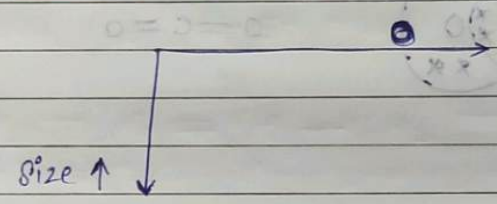
General Organic Chemistry

- A branch of chemistry which deals with Carbon and its Compound it is called **Organic chemistry**.

Introduction of Carbon



→ Carbon → Small in Size Size $\propto \frac{1}{IP}$
→ IP → very high
→ Covalent bond
→ Tetra valent 4 bond
→ Catenation (self bonding)

Types	Hybridisation	Shape	σ	π	S character
$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-$	SP_3	tetra hydral	4σ	0π	25%
$-\overset{|}{C}=\overset{|}{C}-$	SP_2	trigonal	3σ	1π	33.33%
$-C\overset{\sigma}{\underset{\pi}{\equiv}}C\overset{\sigma}{\underset{\pi}{\equiv}}C-$	SP	linear	2σ	2π	50%
$-C\overset{\sigma}{\underset{\pi}{\equiv}}nC-$	SP	linear	2σ	2π	50%

eg :-

$$\overset{SP_3}{CH_3}-\overset{SP_2}{CH}=\overset{SP_2}{CH}-\overset{SP_3}{CH_2}-\overset{SP_3}{CH_2}-\overset{SP_3}{CH_2}-\overset{SP}{C}\equiv\overset{SP}{CH}$$

$$\underset{1}{\quad}\quad\underset{2}{\quad}\quad\underset{3}{\quad}\quad\underset{4}{\quad}\quad\underset{5}{\quad}\quad\underset{6}{\quad}\quad\underset{7}{\quad}\quad\underset{8}{\quad}$$

(1) Total no. of σ & π :-

σ = 19 σ

π = 3 π

(2) Each carbon Hybridisation.

C_1 = SP_3 $\quad$ C_5 = SP_3

C_2 = SP_2 $\quad$ C_6 = SP_3

C_3 = SP_2 $\quad$ C_7 = SP

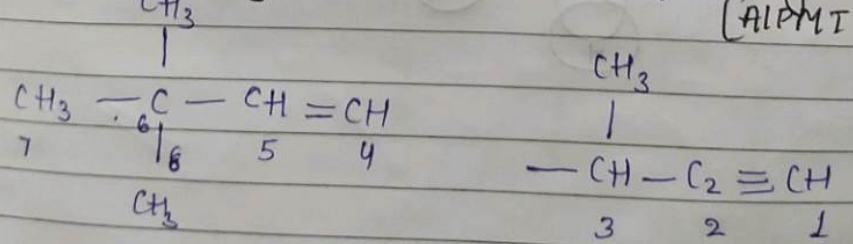
C_4 = SP_3 $\quad$ C_8 = SP

Que → Which of the following molecules represents the order of hybridisation sp^2, sp^2, SP, SP from left to right atoms ? [Neet 2018]

(a) $CH_2=CH-CH\equiv CH_2$ $\quad$ ~~(b)~~ $CH_2=CH-C\equiv CH$

(c) $CH\equiv C-C\equiv CH$ $\quad$ (d) $CH_3-CH=CH-CH_3$.

Que → The state of hybridisation of C_2, C_3, C_5 and C_6 of the hydrocarbon is in the following sequence [AIPMT 2009]



(a) SP, $SP3$, SP^2 and $SP3$
(b) SP^3, SP^2, SP^2 and SP^3
(c) SP, SP^2, SP^2 and $SP3$
(d) SP, SP^2, SP^3 and $SP2$

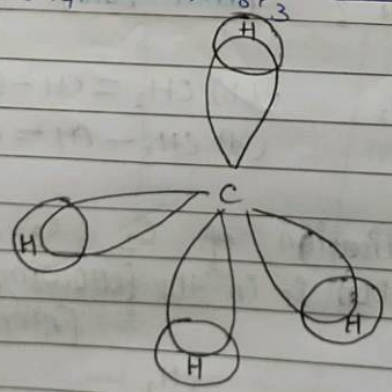
Que → In the hydrocarbon, the state of hybridisation of carbons 1, 3 and 5 are in the following sequence? [AIPMT 2008]

$$\overset{6}{CH_3} - \overset{5}{CH} = \overset{4}{CH} - \overset{3}{CH_2} - \overset{2}{C} \equiv \overset{1}{CH}$$

(a) SP^2, SP, $SP3$
(b) SP, SP^3, SP^2
(c) SP, SP^2, $SP3$
(d)

Structure of Methane

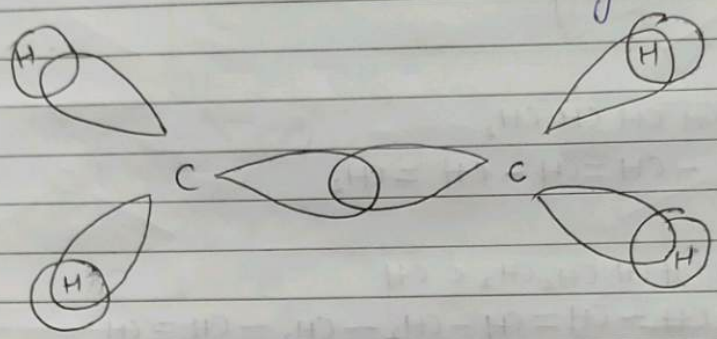
CH_4 → SP_3 → tetrahydral



Structure of C_2H_4 Ethene

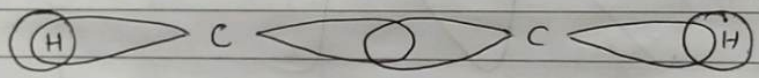
$CH_2 = CH_2$

$\longrightarrow SP_2 \longrightarrow$ Trigonal



Structure of C_2H_2

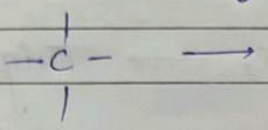
$C_2H_2 \longrightarrow CH \equiv CH \longrightarrow SP \longrightarrow$ linear



Classification of Organic Chemistry

- Open chain (Aliphatic)
  - Saturated
    - Alkanes
  - Unsaturated
    - Alkene
    - Alkynes
- Close chain Cyclic
  - Homocyclic
    - Alicyclic
    - Aromatic
  - Heterocyclic
    - Alicyclic
    - Aroma

Saturated :- All bond are σ



→ alkanes

(i)

Ex :- (i) CH C CH CH CH CH_2

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

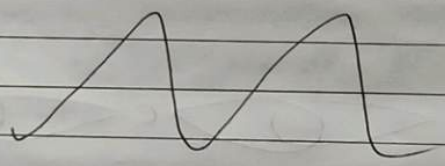
(ii) CH_2 CH CH CH CH_2 CH_2 C CH

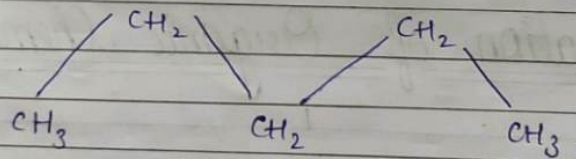
$CH_2 = CH - CH = CH - CH_2 - CH_2 - CH \equiv CH$

(iii)

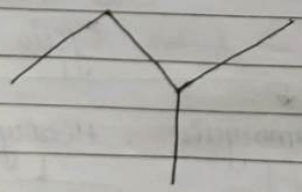
Bond line Structure

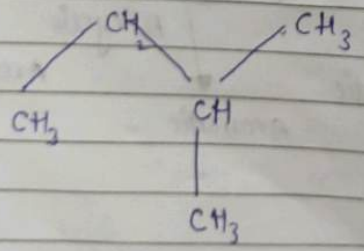
(i)



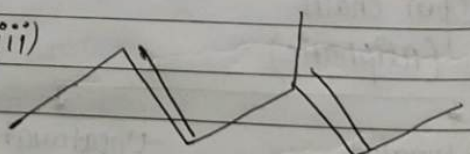


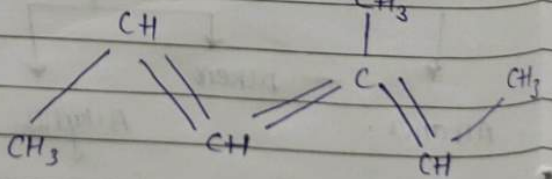
(ii)





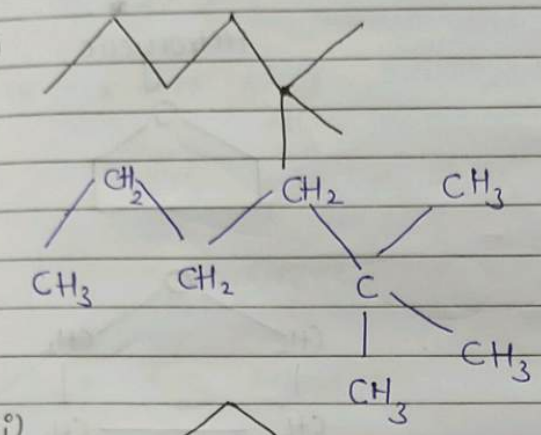
(iii)



