CH_2 = CH -$

free radicle

Alk-yl-ene

$CH_2 = CH_2$

Ethylene.

1° = $CH_3 - (CH_2) -$ → 1° H

2° = $CH_3 - (CH(CH_3)) -$ → 2° H

3° = $CH_3 - C(CH_3)_2 -$ → 3° H

$CH_3 - C(CH_3)_2 - CH_3$ → 4°C & H

→ $CH_2 = CH - CH_3$

Propylene

→ $CH_3 - CH_2 - CH(OH) - CH_3$

FG.

→ $CH_2 = CH - CH_2 - CH_3$

α - Butylene

→ $CH_3 - CH = CH - CH_3$

β - Butylene

→ $CH_2 = CH - CH_3$ (with CH_3 branch)

is obutylene

→ $CH_2 = CH -$ (sp2)

Vinyl

→ $CH_2 = CH - CH_2 -$ (sp3, sp2)

FG.

Allyl

* $CH_3 - CH <$

Ethylidiene

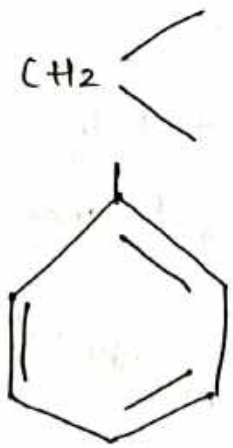
$CH_2 <$

Methylene

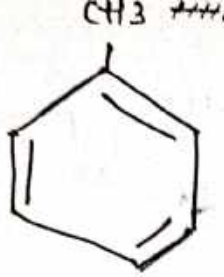
$CH_2 -$

$CH_2 -$

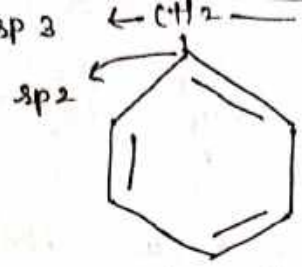
Ethylene



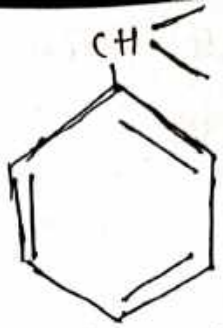
Aryl / Phenyl



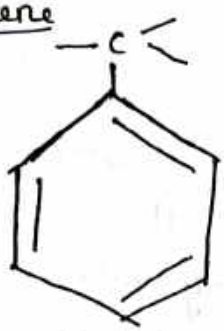
Toluene



Benzyl



Benzal



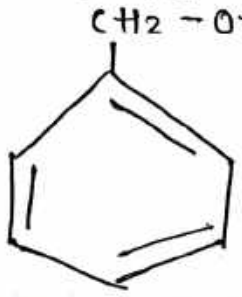
Benzo

→ $CH_3 - CH_2 - OH$

Ethyalcohol.

→ $CH_3 - CH_2 - CH_2 - OH$

propyl alcohol

→ 

Benzyl alcohol

→ $CH_2 = CH - OH$

Vinyl alcohol

→ $CH_3 - \underset{\beta}{CH}(Br) - \overset{\alpha}{CH_2} - COOH$

β Bromo Butyric acid

→ $CH_3 - CH(Cl) - CH_2(Cl)$

Ethylidene Chloride

→ $CH_2(Cl) - CH_2(Cl)$

Ethylene chloride.

→ $CH_3 - \underset{sp2}{CH} = \underset{sp2}{CH} - \underset{sp3}{CH_2} - \underset{F.G.}{OH}$

Allyl alcohol.

→ $CH_3 - CH(CH_3) - CH_2 - COOH$

Iso Valeric acid.

* Di Halide

$CH_2(Cl) - CH_2(Cl)$

2 adjacent C पे 2 Halogen group

vicinal halide.

Gem di halide

$CH_3 - CH_2 - Cl$ (Cl)

α β γ

$CH_2 - CH_2 - CH_2 - CH_2 - CH_2$ (Cl, Cl)

α, ω, dihalide

$CH_2 - OH$

$CH_2 - OH$

glycol

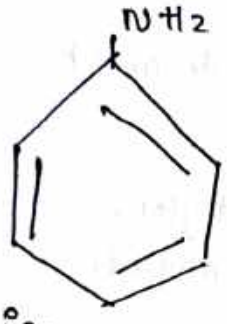
used in radiations in anti freezing

$CH_2 - OH$

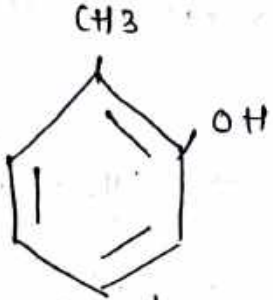
$CH - OH$

$CH_2 - OH$

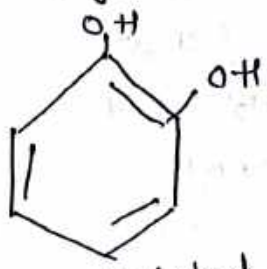
glycerol.



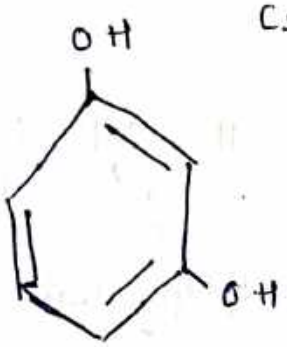
Aniline



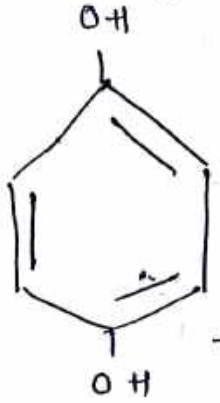
Cresol



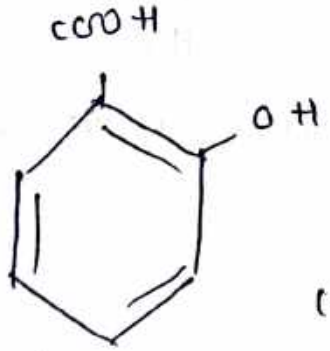
Catechol



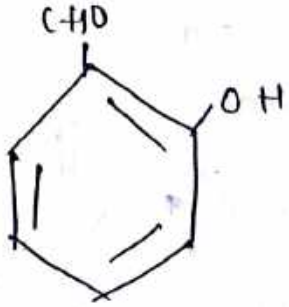
Racemerol



Hydroxyphenol.

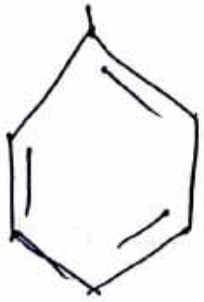


Salicylic Acid



Salicaldehyde

$CH_3 - CH - CH_3$



Cumine.

* IUPAC Names :-

Sec - prefix → pri prefix + Root word + pri suffix + sec. suffix.

Rootword → longest carbon chain.

1 C → Meth
2 C - Eath
3 - prop
4 - but
5 - pent
6 - hex
7C - hept
8 - oct
9 - non
10 - dec
11 - Undec
12 - Dodec
13
20C - Eicos.

* Pri suffix :-

No. of bonds → — — ane
= = ene
≡ ≡ yne

If sec suffix available than do not include (e)
an, en, yn

→ RULES OF VARIATION IN NAME :- (List pg=27)

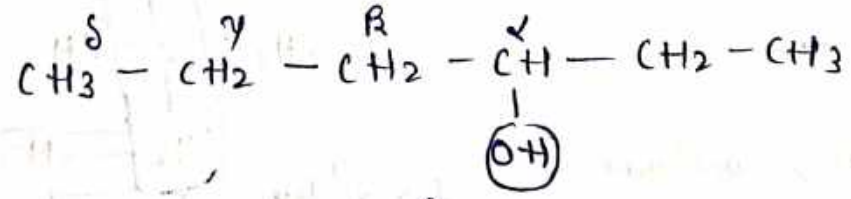
Rule 1) 1st word → Capita — iso, neo, tert, sec.

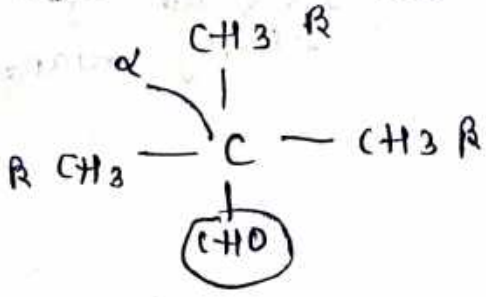
2) longest carbon chain with max branching.

3) lowest Numeric Rule than lower alphabetical ord

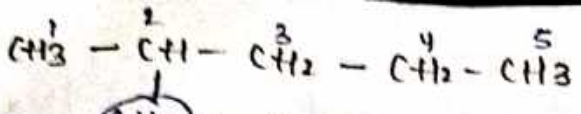
4) Alphabat — Number

5) F.G. > MB > Substitute.





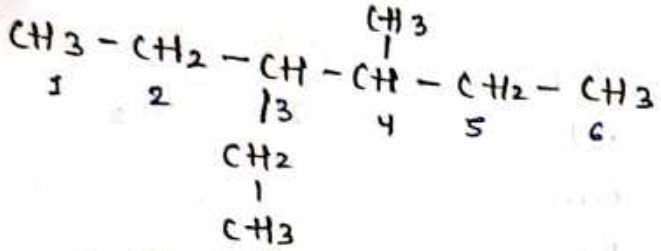
Q 3)



methyl

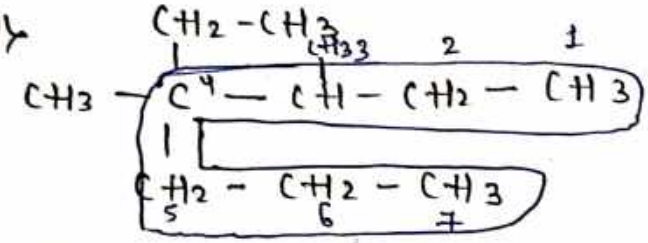
2- methyl pentane.

3)



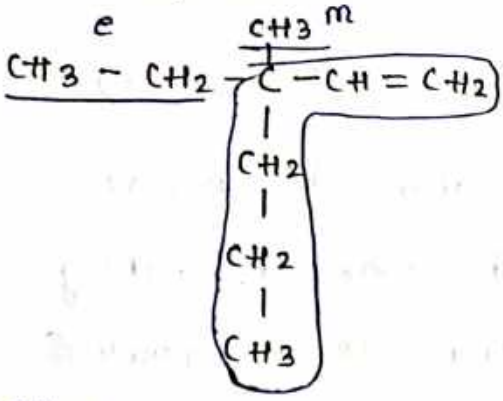
3 Ethyl, 4-methyl hexane.

4)



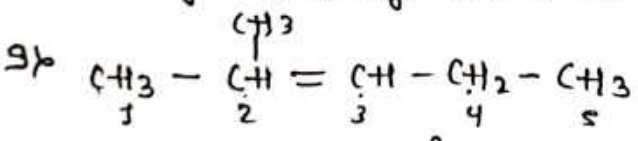
4- Ethyl - 3, 4-dimethyl heptane.

6)



3-Ethyl - 3 methyl hex-1-ene

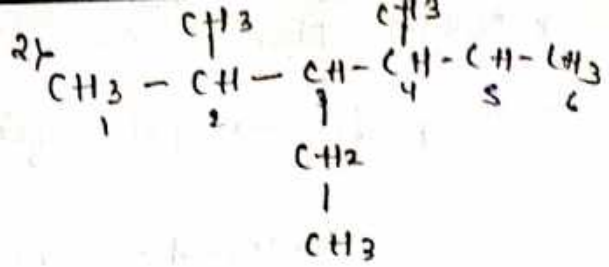
9)



2 - methy hex - 2 - ene.

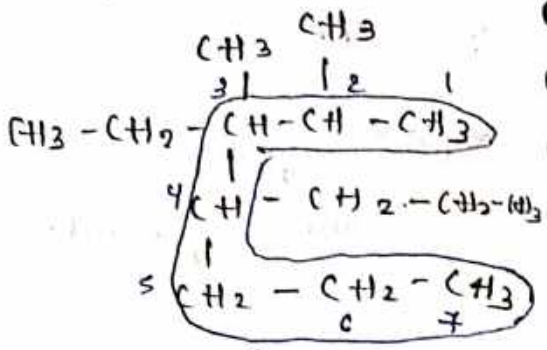
F.G ⟩ Multiple Bonds ⟩ Substituent.

2)



3 - Ethyl - 2, 4 dimethyl hexane.

5)

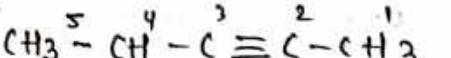


3- Ethyl - 2, 3 - dimethyl 4-propyl heptane.

7)

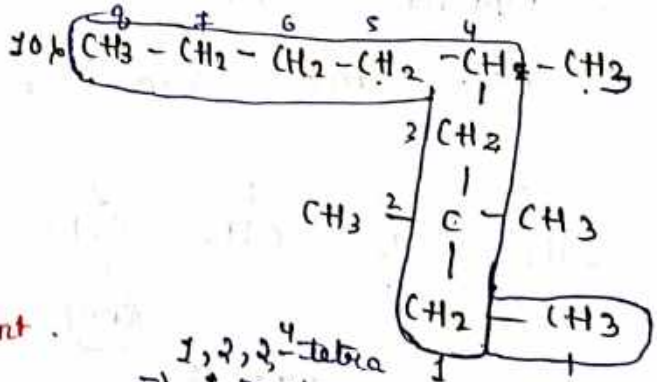
4- methyl pent-4-ene, -1yne

8)



4- methyl pent - 2 - yne.

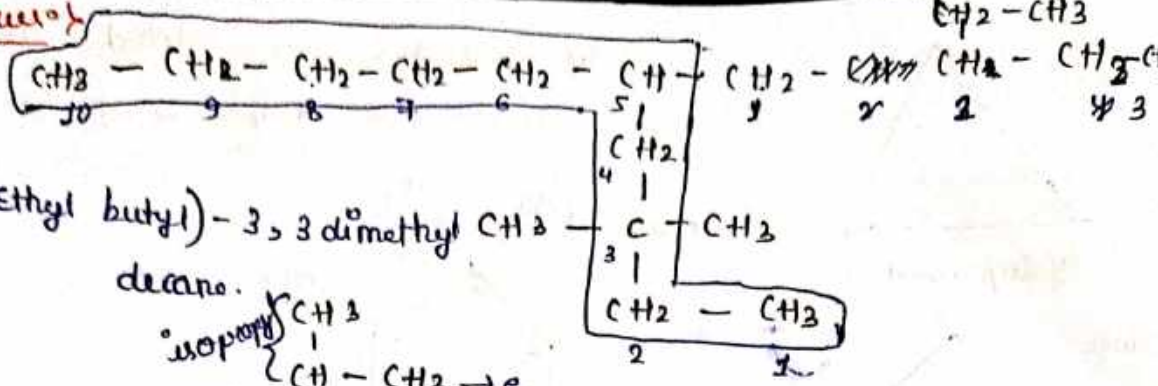
10)



1,2,2,4-tetra

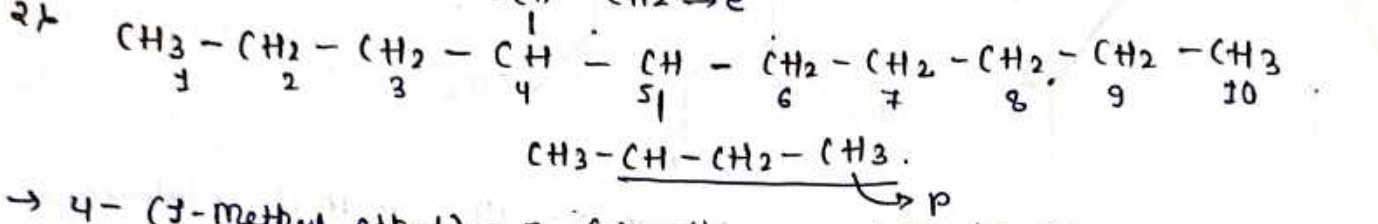
⇒ 4 methy octane.

NCERT Ques:-

1) 

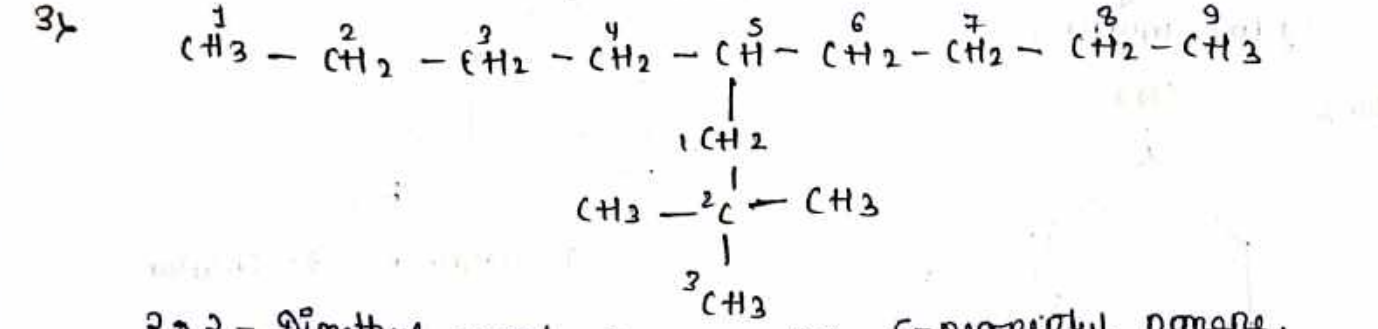
→ 5-(2 Ethyl butyl)-3,3 dimethyl decane.

isopropyl

2) 

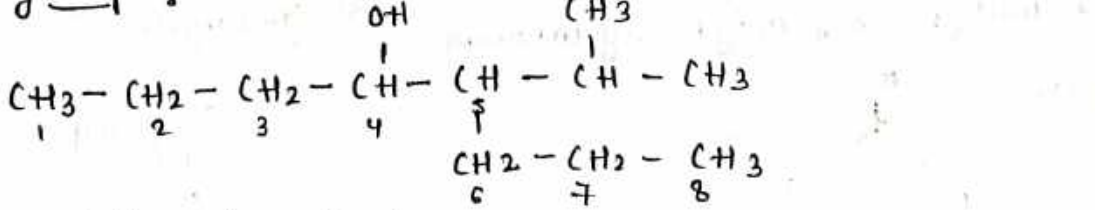
→ 4-(1-methyl ethyl)-5-(1 methy propyl) decane.

→ 5-sec Buty-4-isopropyl decane.

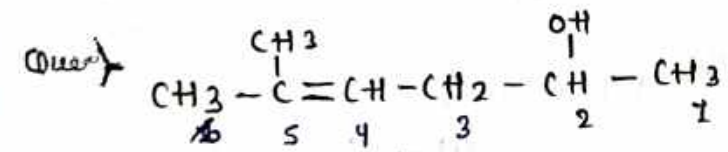
3) 

2,2-Dimethyl propyl nonane or 5-neopentyl nonane.

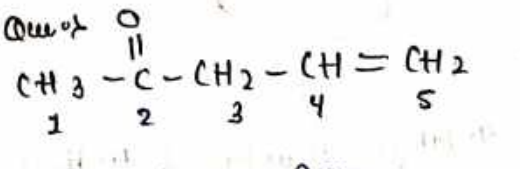
* Functional Groups :-



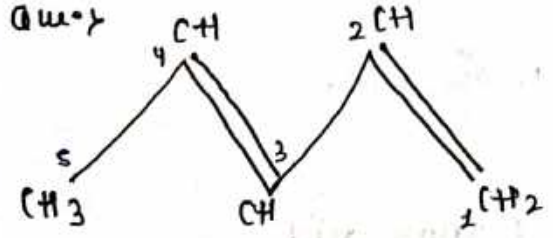
5-iso propyl octan-4-ol.

Ques: 

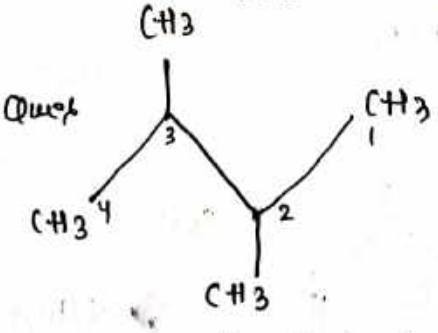
5-methyl hex-4-en-2-ol

Ques: 

Pent-4-ene-2 one.

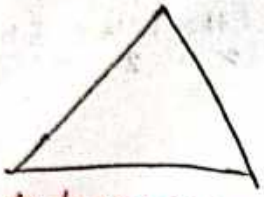
Ques: 

pent-1,3-diene.

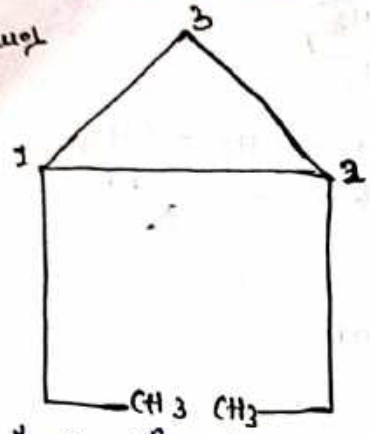
Ques: 

2,3-dimethyl butane.

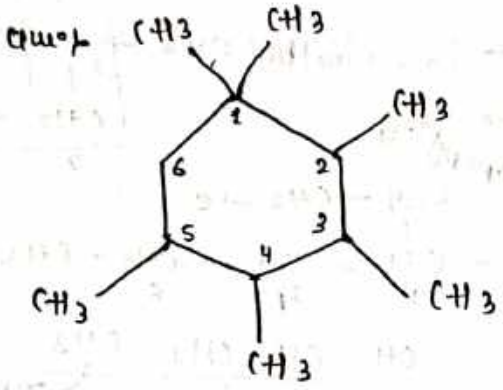
-cyclo word is added as no double or triple bond is present.



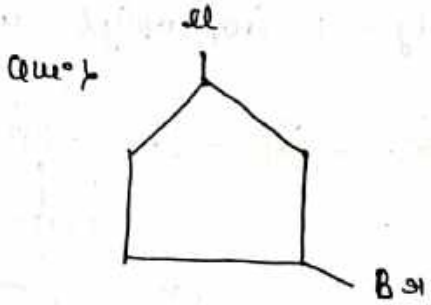
→ cyclopropane

Ques. 

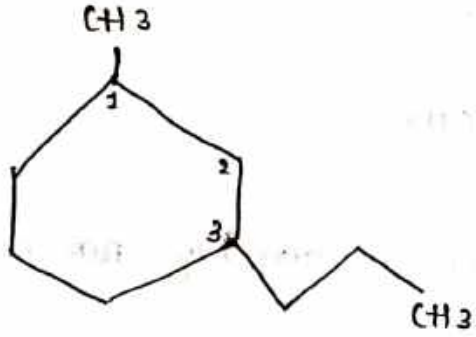
1, 2 - Dimethyl cyclopropane.

Ques. 

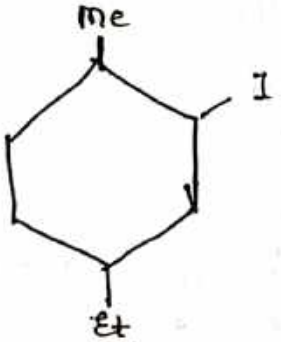
1, 1, 2, 3, 4, 5 - Hexa methyl cyclohexane.

Ques. 

1 - Bromo - 3 - chloro cyclopentane.

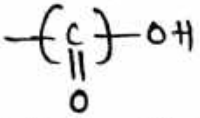
Ques. 

1 - methyl - 3 - propyl cyclohexane

Ques. 

4 - Ethyl - 2 iodo - 1 - methyl cyclohexane.

* Carboxylic Acid



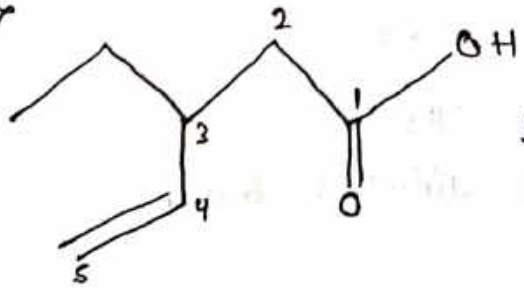
Suffix - oic acid

Ques. $CH_3 - COOH$

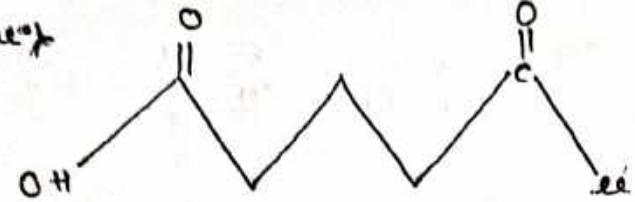
Ethanoic acid

$CH_3 - CH = CH - COOH$

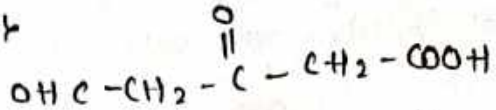
But - 2-en oic acid.

Ques. 

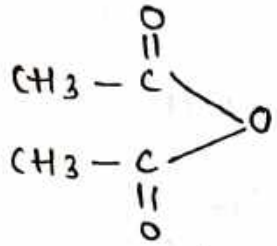
3 - Ethyl pent - 4 - enoic acid

Qu:- 

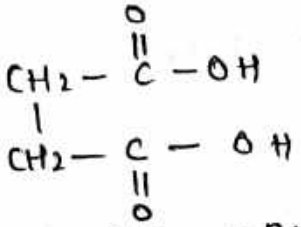
4-Chloro formyl butanoic acid.

