Reactant ⟶ Intermediate ⟶ Product
(want to be stable)

Bond Breaking / Fission :

Homolytic
(if ΔEN is less / zero)

Eg: $Cl-Cl \longrightarrow 2Cl^{\bullet}$
(odd e^- species)
free radical

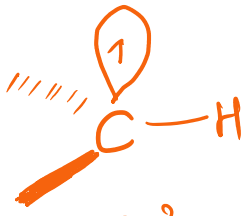
$CH_3-CH_3 \longrightarrow 2CH_3^{\bullet}$

Heterolytic
(if ΔEN is high)

Eg:
$H-Cl \longrightarrow H^+ + Cl^-$

$CH_3-H \longrightarrow \overset{\ominus}{CH_3} + H^{\oplus}$
Carbocanion

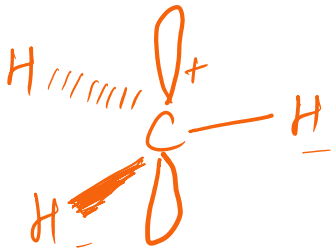
$CH_3-Cl \longrightarrow \overset{\oplus}{CH_3} + Cl^-$
Carbocation



sp^2 - trigonal planar
e^- deficient
paramagnetic
chargeless.

Carbocations : +ve

$1s^2 2s^2 2p^1$



sp^2, trigonal planar
e^- defi
dia, charged.
Electrophile
↳ e^- seeking.

↳ e⁻ seeking.

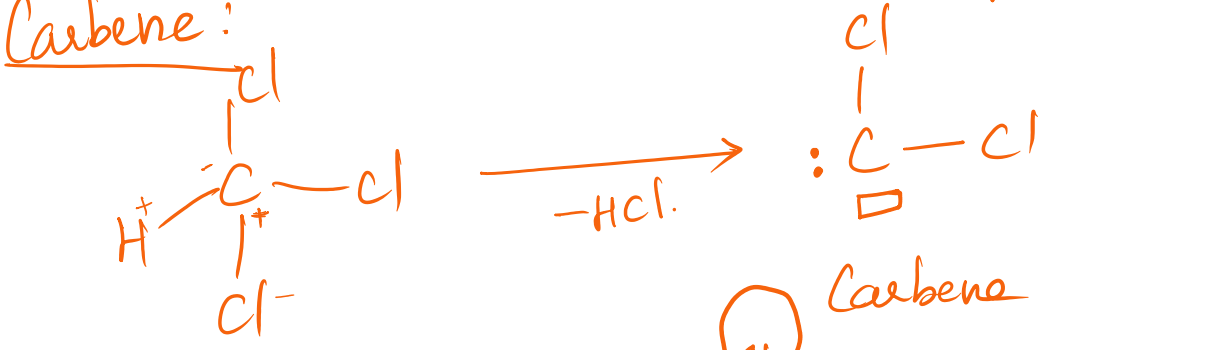
Carbanion: -ve

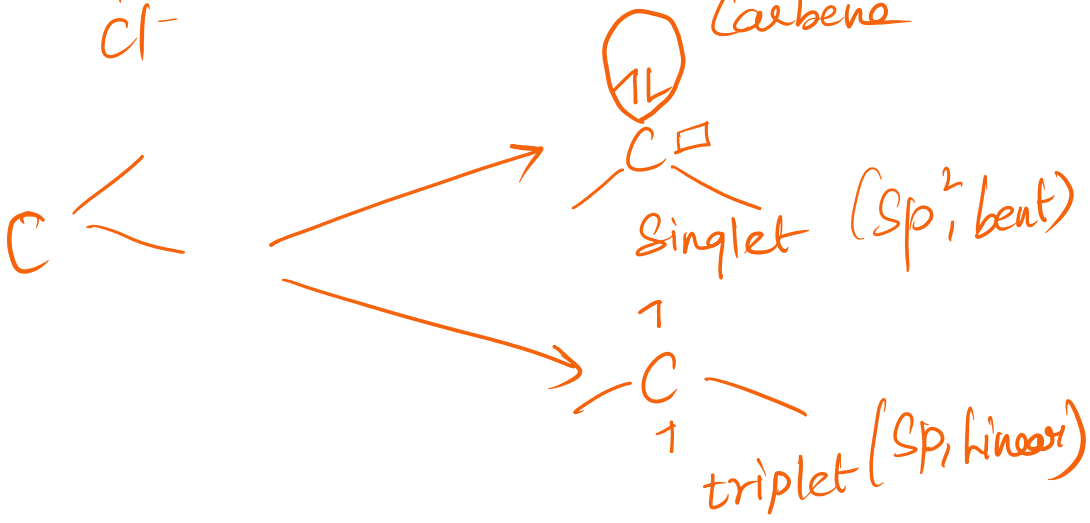
sp^3 – trigonal pyramidal.