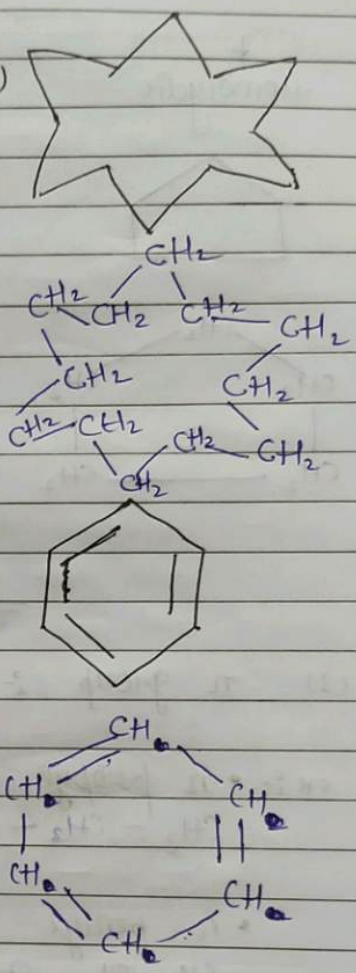


Homework

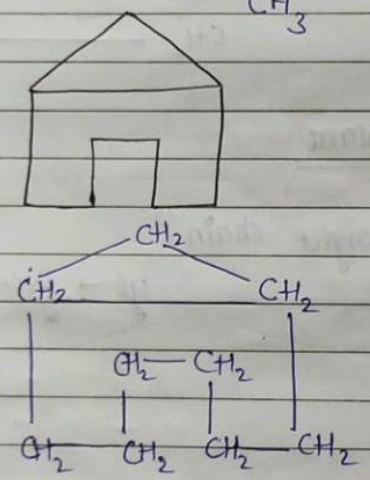
(i)



(ii)



(iii)



(iv)

Unsaturated :-

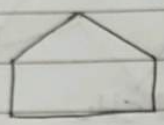
C_nH_{2n} Alkene :- $H_2C = CH - CH_3$

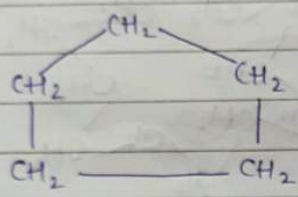
C_nH_{2n-2} Alkyne :- $CH \equiv C - CH_3$

C_nH_{2n+2} Alkane :- $CH_3 - CH_3$

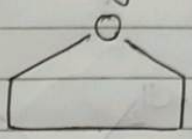
Cyclic

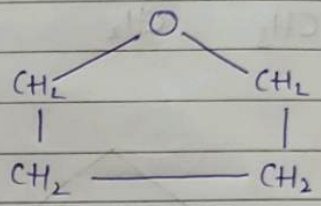
Homocyclic





Hetrocyclic.





Common Name

(1) n group :- long straight chain.

yl → free end.

ex :- • n propyl

$CH_3 - CH_2 - CH_2 -$

• n pentyl

$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 -$

(2) Iso group :- 2nd last Carbon पे 1 free methyl

ex :- • Iso butyl

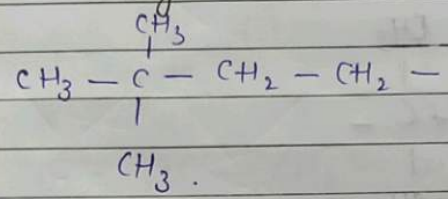
$CH_3 - CH(CH_3) - CH_2 -$

• Iso Hexyl

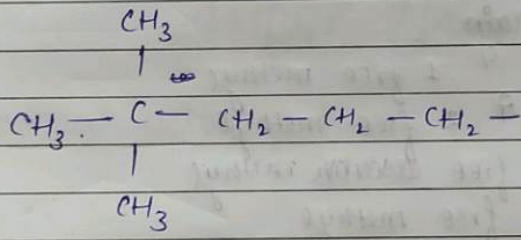
$CH_3 - CH(CH_3) - CH_2 - CH_2 - CH_2 -$

(3) Neo group :- 2nd last carbon ची 2 free methyl.

ex :- • Neo heryl

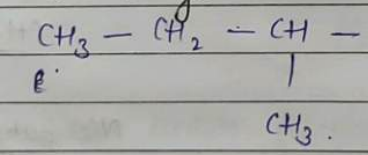


• Neo heptyl

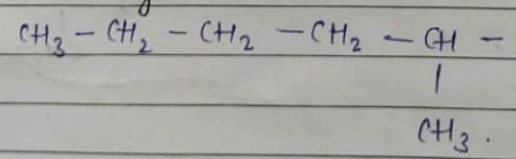


(4) Sec group :- 1st carbon ची 1 free methyl.

ex :- • Sec butyl

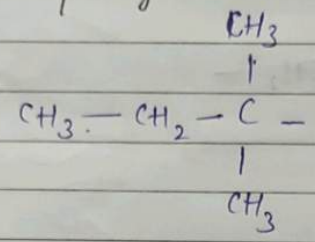


• Sec heryl



(5) ter group :- 1st carbon ☆ 2 free methyl

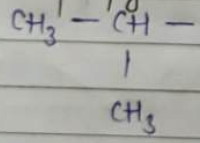
ex :- ter pentyl



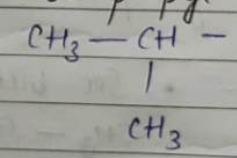
Summary :-

n :- Straight chain
iso :- 2nd last ☆ 1 free methyl
neo :- 2nd last ☆ 2 free methyl
sec :- 1st ☆ 1 free ~~electron~~ methyl
Ter :- 1st ☆ 2 free methyl

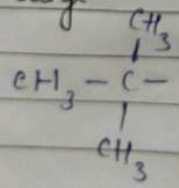
sec propyl



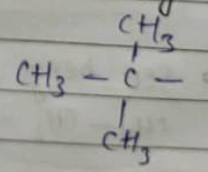
iso propyl



Ter butyl

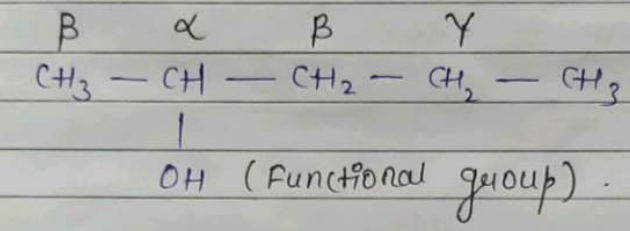


Neo butyl



α, β, γ

α :- Carbon with functional group.
β :- α का पड़ोसी
γ :- β का पड़ोसी



IUPAC Name

International union of pure and applied chemistry.

Rule :-

(1) Longest Carbon Chain.

(2) Numbering lowest to high (Numeric order)
ex :- 2, 3, 5 = 10
4, 5, 6 = 15

(3) Alphabatical order follow
ex :- n, c, d
③ ① ②

(4) तीसरा Alphabat — Number
→ Hypha
ex :- 5 - Methyl
6 - propyl.

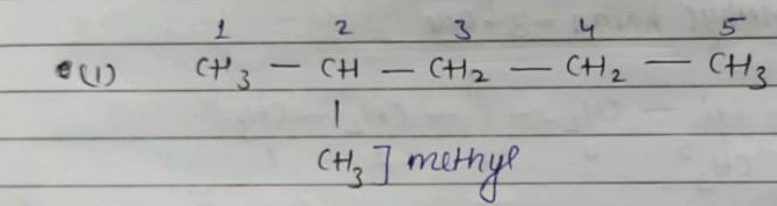
(5) 1st alphabat → Capital.

Formula

Secondary proffix + Primary proffix + Rootword + Pri Suffix + secondary suffix.

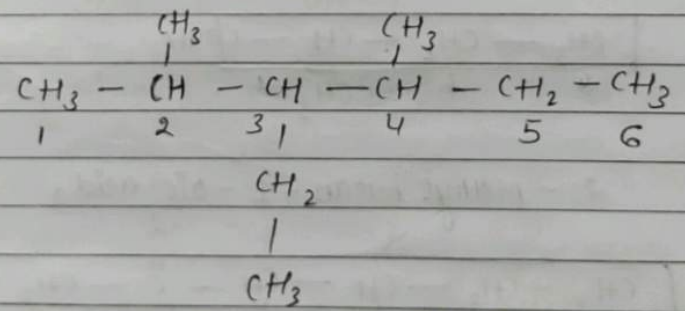
1 Carbon → Meth — ane
2 Carbon → Eth = ene
3 Carbon → Prop ≡ yne
4 Carbon → But
5 Carbon → Pent = = diene
6 Carbon → Hex = ≡ enyne
7 Carbon → Hept

(1)

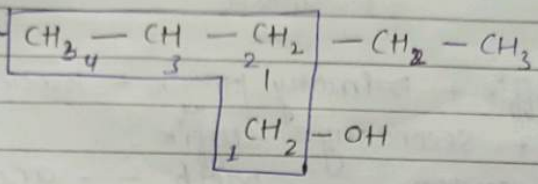


2 - Methyl pentane

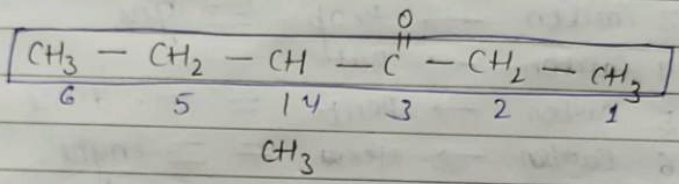
(2)



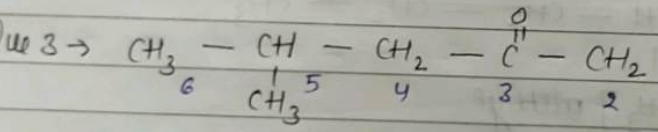
3 - Ethyl - 2,4 - dimethyl Hexane.