Qu:- 

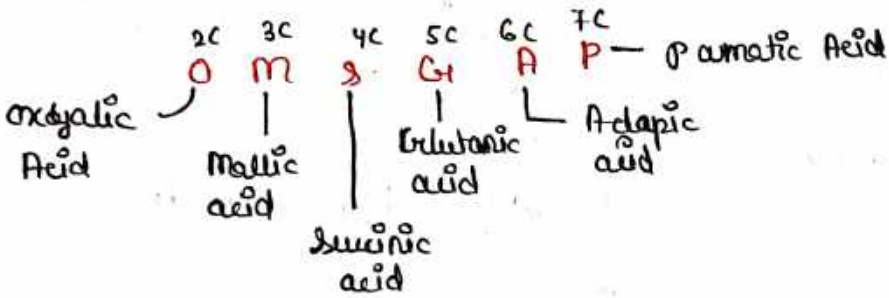
3-keto-5-oxo pentanoic acid.

Qu:- 

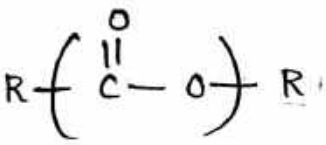
Ethanoic anhydride.

Qu:- 

Succinic Acid

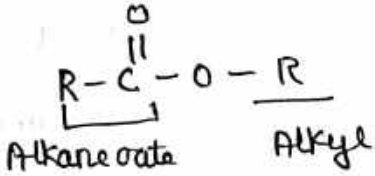


* Ester

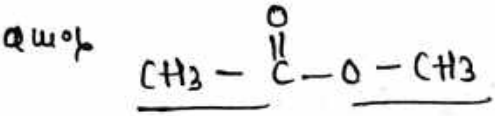


Suffix - oate

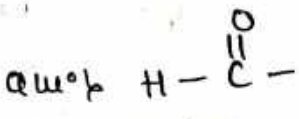
prefix - alkoxy carbonyl

Qu:- 

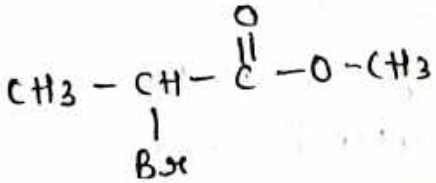
Alkyl alkanoate

Qu:- 

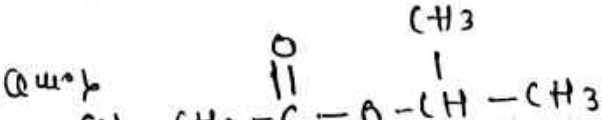
methyl ethanoate

Qu:- 

methyl methanoate

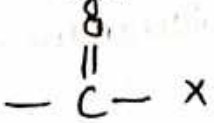
Qu:- 

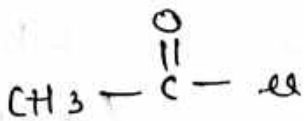
methy-2-Bromo propa-noate.

Qu:- 

propyl-2-propanoate

Suffix acyl halide.



Qu:- 

Ethanoyl chloride.

Qu°) $CH_3-\overset{4}{CH}(OH)-\overset{3}{CH_2}-\overset{2}{C}(=O)-Cl$

3- Hydroxy butanoyl chloride.

Qu°) $CH_3-\overset{4}{CH}=\overset{3}{CH}-\overset{2}{C}(=O)-\overset{1}{Br}$

But-2-enoyl bromide.

Qu°) $R-\overset{O}{\overset{\|}{C}}-NH_2$

Alkanamide.

Qu°) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$

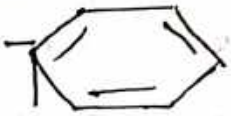
Ethanamide

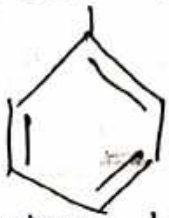
Qu°) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{H}{N}-CH_3$

N-Methyl ethan amide.

Qu°) $H-\overset{O}{\overset{\|}{C}}-NH_2$

Methan amide

Qu°) $O=C-NH$ 



N-phenyl benzenamide.

* $-CN$ nitrate

CH_3-CN

Ethane nitrile

$H-\overset{O}{\overset{\|}{C}}-CN$

2-oxo ethane nitrile

* $-CHO$ – al

CH_3-CHO

ethanal

$CH_2=CH-CHO$

prop-2-enal

$CH_3-CH=CH-CHO$

But-2-enal

$CH_2(CH_2)-CH_2-COOH$

CHO

4-oxo butanoic acid.

$CH_3-\underset{(CH_3)\text{ methyl}}{CH}-\underset{(CHO)\text{ formyl}}{CH}-CH_2-COOH$

4-formyl-4-methyl pentanoic acid.

* $-\overset{O}{\overset{\|}{C}}-$ Keto prefix

Suffix – one

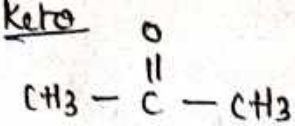
$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

propanone

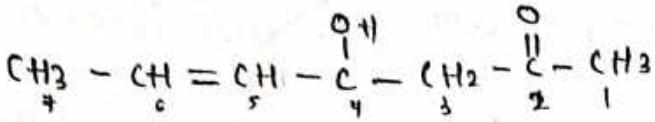
$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

Butanone.

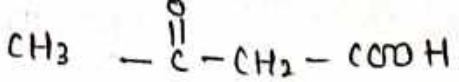
Keto



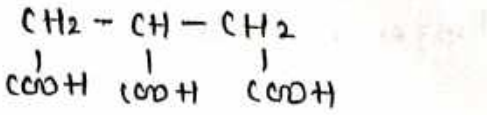
propan-2-one



4-Hydroxy hept-5-en-2one



3-keto butanoic acid.

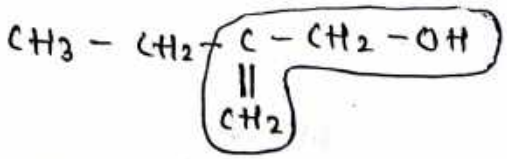


propan-1,2,3-tricarboxylic acid

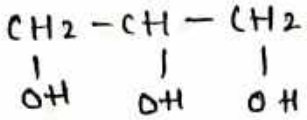
* **Alcohol**

—OH

suffix-ol prefix-hydroxy.



2-Ethyl prop-2en-1-ol

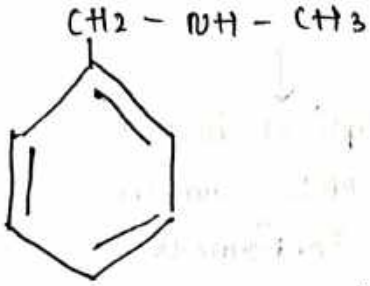


propan-1,-2,3-triol

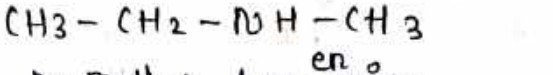
* **Amine**

$CH_3 - NH_2$ — Amine

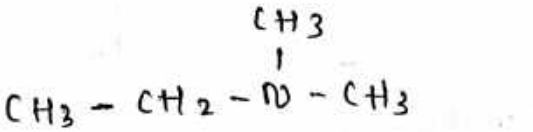
Methanamine



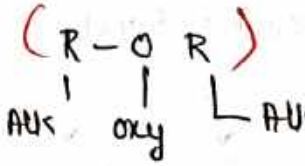
N-methyl benzyl amine



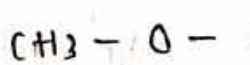
N-methyl benzamine



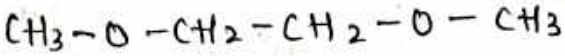
N,N-dimethyl amine.



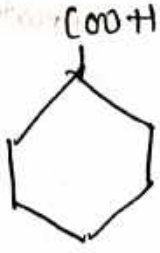
Alk oxy Alkane.



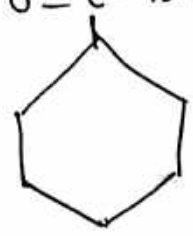
Meth oxy methane



1,2-dimethoxy ethane

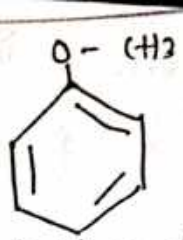


cyclohexan carboxylic acid

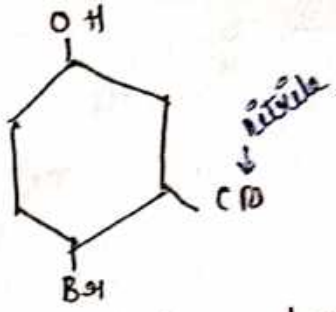


cyclo hexan carbox amide.

Benzenol / Phenol



Methoxy benzene



2. Bromo - 5 - hydroxy benzo - nitrile
or
benzene carbonitrile.

ISOMERISM

→ Molecular formula same physical & chemical properties different.

- Structure also diff. → Structural Isomer
  - Chain isomer
  - Position is.
  - Functional
  - Metamer -ism
  - Tautomerism
- 3D → Stereo isomer
  - Geometrical Isomer
    - Single bond → Conformational → Alkanes
    - Double Bond
      - Alkene → cis / trans
      - oxime → Anti / Syn
      - azo groups → Syn / Anti
  - Optical isomer.
    - PPL - rotate
    - Enantiomers
      - Chiral carbon
        - Right hand C.W → Dextrarotatory
        - left hand A.C.W → Levorotatory.

Structural Isomers

→ same molar mass, same molecular formula but different structure.

1. CHAIN isomer – same mole formula but diff no° of main carbon chain.

C_4H_{10} — C–C–C–C Butane

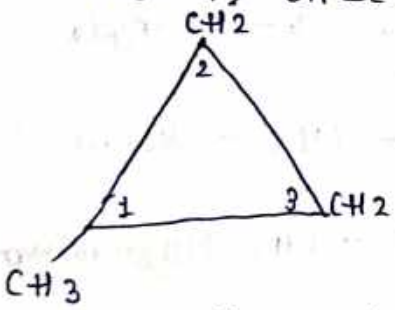
C–C(C)–C 2-methyl propane.

C_5H_{10} — C–C–C–C–C pentane

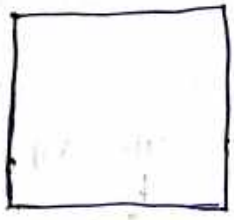
C–C–C(C)–C – 2methyl butane

C–C(C)(C)–C 2, 2 – dimethyl propane

$CH_3-CH_2-CH=CH_2$ — But-1-ene



1-methyl cyclo propane. (4C)



ring chain (4C)

cyclo butane.

2. POSITION isomer – same molecular formula but different position of substituent, MB, FG

eg: C_4H_8 C–C–C=C but-1-ene

C–C=C–C but-2-ene

NOTE for Alkane for P.I atleast 6 C are needed.

C–C–C–C–C–C

C–C–C–C(C)–C

C–C–C(C)–C–C

Degree of unsaturation / Double bond Equivalent (DBE) or Index of Hydrogen Deffiency* (IHD)

→ No. of π bond + No. of Ring.

→ $DU = \text{no. of } C + 1 - \left(\frac{\text{no. of } H + \text{no. of Halogen} - \text{no. of nitrogen}}{2}\right)$

eg:- C_4H_6 → DU

$DU = 4 + 1 - \left(\frac{6}{2}\right)$

$= 5 - 3$

$= 2$

$DU = 1 = 1DB$

$DU = 2 = 2DB$

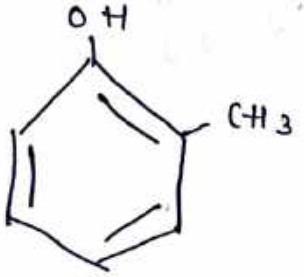
eg:- C_7H_8

$DU = 7 + 1 - \frac{8}{2} = 8 - 4 = 4$ 3π bond, 1 ring

3) FUNCTIONAL Isomers - same molecular formula but different functional group.

eg:- 1) $CH_3 - CH_2 - OH$ - Alcohol 2) $CH_3 - CH_2 - CHO$ - Aldehyde

$CH_3 - O - CH_3$ - ether. $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$ - ketone

3) 

& 

4) $CH_3 - CH_2 - NO_2$ - Nitro

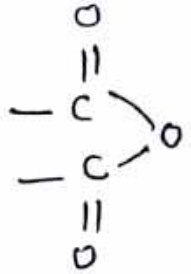
$CH_3 - CH_2 - O - N=O$ - Nitroxyl

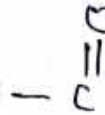
5) $CH_3 - CH_2 - CH_2 - CN$ → cyanide

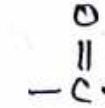
$CH_3 - CH_2 - CH_2 - NC$ → Isocyanide

4) METAMERISM - Same molecular formula but different Alkyl group.

$-(O)-$, $-(\overset{O}{\overset{\|}{C}})-$, $-C(=O)-O-$, $-\underset{|}{N}-$



, 



eg:- $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$ → pentan-3-one

$CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ → pent-2-one

It is PG but it is metamer also. Metamer > PG

Ques:- How many isomer in C_6H_{14}

→ a:- C-C-C-C-C-C Hexane.

b:- C-C-C-C(C)-C 2-methyl pentane

c:- C-C-C(C)-C-C 3methyl pentane

d:- C-C(C)(C)-C 2,3 Dimethyl butane.

e:- C-C(C)(C)-C 2,2-Dimethyl butane

* TAUTOMERISM :-

eg:- $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ (3) $\xrightarrow{H}$ $CH_3-\overset{OH}{\overset{|}{C}}=CH_2$

Hydrogen

ketone. en-ol

Transfer of α Hydrogen.

eg:- $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ → 6α H

eg:- $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ → 5α H

eg:- $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ → 8α H

* more αH more stability more tautomerism.

* GEOMETRICAL ISOMERISM :- 2D rotation

Configuration = 2B → Rotation. (only for Alkenes)

$>C=C<$; $-N=C<$; $-N=N-$

Alkene syn / Anti syn / Anti

cis/trans E/Z

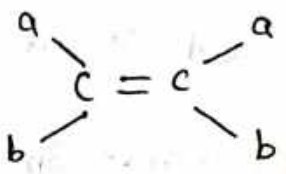
* Condition

i) Double Bond. ii) each & every Carbon have 2 different group.

a)

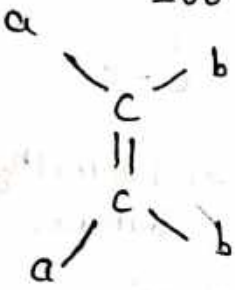
No G.I.S ✗

b)



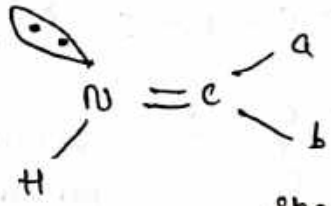
G.I.S ✓

c)



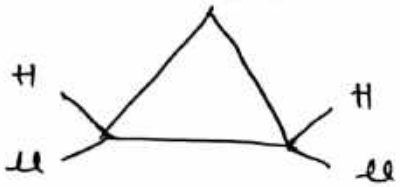
yes G.I.S

d)

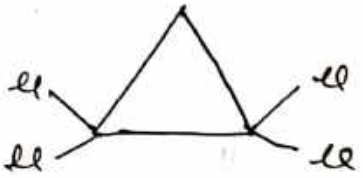


show G.I.S ✓

→ cyclo group → propane



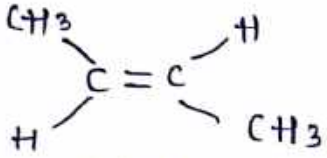
G.I.S ✓



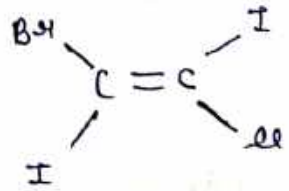
No G.I.S same group

* CIS / TRANS → Alkenes

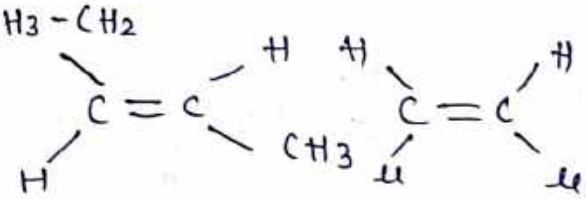
→



trans



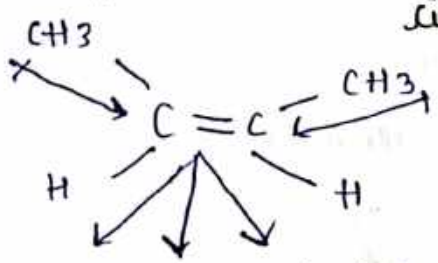
trans



trans cis

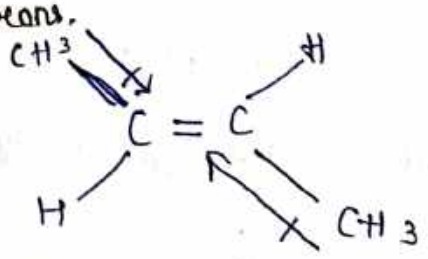
properties of cis / trans

1) Dipole moment



$\mu \neq 0$

cis > trans.



$\mu = 0$

trans

2) Polarity $\mu \neq 0$

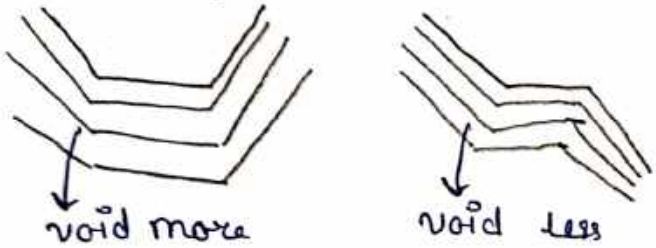
Trans are non polar

Cis are polar

3) B.P $\propto$ Polarity $\propto$ dipole moment

Cis > trans

4) Melting point.



Cis < Trans

5) stability

Cis < Trans

Summary :-

1) Polarity
2) μ
3) Boiling point } Cis > Trans
4) Melting point
5) stability } Trans > Cis

* E-Z Configuration

E = Entgegen - Trans

Z = Zusammen - Cis

Imp.

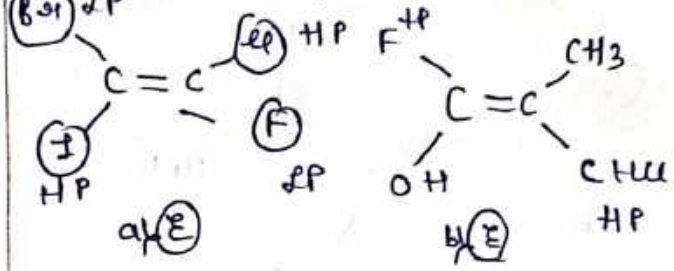
Chain Ingold prelog Rule - CIP

CIP →

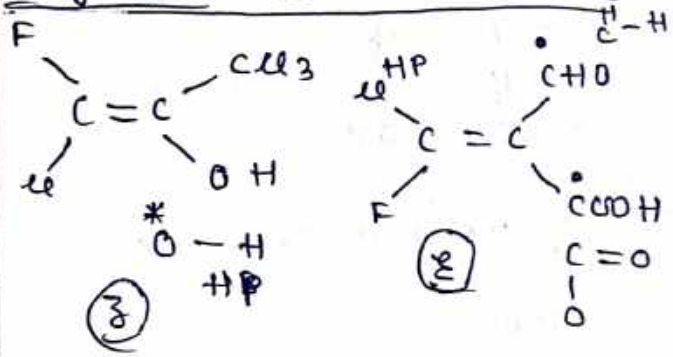
High proper priority

↳ wt. high

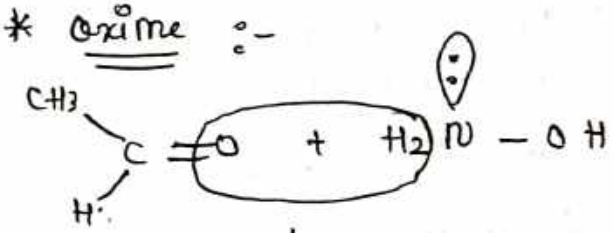
Low priority - wt. less

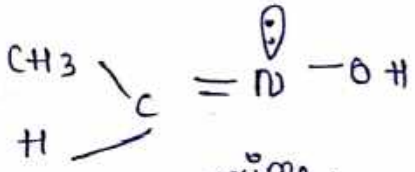


only attach atom's wt is seen.



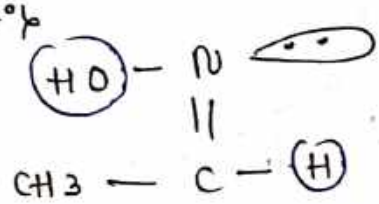
* Oxime :-





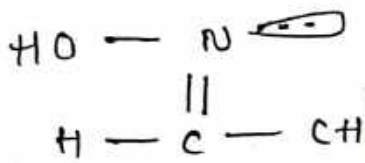
oxime :

Ques)



Anti

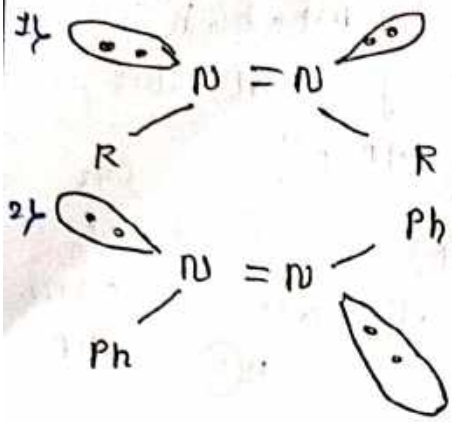
H & OH opposite sides.

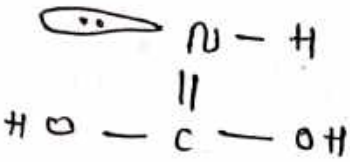


Syn

H & OH same side

Azo group





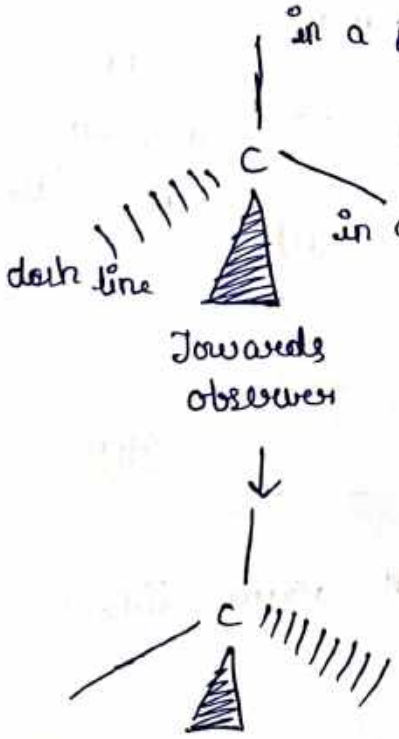
Iso Eg

* Conformational isomers :-

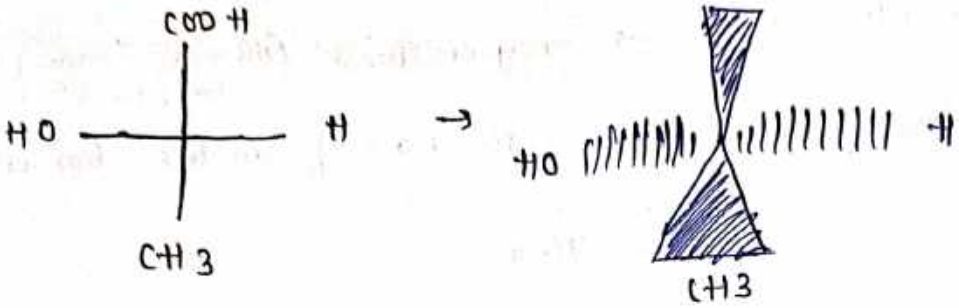
ALKANES

1) Wedge – dash projection
2) Fisher projection
3) Saw – Horse projection
4) Newman projection.

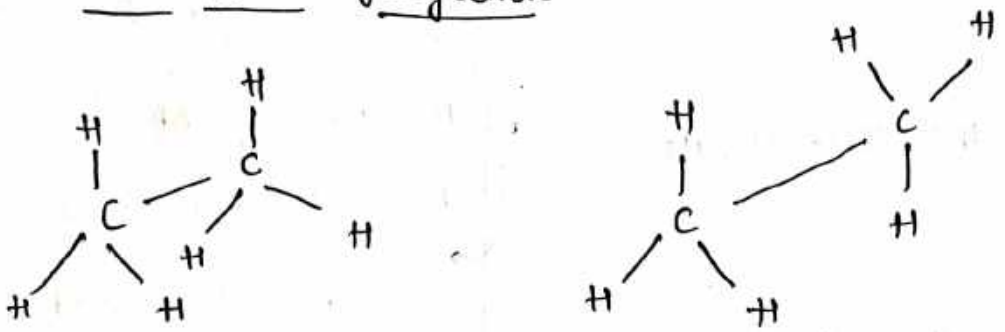
1) Wedge dash projection 3D



2) Fisher projection - 2D



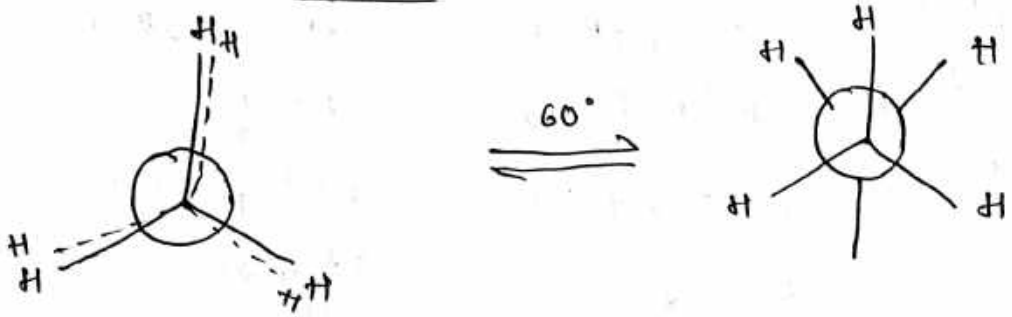
*3) Saw horse projection



Eclipsed

staggered

4) Newmann projection



→ There are infinite str. in conformational of Alkanes.

→ 0°, 60°, 120°, 180°, 240°, 300°, 360°

other than that → SKEW

* Total no. of Geometrical isomer :-

$CH_3 - HC = CH - CH = CH_2$ → unsymmetrical. (mirror image not possible)

Total no. of GI = 2^n n = no. of double bonds.