e^- rich ⇉ Nucleophile

Diamagnetic

Carbene:





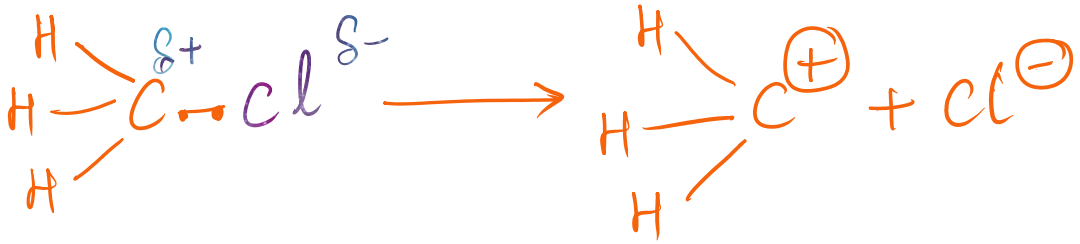
Electronic Effects:

1. Inductive Effect
2. Mesomeric (or) Resonance effect
3. Hyper Conjugation

3. Hyper Conjugation
4. Electromeric effect.

Inductive Effect:

"The permanent displacement of σ e^- along the sat. Carbon chain towards more electronegative atom"

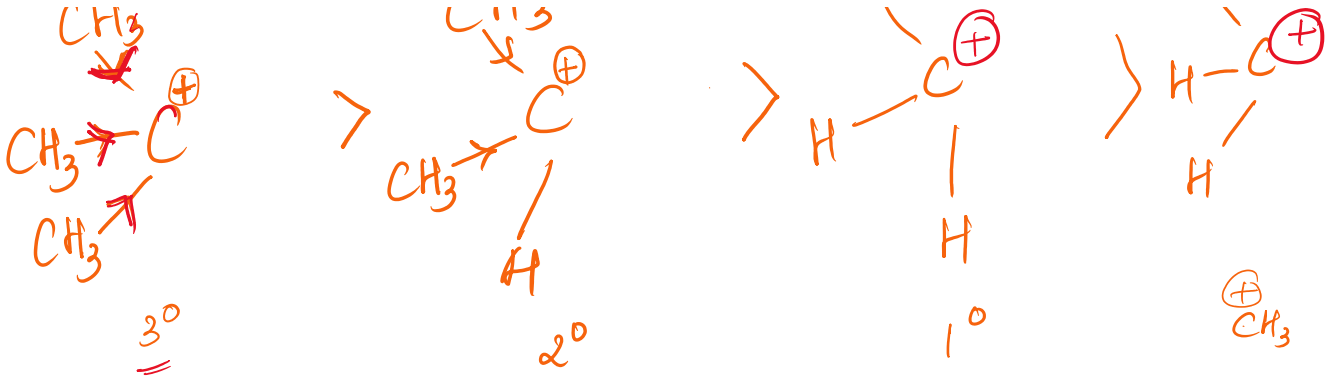


$X = F, Cl, Br, I$

I → +I effect
I → −I effect

+I effect: e^- releasing group (or) repelling grp.

CH_4 [All alkyl groups]



Stability Order.