Que1 → 

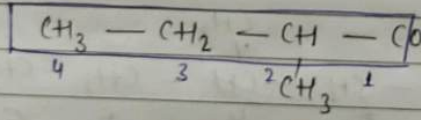
Ans → 2 - Ethyl butan - 1 - ol

Que2 → 

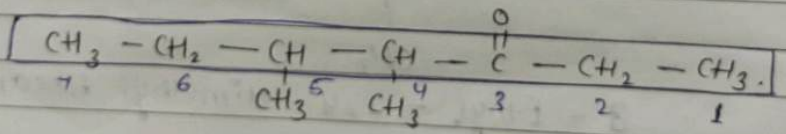
Ans → 4 - Methyl hexan - 3 - one

Que 3 → 

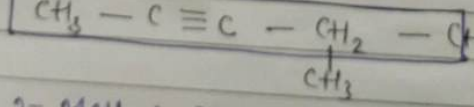
Ans → 5 - Methyl hexan - 3 - one.

Que 4 → 

Ans → 2 - Methyl butan - 1 - oic acid.

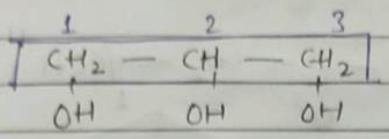
Que 5 → 

Ans → 4, 5-dimethyl heptan - 3 - one.

Que 6 → 

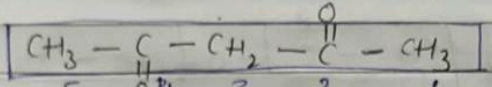
→ 2- Methyl pent - 3 - yne - 1 - al.

Que 7 →



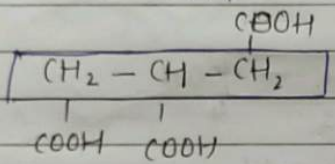
Ans → Propan - 1, 2, 3 - triol.

Que 8 →



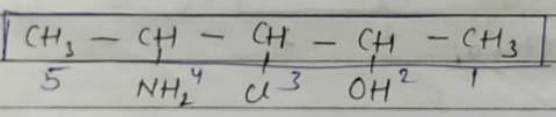
Ans → Pentan - 2, 4 - dione.

Que 9 →



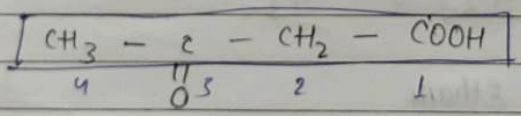
Ans → Propan - 1, 2, 3 - tri, Carboxylic acid.

Que 10 →



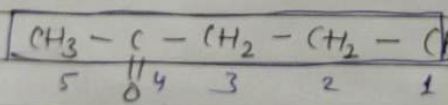
Ans → 4 - Amino - 3 - chloro pentan - 2 - ol

Que 11 →

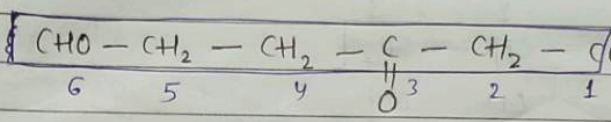


Ans → 3 - keto butan - 1 - oic acid

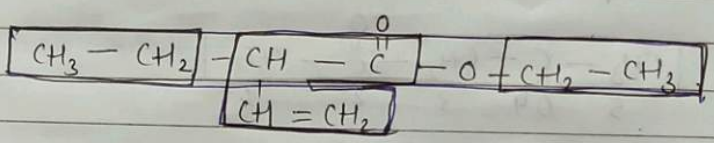
Que 12 →



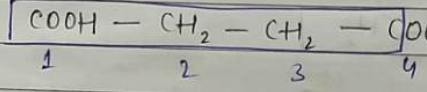
Ans → 4 - keto pentan - 1 - al.

Que 13 → 

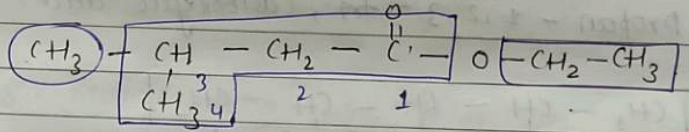
Ans → 3 keto - 6 - oxo hexan - 1 - oic acid.

Que 14 → 

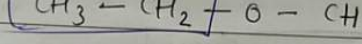
Ans → 1,2 - Diethyl but - 3 - en - 1 - oate.

Que 15 → 

Ans → Butan - 1 - 4 - dioic acid

Que 16 → 

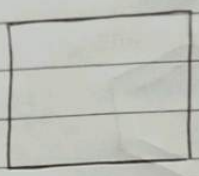
Ans → 1 - Ethyl - 3 - methyl butan - 1 - oate.

Que 17 → 

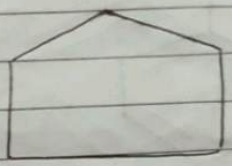
Ans → Meth oxy Ethane

Que 18 →

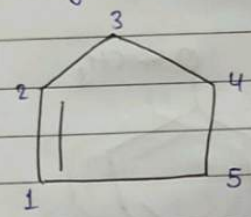
IUPAC of Cyclic Compound



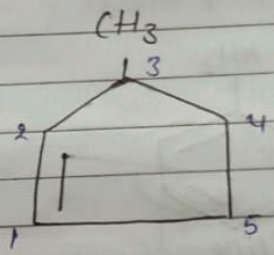
Cyclo Butane



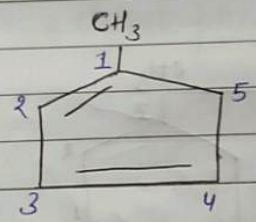
Cyclo Pentane



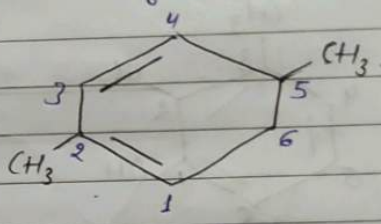
Cyclo pentene



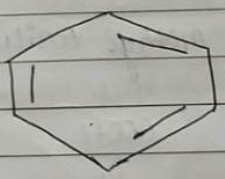
3-Methyl Cyclo pent-1-ene.



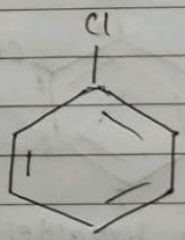
1-Methyl Cyclo pent-1,3 diene



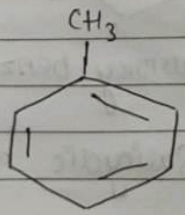
2,5-Dimethyl cyclo hex-1,3-diene.



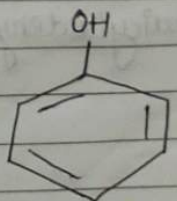
benzene



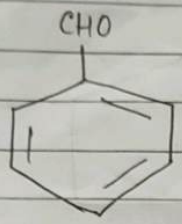
Chlorobenzene.



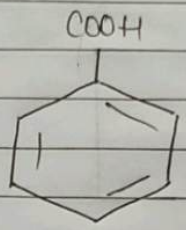
Methyl benzene / Toluene



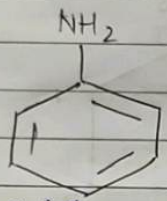
Phenol



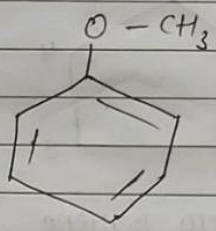
benzaldehyde



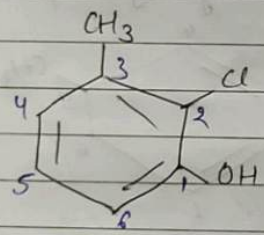
benzoic acid.



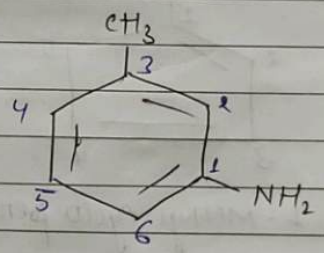
Aniline



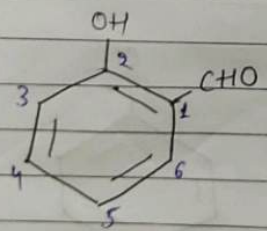
Anisole



2-Chloro-3-methyl Phenol

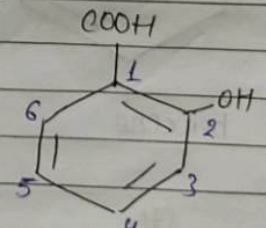


3-methyl Aniline



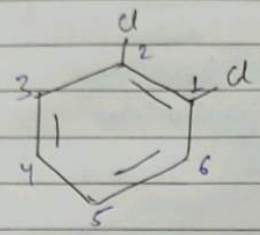
2-Hydroxy benzaldehyde

Salicylaldehyde

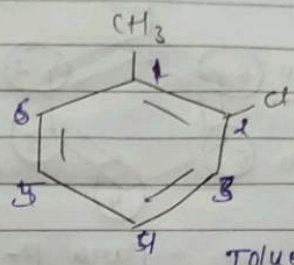


2-Hydroxy benzoic acid

Salicylic acid.