$= 2^2 = 4$ GI.

* Symmetrical

1) $CH_3 - CH = CH_2 - CH_3$

n = 1

2) $CH_2 = CH - CH = CH - CH = CH_2$

n = 3

3) $CH_2 = CH - CH = CH - CH = CH - CH = CH_2$

n = 4

$2^{n-1} + 2^{p-1}$

n = no. of DB.

$p = \frac{n}{2} = n$ = even

$= \frac{n+1}{2}$ n = odd.

eg 1) n = 1

$2^{n-1} + 2^{p-1}$

$n = 1 \quad p = \frac{1+1}{2} = 1$

$2^{1-1} + 2^{1-1}$

$2^0 + 2^0$

$1 + 1 = 2$

eg 2) n = 3

$2^{n-1} + 2^{p-1}$

$p = \frac{n+1}{2} = 2$

$2^{3-1} + 2^{2-1}$

$2^2 + 2$

$4 + 2$

$= 6$

eg 3) n = 4

$2^{n-1} + 2^{p-1}$

$p = \frac{4}{2} = 2$

$2^{4-1} + 2^{2-1}$

$2^3 + 2^1$

$8 + 2 = 10$

* Steric - when two same groups repel each other.

repulsion ↓ stability ↑. , Energy ↑ repulsion ↑

* Configuration → some imp. terms.

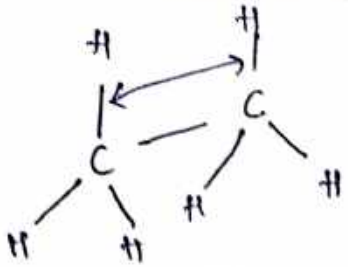
Types of Strain

Vander walls strain / Steric strain

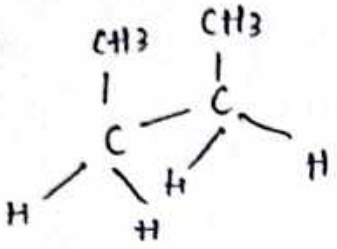
→ Staggered - min repulsion

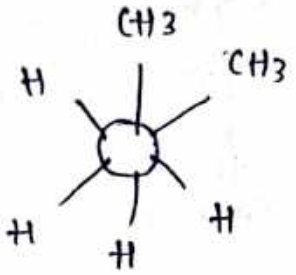
Eclipsed - max rep.

Torsional strain

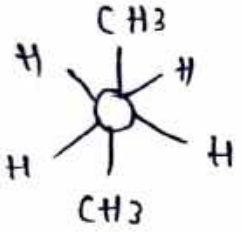


repulsion b/w two non-bonded atoms / molecule



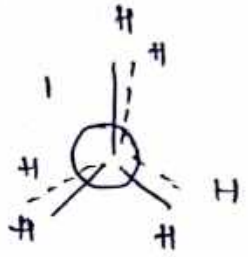


rep max

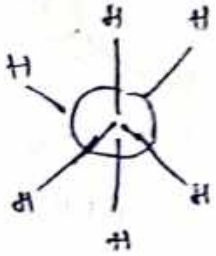


Rep min

Bonded e^- bond - repulsion of that bonded grp



Eclipsed - max repulsion



staggered - zero

→ Dihedral Angle / Torsional Angle

θ = Dihedral Angle.

$0° \rightarrow 60°, 120°, 180°, 240, 300$

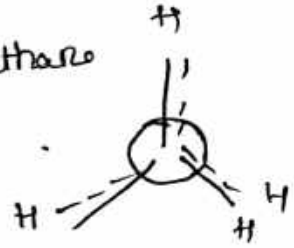
Eclipsed | Stagg

0 —— 20°

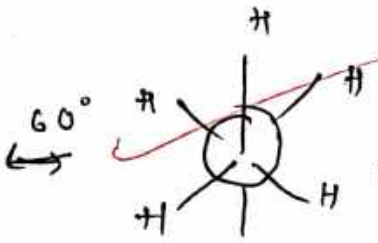
Ecli Skew

There are ∞ dihedral angle in between any structure

*Ethane



E

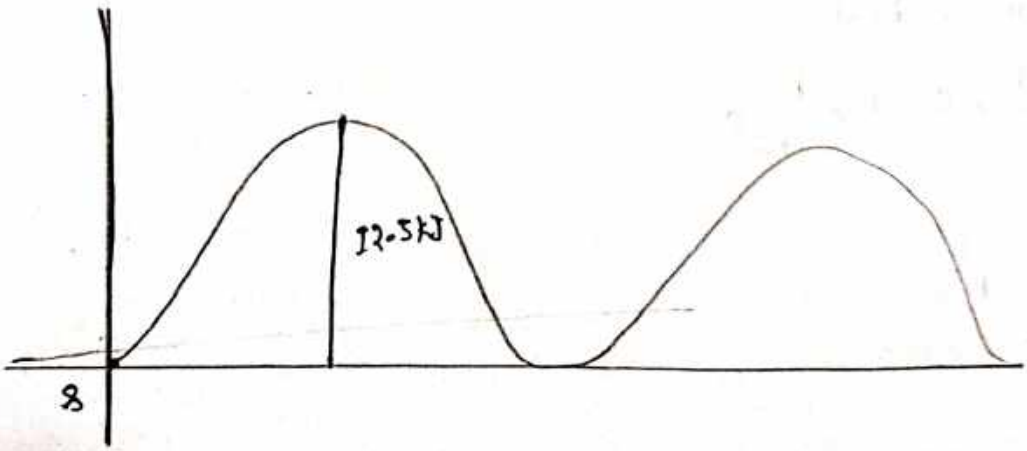


S

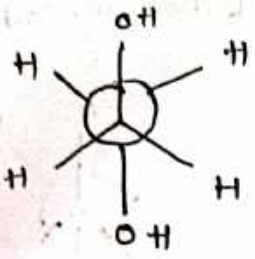
60° 60°

and so on.

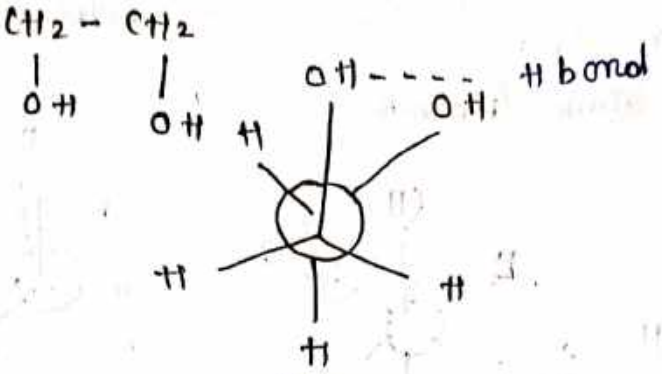
Energy from S to E is 12.5 kJ.



* Special Case



Anti



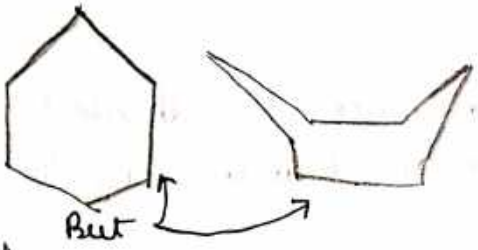
Gauche

→ CH_2-CH_2 (2 = F, -COOH, $-NH_2$, -OH, -NO, -O)

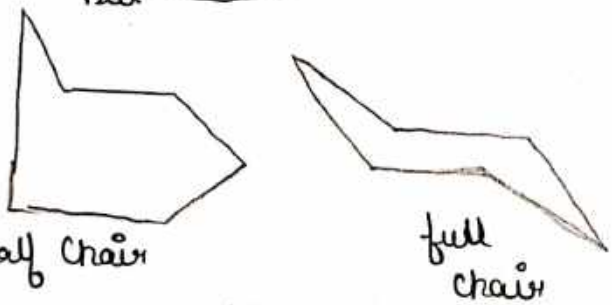
Gauche > Anti

Due to making of H-bond

* Cyclo hexane :-



Boat



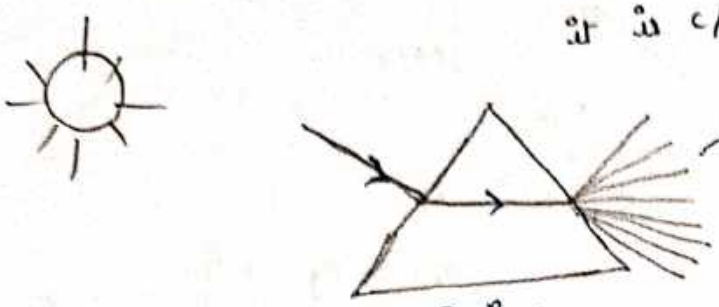
half Chair

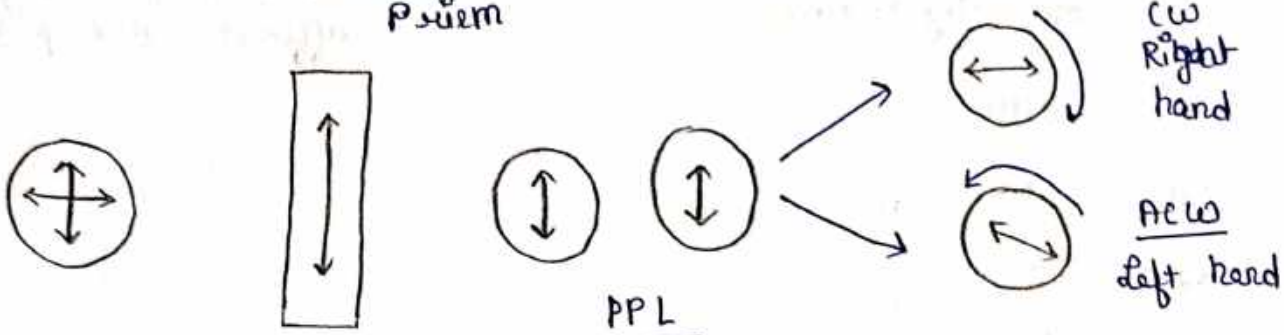
full Chair

Twisted boat

Chair > Twisted boat > Boat > half Chair.

* Optical Isomer (12th) → A compounds which can rotate PPL it is c/a enantiomers.





PPL
Plane polarized light

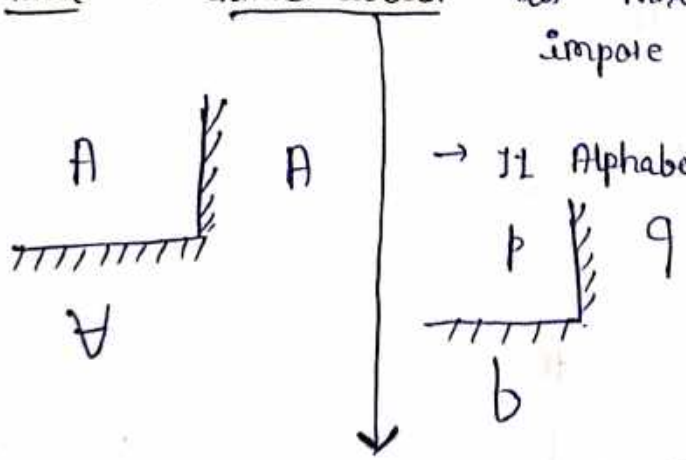
→ PPL → Right Hand → Dextrorotatory d form +ve form.

→ PPL → left Hand → Levorotatory s form -ve form

→ which cannot rotate PPL → meso compound.

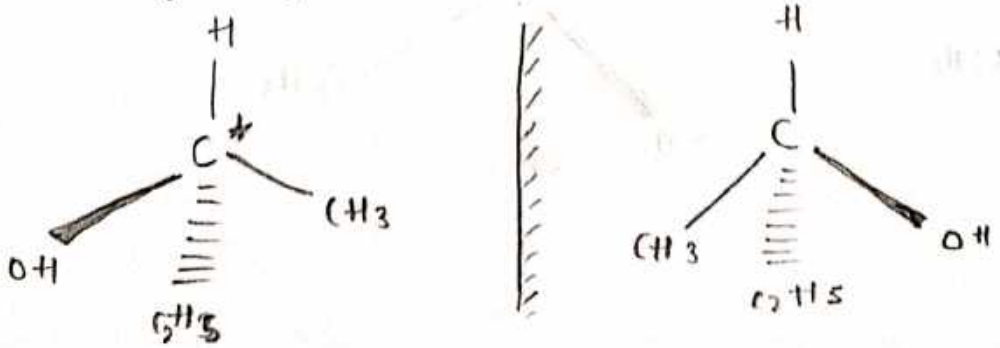
→ 50% RH & 50% LH → Racemic mixture

TRICK → chiral Carbon - its mirror image do not superimpose itself.

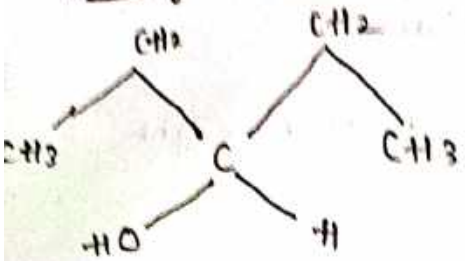


→ If Alphabetic → Chiral.

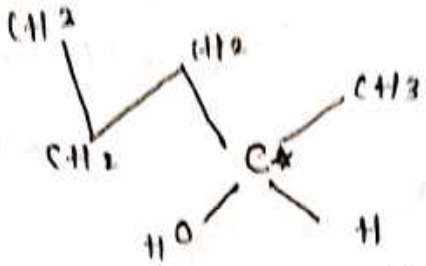
Trick - If any Carbon are attach with 4 different group



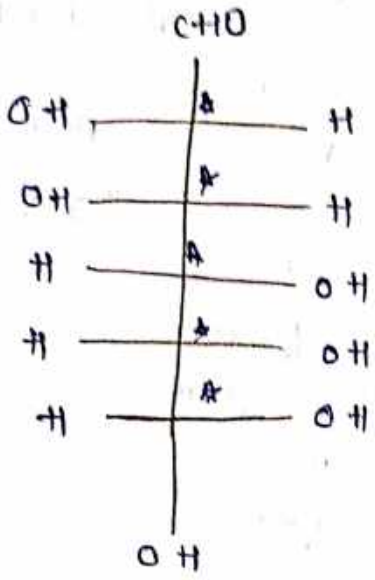
optically active



optically inactive

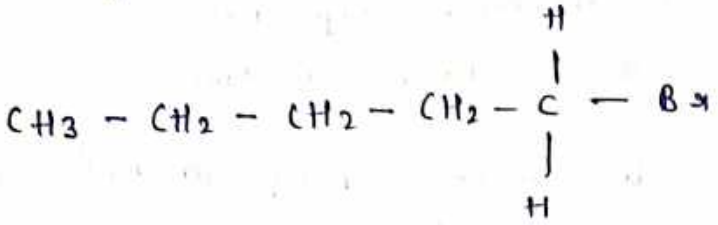


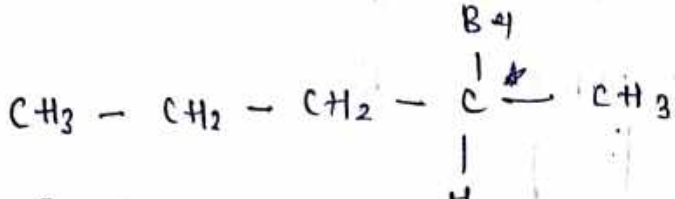
optically active as 4 different Groups is there.



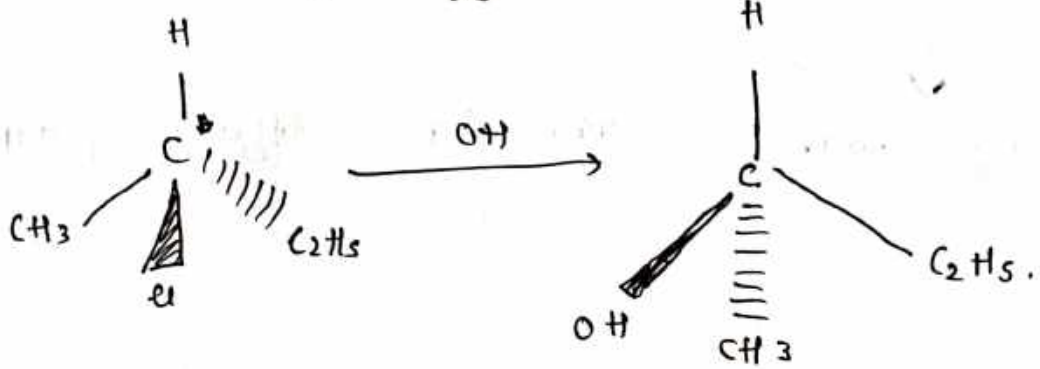
→ 5 chiral carbons

eg:-

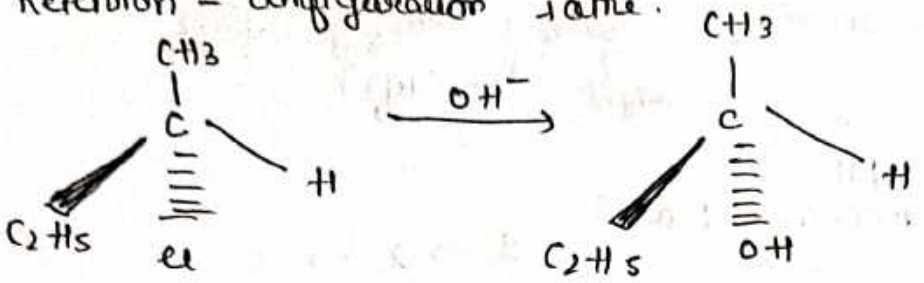




* Inversion of configuration.

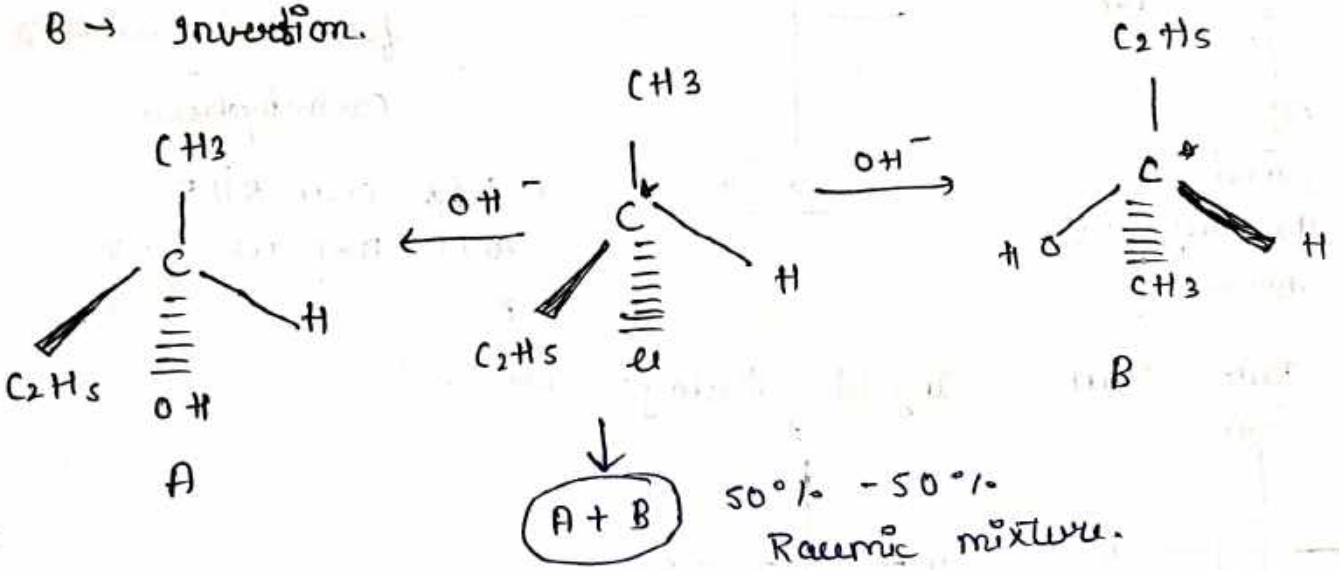


Retention – configuration same.



A → Retention

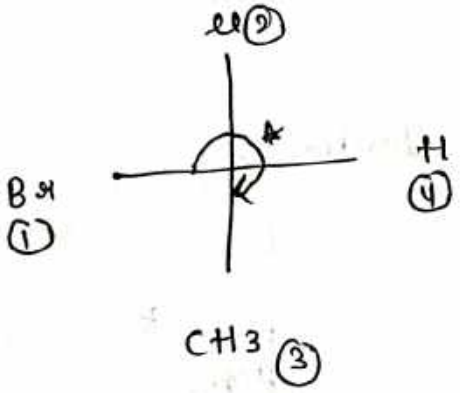
B → Inversion.



A + B → 50% - 50%
Racemic mixture.

→ CIP-Rule — RS configuration

Chain Ingold prelog Rule



CoW
RHR

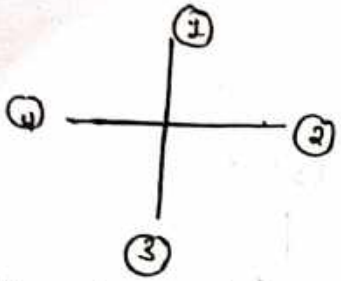
R & S configuration - Chiral
(right) (left)

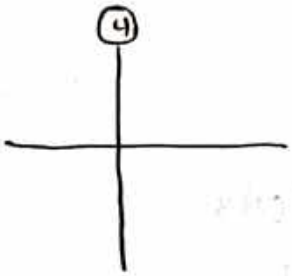
D & L configuration
(right) (left)

RH C.W. R or D

LH A.C.W L or S

1 → 2 → 3





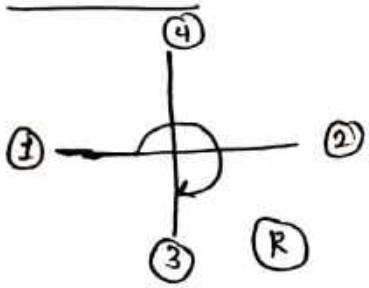
vertical

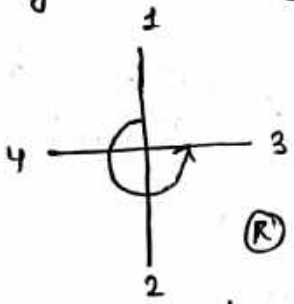
* D & L configuration for Amino acids & carbohydrates.

* R/S C.W RHR
D/L A.C.W LHR

(4) Horizontal means the configuration will inverse.

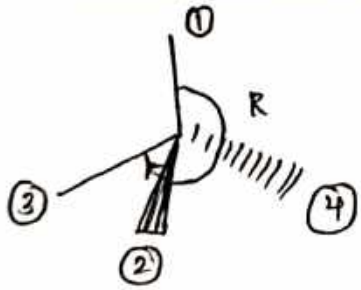
→ CIP Rule Chan Ingold Prelog Rule.

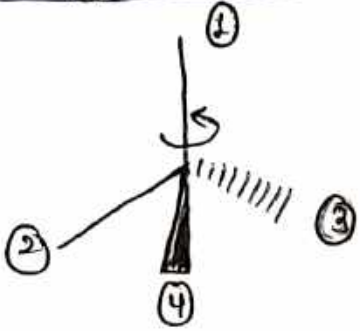


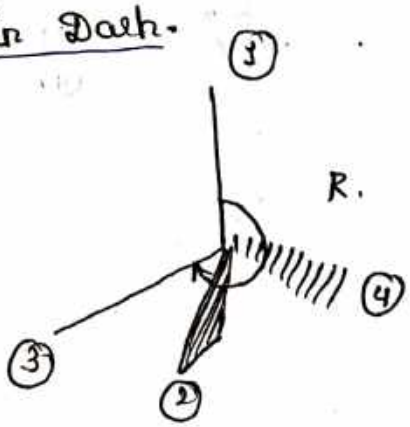


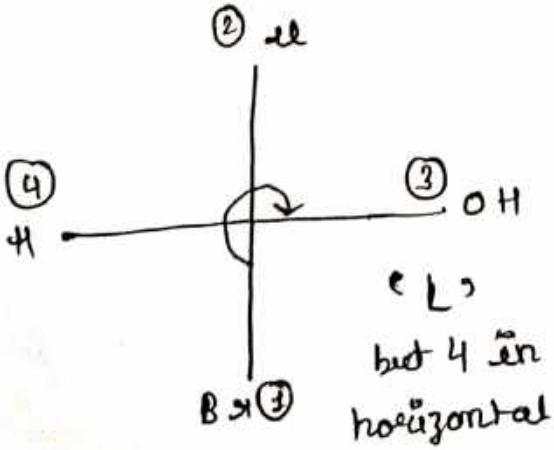
as A.C.W → L
but 4 in horizontal
so inverse.

→ In Wedge dash the (4) should be in Dash.

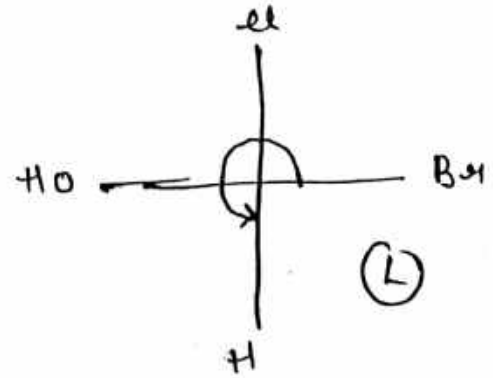






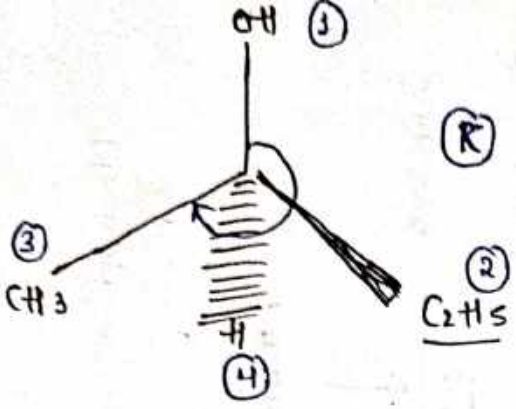


('L')
but 4 in horizontal.