-I effect: e^- withdrawing grp

Fg: $NO_2 > CN^{\ominus} > -\overset{\overset{O}{\|}}{C} - > F > Cl > Br > I,$

$-OH > O-CH_3 > -C\equiv C, > -C=C-$

$\delta = 50\%$ $\quad$ $\%\,\delta = 33.3\%$

$CH_3-CH_2-\overset{\delta\delta\delta+}{C}H_2-\overset{\delta\delta+}{C}H_2-\overset{\delta+}{C}H_2-X^{\delta-}$

3 Carbon.

> distance dependent effect

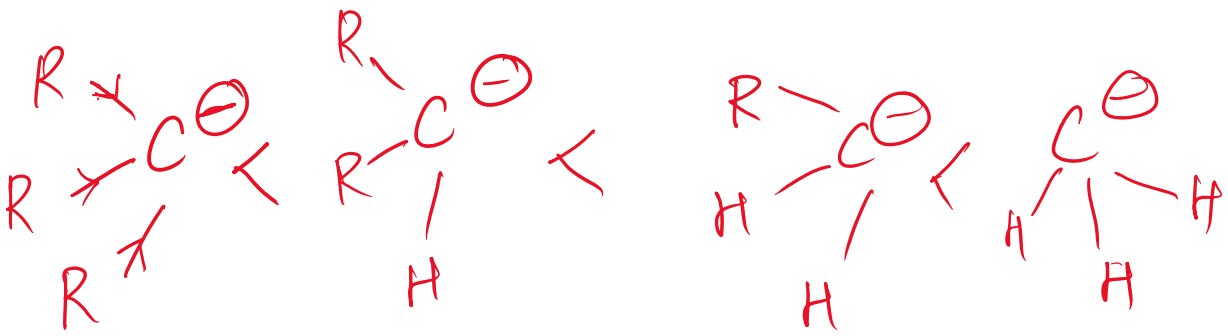
Application:

1) Stability of Carbocation:

$3^{\circ} > 2^{\circ} > 1^{\circ} > \overset{+}{C}H_3$

$3^{\circ} > 2^{\circ} > 1^{\circ} > CH_3^+$

ii) Stability of Carboanion:



Stability Order

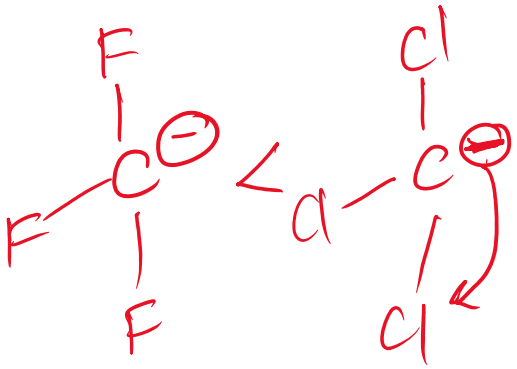
Note:

(i) (ii) (iii)

$F - 1s^2 2s^2 2p^5$

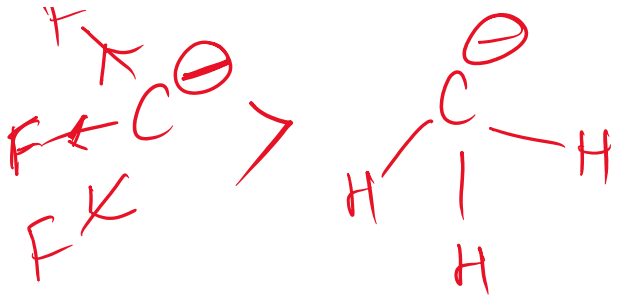
$Cl - 1s^2 2s^2 2p^6 3s^2 3p^5$

Exception:



Vacant-d-orbital

More Stable

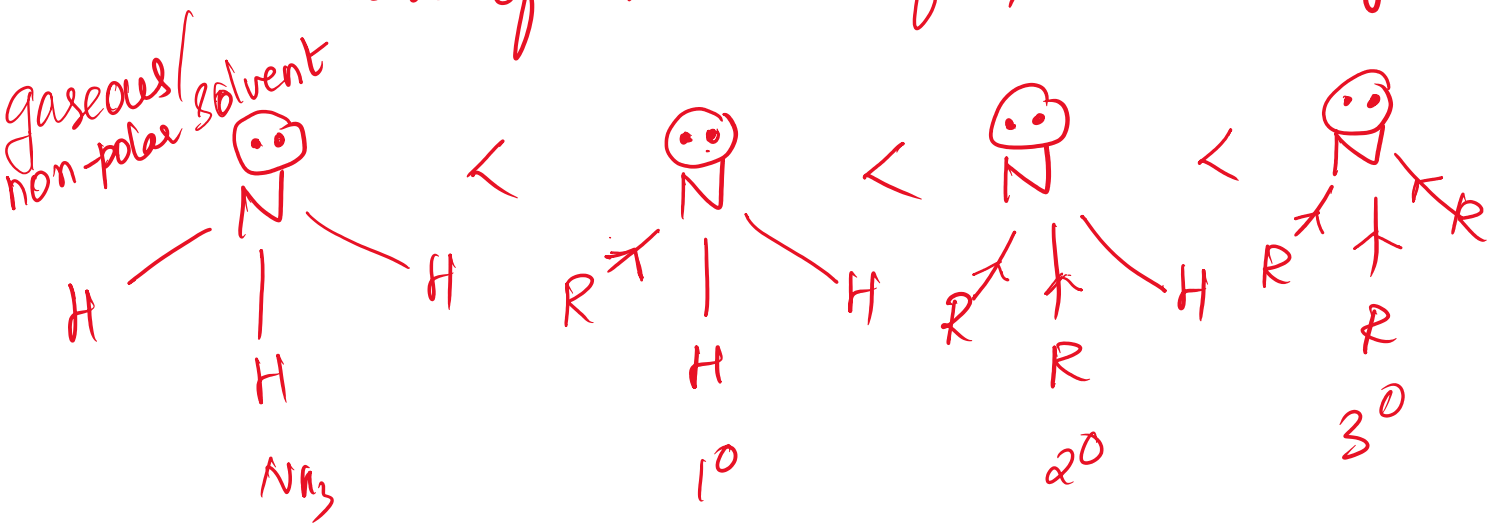


(ii) > (i) > (iii)

ii) Basic strength of Amines: $R-NH_2$

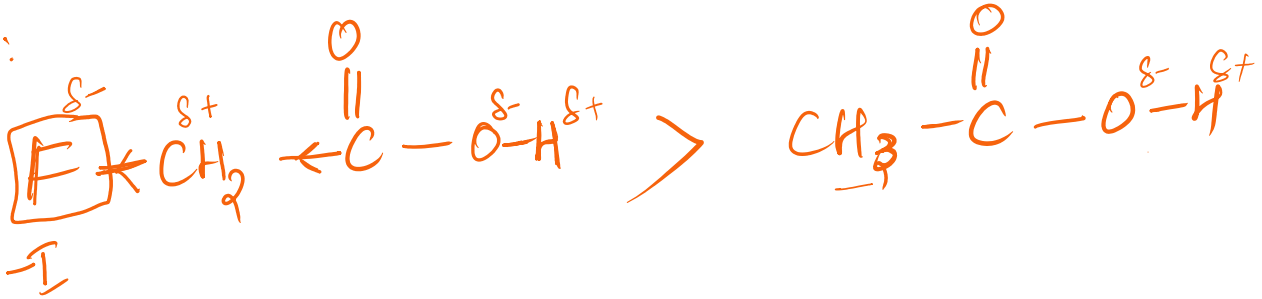
ease of donation of l.p ↑ basicity ↑

gaseous/non-polar solvent

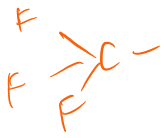


③ Acidity of Carboxylic acid:

Eg:



-I

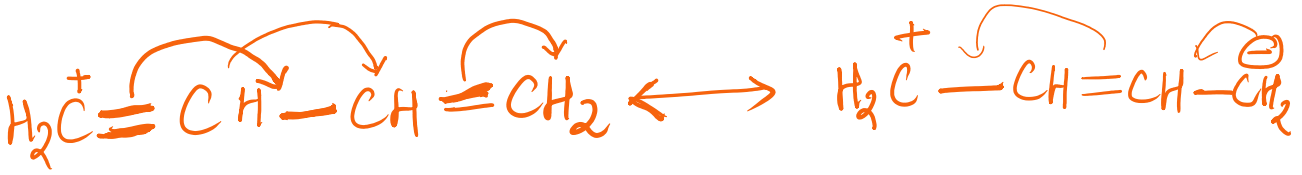


ii) Resonance (or) Mesomeric effect
(R) (M)

"delocalisation of π e^- Conjugated system"