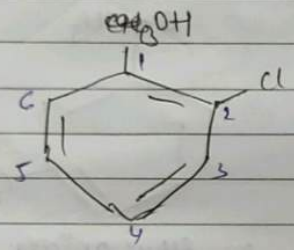


1,2 - dichloro benzene.

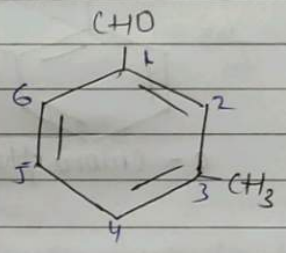


Toluene

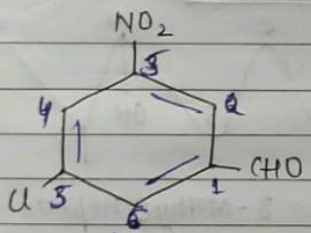
1- Chloro 2- ~~Methyl~~ ~~Benzene~~.



2 Chloro phenol



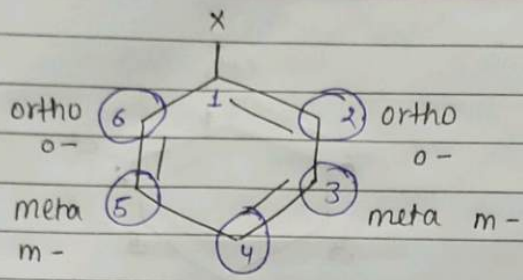
3 - Methyl Benzaldehyde

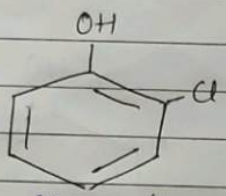


3, Amino - 5 -chloro Benzaldehyde

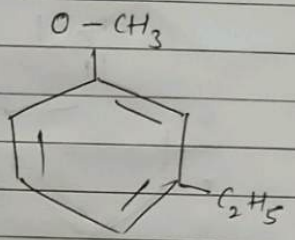
acid

d.



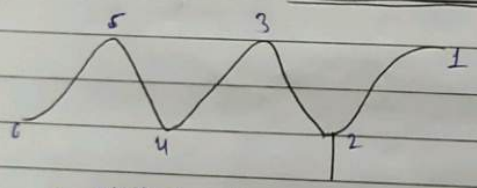


o - Chloro phenol

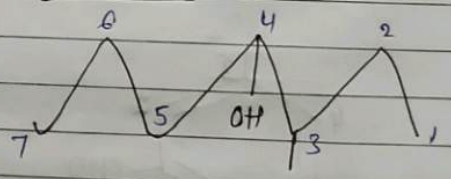


m - Ethyl anisole.

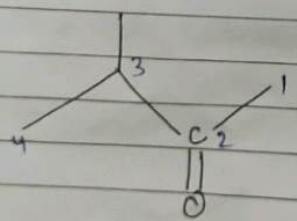
Bond line Structure



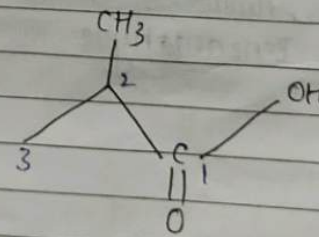
2 - Methyl Hexane



3 - Methyl heptan - 4 - ol

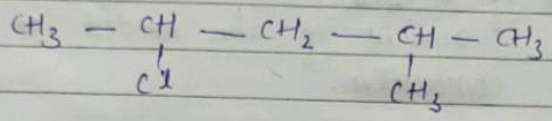


3 - Methyl butan - 2 - one

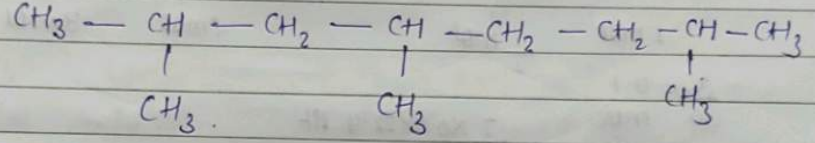


2 - Methyl propon - oic acid

Que → 2 chloro - 4 - methyl pentene

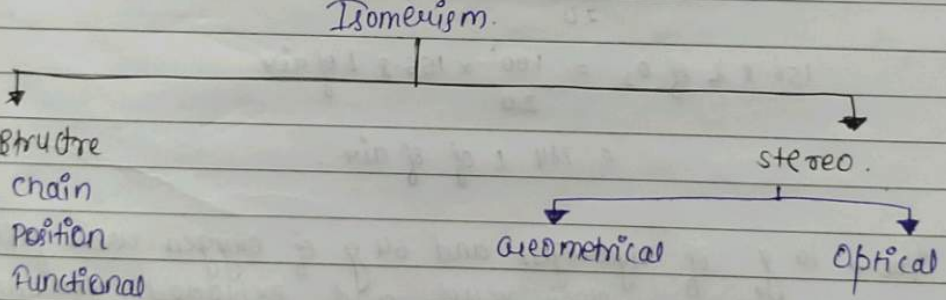


Que → 2,4,7 - Tri Methyl octane



Isomerism

Same molecular mass, same molecular formula but different structure or Rotation.



Mole Concept Numericals.

Que → Three gram of C_2H_6 burn in air and make CO_2 and H_2 amount of air needed at STP during combustion.

Solu → $C_2H_6 + \frac{7}{2} O_2 \longrightarrow 2CO_2 + 3H_2O$

1 mol $\quad \frac{7}{2}$ mol $\quad$ 2 mol $\quad$ 3 mol

$\frac{3}{30} = 0.1$ mol

$\frac{7}{2} \times 0.1 \times 22.4$ lit

$= 156.8$ l of O_2.

amount of air

20 lit O_2 = 100 l air

1 lit O_2 = $\frac{100}{20}$ l air

156.8 l of O_2 = $\frac{100}{20} \times 156.8$ l of air

= 784 l of of air.

Que → 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be [AIPMT 2009]

Solu → $2H_2 + O_2 \longrightarrow 2H_2O$

2 mol $\quad$ 1 mol $\quad$ 2 mol

$\frac{10}{2} = 5$ mol $\quad$ 2.5 mol

2.5×32

$= 80$ g

We don't have 10 g of O_2

$\frac{35}{2}$ $\frac{207}{16}$
$\frac{40}{223}$

4 mol $\frac{64g}{32} = 2 mol$ 4 mol.

$4 \times 2 = 8g$ limiting reagent

2g Rest

because we have 10g of H_2

Que → PbO = 6.5g, HCl = 3.2g, lead Chlorid = ?

Solu → $PbO + 2HCl \longrightarrow PbCl_2 + H_2O$

1 mol 2 mol 1 mol 1 mole

$\frac{6.5}{223}$ 0.06×36.5 0.03

$= 0.03$ $= 2.19\ g$

Que →

Solu → $C_3H_8 + \frac{10}{2} O_2 \longrightarrow 3CO_2 + 4H_2O$

1 mol 5 mol 3 mol 4 mol

1 lit 5 Lit

Que →

Sol →

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

3 mol — 2 mol

30 — 20

Que → 30 →

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

1 mol — 3 mol — 2 mol

$\frac{20}{28}$ — 5

$= 0.71$ mol → 1.42 mol.

Que 28 →

$$4HNO_3 + 3KCl \longrightarrow Cl_2 + NOCl + 2H_2O + 3KNO_3$$

4 mol — 3 mol — 1 — 1 — 2 mol — 3 mol

$\frac{4}{3}$ — $\frac{110}{101} = 1.08$

$\frac{4 \times 1.08}{3}$

1.45×63

$=$

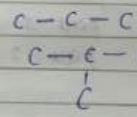
→ classification of organic compounds.

Isomerism

(1) Structure isomers
- → same formula
- → same molar mass
- → Different in structures.

(2) Chain Isomers
- → Formula same
- → Molar mass same
- → main Carbon chain different

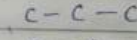
ex:- C_4H_{10}



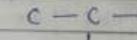
Butane

2-Methyl propane.

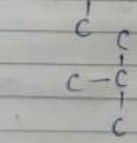
C_5H_{12}



Pentane.



2 methyl butane.

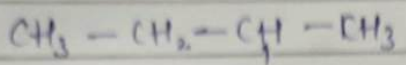


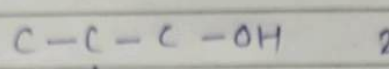
2,2 Dimethyl propane.

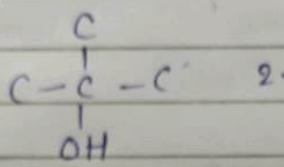
(b) Position Isomers
- → Same formula
- → Same molar mass
- → Different in no of substituent, functional group, multiple bonds.

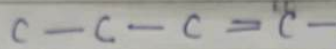
ex:- $CH_3 - CH_2 - CH_2 - CH_2 - OH$

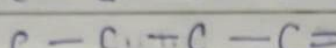
Butane-1-ol

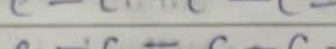

Butano-2-ol


2-methyl propano-1-ol


2-methyl propan-2-ol.

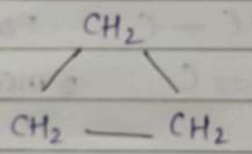
ex :- 
pent-2-ene

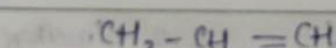

pent-1-ene


pent-2-ene.