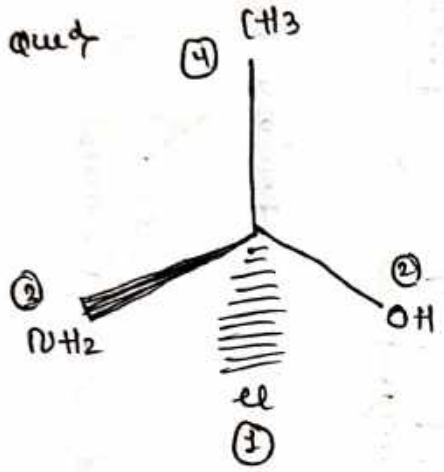


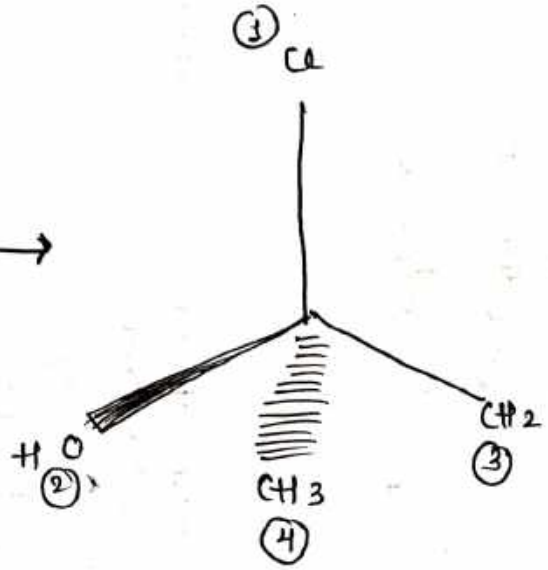
only the attached atom is seen.
eg - C_2H_5 both C as another C is present.

C_2H_5 only C is seen as it is attach



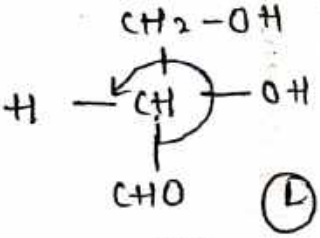
Quad





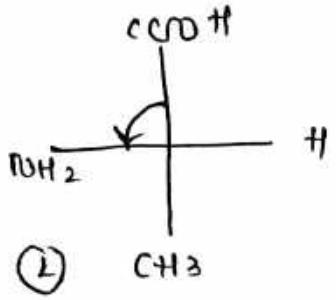
* D-L → Functional group

CW — L — ACW

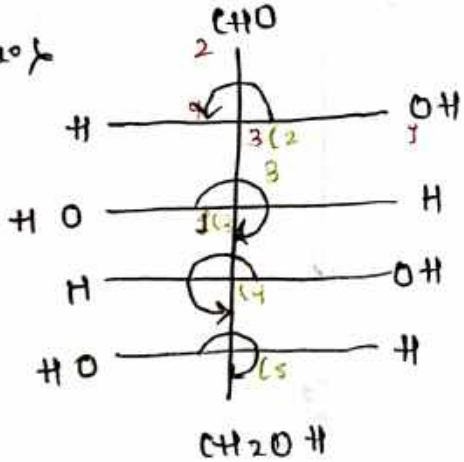


1) Carbohydrates
(OH) is given priority.

2) Amino acids
(NH2) is given priority.



Quad



$C_1 - X$ not possible.

~~CW~~ 2R, 3L, 4R, 5L

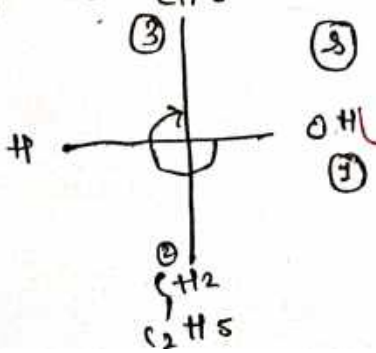
Ans.

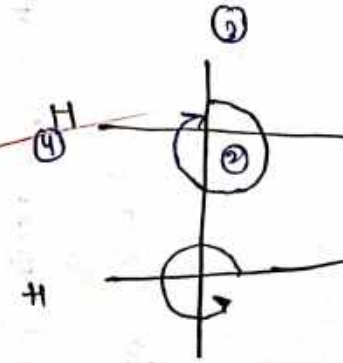
R/S to D/L

are ~~same~~ opposite

are ~~same~~ opposite.

pg - 165 · CH3





GOC – II

Reaction mechanism.

Nucleophiles [Nu⁻] — Electrophiles [E⁺] → Attacking Reagent

Substrate → (catalyst) → mechanism → (Intermediate) → Product

- s, l, g → solution: solute + solvent
  - polar
    - protic
    - Aprotic
  - non-polar

mechanism:
- SN-1
- SN-2
- E1
- E2
- Markovnikov
- Anti Markovnikov

(Intermediate):
- → carbocation
- → carbanion
- → carb free radical
- → Carbene

Satibity of Inter- – mediate

Substrate – Acidic prop & basic prop.

* Types of Rxn

- → substitution
- → Elimination
- → Addition
- → Rearrangement.

GOC

Reaction mechanism

A + B (Rxn) → Substrate → intermediate → product

Solvent
- Polar
- Non-Polar.

1) Type of organic Rxn :-

1) substitution → Displacement Rxn

$$A-B + C-D \rightarrow A-C + B-D$$

eg) $CH_3-Cl + KOH(aq) \rightarrow CH_3-OH + KCl$.

2) Elimination Rxn →

$$\underset{\substack{| \\ H}}{\overset{\substack{| \\ H}}{A-B}}-\underset{\substack{| \\ OH}}{} \xrightarrow[H_2SO_4]{Conc^n} A=B + H_2O$$

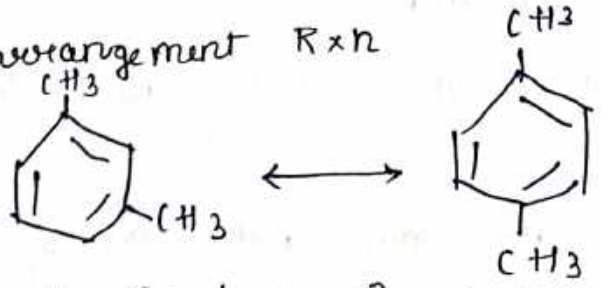
eg) $CH-CH_2 \xrightarrow[KOH]{Alc} CH_2=CH_2 + KCl + H_2O$

(H on CH, Cl on CH_2)

3) Addition Rxn

$$CH_2=CH_2 + H-Cl \rightarrow CH_3-CH_2Cl$$

4) Rearrangement Rxn



* Type of Bond breaking (fission)

1) Homolytic Bond fission → uniform bond breaking.

CH_3-CH_2-H (covalent bond)

1) EN → same
2) hν (sunlight), UV rays.
3) ozone (O_3)
4) peroxide
   → H_2O_2, Benzoyl peroxide, $C_6H_5-C(=O)-O-O-C(=O)-C_6H_5$
   → $C_6H_5-(O-O)-C_6H_5$

→ A — B → $A^\cdot + B^\cdot$ (Homolysis; covalent bond; 2C, 1C)

→ Intermedia $-\overset{|}{\underset{|}{C}}^{\cdot}$ ← CFR carbon free radical

2) Heterolysis – Non uniform bond fission.

$-\overset{|}{\underset{|}{C}}^{+\delta}-\overset{}{}^{-\delta}\text{u}$ → $-\overset{|}{\underset{|}{C}}-\text{u}$ carbocation $-\overset{|}{\underset{|}{C}}^{+} + \text{u}^-$

→ CONCLUSION :- Homolytic – Uniform bond break – CFR $-\overset{|}{\underset{|}{C}}^{\cdot}$

Heterolytic – Non-uniform bond break → carbocation $-\overset{|}{\underset{|}{C}}^{+}$

carbanion $-\overset{|}{\underset{|}{C}}^{-}$

* Types of SOLVENT *

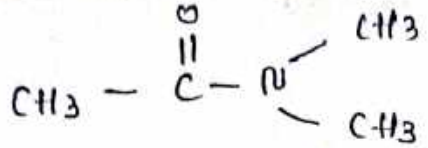
- Polar
  - Protic
  - Aprotic
- Non-polar

1) Polar protic solvent – H-atom directly attack with high EN compound

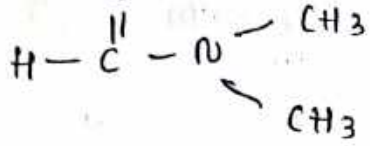
eg) H_2O, $R-OH$, CH_3-COOH, NH_3 etc.

2) Polar Aprotic solvent – H– atom not directly attack with high EN compounds

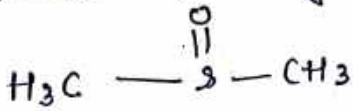
eg:- 1) N-N → Dimethylacetamide (DMA)



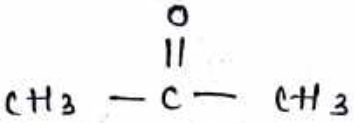
2) N-N-Dimethyl formamide (DMF)



3) DMSO - Dimethyl sulphoxide



4) Acetone



2) Non-polar solvent :- $\mu = 0$ (Non polar)

eg:- CS_2, CCl_4, ect benzene & petrol.

3) Type of Attacking Reagent :-

Nucleophiles → Nucleo + philes

Nu^- nucleus love

charge +ve love

→ e⁻ efficient

→ A species which is negatively charged or electron efficient.

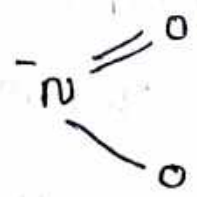
-ve charged or e⁻ efficient is act as Nucleophiles.

eg:- 1) H^-, Cl^-, CH_3^-, $RCOO^-$, NH_2^-

2) $H_2\ddot{O}$, $\ddot{N}H_3$, $R-OH$, $R-\ddot{N}H_2$, $R-\ddot{N}H-R$

3) $R-Mg-X$, $CH \equiv CH$, $CH_2 = CH_2$, benzene
$LiAlH_4$, $R-O^-$, $C_6H_5O^-$, CN^- etc

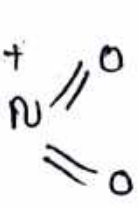
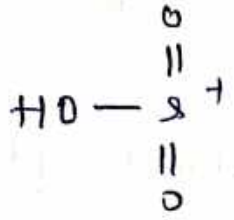
* Ambident Nucleophiles

NO_2  , $O-N=O$

CN^- $\bar{C} \equiv N$ $^-N \equiv C$

* Electrophiles - Electron phile Electron loving.

A species which is positively charged or e⁻ deficient act as electrophiles

eg:- H^+, Li^+, NO_2^+,  , HSO_3^+,  , R^+, $R-C^+=O$

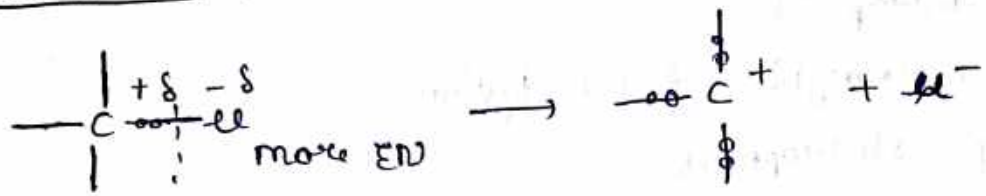
eg:- BF_3 , $AlCl_3$, $ZnCl_2$, $BeCl_2$
$3+3=6e^-$

* Types of Rxn Intermediate

Substrate + Attacking Reagent ⟶ [Intermediate]

1) Carbocation
2) Carb anion
3) carbon free radical
4) Carbene (Not in Book)

1) CARBOCATION :-



→ no. of electron left = 6e⁻

→ no. of e⁻ deficient = 2e⁻

hybridization = 6/2 = 3 = sp2

Hy = no. of e⁻ left / no. of e⁻ deficiency

→ Result, of heterolytic Bond fission

→ Attacked by Nu⁻ → Nucleophiles

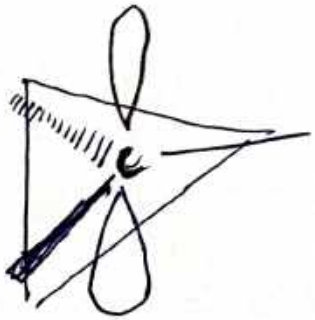
→ Behaves like → Electrophiles (E+)

* Types of Carbocation :-

1) Methyl Carbocation $CH_3^{\oplus}$
2) 1° Carbocation $CH_3-CH_2^{\oplus}$
3) 2° Carbocation $CH_3-\underset{CH_3}{\overset{}{CH^{\oplus}}}$
4) 3° Carbocation $CH_3-\underset{CH}{\overset{CH_3}{\overset{|}{C^{\oplus}}}}$

positively charged.

* Structure :- hybridisation = sp2 — Trigonal.



Stability of CC :-

3° > 2° > 1° > methyl CC

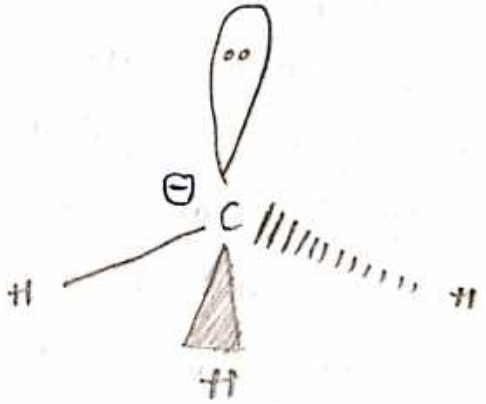
Stability on the Basis of

1) I effect
2) Hyper conjugation
3) M effect.

2) CARBANION :-

→ Result of heterolytic Bond fission.
→ Attack by Electrophiles
→ Act as Nucleophiles

→ no. of electron = 8e⁻
→ no. of deficiency = 0e⁻
→ hybridisation = 8e⁻
→ Structure = tetrahedral



* Types Of Carbanion

1) Methyl Carbanion CH_3^-

2) 1° CA = $CH_3 - CH_2^{\ominus}$

3) 2° CA = $CH_3 - \underset{\underset{CH_3}{|}}{CH^{\ominus}} -$

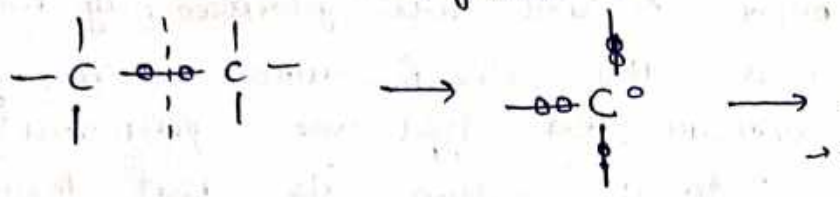
4) 3° CA = $CH_3 - \underset{\underset{CH_3}{|}}{\overset{CH_3}{\underset{|}{C^{\ominus}}}}$

stability - , Methyl > 1° > 2° > 3°

1) M - effect
2) 9 - effect.

3) CARBON FREE RADICLES :-

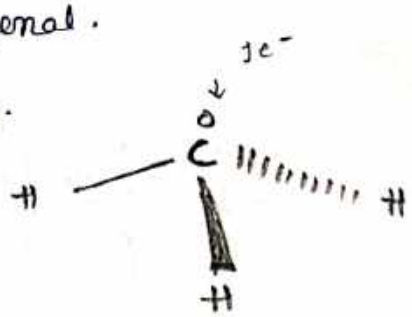
→ hν / U.V / 573K
→ ozone
→ peroxide.



→ sp2 → trigonal.

→ Homolytic Bond fission.

→ 7e⁻ available
→ 1e⁻ deficient.



* Behave like carbocation.

Act as Electrophiles
Attacked by Nucleophiles

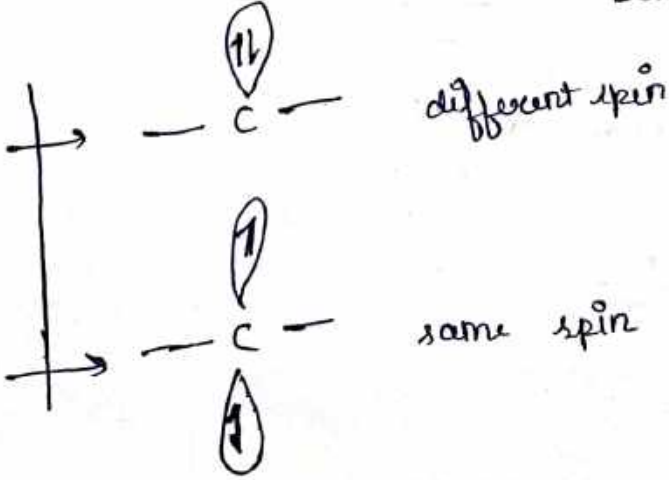
Types :- 1) Methyl CFR
2) 1° CFR
3) 2° CFR
4) 3° CFR

Stability → 3° > 2° > 1° > Methyl CFR.

Stability defined by - I effect
- M effect
- Hyperconjugation.

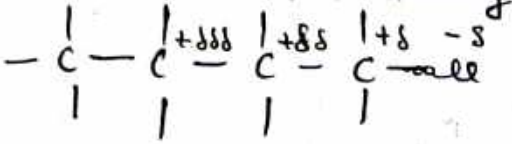
4) CARBENE → °CH2

6e⁻ → sp2 → neutral species
→ behave like electrophiles



* Factors Affecting Rxn Intermediate

1) Inductive Effect :- Polarity of the non-polar carbon σ bond electron are permanently moves towards that direction where electronegativity is maximum. This effect are permanent & after 3 to 4 carbon its effect becomes permanently vanished.



→ permanent Effect
→ polarity b/w atoms

→ +I effect - e^- donar group.
→ e^- repulsive group.

eg)

$-CH_3^- > -NH_2^- > -O^- > -COO^- > -\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3 > -CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_3$

$> -CH_2-CH_3 > -CH_3 >$ - Tritium (^3H) > - Deuterium (^2H)

→ -I effect - e^- withdrawl group
e^- accepter group.

eg)

$-OR_2^+ > -NR_3^+ > -\overset{+}{N}H_2 > -N\overset{O}{\underset{O}{<}} > -C\equiv N > -\overset{O}{\overset{||}{C}}-OH >$

$-X > -OR > -OH > -NH_2 > -C_6H_5 > -C\equiv CH > -CH=CH_2$

eg) ↑ Cl, F, Br, I — Benzene ring

* Application of Inductive Effect :-

1) stability of carbocation $\propto \frac{+I}{-I}$

2) Stability of carbanion $\propto \frac{-I}{+I}$

3) Stability of CFR $\propto \frac{+I}{-I}$

4) Acidic Effect - $\propto \frac{-I}{+I}$

5) Basic Effect $\propto \frac{+I}{-I}$

* Resonance / Mesomeric Effect

* Definition - movement of πe^-

Temporary Effect.
Permanent

lp = πe^-
DB = πe^-
TB = πe^-

Condition :-

1) =, —, = eg $CH_2 = CH - CH = CH_2$
2) =, —, -ve eg $CH_2 = CH - CH_2^{\ominus}$
3) =, —, +ve eg $CH_2 = CH - \overset{\oplus}{C}H_2$
4) =, —, lp eg $CH_2 = CH - \ddot{O}H$
5) =, —, Free radical eg $CH_2 = CH - \dot{C}H_2$

* Resonance steps :-

Rule 1) Double Bond wiping.

eg) $= CH - C \longleftrightarrow CH - C =$

↑ sign of resonance

Rule 2) charge → Alternation

$\overset{\ominus}{C}H_2 - CH = CH_2 \leftrightarrow CH_2 = CH - CH_2^{\ominus}$

Rule 3) lp → give → self → +ve → DB
→ alternative = -ve

$CH_2 = CH - \ddot{O}H \leftrightarrow {}^{-}CH_2 - CH = \overset{+}{O}H$

→ Mesomeric effect → charge before after same

the other examples :-

$\overset{-ve}{CH_2} = \overset{+ve}{CH} - CH = CH - CH = CH - CH_3$

$\updownarrow$

$\overset{\ominus}{CH_2} - \overset{\oplus}{CH} - CH = CH - CH = CH - CH_3$

$\updownarrow$

$\overset{\ominus}{CH_2} - CH = CH - \overset{\oplus}{C}H = CH - CH = CH_2$

$\updownarrow$

$\overset{\ominus}{CH_2} - CH = CH - CH = CH - \overset{\oplus}{C}H - CH_3$

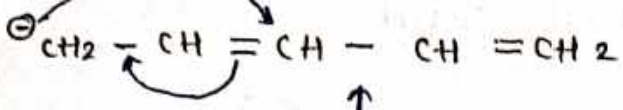
EN

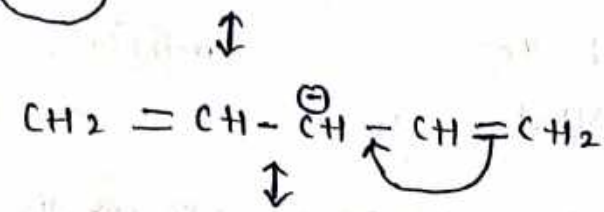
sp > sp^2 > sp^3

= =

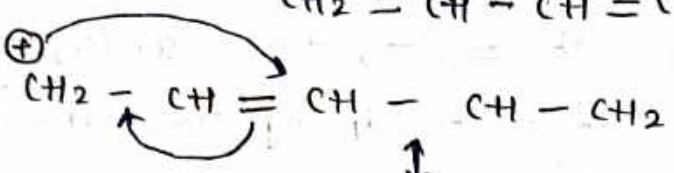
more EN always has -ve charge → more stable

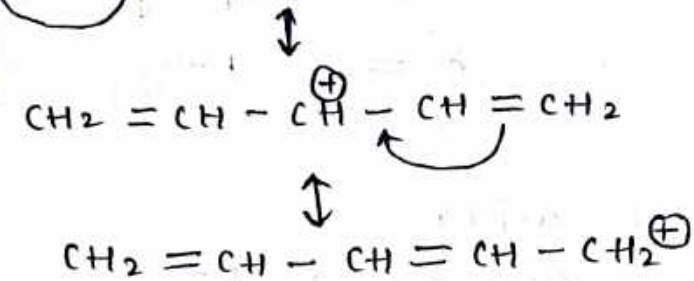
eg 2:





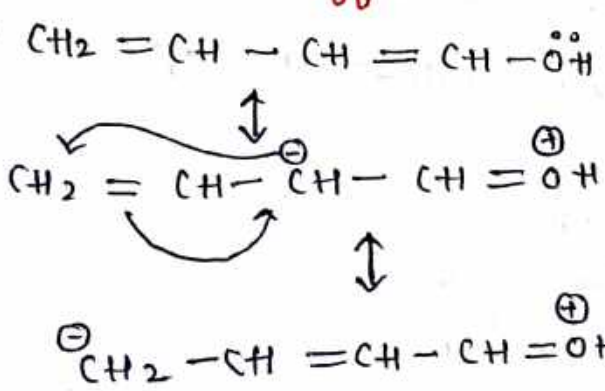
eg 3:



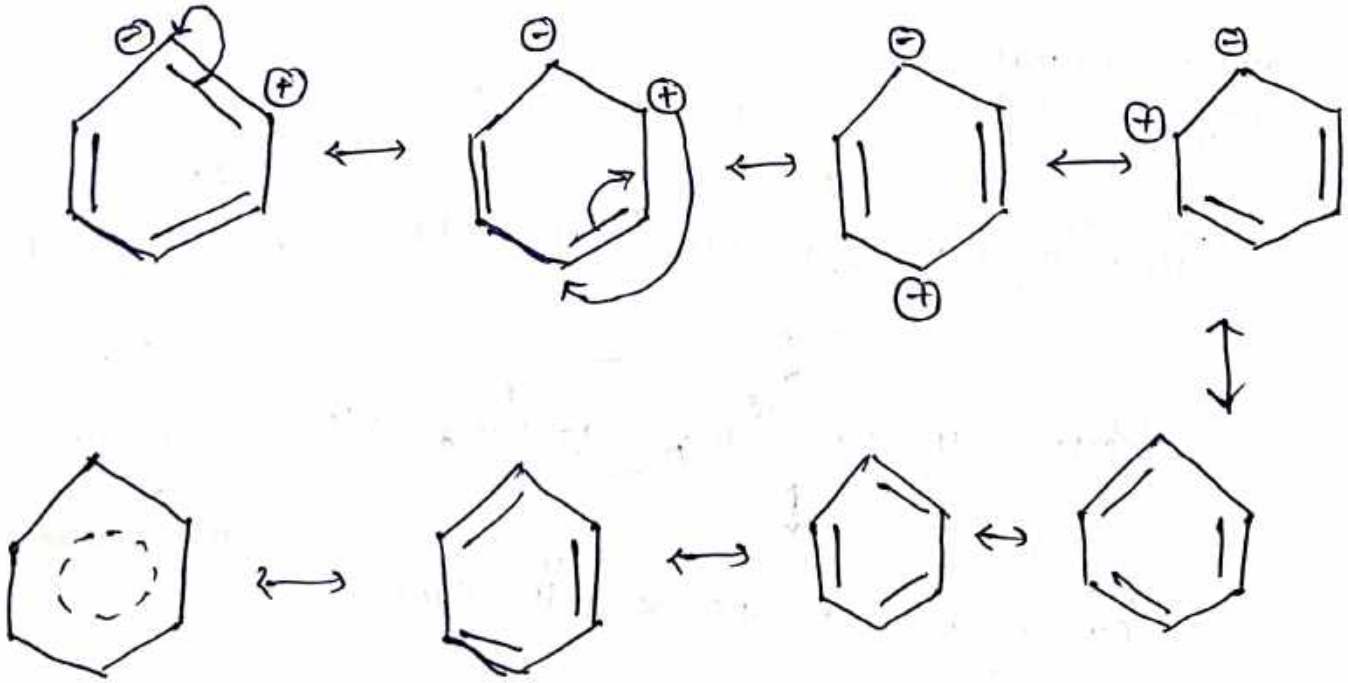


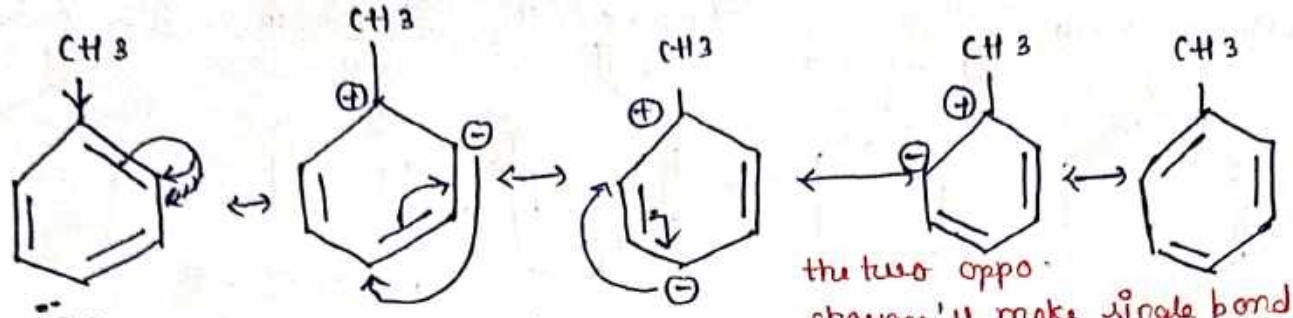
* The charge & π bond moves at the opposite direction in Resonance Effect.