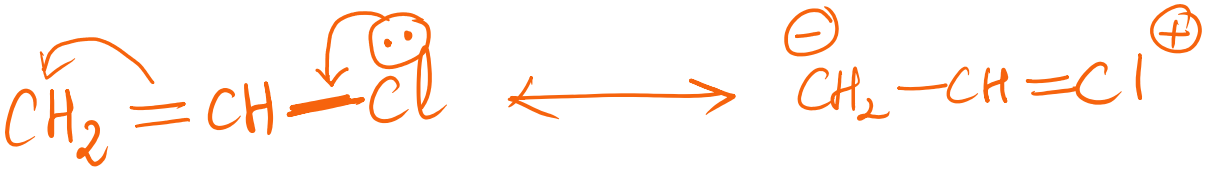
↳ Alternate double bond

Eg:



+M/+R Effect: Electron donating group

O–R, O–H, NH_2, NH–R, :X



Bond length ↓ Bond Strength ↑

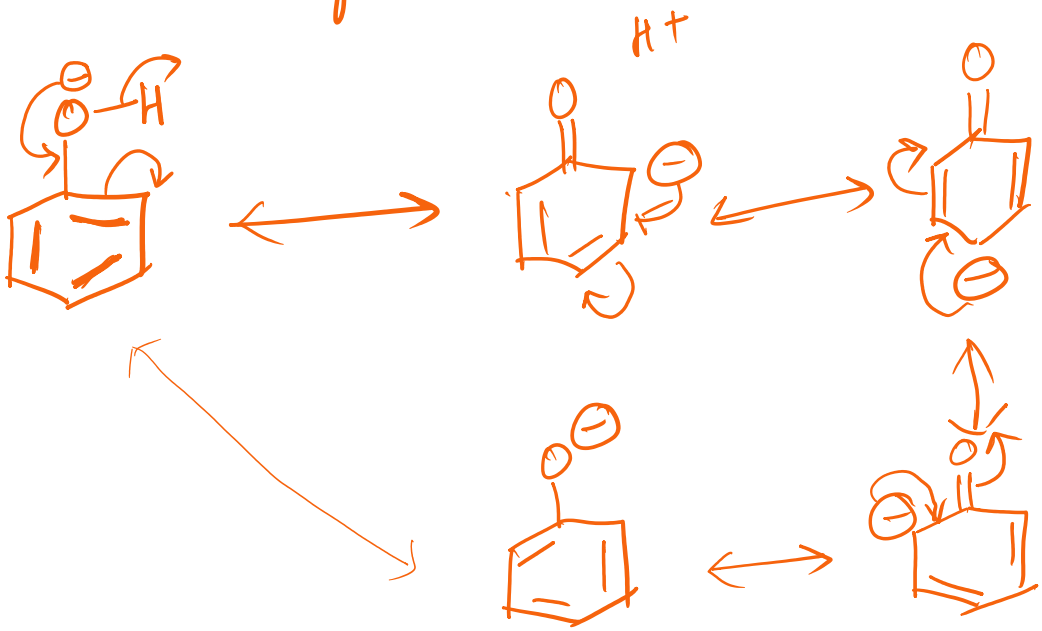
Eg:

a > b

bond length C–Cl

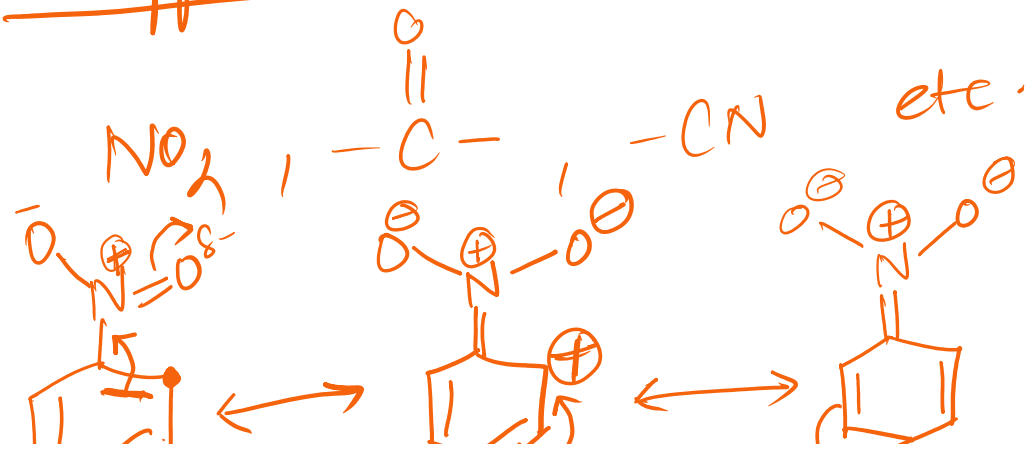
b > a

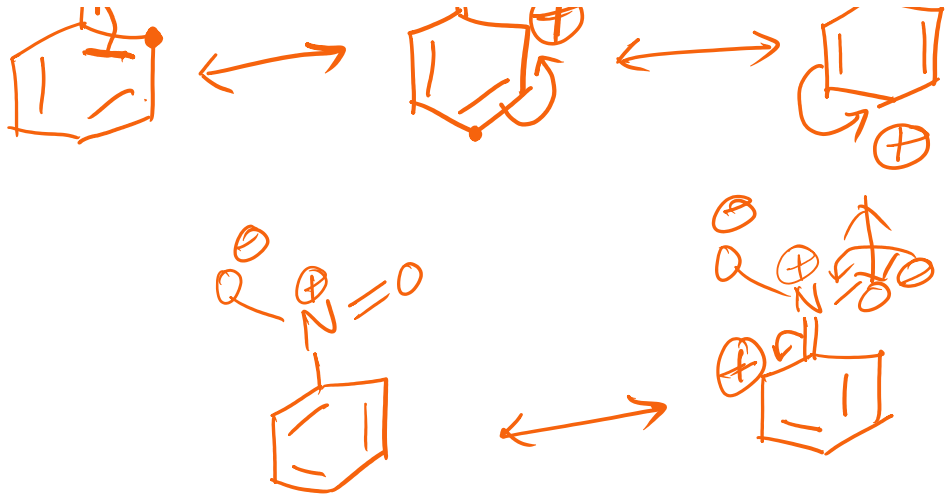
bond strength C–Cl



'O, P' ⇒ e⁻ rich

–M effect: e⁻ withdrawing grp





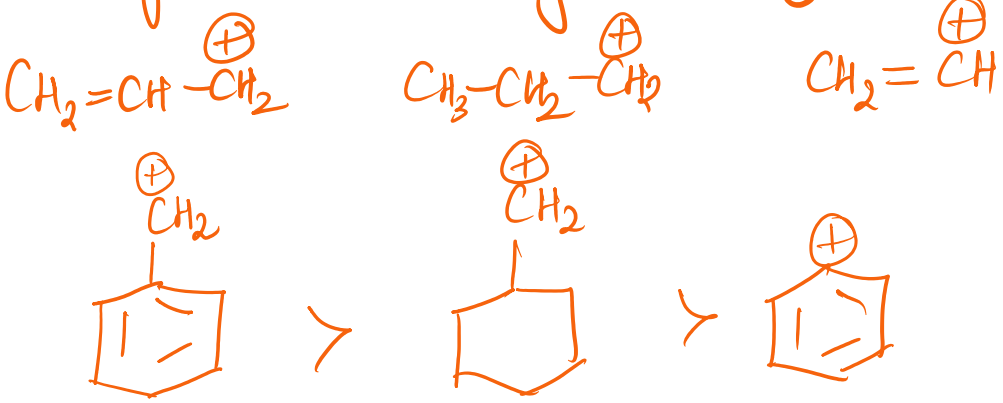
O, P ⇒ e^- deficient

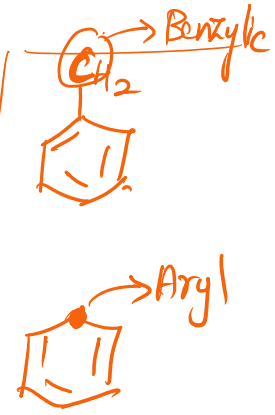
M ⇒ e^- rich.