(c) Ring chain

C_3H_6


Cyclopropane.


prop-1-ene.

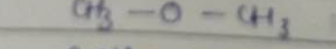
(d) Functional Isomers

→ Same formula

→ Same Molar Mass

→ Functional group.

ex :- C_2H_6O


methoxymethane

&


Ethan-ol.

(1) Aldehyde & ketone.

$CH_3-CH_2-\underset{al}{CHO}$ & $CH_3-\underset{\underset{one}{}}{\overset{\overset{O}{\|}}{C}}-CH_3$

(2) Alcohol & ether

CH_3-CH_2-OH & CH_3-O-CH_3.

(3) Acid & ester

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

(4) Cyanide & Isocyanide

CH_3-CH_2-CN & CH_3-CH_2-NC.

(5) Nitro & Nitrite

$CH_3-CH_2-N(=O)\rightarrow O$ & $CH_3-CH_2-O-N=O$

(6) Keto & Enol

$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ & $CH_2=\underset{\underset{OH}{|}}{C}-CH_3$.

(7) Amide & oxime

$CH_3-\underset{\underset{O}{\|}}{C}-NH_2$ & $CH_3-CH=N-OH$

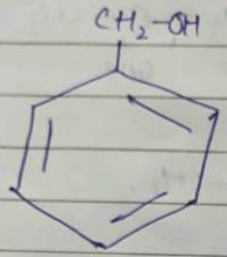
(8) 1°, 2°, 3° Amine.

$CH_3-CH_2-CH_2-NH_2$ — 1° Amine

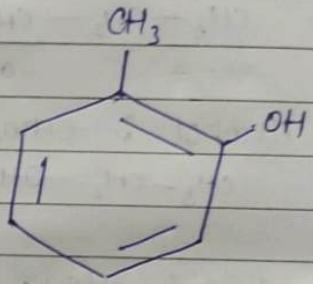
$CH_3-CH_2-NH-CH_3$ — 2° Amine.

$CH_3-\underset{\underset{CH_3}{|}}{N}-CH_3$ — 3° Amine.

(9) Alcohol & phenol



and



Metamerism

→ only & only groups. which have minimum 2 valency.

(1) $-S-$

(2) $-O-$

(3) $-\overset{O}{\overset{\|}{C}}-$

(4) $-\overset{O}{\overset{\|}{C}}-NH-$

(5) $-NH-$

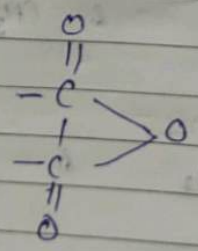
(6) $-\overset{O}{\overset{\|}{C}}-NH-$

(7) $-\overset{O}{\overset{\|}{C}}-\overset{|}{N}-$

(8) $-\overset{|}{N}-$

(9) $-NH-$

(10)



R → Alkyl groups.

$CH_3-CH_2-O-CH_2-CH_3$ Ethoxyethane

&

$CH_3-O-CH_2-CH_3$ Methoxypropane.

Isomerism

(1) $CH_3 - CH_2 - CH = CH - CH_2 - CH_3$

1 2 3 4 5 6

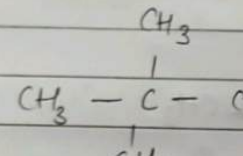
Hex-3-ene.

$CH_3 - CH = CH - CH_2 - CH_2 - CH_3$.

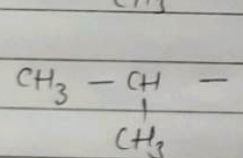
Hex-2-ene

* Position Isomer.

(2)



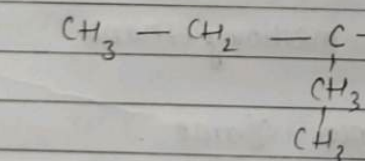
2,2 Dimethyl butane.



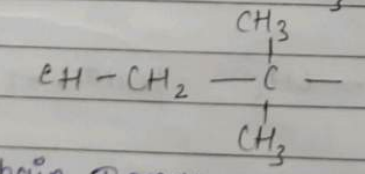
2,3 dimethyl butane.

→ position Isomer.

(3)



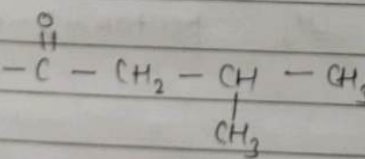
3 Ethyl pentane.



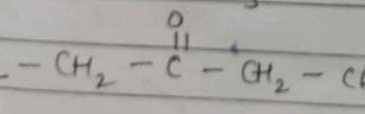
3-3 Dimethyl pentane.

→ Chain Isomer.

(4)



4 methyl pentan-2-one.



Hexan-3-one.

* Chain Isomer, Position Isomer, Metamer.

(5) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3-CH_3$ C_7H_{16}

$CH_3-CH_2-CH=CH-\underset{\underset{CH_3}{|}}{CH}-CH_3$ C_6H_{14}

★ No Isomer.

(6) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CH_2-CH_2-CH_3$

-ol alcohol

$CH_3-CH_2-O-CH_2-CH_2-CH_2-CH_3$

ether.

-oxy-

★ functional Isomer

(7) $CH_3-O-CH_2-CH_3$ Methoxyethane

$CH_3-CH_2-O-CH_3$ methoxyethane

★ chain & metamer isomer same.

(8) $CH_3-CH_2-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$ pentan-2-ol

$CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_2-CH_3$ pentan-3-ol

★ position Isomer.

(9) $CH_3 - CH_2 - O - CH_2 - CH_3$ Ethoxyethane

$CH_3 - O - CH_2 - CH_2 - CH_3$ Methoxypropane.

★ Chain Isomer & metamer.

(10) $CH_3 - CH_2 - CH_2 - CHO$] → al

$CH_3 - CH_2 - \underset{\text{one}}{\underset{\|}{C}} - CH_3$

one.

★ Functional Isomer.

Tautomerism [Not in ~~Neet~~ ncert]

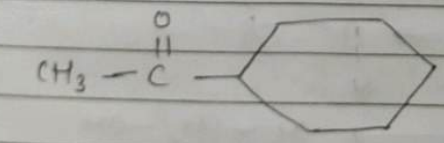
⇒ It is a transfer of α hydrogen.

more αH, more stability

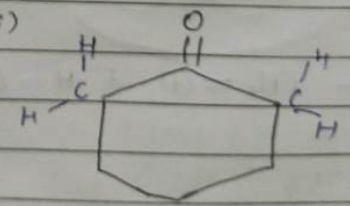
$CH_3 - \underset{\alpha C}{CH_2} - \underset{F.G}{OH}$ = 2αH

(1) $\underset{FG}{CH_3 - CHO}$ = 3αH (2) $H - \underset{\|}{\underset{O}{C}} - H$ = 0αH

(3) $CH_3 - \overset{\|}{\underset{O}{C}} - CH_3$ = 6αH (4) $CH_3 - \overset{\|}{\underset{O}{C}} - CH_2 - \overset{\|}{\underset{O}{C}} - CH_3$ = 8αH

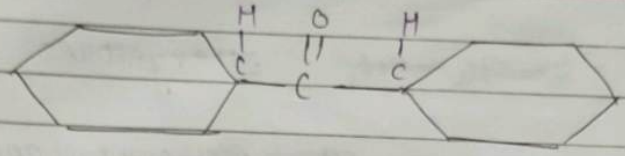
(5) 

= 4αH

(6) 

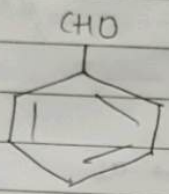
= 4αH

(7)



= 2αH

(8)



0αH

Reaction Machanism

Substrate —(Conditions / Reagent)→ Product

Homolytic
Heterolytic

Intermediate
+ Nucleophiles
Electrophiles.

Types of Organic Reaction.

(1) Substitution Reaction.

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

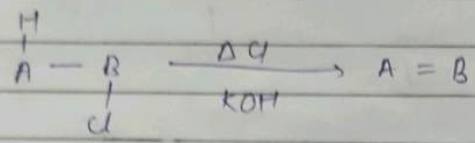
eg:- $CH_3-Cl + H-OH \longrightarrow CH_3-OH + HCl$

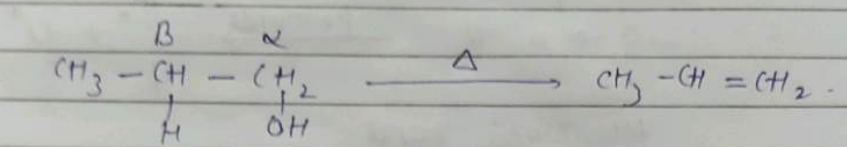
(2) Addition Reaction.

$$A=B + H-OH \longrightarrow \overset{H}{A}-\overset{OH}{B}$$

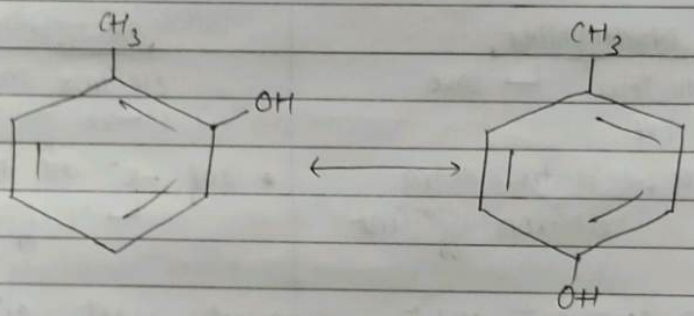
eg:- $CH_2=CH_2 + H-OH \longrightarrow CH_3-CH_2-OH$

(3) Elimination reaction.] inverse of addition.