eg 4:

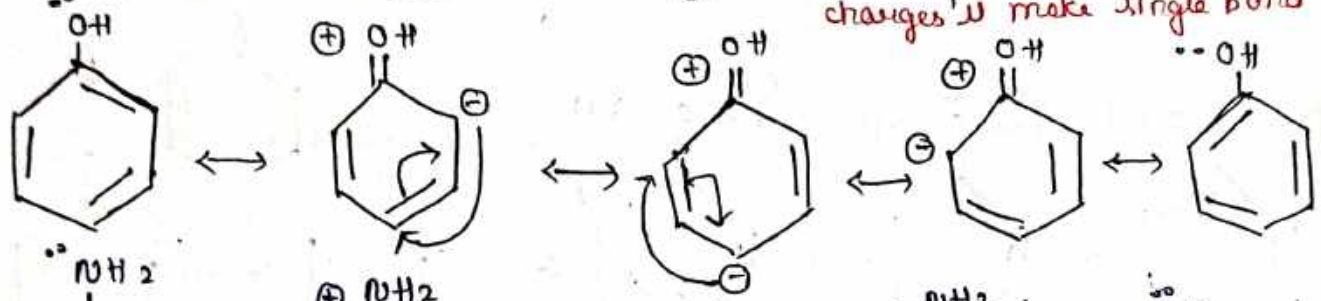


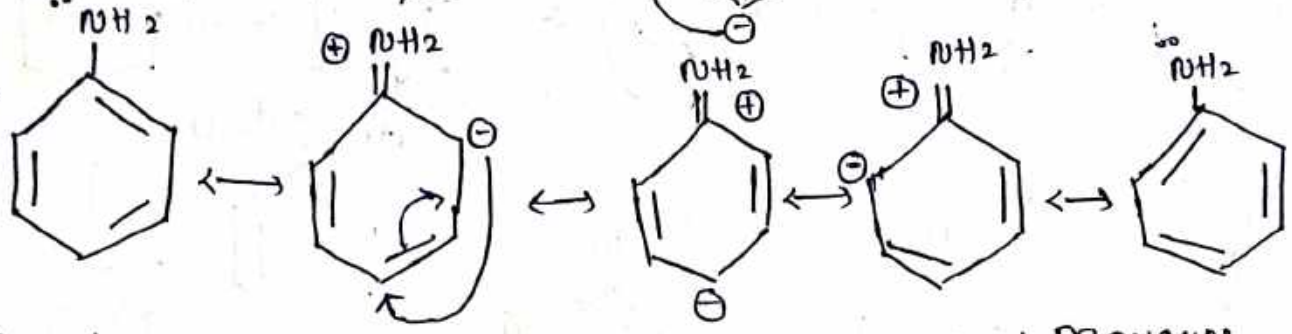
* Resonance in BENZENE :-



1) 

the two oppo. charges'll make single bond.

2) 

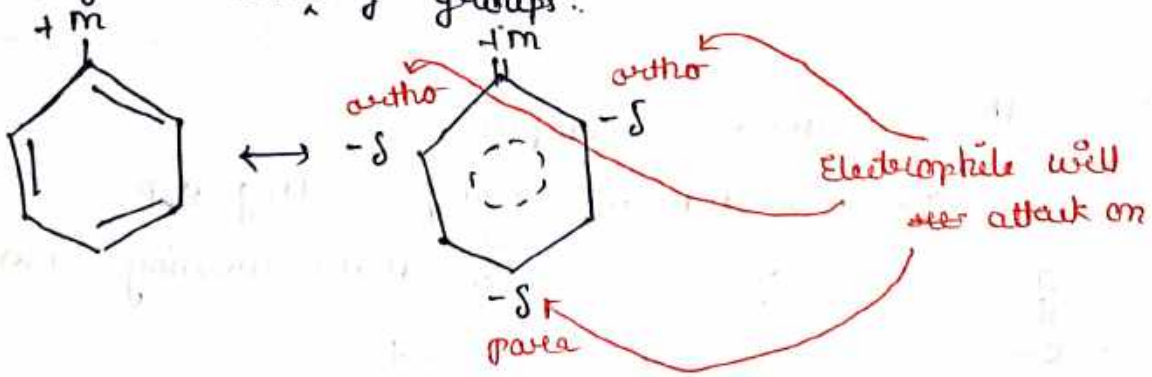
3) 

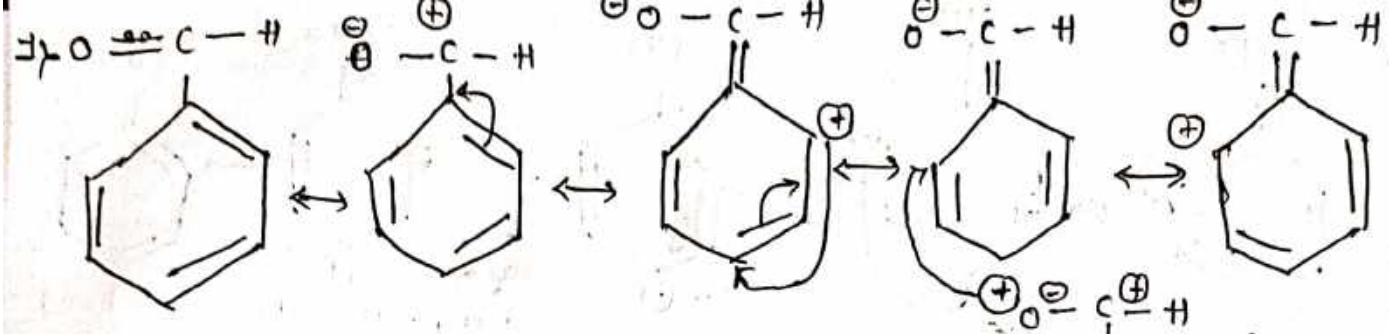
the above 3 egs are πe^- Donar groups → +M groups

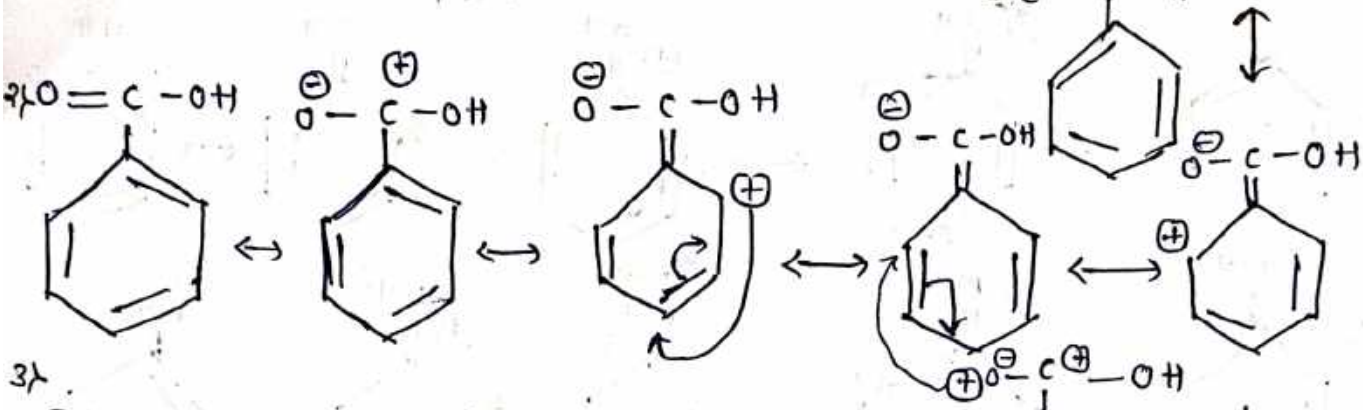
eg :- $-CH_3$, $-\ddot{N}H_2$, $-\ddot{O}H$, $-\ddot{O}-CH_3$

$-\ddot{N}H-R$, $-\ddot{N}(R)-R$

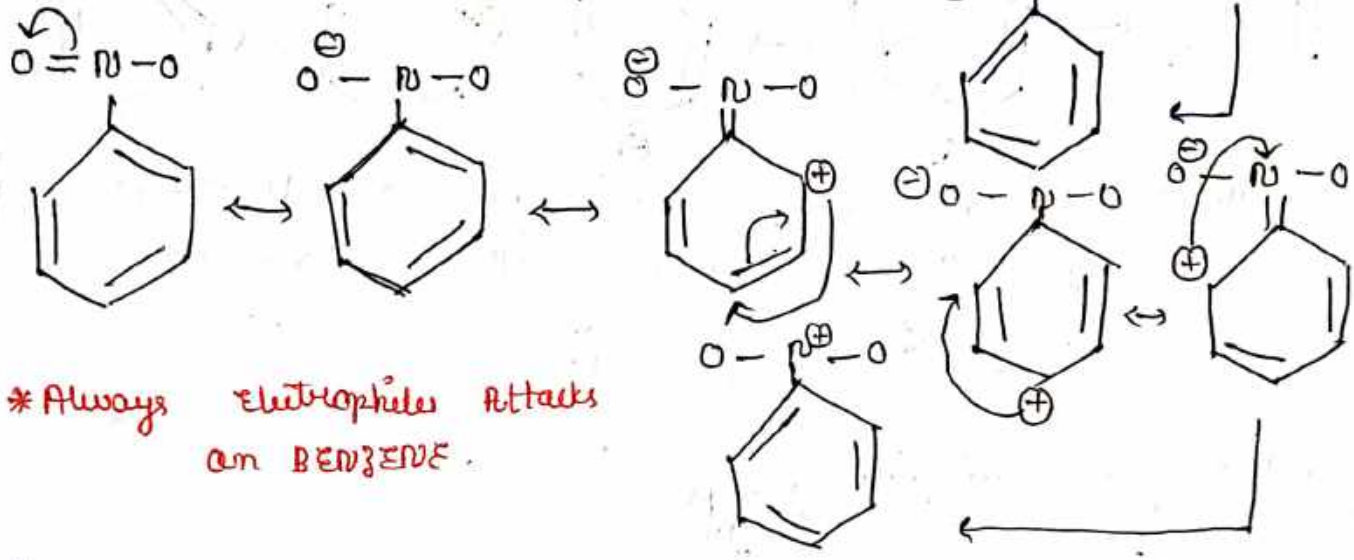
ortho / para directing groups.







3)



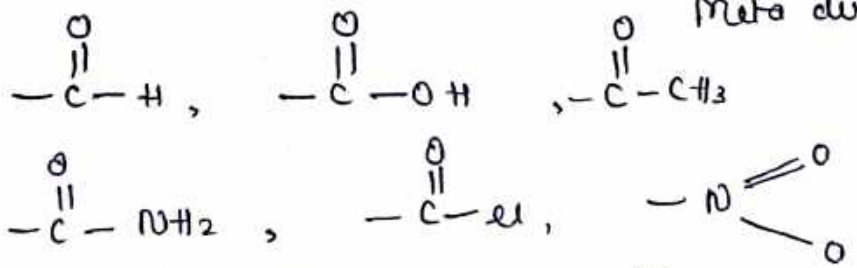
* Always Electrophiles Attacks on BENZENE.

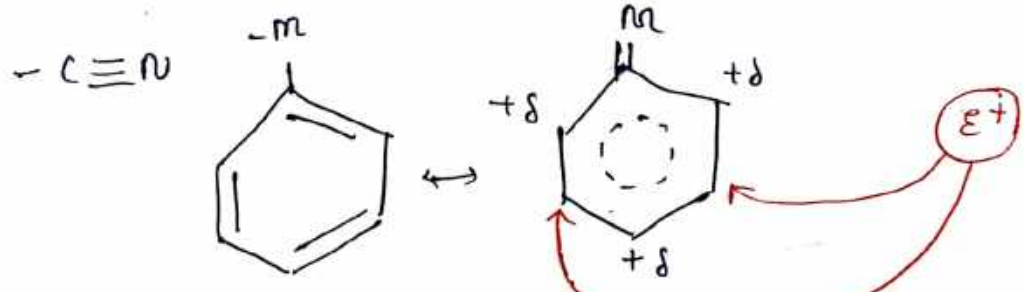
from the above examples

πe^- withdrawl group = -M group

Meta directing group

eg)





* Applications / Properties of Mesomeric Effect :-

→ Acidic Effect $\alpha \frac{-m}{+m}$

→ Nucleophilic Substitution Rxn $\alpha \frac{-m}{+m}$

→ Basic Effect $\alpha \frac{+m}{-m}$

→ Electrophilic Substitution Rxn $\alpha \frac{+m}{-m}$

→ Electron Addition Rxn $\alpha \frac{+m}{-m}$

* AROMATIC COMPOUNDS

→ Conditions - 1) Cyclic
2) Planar - sp, sp^2 only
3) Conjugated (each and every carbon / atom do Resonance)
4) Huckle's Rule → $(4n+2)\pi e^-$ or the no. of e^- present in s, p, d, f.

eg:- if $n = 0$, if $n = 1$
$= 2\pi e^-$ $6\pi e^-$ Aromatic

Note :- (-ve) charge is considered as $2\pi e^-$ & is COUNTED.

if $n = 2$
$4 \times 2 + 2 = 10\pi e^-$

if $n = 3$
$4 \times 3 + 2 = 14\pi e^-$

eg:- πe^- are in $= 2\pi e^-$
$\equiv 2\pi e^-$ (Only two e^- are participating)

$n = 0 \quad = 2\pi e^-$

-ve charge $= 2\pi e^-$

3) Electromeric Effect / Electronic Effect :-

i) It is only shown in multiple Bonds (=, ≡)

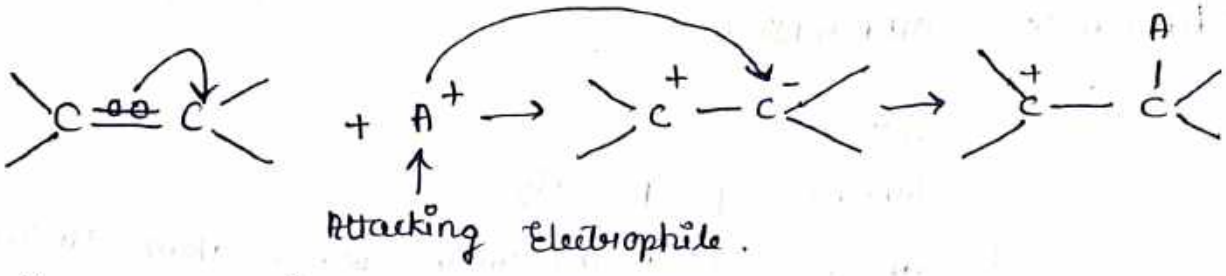
ii) It is only in the presence of Attacking Reagent only which are E+ & Nu⁻

iii) It is a ~~temporary~~ effect.

iv) It is defined as complete transfer of πe⁻ into any one atom. (Conversion of π bond → σ bond)

→ +E Effect (positive electromeric Effect)

This effect is only in the presence of any electrophiles (E+) & electrons are transferred into those atoms where E+ are attached



→ Negative Electromeric Effect (-E effect)

In this Effect πe⁻ are transferred to that atom where attacking reagent (Nu⁻) does not get attach.

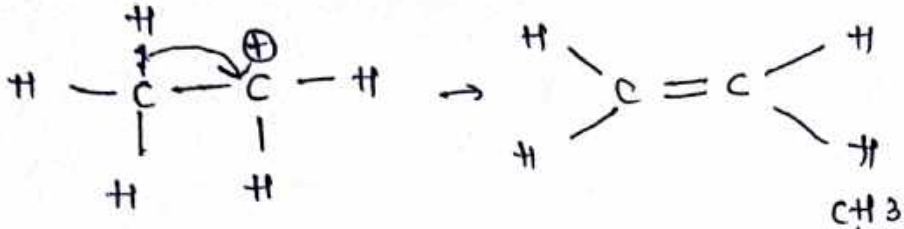
* HYPERCONJUGATION :- (Permanent Effect)

In Hyperconjugation, complete transfer of e⁻ of C-H σ bond towards +ve charge or free radical or π bond. ~~is called~~ It is also known as no bond resonance.

Condition :- i) α-Carbon must have sp^3 Hybridization.

ii) β-Hydrogen must be present.

Hyperconjugation ∝ stability of Carbocation.



a) $CH_3^+ \rightarrow$ 0 α-H

b) $CH_3-CH_2^+ \rightarrow$ 3 α-H

1° carbocation.

c) $CH_3-CH(CH_3)^+ \rightarrow$ 6 α-H

2° carbocation

d) $(CH_3)_3C^+ \rightarrow$ 9 α-H

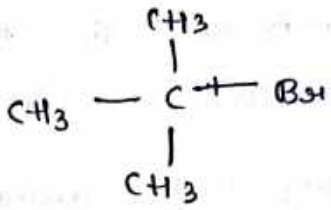
3° carbocation.

most stable.

Mechanism

1) Nucleophilic Substitution Rxn (SN Rxn)

SN-1	SN-2	Ring
→ Alkane – CH_3	→ Alkanes – CH_3	Benzene.
→ Alcohol – OH^-	→ Alcohol	
→ Haloalkanes – Br^-	→ Haloalkanes	

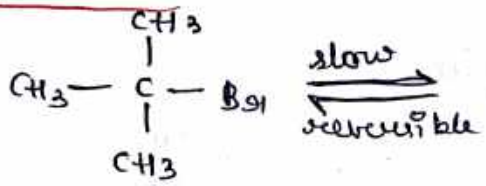


1.1) SN-1 Mechanism

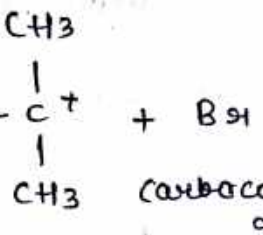
1) When
- 3° Carbon
- Polar Protic solvent – C_2H_5OH, H_2O, Acid

→ Two step Process :-

Step 1)

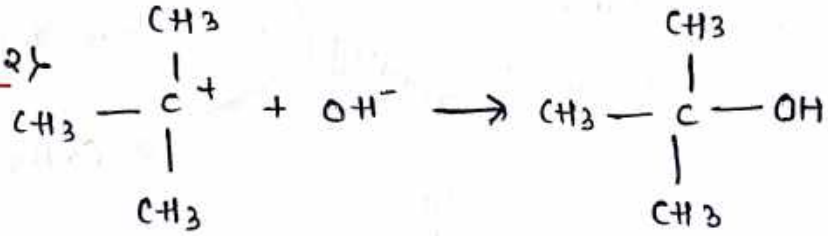


slow, reversible



Carbocation or the Intermediate

Step 2)



* Rate of Reaction :-

1) $A + B \longrightarrow C$

Rate of Rxn $= k[A]^1[B]^1$

$=$ order $= 1 + 1 = 2$

Que. 2) $2A + 4B \rightarrow 9C$

Rate of Rxn $= k[A]^2 + [B]^4$

$=$ order $= 2 + 4 = 6$.

Rate of Rxn for SN-1

$$r = k\left[C(CH_3)_3Br\right]^1$$

order $= 1$

* SN-1 Mechanism Summary :-

→ order = 1 Haloalkane → Halogen + Alkane

→ Rate of Rxn = $k[-\overset{\downarrow}{H}A]$

→ Step → Two step Rxn.

→ Rate determination step (RDS) :- formation of carbocation (which slows the Rxn)

→ Intermediate → Carbocation.

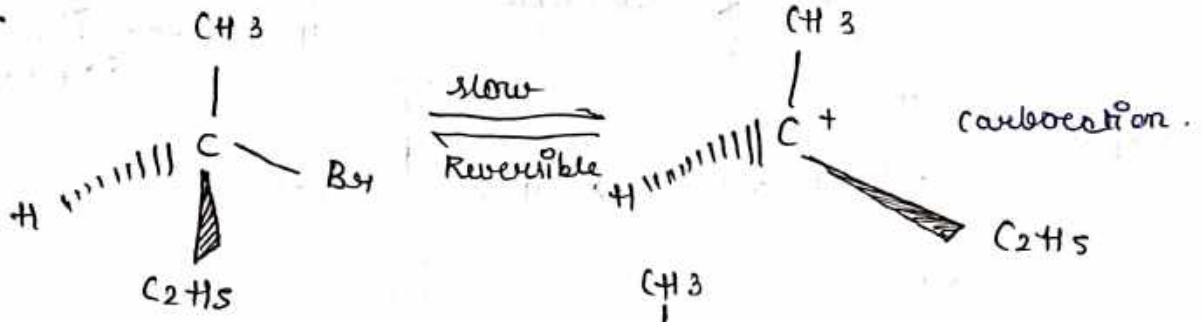
→ Stability of Carbocation → 3° > 2° > 1° > Methyl CC.

→ When 3° Haloalkane are present & when polar protic solvent are present. (CONDITIONS)

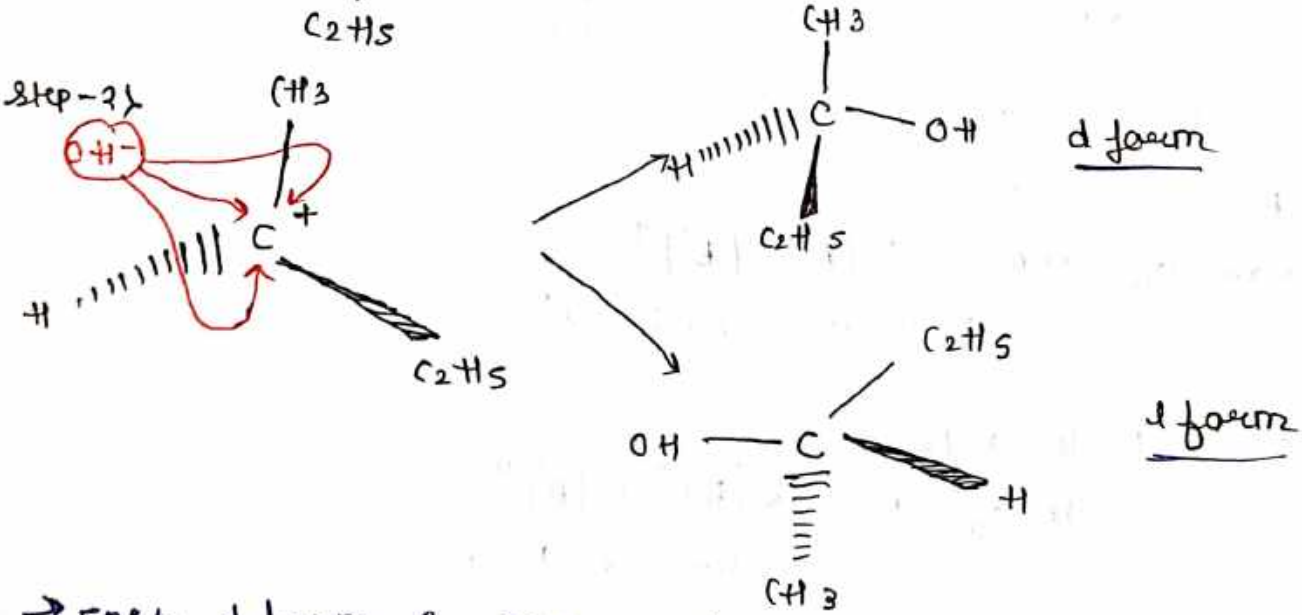
→ Product → Racemic mixture.

→ Product of SN-1 Mechanism

Step - 1 :

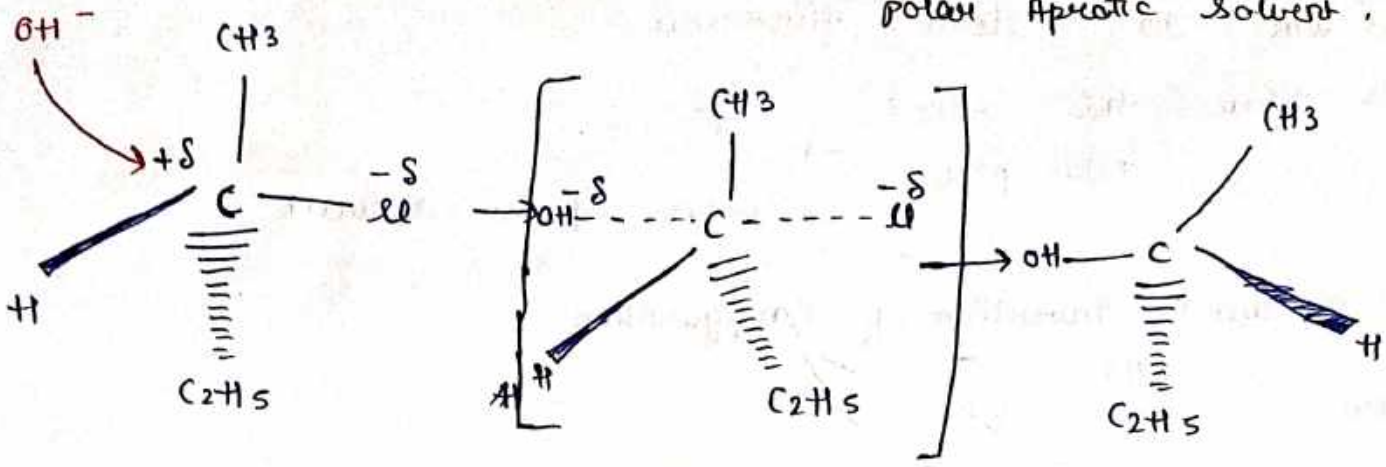


Step - 2 :

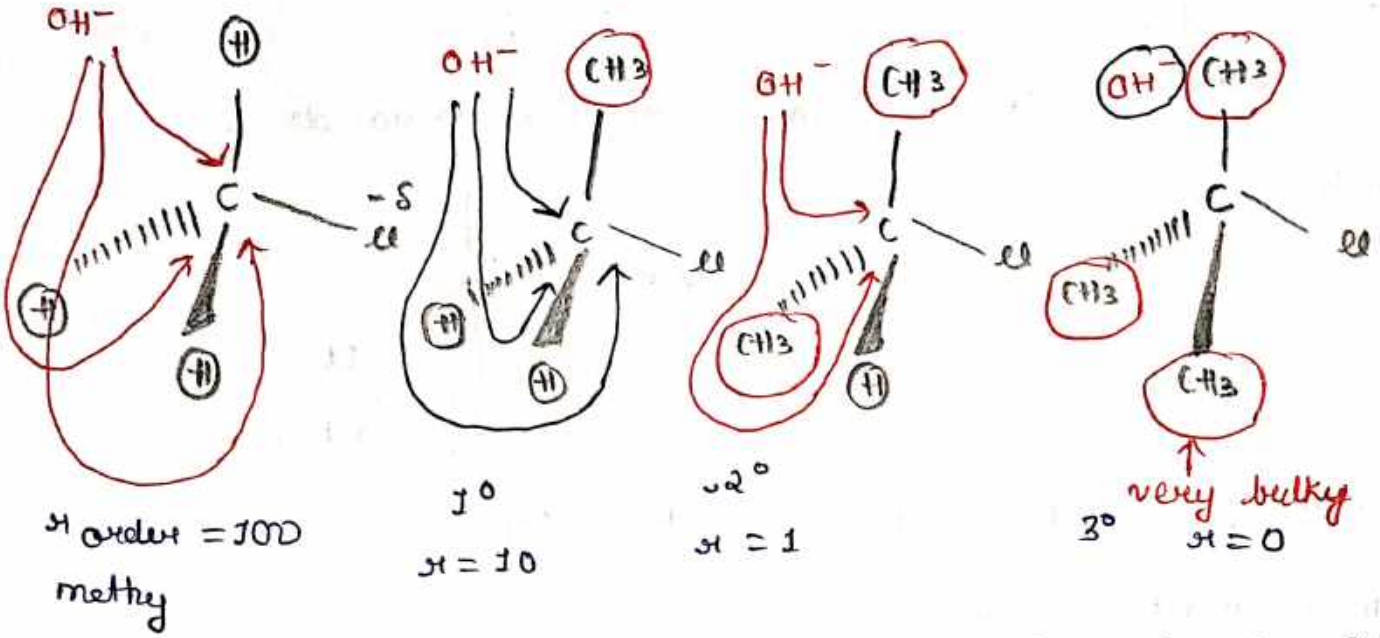


→ 50% d form & 50% l form → racemic mixture.

SN-2 Mechanism → 1° Haloalkane or polar Aprotic Solvent.



d form | Transition State | l form



1° order = 100
methy
r = 10

2°
r = 1

3°
r = 0

→ Steric hindrance – when one group oppose the other to join or which slows down the reaction.
eg :- bulky CH_3.

SN-2 Reactivity → Methy > 1° > 2° > 3°

* SN-2 Mechanism summary :-

→ order = 2

rate of rxn = $r = [R-X]^1 [Nu^-]^1$

Step → one step

RDS → NO

Intermediate → transition state

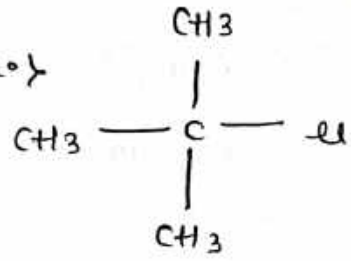
→ order of reactivity → methyl > 1° > 2° > 3°

→ Due to steric hindrance

→ when this SN-2 take place → 1°,
→ polar aprotic solvent.

→ product → Inversion of Configuration.

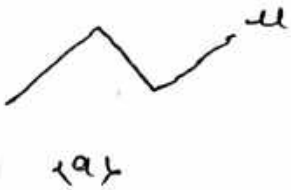
Que>



& $CH_3-CH_2-CH_2-Cl$

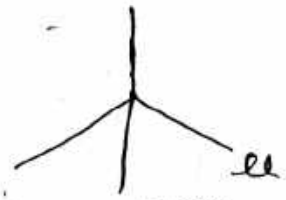
b> SN-1 → more reactive towards a

Que>



(a)

&



SN-1 more reactive

* Leaving group :- $F < Cl < Br < I$

SN-1 most reactive ?

a>

b>

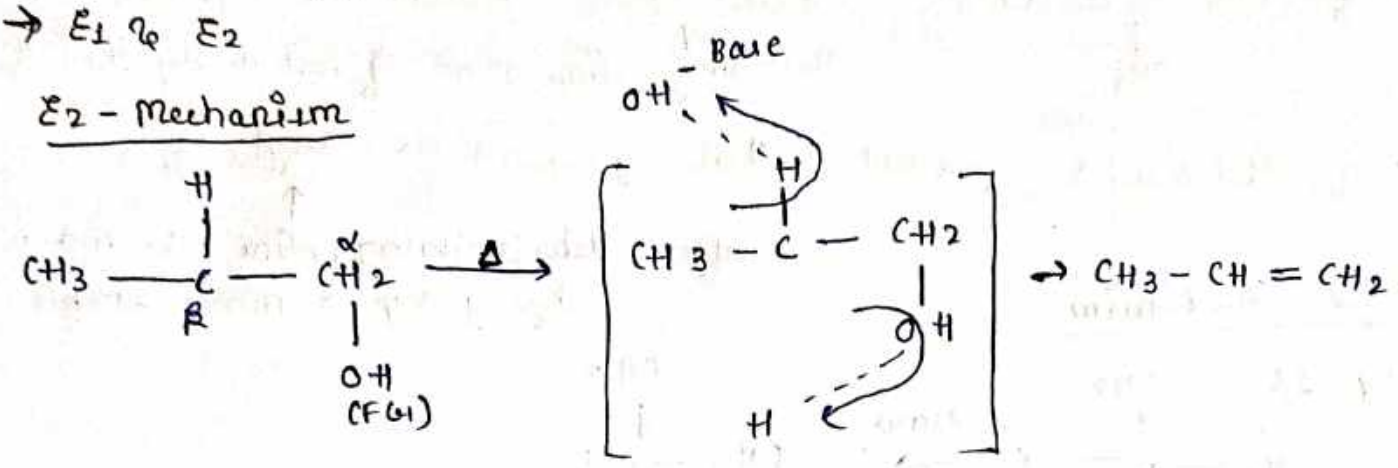
SN-1 / SN-2 → Best leaving group are more reactive.

Elimination Reaction.

α, β elimination & β elimination.

→ E_1 & E_2

E_2 - Mechanism



→ Single step Rxn

→ No Intermediate formation.

→ Base strong KOH, NaOH, $Ba(OH)_2$, $Ca(OH)_2$.

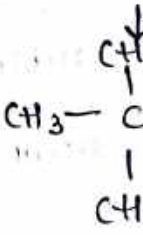
→ order = 2

→ rate of reaction $r = k[R-OH]^1[Base]^1$

→ No Intermediate formed.

→ Stability defined by stability of Alkene.

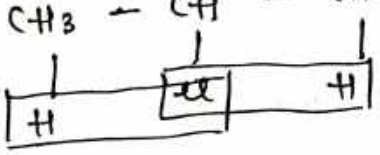
→ Reagent Alc. KOH / Δ or NaNH2 / Δ or Bulky base
soda Amide



→ product → ALKENE.

→ 3° > 2° > 1°

eg :-



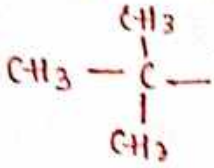
Alc. KOH Δ → $CH_2 = CH - CH_2 - CH_3$ (1 branch)
Hoffman product.

Alc. KOH Δ → $CH_3 - CH = CH - CH_3$ (2 branch)
Saytzeff product → Major.

→ Saytzeff / Zeff sayt → $-\overset{|}{C}=\overset{|}{C}-$

more alkyl branching
more stable.

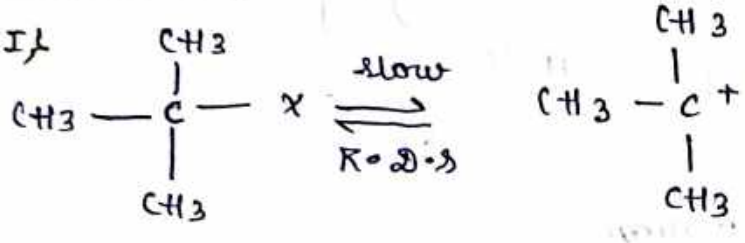
→ If F are present → product → Hoffmann

→ If  Bulky Base present → Hoffmann
then only Elimination if not bulky then S.

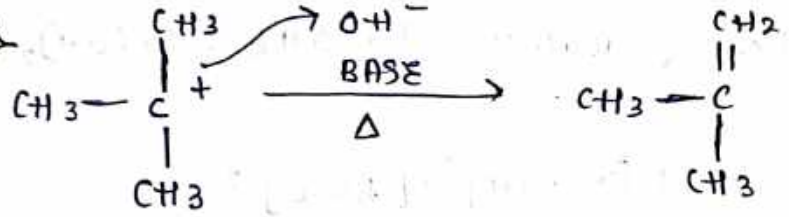
→ If Cl / Br / I present then product → Saytzeff
after dehydrohalogenation the more alkyl group → more stable.

* E1 Mechanism

Step-I)



Step-II)



→ E1 - order = 1

→ rate of Rxn = $r = k[R-X]^1$

→ Intermediate are carbocation.

→ product stability of carbocation 3° > 2° > 1°

→ reagent → Alcohol R-OH or H_2O and Heat Δ.

SUMMARY

E1

→ 3° > 2° > 1°

→ Reagent - H_2O, R-OH and Heat

E2

→ 3° > 2° > 1°

→ Reagent - Alc. KOH, Bulky base, $NaNH_2$ } Δ

→ No Intermediate

SN-1 → 3° > 2° > 1°

SN-2 → 1° > 2° > 3°

E1 / E2 → 3° > 2° > 1°

SUMMARY

1° Alkyl Halide / Alcohol

→ SN-2 / E-2

→ mainly SN-2

→ If you to do elimination then use Bulky Base

(less steric) 1° Alkyl Halide / hindrance Alcohol + Bulky Base → Elimination (Saytzeff)

→ SN-1 / E-1

→ NO SN-1 or E1

2° Alkyl Halide / 2° Alcohol.

SN-2
E-2

Alkyl halide + Alc. KOH / NaNH2 / Bulky Base → (Δ) Elimination E-2

SN-1
E-1

* Alkyl halide → (H2O, KOH, R-OH) SN-1

* Alkyl halide → (H2O, R-OH, Δ) E1

3° Alkyl Halide /

SN-2
E-2

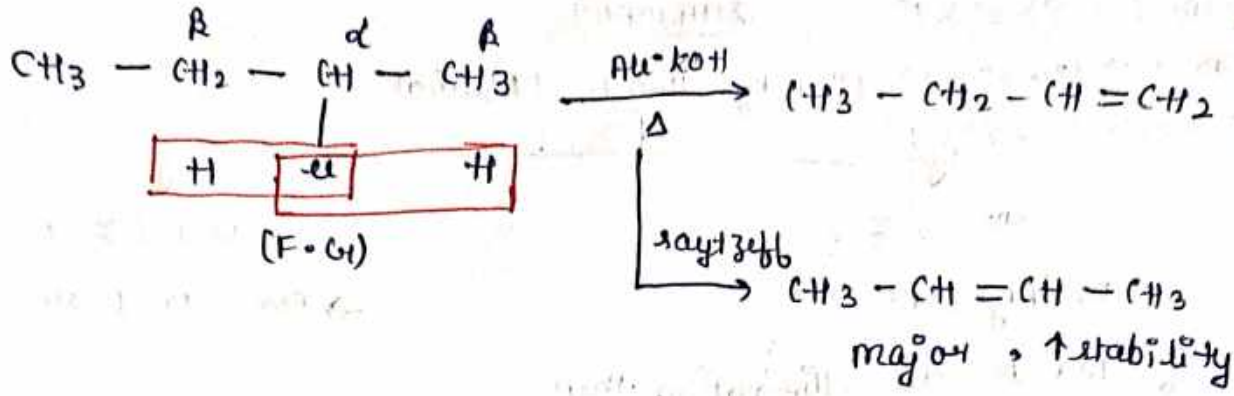
NO SN-2
only E2
use NaNH2 / Bulky Base / Alc. KOH

SN-1
E-1

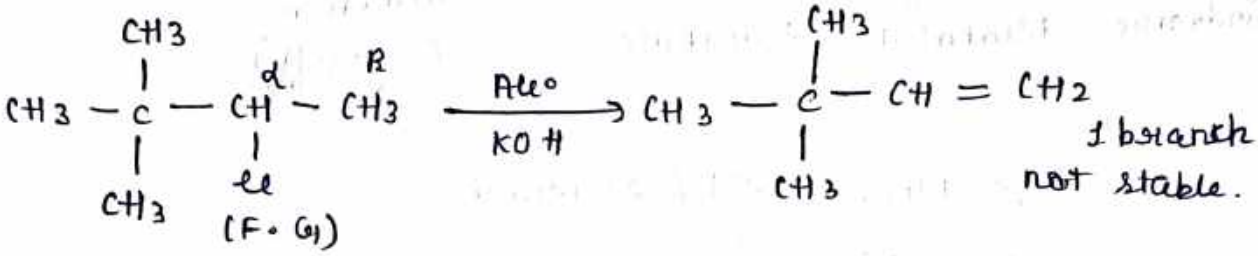
* Alkyl Halide → (H2O, R-OH) SN-1

* Alkyl halide → (H2O, R-OH, Δ) E1

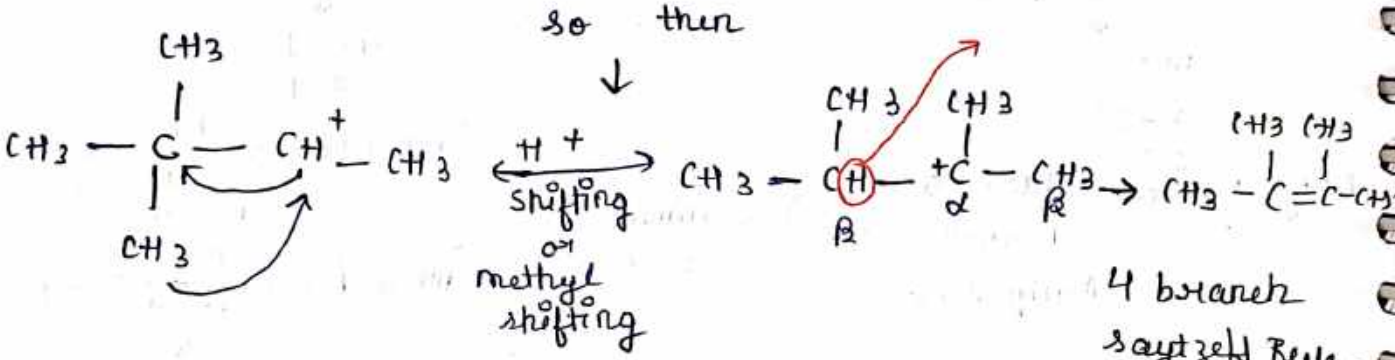
eg 1:



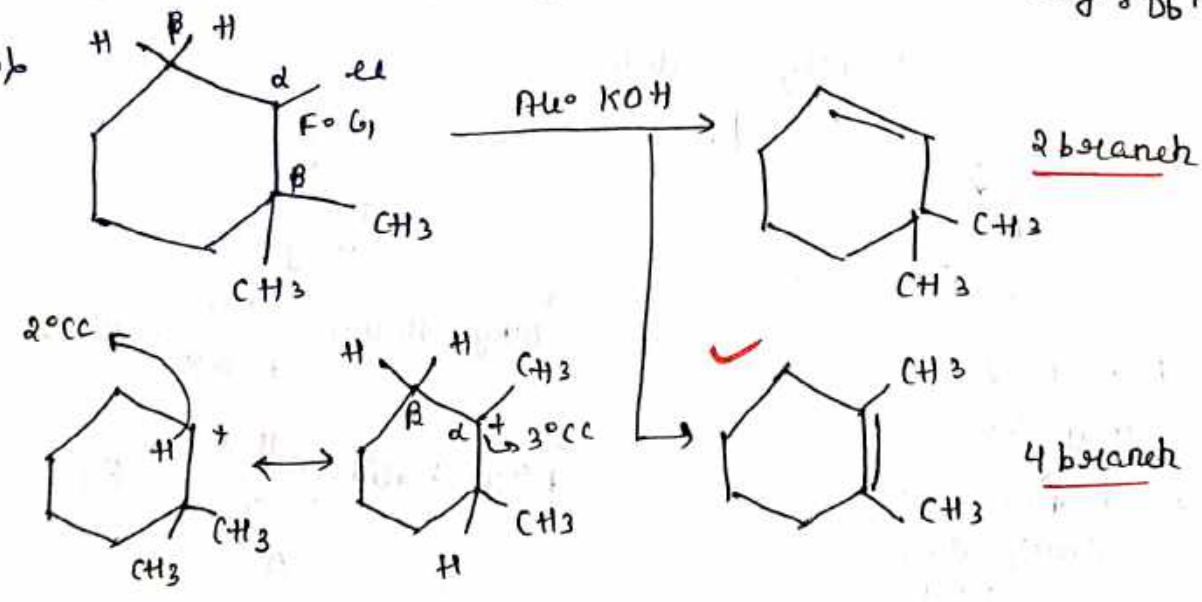
* PROTON SHIFTING → Special case for Elimination.

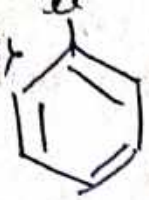


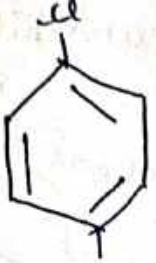
So then

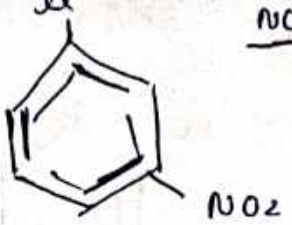


eg 2:



Ans 26) 





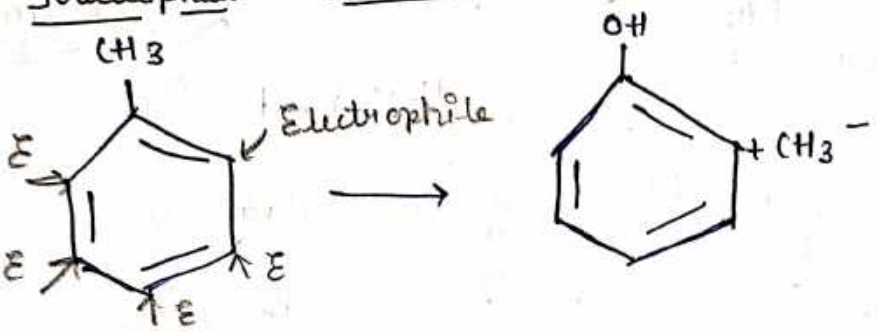
a < c < b

Option - 4) 27) para & ortho

Ans 28) a < b < c meta.

Ans 29) iii)

* Nucleophilic substitution Rxn in Benzene :-



→ Nucleophilic substitution Reaction $\alpha \frac{-M}{+M}$ $\alpha \frac{-I}{+I}$ $-M >> I$

eg) $-OH \rightarrow +M$ & $-I$

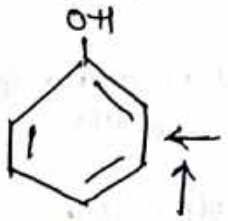
position → ortho / para and meta $-NO_2$

$-I$ $-M$ $+M$ $-I$

→ $-I$ → distance → less distance powerful

Que 1)

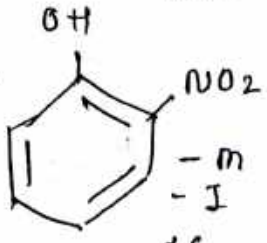
eg 1) what is the series of N-S Rxn in Phenol $\alpha \frac{-M}{+M}, \frac{-I}{+I}$

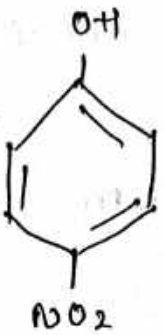
a) 

it means no effect except OH

b) 

$-I$

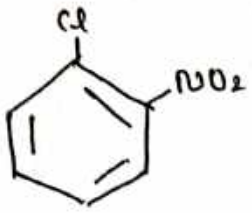
c) 

d) 

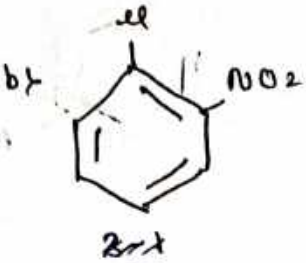
$-I$

$-M$ (4C)

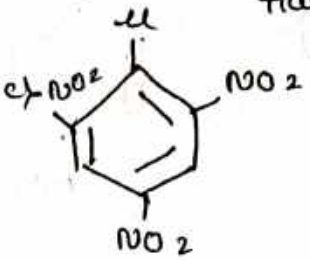
Que:- Write a series in Nucleophilic S.R.Rxn in Halo arenes.

a) 

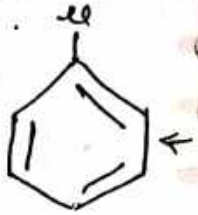
-M
-I

b) 

2-M
2-I

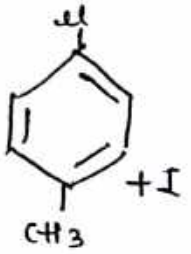
c) 

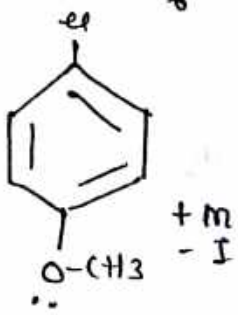
3-M
3-I

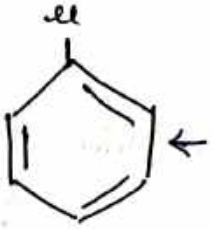
d) 

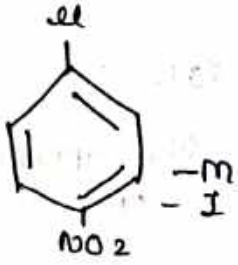
c > b > a > d

Que:- Write the order of S.N. in Halo arenes.

a) 

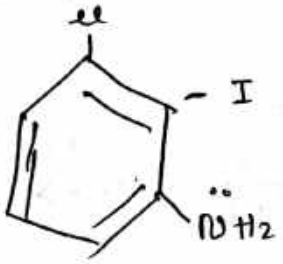
b) 

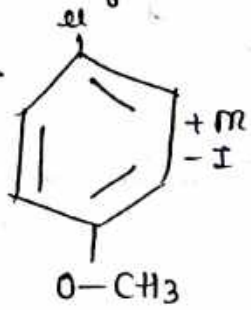
c) 

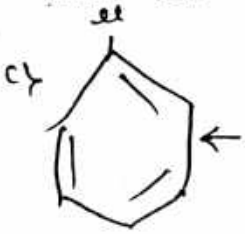
d) 

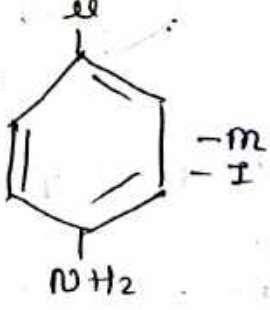
d > c > a > b

Que:- Write the order of S.N. Rxn in Haloarene

a) 

b) 

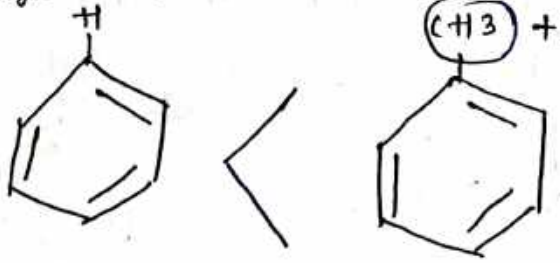
c) 

d) 

d > a > c > b

* Electrophilic sub. Rxn $\propto \frac{+M}{-M}$ $\propto \frac{+I}{-I}$

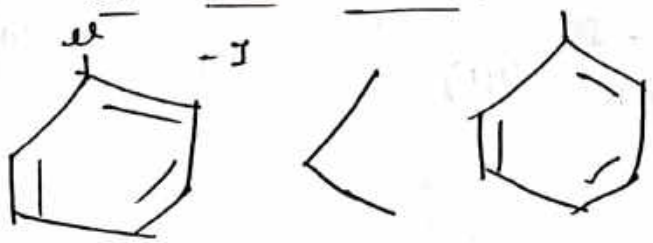
Que:- Benzene & Toluene which is more reactive in E.S. Rxn

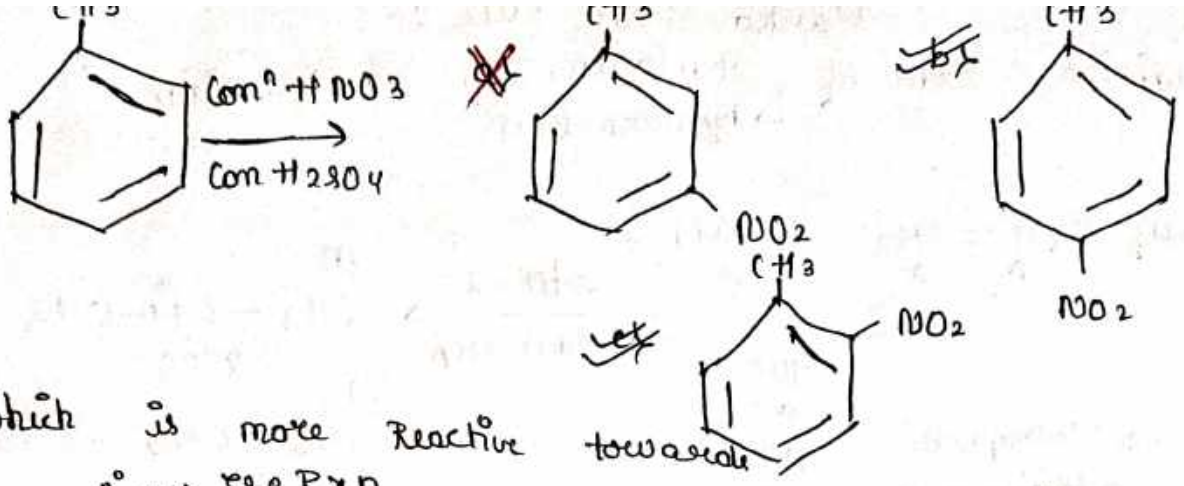


+I, -I, +M ∝ ortho & para

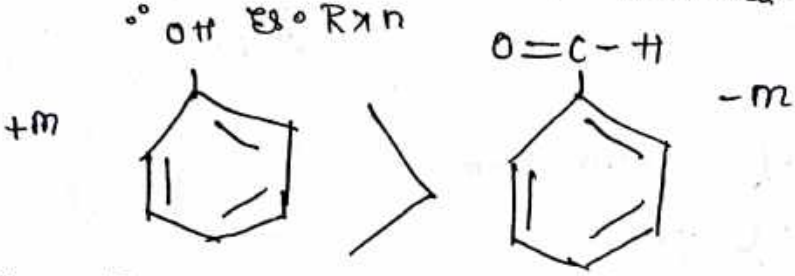
-M ∝ Meta directing group.