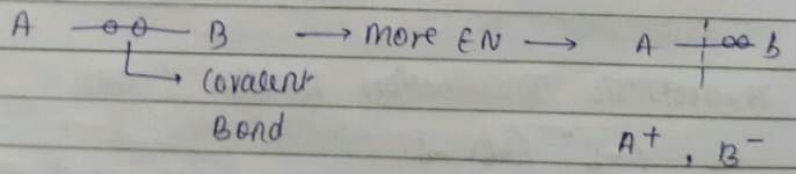


(4) Rearrangement Reaction.

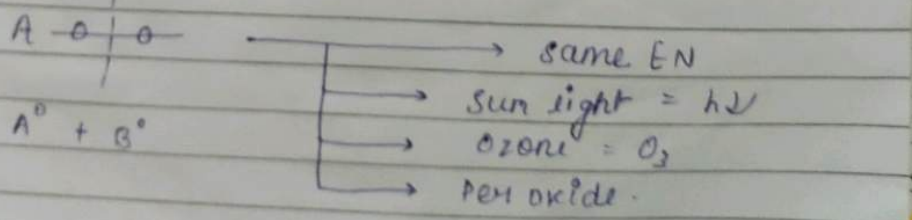


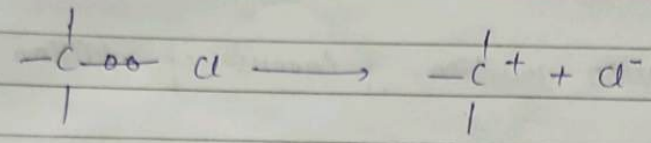
Type of Bond fission.

(1) Heterolytic bond fission :-

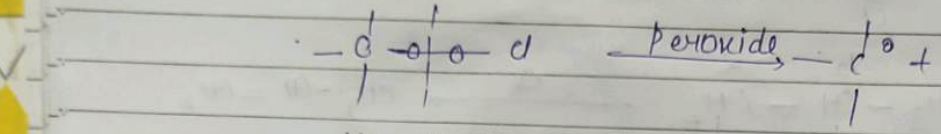


(2) Homolytic bond fission.



eg:- 

Heterolytic bond -



Homolytic bond

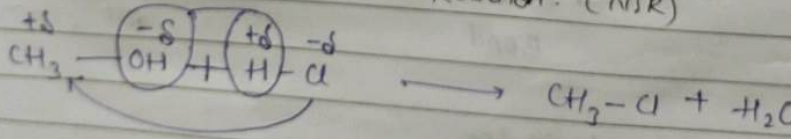
Type of Attacking Reagent

(Nu⁻) Nucleophiles	(E⁺) Electrophiles
Nucleus ↳ Love +ve	Electron love. −ve
• Self −ve, electron extra electron efficient	• Self −e⁻ की कमी ↳ Deffficient
• H^-, OH^-, CN^-, I^-, NH_2^-, H_2O, NH_3, $R-OH$,	• H^+, SO_3H^+, Cl^+, NO_2^+, CH_3^+, $CH_3-\overset{\oplus}{C}+$
↓	
• Lewis base.	• lewis acid :- BF_3, $AlCl_3$, CCl_2, CO_2, BeF_2, $ZnCl_2$

(1)

(2)

Nucleophilic Substitution Reaction. (NSR)

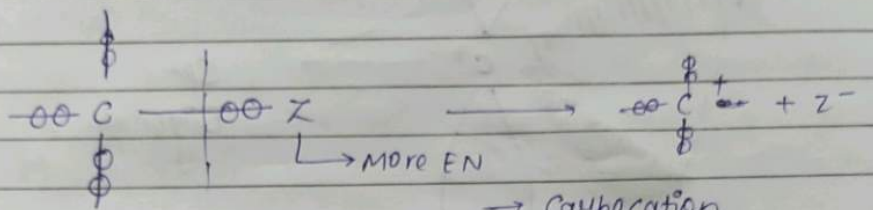


(1)

(2)

50★ Type of Reaction intermediate

(1) Carbocation



→ Carbocation

→ 6e⁻ available

→ Heterolytic bond fission.

→ 2e⁻ lack

→ Hyb = sp^2 trigonal → Attacking reaction ← Nu⁻ favour.

Types of Carbo Cation.

(1) CH_3^+
Methyl Carbocation.

(2) $CH_3 - CH_2^+$
1° Carbocation

(3) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH^+}}$
2° Carbocation.

(4) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{\oplus C^+}}}}$
3° Carbocation.

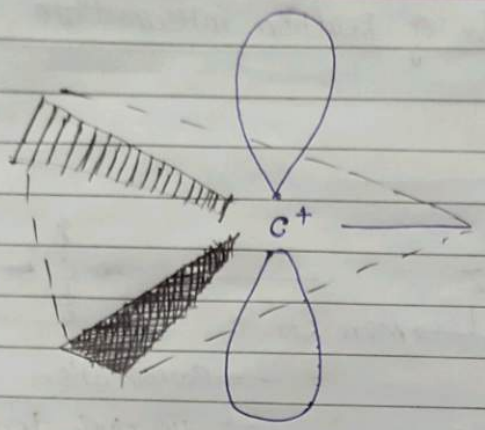
Stability of Carbocation.

3° > 2° > 1° > Methyl Carbo Cation.

Reason:-

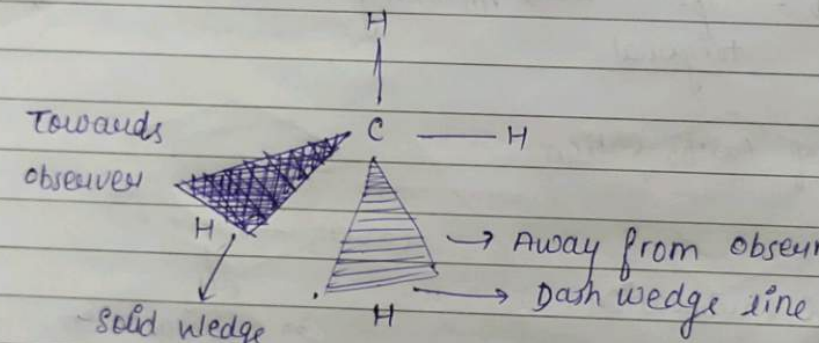
(1) +I effect

(2) Hyper Conjugation

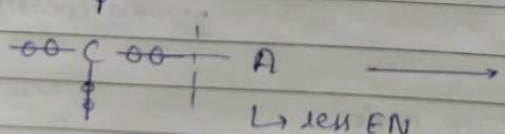


Sp^2
Trigonal.

$CH_4 \longrightarrow Sp^3$



(2) Carbanion.



↳ less EN

→ No. of e = 8e
→ Lack = 0e
→ Hyb = Sp^3

→ Carbanion.

→ Heterolytic bond fission.
→ Attack species E+.

Types of Carbanion.

(1) CH_3^-
Methyl Carbanion.

(2) $CH_3 - CH_2^-$
1° Carbanion

(3) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH^-}}$
2° Carbanion

(4) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C^-}}}}$
3° Carbanion.

→ Stability of Carbanion.

Methyl > 1° > 2° > 3°

(1) -I effect → Inductive effect.
(2) R/M effect
Resonance / Mesomeric.

Que → Which amongst the following is the most stable carbocation [AIPMT 2005]

(a) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - H$

(b) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C^+}}}}$

(c) $^+CH_3$

(d) CH_3CH_2

Que → Which of the following reaction is an example of nucleophilic substitution reaction? [AIPMT 2009]

(a) $RX + ROH \longrightarrow ROH + KX$

(b) $2RX + 2Na \longrightarrow R - R + 2NaX$

(c) $RX + H_2 \longrightarrow RH + HX$

(d) $RX + Mg \longrightarrow RMgX$.

Que → A tertiary butyl carbocation is more stable than a secondary butyl carbocation because of which of the following [Neet 2020]

(a) -I effect of $-CH_3$ groups

(b) +R effect of $-CH_3$ groups

(c) -R effect of $-CH_3$ groups.

(d) Hyper conjugation

(1)

Que → The correct statement regarding electrophile is [Neet 2017]

(2)

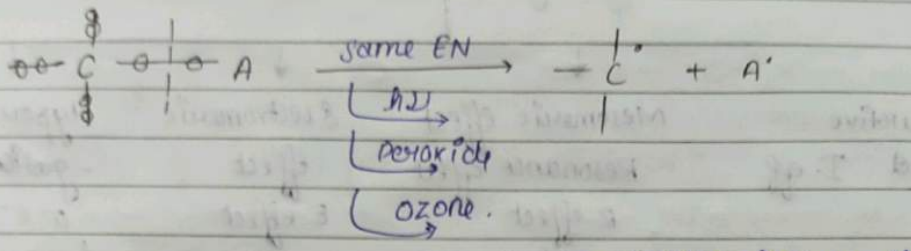
(a) Electrophile is a negatively charge species and can form a bond by accepting a pair of electrons from a nucleophile.

(b) Electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile.

(c) Electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile.

(d) Electrophile can be either neutral or positively charged species and can form a bond by accepting a pair electrons from a nucleophile.

Carbon Free Radical.