Es. more reactive OH

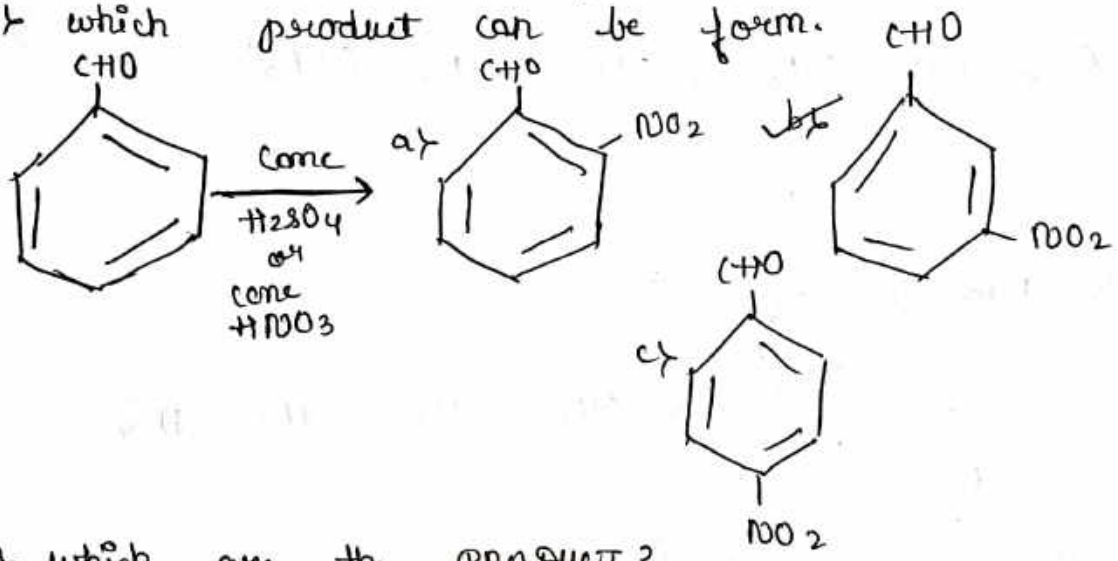
eg:- 

eg:- 

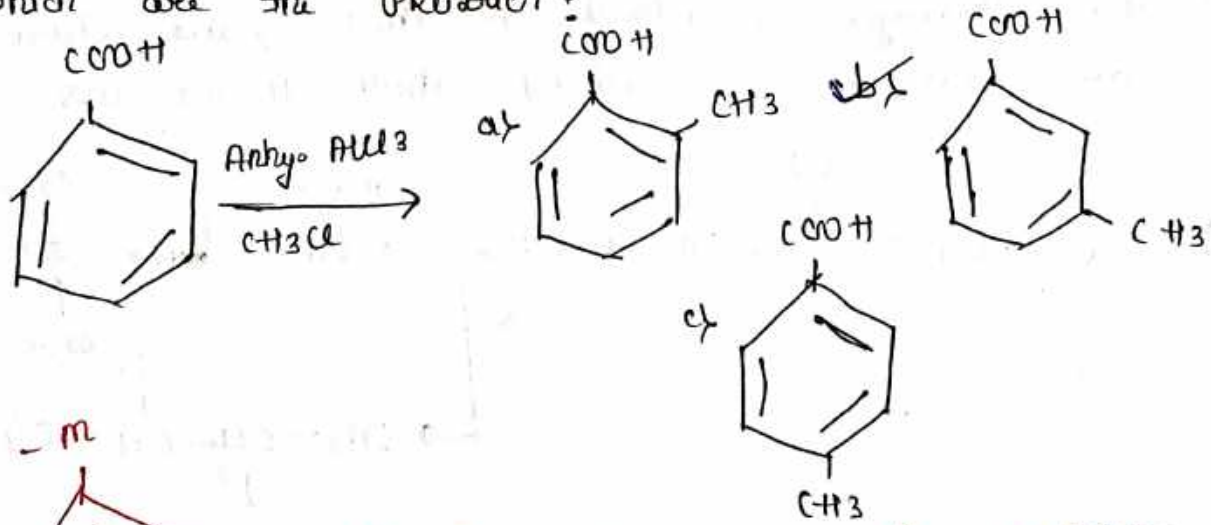
eg:- which is more Reactive towards E.S.R.n

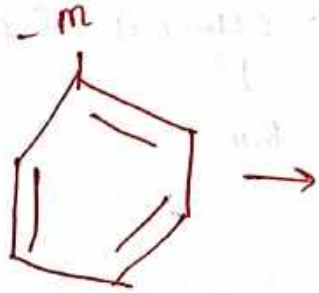


Que:- which product can be form.



eg:- which are the PRODUCT ?



* 

→ Deactivate for electrophilic S.R.M

-m → Product

Markovnikov Rule :-

Addition Rxn of $\begin{cases} \text{Halogenation} \\ \text{hydrocarbon} \end{cases}$ & Hydration.

$CH_3 - CH = CH_2 + HBr$ (or HI) $\xrightarrow[\text{slow step}]{\text{step-I}}$ ① $CH_3 - \overset{+}{C}H - CH_3$ (2°CC)

② $CH_3 - CH_2 - \overset{+}{C}H_2$ (1°CC)

$H^+ \rightarrow$ Electrophilic addition rxn

Step-I } formation of carbocation

2°CC > 1°CC

$CH_3 - \overset{+}{C}H - CH_3 > CH_3 - CH_2 - CH_2^+$

Br^-

Step-II } Addition of Br^-

$CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3 > CH_3 - CH_2 - CH_2 - Br$

→ when hydrogen is added in that place where H are more & Br is added where H are less.

eg } $CH_3 - CH = \underset{\underset{CH_3}{|}}{C} - CH_3 + HBr \longrightarrow$ major $CH_3 - CH_2 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3$

$CH_3 - \underset{\underset{Br}{|}}{CH} - \overset{\overset{CH_3}{|}}{CH} - CH_3$

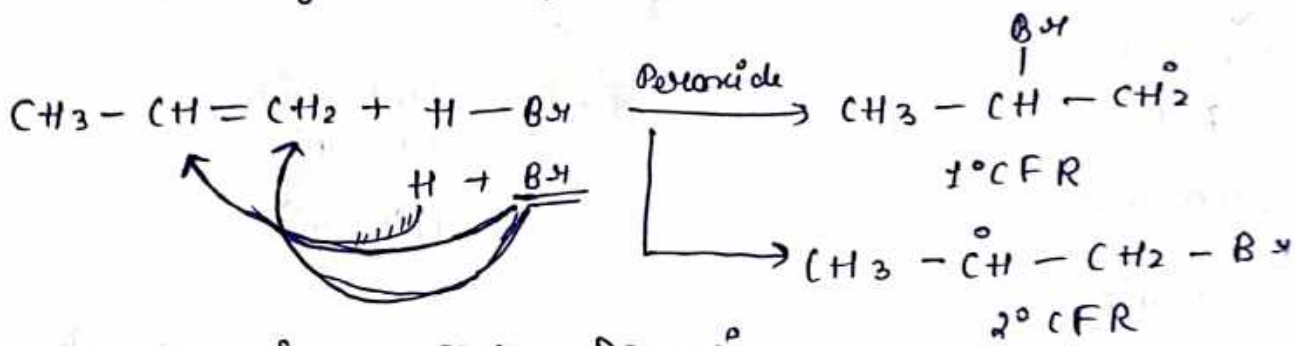
→ proton transfer valid

why? carbocation

Anti- Markovnikov / Peroxide Effect :-

k/a Kharasch effect

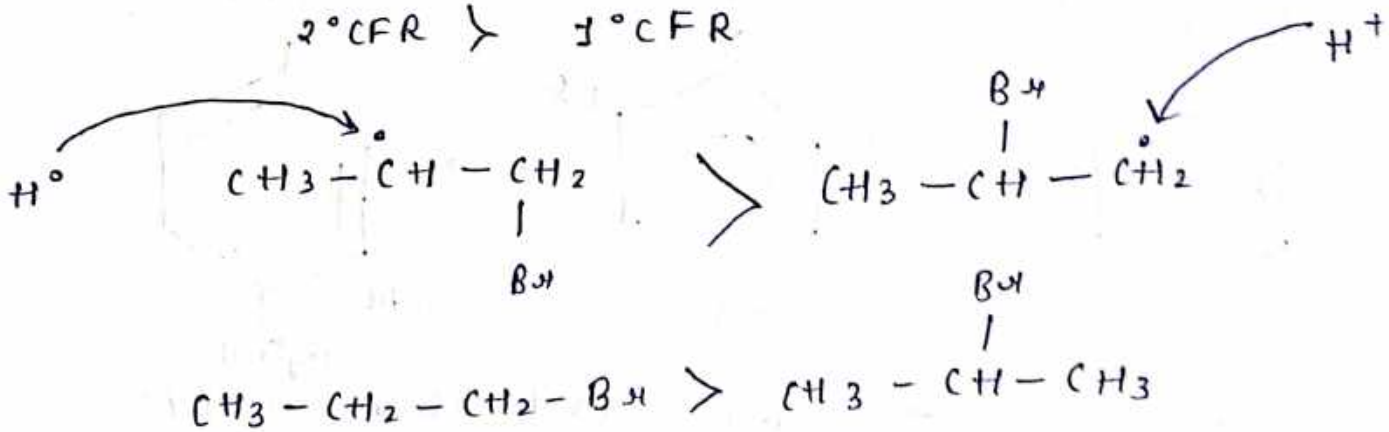
only & only valid for HBr with Peroxide.



Br° are more Aggressive

→ 2°CFR are more stable than 1°CFR.

2°CFR > 1°CFR



$CH_3 - CH_2 - CH_2 - Br$ > $CH_3 - \underset{Br}{CH} - CH_3$

→ $CH_3 - CH = CH_2 \xrightarrow[\text{peroxide}]{HBr} CH_3 - CH_2 - CH_2 - Br$ (major)

Antimarkr.

$CH_3 - \underset{Br}{CH} - CH_3$

→ H → less H

→ Br → more H

} HBr peroxide

Stability of Carbocation $\propto \frac{+I}{-I} \propto \frac{+M}{-M}$ $M >> I$

dominant.

→ $CH_3 \rightarrow CH_2^+$ ≈ $Cl \leftarrow CH_2^+$

↓ Donar + I

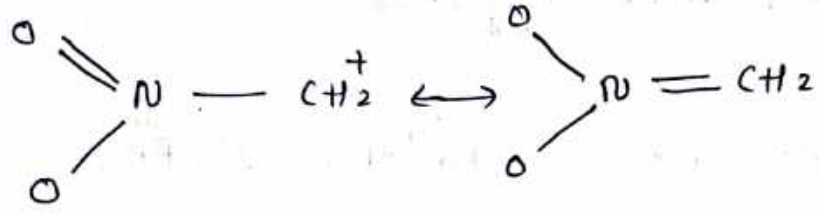
कमी

1000 unit
−10
990 unit

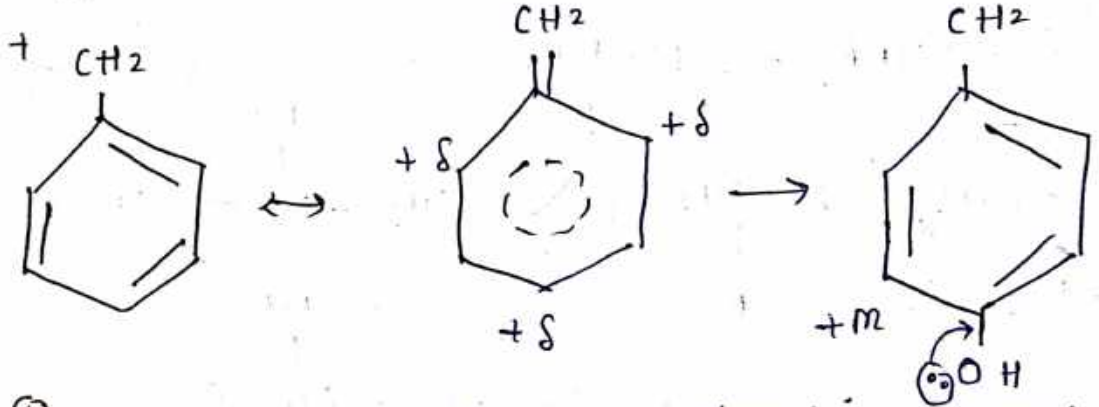
-I

कमी

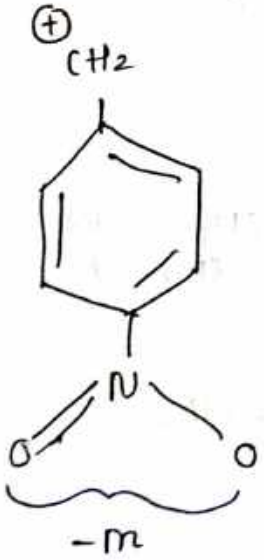
100 unit
10 unit
110 unit

→ 

100 unit
−50 unit
50 unit

→ 

→ Target Carbocation − 100%

→ 

−M → benzene → +ve

π e⁻ acceptor.

+M → benzene → −ve

π e⁻ donor

Qu°) Write the order of stability of carbocation $\alpha \frac{+I}{-I}$ $\alpha \frac{+m}{-m}$.

a) $CH_3 - \overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}{}^{+}$ 3 +I

b) $CH_3 - CH_2^{+}$ 1 +I

c) $CH_3 - \overset{CH_3}{\overset{|}{CH}}{}^{+}$ 2 +I

d) CH_3^{+} ← nothing

a) c) b) d

Qu°) Write the order of stability of carbocation.

a) $Cl - CH_2^{+}$ ±I 2nd max

b) $Br - CH_2^{+}$ -I 3rd

c) $HO - CH_2^{+}$ -I 4th maximum

d) $F - CH_2^{+}$ -I max

c) b) a) d

Qu°) Arrange in the order of stability of carbocation

a) $CH_3 - CH_2 - \underset{F}{\overset{|}{CH}} - CH_2^{+}$ ∓I 1C

b) $CH_3 - \underset{F}{\overset{|}{CH}} - CH_2 - CH_2^{+}$ -I 2C

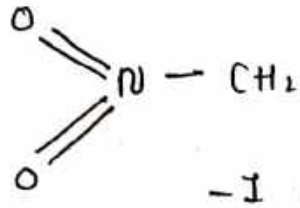
c) $\underset{F}{\overset{|}{CH_2}} - CH_2 - CH_2 - CH_2^{+}$ -I 2C

d) $CH_3 - CH_2 - CH_2 - \underset{F}{\overset{|}{CH}}{}^{+}$ -I

d < a < b < c

Que. Arrange in order of carbocation -

a) $CH_3 - CH_2 - CH_2^+$
+I

b) 
-I max

c) $CN - CH_2 - CH_2^+$
-I 2nd max

d) $HO - CH_2 - CH_2^+$
-I 3rd max

~~b > c > d > a~~

a > d > c > b

Que. Arrange in the order of stability of carbocation.

a) 

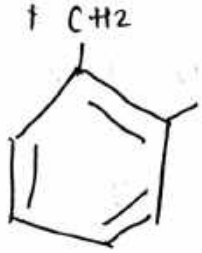
c) 
-I

b) 
-I
+m

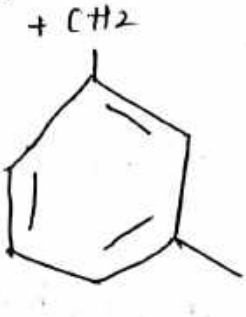
d) 
-m
-I

b > a > c > d

Que. In the order of stability of carbocation.

a) 
$\frac{-I + m}{1C}$

b) 
$\frac{-I}{4C}$, +m

c) 
$\frac{-I}{3C}$

d) 

b > a > d > c

* Conclusion

→ stability of carbon free radical $\alpha \frac{+m}{-m}$ $\alpha \frac{+I}{-I}$

→ stability of carbanion $\alpha \frac{-m}{+m}$ $\alpha \frac{-I}{+I}$

* Acidic Effect $\propto \frac{-m}{+m}$ $\propto \frac{}{+I}$

P_{Ka} → less → more Acidic

P_{Ka} → dissociation capacity.
equilibrium k.

P_{Ka} → -ve → strong eg- HCl, H_2SO_4, HNO_3.
↳ as it 100% dissociates & gives H^+ ion & Hence the value is -ve.

P_{Ka} → 1-6 → strong Acid organic.

P_{Ka} → 7-14 → weak Acid

P_{Ka} → 15-16 → very very weak Acid.

$P_{Ka} \propto \frac{1}{\text{Acidic strength}}$

eg:

Acidic

$CH_3 - OH \longrightarrow CH_3 - O^- + H^+$

Alcohol are acidic in nature.

$CH_3 - COOH \longrightarrow CH_3 - \overset{O}{\overset{\|}{C}} - O^- + H^+$

carboxylic acid are acidic in nature.

eg: $R - \ddot{N}H_2 + H - OH \longrightarrow R - \overset{+}{N}H_3 + \underline{OH^-}$

In organic, lp donor → BASE, NH_2 (Amine) are BASIC in nature.

Q.no: Arrange in the order of Acidic effect & P_{Ka} value

a) $CH_3 - CH_2 - OH$

$1+I \rightarrow 1$

b) $(CH_3)_2 - CH - OH$

$2+I$

c) $(CH_3)_3 - C - OH$

$3+I$

d) $CH_3 - OH$

Acidic

d > a > b > c

P_{Ka}

d < a < b < c

Que° 2) Arrange in the order of Acidic Effect & Pka value.

a) $CH_3 - CH_2 - \underset{\textcircled{F}}{CH} - OH$

$-I \rightarrow 1C$

b) $CH_3 - \underset{\textcircled{F}}{CH} - CH_2 - OH$

$-I \rightarrow 2C$

c) $CH_2 - CH_2 - CH_2 - OH$

$\textcircled{F}$ $-I \rightarrow 3C$

d) $\textcircled{CH_3} - CH_2 - CH_2 - OH$

$+I \leftarrow$

Acidic → a > b > c > d

Pka → a < b < c < d

Que° 3) Arrange in the order of Acidic Effect / Pka value.

a) $CH_3 - \underset{\textcircled{NO_2}}{CH} - CH_2 - OH$ $-I$

b) $CH_3 - \underset{\textcircled{CN}}{CH} - CH_2 - OH$ $-I$

Acidic → c < d < b < a

b) $CH_3 - \underset{\textcircled{OH}}{CH} - CH_2 - OH$ $-I$

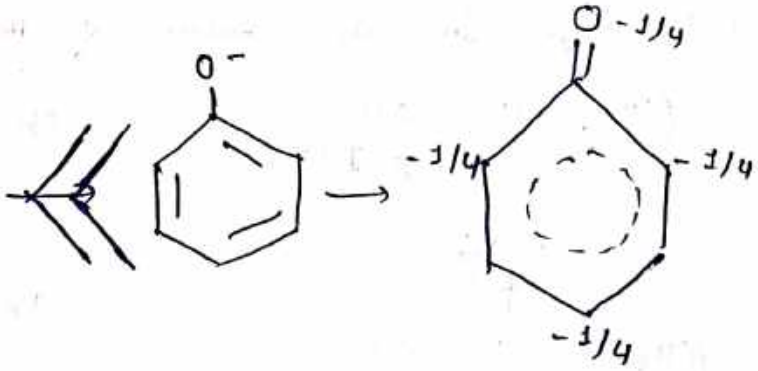
d) $CH_3 - \underset{\textcircled{H}}{CH} - CH_2 - OH$ $-I$

Pka → c > d > b > a

* Alcohol & Phenol

$CH_3 \rightarrow CH_2 \rightarrow O^-$

Unstable

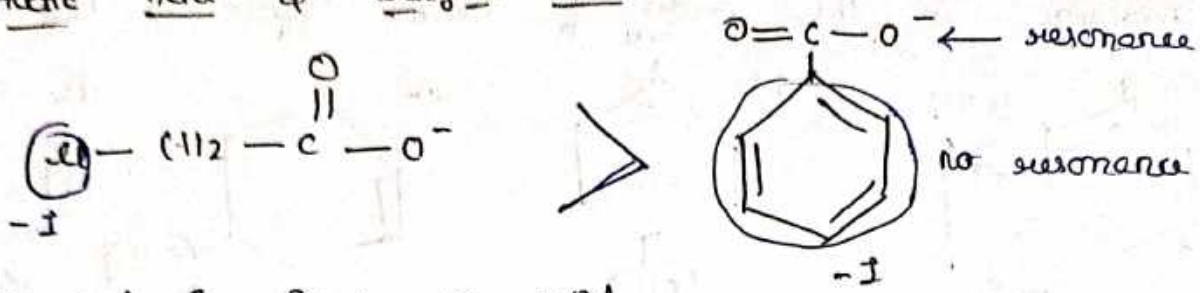


→ Phenol are more acidic than Alcohol.

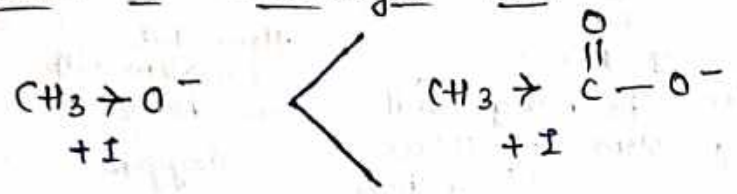
↓

they are more stable as it shows RESONANCE.

2) Acetic Acid & Benzoic Acid



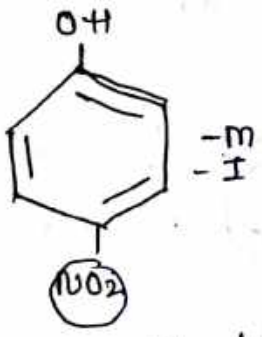
3) Alcohol & carboxylic Acid



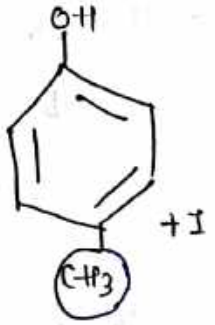
→ RING $\alpha - \frac{m}{+m}$ $m >>> I$

Q) Arrange in the order of Acidic Effect & Pka value.