→ Carbon free radical
→ Homolytic fission.
→ Attack by Nu^-

No. of e^- = $7e^-$
lack of e^- = $1e^-$

Types.

(1) $CH_3^{\bullet}$
→ Methyl Carbon Free Radical

(2) $CH_3 - CH_2^{\bullet}$
1° CFR

(3) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH^{\bullet}}}$
→ 2° CFR

(4) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C^{\bullet}}}}}$
3° CFR.

Stability

3° > 2° > 1° > Methyl Carbon Free Radical

Stability defined by

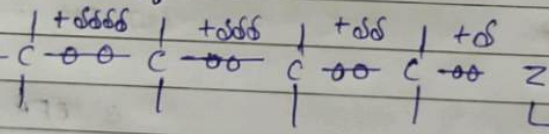
→ +I effect
→ Hyperconjugation

Factor affecting Reaction Intermediate.

- Inductive effect I. eff → shifting of σ e⁻
- Mesomeric effect / Resonance effect / R effect / M effect → shifting of π e⁻
- Electromeric effect / E effect → π e⁻ → σ e⁻ charge.
- Hyperconjugation. σ e⁻ ↳ π bond

Inductive effect

(1) Movement of σ bond ⟶ polarity (Reason ↓)
(2) Permanent effect.



Types of I

−I → e⁻ attract करने वाले
↳ e⁻ withdrawing group.

$OR^+ > NR_3^+ > \overset{+}{N}H_3 > -NO_2 > -SO_3H > -CN$
$-COOH > -X > -OH > -NH_2 > -C_6H_5 > -H.$
↳ Halogen ($-F > -Cl > -Br > I$)

+I → e⁻ doner group.

$CH_3- < CH_3-CH_2- < CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-$

Application of I effect

(1) Stability of carbocation.
(2) Stability of Carbon free Radical
(3) Basic effect

} $\alpha \frac{+I}{-I}$

(4) Stability of Carbanion.
(5) Acidic effect

} $\alpha \frac{-I}{+I}$

Qu1 → Arrange the order of stability of Carbocation.

(a) CH_3^{+}

(b) $CH_3-\underset{\underset{CH_3}{|}}{CH}^{+}$ 2+I

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

(d) $CH_3-CH_2^{+}$ 1+I

∴ c > b > d > a

Que 2 → Arrange the order of stabity of Carbocation.

(a) $\underset{+I}{(CH_3)}-CH_2-CH_2^{+}$

(b) $\underset{-I\ max}{(NO_2)}-CH_2-CH_2^{+}$

cc) $\underset{-I\ 2nd\ max}{(CN)}-CH_2-CH_2^{+}$

(d) $\underset{-I\ 3rd}{(Cl)}-CH_2-CH_2^{+}$

a > d > c > b

Que3 → Arrange the order of stability of carbocation.

(a) $CH_2-CH_2-CH_2-CH_2-CH_2^+$ (F)

(b) $CH_3-CH-CH_2-CH_2-CH_2^+$ (F)

(c) $CH_3-CH_2-CH-CH_2-CH_2^+$ (F)

(d) $CH_3-CH_2-CH_2-CH_2-CH_2^+$

a > b > d > c

Homwork

Que1 → Arrange the order of carboanian.

(a) CH_3^-

(b) $CH_3-\underset{CH_3}{\underset{|}{CH}}-$

(c) $CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-$

(d) $CH_3-CH_2^-$

c > b > d > a

Que 2 → Arrange the - - - - carboanian.

(1) $NO_2-CH_2-CH_2^-$ 1

(2) $CN-CH_2-CH_2$ 2

(3) $CH_3-CH_2-CH_2^-$ 4

(4) $Cl-CH_2-CH_2^-$ 3

1 > 2 > 4 > 3

Que3 → Arrange the - - - - carboanian

(a) $CH_3-CH_2-CH_2-\underset{NO_2}{\underset{|}{CH}}^-$

(b) $CH_3-\underset{NO_2}{\underset{|}{CH}}-CH_2-CH_2^-$

(c) $CH_3-\underset{NO_2}{\underset{|}{CH}}-CH_2-CH_2^-$

(d) $\underset{NO_2}{\underset{|}{CH_2}}-CH_2-CH_2-CH_2^-$

d > b = c > a

Que 4→ stability of carb free radical.

(a) $CH_3 - CH_2^{\bullet}$

(b) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}{}^{\bullet}$

(c) $CH_3 - \underset{\displaystyle CH_2}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}{}^{\bullet}$

(d) $CH_3^{\bullet}$

c > b > a > d

Que 5→ stability of C.F.R.

(a) $CH_3 - CH_2 - CH_2^{\bullet}$

(b) $CH_3 - \underset{\displaystyle NO_2}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}} - CH_2^{\bullet}$

(c) $CH_3 - \underset{\displaystyle CN}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}} - CH_2^{\bullet}$

(d) $CH_3 - \underset{\displaystyle Cl}{\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}} - CH_2^{\bullet}$

b > c > d > a

Que 6→ Arrange order of stability of carbocation.

(a) $CH_3 - \underset{\displaystyle F}{\overset{\displaystyle F}{\underset{|}{\overset{|}{C}}}} - CH_2^{+}$

(b) $CH_3 - \underset{\displaystyle NO_2}{\overset{\displaystyle NO_2}{\underset{|}{\overset{|}{C}}}} - CH_2^{+}$

(c) $CH_3 - \underset{\displaystyle Cl}{\overset{\displaystyle Cl}{\underset{|}{\overset{|}{C}}}} - CH_2^{+}$

(d) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}} - CH_2^{+}$

b > c > a > d

Que 7→ Acidic effect order.

(a) $CH_3 - OH$

(b) $CH_3 - CH_2 - OH$

(c) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}} - OH$

(d) $CH_3 - CH_2 - OH$

Que 8 → Acidic effect order.

(a) $H-COOH$

(b) CH_3-COOH

(c) $CH_3-\underset{CH_3}{\underset{|}{CH}}-COOH$

(d) $CH_3-\underset{NO_2}{\underset{|}{CH}}-COOH$

Que 9 → Acidic effect order.

(a) $CH_3-\underset{NO_2}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-OH$

(b) $CH_3-\underset{NO_2}{\underset{|}{\overset{NO_2}{\overset{|}{C}}}}-OH$

(c) $CH_3-\underset{F}{\underset{|}{CH}}-OH$

(d) $CH_3-\underset{CN}{\underset{|}{CH}}-OH$

Que 10 → Basic effect order.

(a) CH_3-NH_2

(b) $CH_3-CH_2-NH_2$

(c) $CH_3-\underset{CH_3}{\underset{|}{CH}}-NH_2$

(d) $CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-NH_2$

$d > c > b > a$.

Mesomeric effect
Resonance.

⇒ π e⁻ movement
⇒ Temporary.

Conditions.

(1) DB SB DB
$CH_2 = CH - CH = CH_2$

(2) DB SB −ve
$CH_2 = CH - CH_2^-$

(3) DB SB +ve
$CH_2 = CH - CH_2^+$

(4) DB SB lP
$CH_2 = CH - NH_2$

(5) DB SB free Radical.

Rules :-

(1) Double Bond = Wiping.

(2) Sign = alternation.

(3) Loan pair = = bond
+ ve charge
alternation −ve charge

(I) $CH_3 - CH = CH - CH = CH - CH = CH_2$

$CH_3 - CH = CH - CH = CH - CH^+ - CH_2^-$

$CH_3 - CH = CH - CH^+ - CH = CH - CH_2^-$

$CH_3 - CH^+ - CH = CH - CH = CH - CH_2^-$

(II) $CH_2 = CH - CH = CH - \ddot{O}H$

$CH_2 = CH - CH^- - CH = OH^+$

$CH_2^- - CH = CH - CH = OH^+$

(III) $CH_2 = CH - CH = CH - CH = CH_2$

$CH_2 = CH - CH = CH - CH^+ - CH_2^-$ Canonical form.

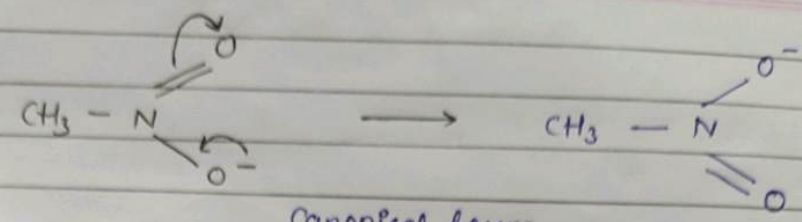
$CH_2 = CH - CH^+ - CH = CH - CH_2^-$

$CH_2^+ - CH = CH - CH = CH - CH_2^-$

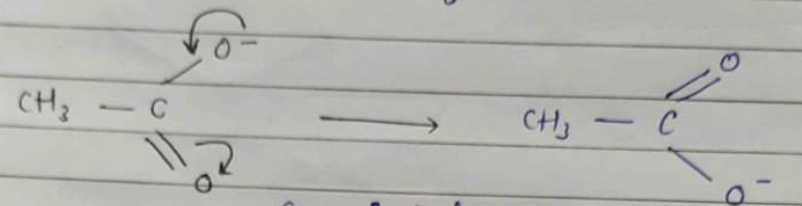
(IV) $CH_3 - CH = CH - CH = CH - CH - \ddot{N}H_2$

$CH_3 - CH = CH - CH^- - CH = NH_2^+$

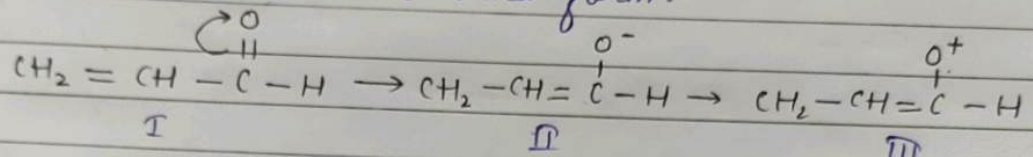
$CH_3 - CH^- - CH = CH - CH = NH_2^+$



Canonical form.



Canonical form.

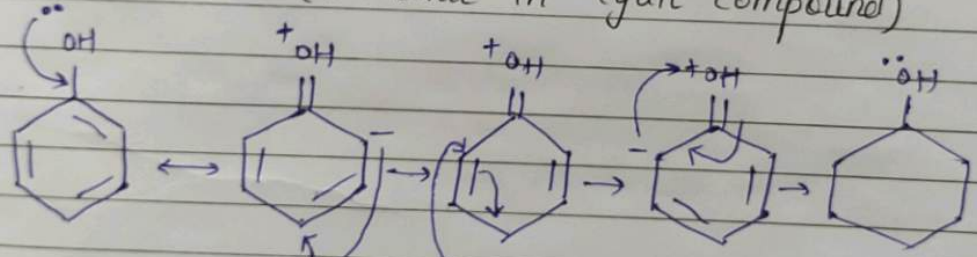


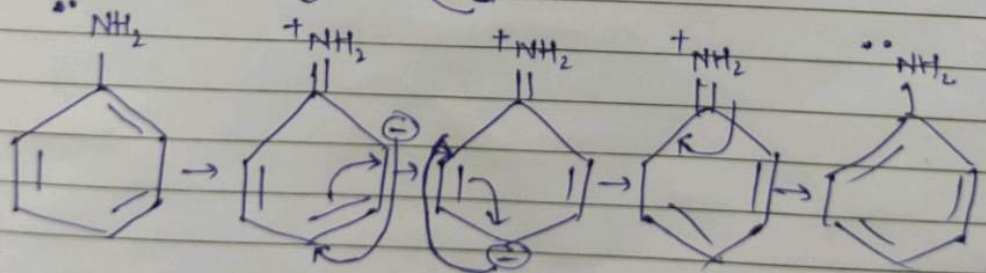
Stability order

I > II > III

Cyclic Structure

(Resonance in Cyclic compound)

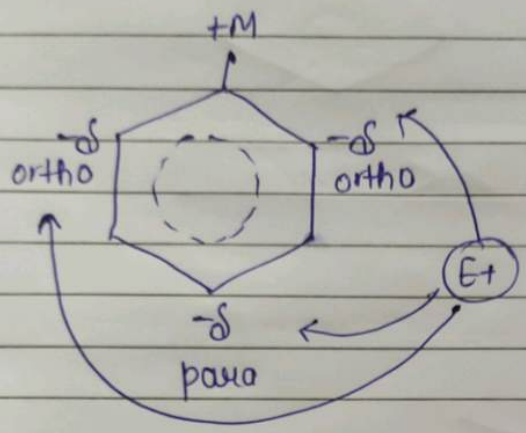




+R / +M group

π e⁻ donor group

eg :- $-\ddot{O}H$, $-\ddot{N}H_2$, $-\ddot{N}HR$, $-NR_2$, $-O-R$

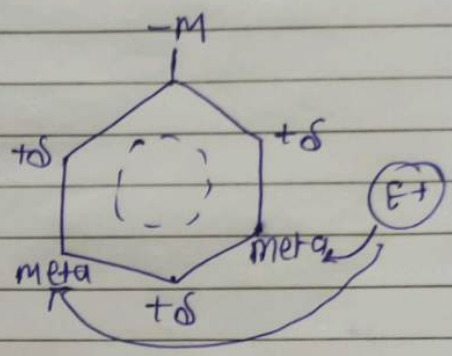


ortho / para directing group.

-R / -M group

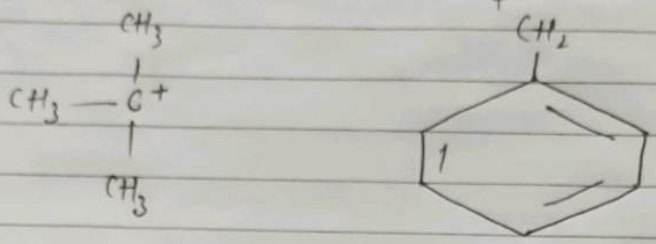
π e⁻ with drawl group

$-NO_2$, $-CHO$, $-\overset{\cdots}{\underset{\cdots}{C}}\equiv N$, $-COOH$, $-CONH_2$, $-COCl$

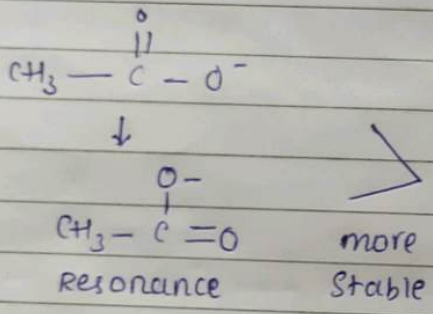


Meta directing group.

Stability ∝ Resonance.



I effect < Resonance



(a) $C_6H_5 - CH_2^+$

(b) $\underbrace{(C_6H_5)_2}_{\text{phenyl.}} CH^+$

(c) $(C_6H_5)_3 C^+$

(d) $(CH_3)_3 C^+$ 3°

(e) $(CH_3)_2 CH^+$ 2°

(f) $CH_3 CH_2^+$ 1°

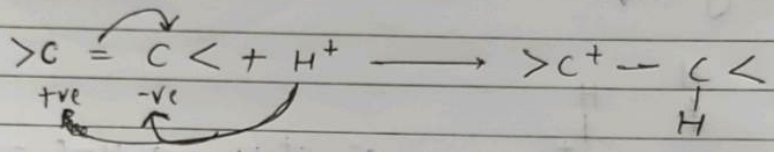
c > b > a > d > e > f.

Electromeric Effect.

(i) It is a temporary effect
(ii) It is only present when multiple bonds are present and attacking reagents are present.
(iii) It is denoted by ↷

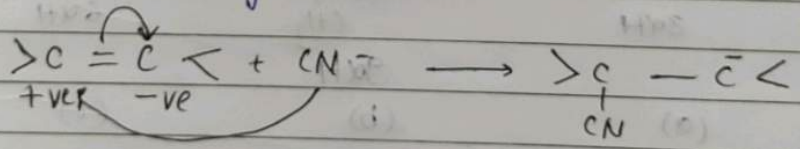
(i) Positive electromeric effect :- +E effect

In this effect the π electron of the multiple bond are transfer to that atom where reagent (electrophyl) get attached.



(ii) Negative electromeric effect = -E effect

In this effect π electron of multiple bond are transferred to that atom in which the attacking reagent doesn't get attached.



Note :- (I) : (e)
When ± inductive effect and electromeric effect are opp. to each other that means (i.e) E effect are more dominant.

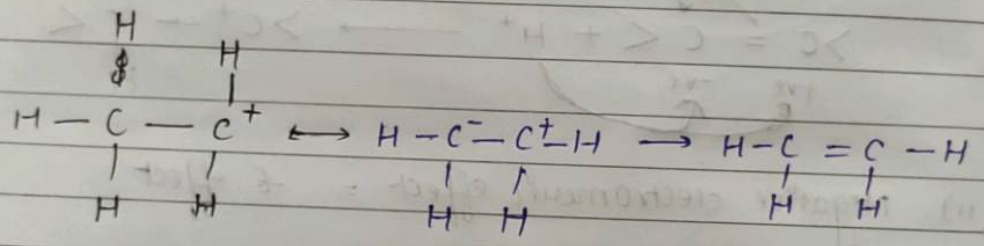
Hyperconjugation.

* It is denoted as the dislocation of σe^- in that direction where +ve charge are attached (carbocation).

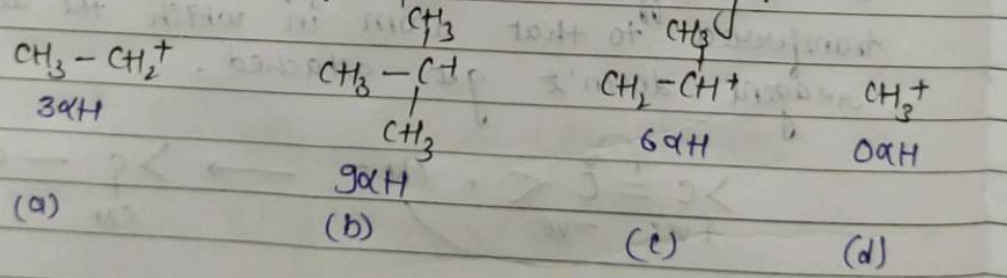
* Conversion of σe^- into πe^-

* Hyperconjugation is a permanent effect.

* Hyperconjugation is directly proportional to the stability of carbocation.



No. of alpha H $\propto$ stability.



(a) $CH_3-CH_2^+$ — 3αH

(b) $CH_3-CH^+(CH_3)$ — 9αH

(c) $CH_2=CH^+$ — 6αH

(d) CH_3^+ — 0αH

(b) > (c) > (a) > (d)