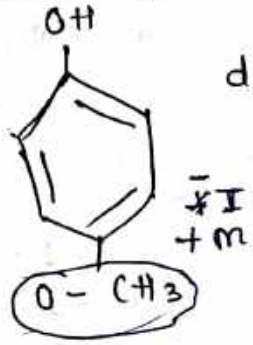
a)



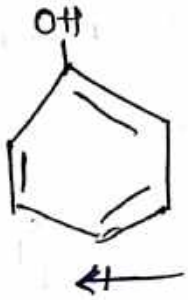
b)



c)



d)

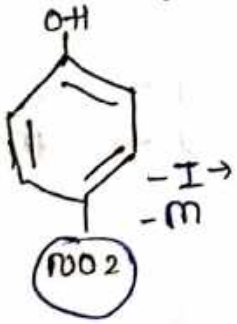


Acidic → a > d > b > c

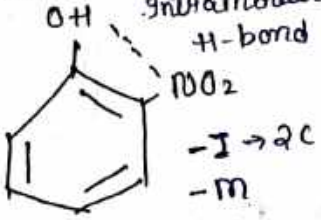
Pka → a < d < b < c

Q) Arrange in the order of Acidic Effect & Pka value

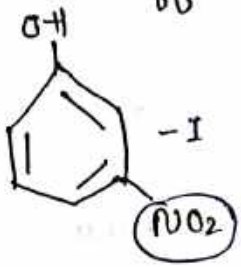
a)



b)



c)



d)

Acidic → a > b > c > d

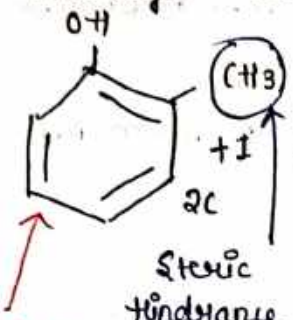
Pka → a < b < c < d

Exception

Q)

exception

Qno> Arrange in the order of Acidic Effect & Pka

a> 

Steric hindrance

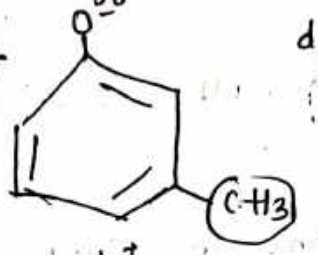
CRESOL

b> 

+I

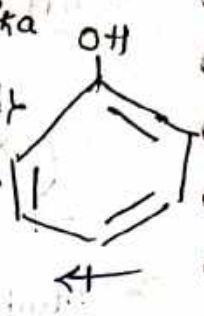
4C

Here the charge will make problem at 4C as +I is there

c> 

+I

Here no problem with -ve charge of oxygen.

d> 

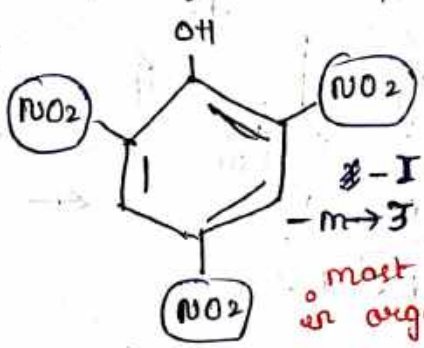
Acidic

d> c> b> a

Pka

d< c< b< a

Qno> Arrange in the order of Acidic effect.

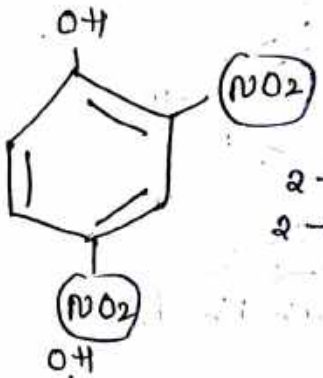
a> 

-I → 3

-m → 3

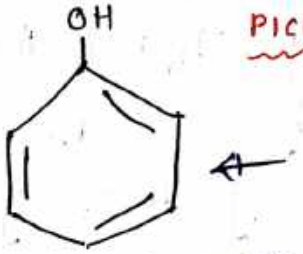
most acidic substance in organic chem

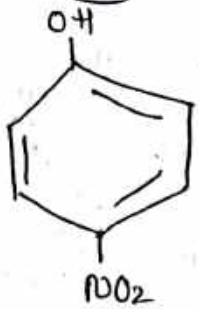
PICRIC ACID

b> 

2 → -I

2 → -m

c> 

d> 

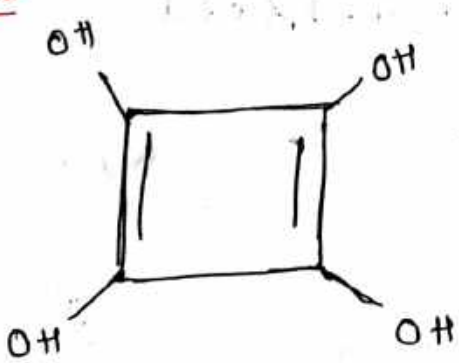
1 → -I

1 → -m

Acidic → a > b > d > c

Pka → a < b < d < c

Note



squaric acid

2nd most acidic //

* BASIC EFFECT :-

→ organic → $R-NH_2 + H_2O \rightleftharpoons RNH_3^+ + OH^-$

Base	Acid	Conjugate Acid	Conjugate Base
Strong	weak	weak	Strong

depends upon

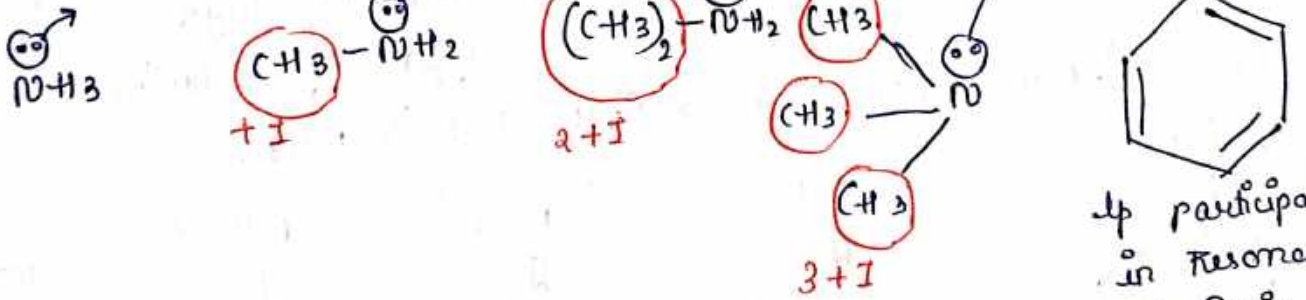
1) stability of cation $\alpha \frac{+I}{*-I} \alpha \frac{+R/+m}{-R/-m}$

2) Solvation

3) Steric hindrance

1) stability :-

NH_3	$R-NH_2$	$(R)_2-NH$	$(R)_3N$	$Ar-NH_2$
Ammonia	1° Amine	2° Amine	3° Amine	Aniline.



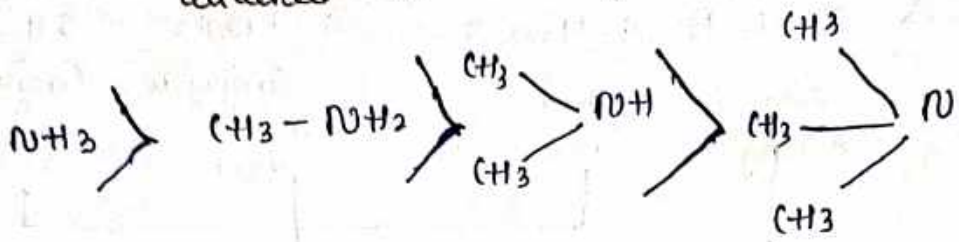
1p participat
in Resonan
→ not Basic
than parti

Those who give 1p to another one rather -pating in Resonance k/a # BASIC IN NATURE.

→ stability of Basic Effect

3° Amine > 2° Amine > 1° Amine > NH_3 > Aniline.

2) Solvation α no. of hydrogen atom which is directly attached to Nitrogen.



→ Ammonia > 1° > 2° > 3° Amine.

3) Steric Hindrance

$-CH_3$ → no steric , $-C_2H_5$ → steric high

Remember

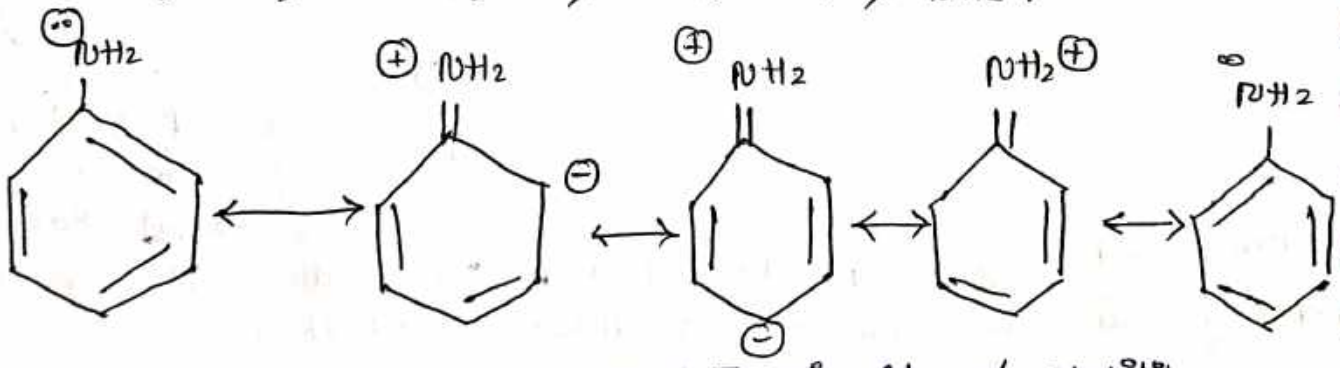
Same series practically.

for methyl $2° > 1° > 3° > NH_3$ → solvation effect of 3° is very less

$(CH_3)_2NH > CH_3-NH_2 > (CH_3)_3N > NH_3$.

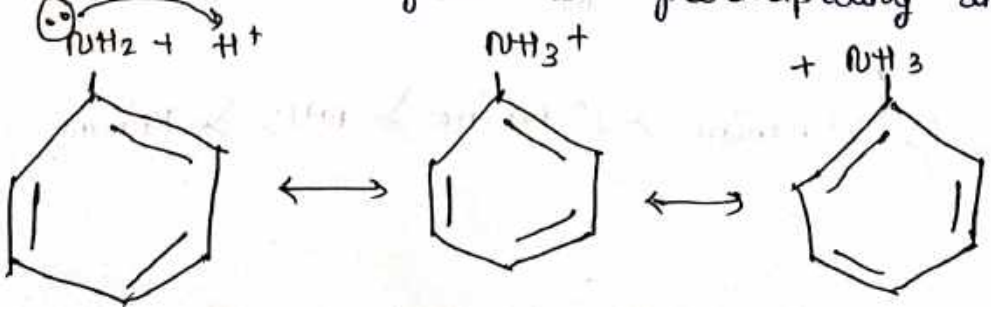
for ethyl $2° > 3° > 1° > NH_3$ → Due to high steric effect of 3° Amine.

$(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5-NH_2 > NH_3$.



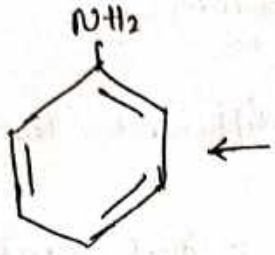
→ 5 Resonic Str. α stability

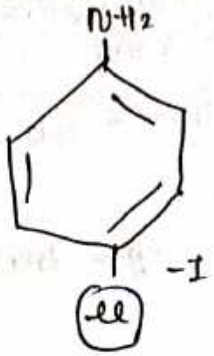
→ when the lone pair is participating in Resonance

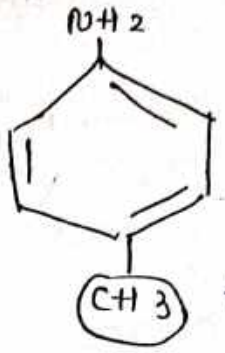


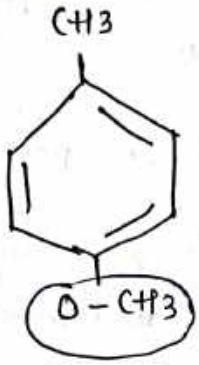
+M → Donar

eg:- Arrange in the order of Basic effect ∝ $\frac{+M}{-M}$ ∝ $\frac{+I}{-I}$

a) 

b) 

c) 

d) 

→ Basic Effect

d > c > a > b

→ Pkb

d < c < a < b

Pkb → more then less Basic.

Pkb → less than more Basic.

Basic Effect ∝ $\frac{1}{Pkb}$.

* PURIFICATION

1) Sublimation — solid → gas (condense) → solide pure

solid → Impure

gas → pure

Impure

eg:- Nepthalene, I_2

2) Crystallisation - solid salt (impure) + solvent → Solution Saturation

Saturation → Boil → Cooling → pure salt

3) Distillation :- To seperate two different liquid in the mixture

3.1) simple distillation - Boiling point difference should be minimum → 30°C

eg:- i) Alcohol & water

67°C 100°C

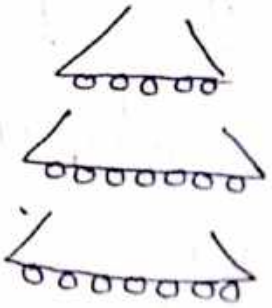
ii) Mixture of ether & Toluene

308K 384K

3) Mixture of Hexane & Toluene
342 K 384 K

4) Mixture of chloroform & Aniline.
334K 457K

3.2) Fractional distillation – when B.P difference less than 10K



eg) Acetone & methyl alcohal
329K 338K

Crude oil in petroleum industries.

3.3) Vacuum distillation – one which have very high B.P &
(reduced Pressure) one which decompose lower than B.P.

eg) 1) Conc^{n} of sugar juice.
2) Recovery of glycerol from spent-lye in soap industries.
3) Glycerol.

3.4) Steam distillation – substances which are water insoluble but steam soluble

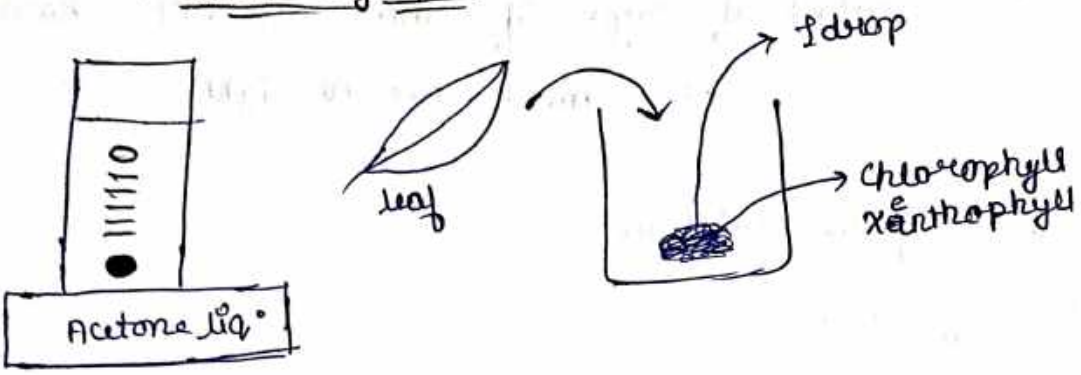
$P_{total} = P_1 + P_2$
vapour of organic liquid, vapour of steam / water.

1) Aniline is seperated from water.
2) Terpentine oil
3) Nitrobenzene
4) Bromobenzene
5) Nepthalene
6) O- Nitrophenol.

* Differential Extraction :- when two kind of solution one is polar & other is non-polar (water soluble or water insoluble)

→ large quantity of solvent must be used in the method to extract small quantity of solute.

* Chromatographic



→ Adsorption chromatographic
→ Based on adsorbent & adsorbed

→ Commonly used adsorbent → alumina silica gel.

Types → i) thin layer.
ii) column layer.

i) thin layer chromatographic - mixtures of solid & liquid can be differentiated by this method with the help of acetone or other solvent.

ii) column chromatographic → two liquid extraction

$$Rf = \frac{\text{Distance moved by the substance from Base line (x)}}{\text{Distance moved by the solvent from base line (y)}}$$

iii) Partition chromatographic → Based upon continuous differential partition.

eg:- Paper chromatographic

→ In this method chromatographic paper can be used. The paper strip to so developed is known as chromatograph

→ Solvent, methanol, acetone (Polar) & Benzene (Non-polar) can be used as solvent (Non-polar)

→  → Different compound spotted in the different color of layer if color is not shown we must use uv light.

* Test of organic substance :-

i) The Test of carbon :-

Leibig's method :- The test of carbon, Hydrogen & oxygen.

from Cu(II) oxide

CuO

i) $C + 2CuO \longrightarrow 2Cu + CO_2$

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$ } confirm test of C

This CO_2 is absorbed by KOH

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow x\,CO_2 + \frac{y}{2}\,H_2O$$

$$\% \text{ of } C = \frac{12}{44} \times \frac{\text{mass of } CO_2}{\text{mass of sample}} \times 100\%$$

$$\text{any substance} = \frac{\text{mass of atom}}{\text{mass of compound}} \times \frac{\text{mass of compound (given)}}{\text{mass of same}} \times 100\%$$

2) Detection of oxygen.

$$\text{Compound} \xrightarrow{\Delta} O_2 + \text{other volatile subs}^{\circ}$$

$$2C + O_2 \xrightarrow{1373\,K} 2CO$$

$$I_2O_5 + 2CO \longrightarrow I_2 + 2CO_2 + O_2$$

compound pass through stream of inert gases like N_2 then pass over red hot coke, oxygen converted to CO then again oxidised with I_2O_5 to convert into CO_2.

$$\%\text{ of } O_2 = \frac{32}{88} \times \frac{\text{mass of } CO_2 \text{ given}}{\text{mass of sample}} \times 100\%$$

Que) Intext Que. 8.20)

$$\%\text{ of carbon} = \frac{12}{44} \times \frac{0.198\,g}{0.246\,g} \times 100\% = 27.95\%$$

→ Test of Hydrogen

Lebbige Test (CuO)

$$2H + CuO \longrightarrow Cu + H_2O$$

$$5H_2O + CuSO_4 \longrightarrow CuSO_4 \cdot 5H_2O$$

blue vitriol.

Now H_2O absorbed by anhydrous $CaCl_2$.

$$\%\text{ of } H = \frac{2}{18} \times \frac{\text{mass of } H_2O \text{ (given)}}{\text{mass of sample}} \times 100\%$$

$$= \frac{2}{18} \times \frac{0.1014}{0.246} \times 100\%$$

$$\Rightarrow 4.58\%$$

4) Test of Nitrogen.

Lassigne's test (Na) fusion

$$\text{compound} + Na \longrightarrow NaCN$$

(N, C)

$$FeSO_4 + NaCN \longrightarrow Na_4[Fe(CN)_6]$$

(II) II

$Na_4[Fe(CN)_6] + FeCl_3 \xrightarrow{H_2SO_4} Fe_4[Fe(CN)_6]_3 \cdot x H_2O$

(II) (III) (Prussian blue) ferri ferrocyanide

→ [N, S, C] combine

$Na + C + N + S \longrightarrow NaS \cdot CN$

$FeCl_3 + NaSCN \xrightarrow{H_2SO_4} [Fe(SCN)_2]Cl_2$

Blood Red

$NaS \cdot CN + Na \text{ fusion} \longrightarrow Na_2S + NaCN$

$Na_4[Fe(CN)_6] + FeCl_3 \xrightarrow{H_2SO_4} Fe_4[Fe(CN)_6] \cdot x H_2O$

(II) (III) prussian blue ferri ferro cyanide

→ [N, S, C] combine

$Na + C + N + S \longrightarrow NaS \cdot CN$

$FeCl_3 + NaSCN \xrightarrow{H_2SO_4} [Fe(SCN)_2]Cl_2$

Blood red.

$NaSCN + Na \text{ fusion} \longrightarrow Na_2S + NaCN$

→ Quantitative test of N_2 gas.

1) Dumas test

$C_xH_yN_2 + \left(2x + \frac{y}{2}\right) CuO \longrightarrow xCO_2 + \frac{y}{2} H_2O + \frac{z}{2} N_2 + N_2O, NO, NO_2$

↑ oxi° agent

CO_2 removed by KOH

H_2O removed by $CaCl_2$

trace of N_2O, NO_2 & NO are removed by passing them on high temp / heated at high temp with CuO & it again convert in N_2.

Imp

* Now N_2 is gas and we needed to have to calculate volume.

Ideal gas Equation. $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$\Rightarrow V_2 = \frac{P_1 V_1 \times T_2}{T_1 \times P_2}$

T_2 always → STP at ↳ 273k

P_2 always → 1 atm → 760 mm of Hg, 760 torr

P_1 → given → aqueous tension pressure ↳ always given

(V_2 or V of N_2 at STP $= \frac{28}{22400} \times V$) value in gram

$$\% \text{ of } N_2 = \frac{28\ g/mol \times \text{Volume of } N_2\ ml}{22400\ ml/mol \times \text{mass of sample } (g)} \times 100\ \%$$ no units

$$= \frac{28 \times \text{volume of } N_2\ (V_2)}{22400 \times \text{mass of sample}} \times 100\ \%$$

Short Que. In Dumas method of estimation of nitrogen. 0.3g of an organic compound gave 50ml of nitrogen collected at 300k temp and 715mm pressure. Calculate the % of composition of N_2 in the compound.
(Aqueous tension at 300k = 15mm)

Ans. given sample = 0.3g

$T_1 = 300k$, $V_1 = 50ml$

$T_2 = 273K$

$P_{given} = 715\ mm$

$P_2 = 760\ mm$ of Hg

$P_1 = (715 - \text{aqueous tension})$

$P_1 = 715 - 15 = 700\ mm$ of Hg

$$V_2 = \frac{P_1 V_1 \times T_2}{T_1 \times P_2}$$

$$V_2 = \frac{700 \times 50 \times 273}{300 \times 760}$$

$$= 41.9 \text{ ml}$$

$$\% \text{ of } N_2 = \frac{2\,g \times 41.9\,ml}{22400\,ml \times 0.3\,(g)}$$

$$= 17.45\%$$

Kjeldahl method

Sample (C, N, O, P, H) + H_2SO_4 (conc.) $\longrightarrow$ $(NH_4)_2SO_4$

wB + SA

NaOH

$2NH_3 + 2H_2O + Na_2SO_4$

wB

H_2SO_4 known

$\longrightarrow (NH_4)_2SO_4$ + excess of H_2SO_4

NaOH known

$m_2 V_2$ → H_2SO_4

$2NaOH + H_2SO_4$

370 ml

H_2SO_4 → Half of NaOH = 175 ml

known H_2SO_4 soln

NaOH solution titration

$$\% \text{ of } NH_3 = \frac{14 \times m \times 2 \left(V - \frac{V_1}{2}\right) g}{100 \times \text{mass of sample}} \times 100\%$$

$$m_1 = \frac{\text{mol}}{\text{vol}} = \frac{m \times \text{vol}}{1000}$$

$\rightarrow 2NH_3 \longrightarrow 1\,H_2SO_4$

Q:- During estimation of nitrogen present in an organic compound by Kjeldahl's method the NH_3 evolved from 0.5 g of the compound in Kjeldahl's estimation of nitrogen, neutralized 10 ml of 1M H_2SO_4. Find % of N_2.

→ $2NH_3 \longrightarrow 1H_2SO_4$

$$\frac{14 \times 12 \times 10}{1000 \times 0.5} \times 100$$

mass of same = 0.5 g

$M = 1M$
$V = 10ml$] H_2SO_4

$$\Rightarrow \frac{28 \times 2}{0.5 \times 2} = 56\%$$

→ Kjeldahl method not use for :-

$-N=N-$, Pyridine

azo compounds

→ It cannot change Ammonia with the rxn with H_2SO_4

* Test of Sulphur

Lassigne test

$$2Na + S \xrightarrow{\Delta} Na_2S$$

↳ Sulphide

$$S^{-2} + Pb^{+2} \longrightarrow \underline{PbS}$$

lead acetate — black

$$S^{-2} + [Fe(CN)_5NO]^{-2} \longrightarrow [Fe(CN)_5NOS]^{-4}$$

violet

sulphur → Carius tube

Na_2O_4 + HNO_3 fusion fuming

↳ H_2SO_4

if S present

Ball 2

$BaSO_4$

wh ppt

↳ filter / wash / Rinse / dry → weight

N^{3-} → Nitride

NO_2^- → Nitrite

NO_3^- → Nitrate

S^{-2} → sulphide

SO_2^- → sulphite

SO_3^- → sulphate

Qu:- In sulphur estimation 0.157g of an organic compound gave 0.4813g of ---? B-34

Ans:- $BaSO_4$

mass of sample = 0.157g

mass of $BaSO_4$ = 0.4813g

$$\% \text{ of } S = \frac{32 \times \text{mass of } BaSO_4}{233 \times \text{mass of sample}} \times 100\%$$

mass of $BaSO_4$ ↵

$$= \frac{32 \times 0.4813}{233 \times 0.157} \times 100\%$$

$$= 42.10\% \text{ of Sulphur}$$

* Test of HALOGENS

Lassigne Test

$Na + X \xrightarrow{\Delta} NaX$ $\quad X = Cl, Br, I$

Sodium fusion + sample + HNO_3 (carious tube) → $AgNO_3$

- AgX → white ppt soluble in NH_4OH → Cl confirm
- AgX → yellow ppt soluble in NH_4OH → Br confirm
- AgX → yellow insoluble in NH_4OH → I confirm

↳ filter → Rinse → dry → weight
wash

→ If S & N are also present in the sample then react with HNO_3 → CN^-, SO_4^-, S^{-2} & it can interfere with $AgNO_3$ solution

Carbon & Hydrogen are also present

↳ $\frac{KOH}{CO_2}$; $\frac{CaCl_2}{H_2O}$

$$\% \text{ of } X = \frac{\text{At. mass of } X \times \text{mass of } AgX}{\text{mw of } AgX \times \text{mass of sample}} \times 100\%$$

$Ag = 108$

$$\% \text{ of Br} = \frac{80 \times 0.12}{188 \times 0.15} \times 100\%$$

$$= 34.04\%$$

* Test of Phosphorous

Rxn with Na_2O_2 → sodium phosphate

$$Na_3PO_4 + 3HNO_3 \longrightarrow H_3PO_4 + 3NaNO_3$$

$$H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3$$

Ammonium molybdate colorless

$(NH_4)_3PO_4 \cdot 12MoO_3 \cdot 2 1 NH_4NO_3$

Ammonium phospho molibdidate + $12H_2O$

yellow ppt.

$(NH_4)_3PO_4 \cdot 12Mo \cdot O_3$

$$\% \text{ of } P = \frac{31 \times \text{mass of Am-Ph mol}}{1877 \times \text{mass of sample}} \times 100\%$$

cheap Alternative

$$H_3PO_4 + MgNH_4PO_4 \longrightarrow Mg_2P_2O_7$$

white — reddish orange ppt

$Mg_2P_2O_7$

$$\% \text{ of } P = \frac{62 \times \text{mass of } Mg_2P_2O_7}{222 \times \text{mass of sample}} \times 100\%$$