Application:

1) Stability of Carbocation:

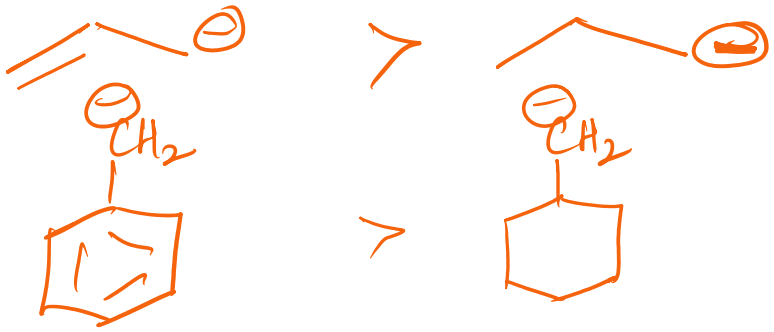
Allylic > Alkyl > Vinyl



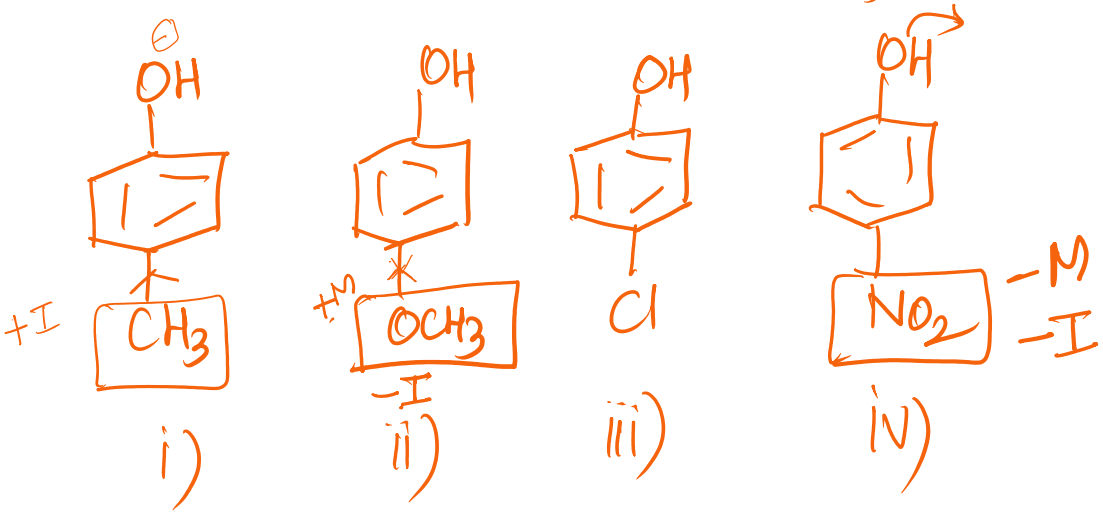


ii) Stability of Carbanion:

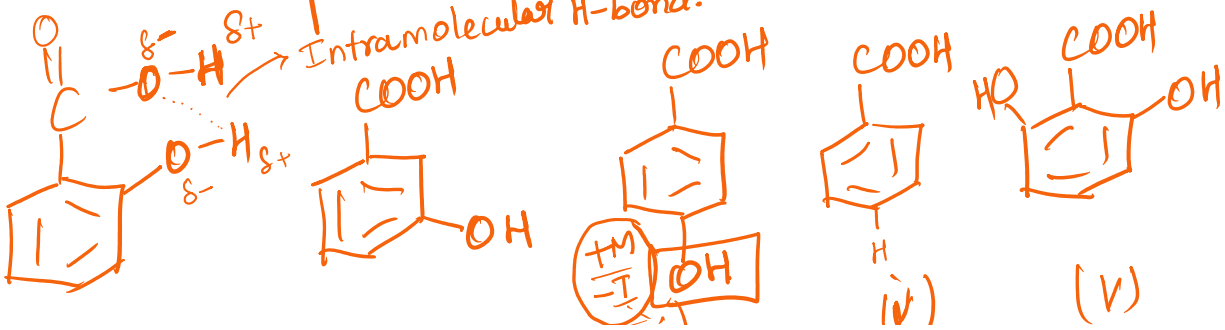
ii) Stability of Carbanion:



↳ Vacant 3d-orbital



Acidic Strength : (iv) > (iii) > (i) > (ii)

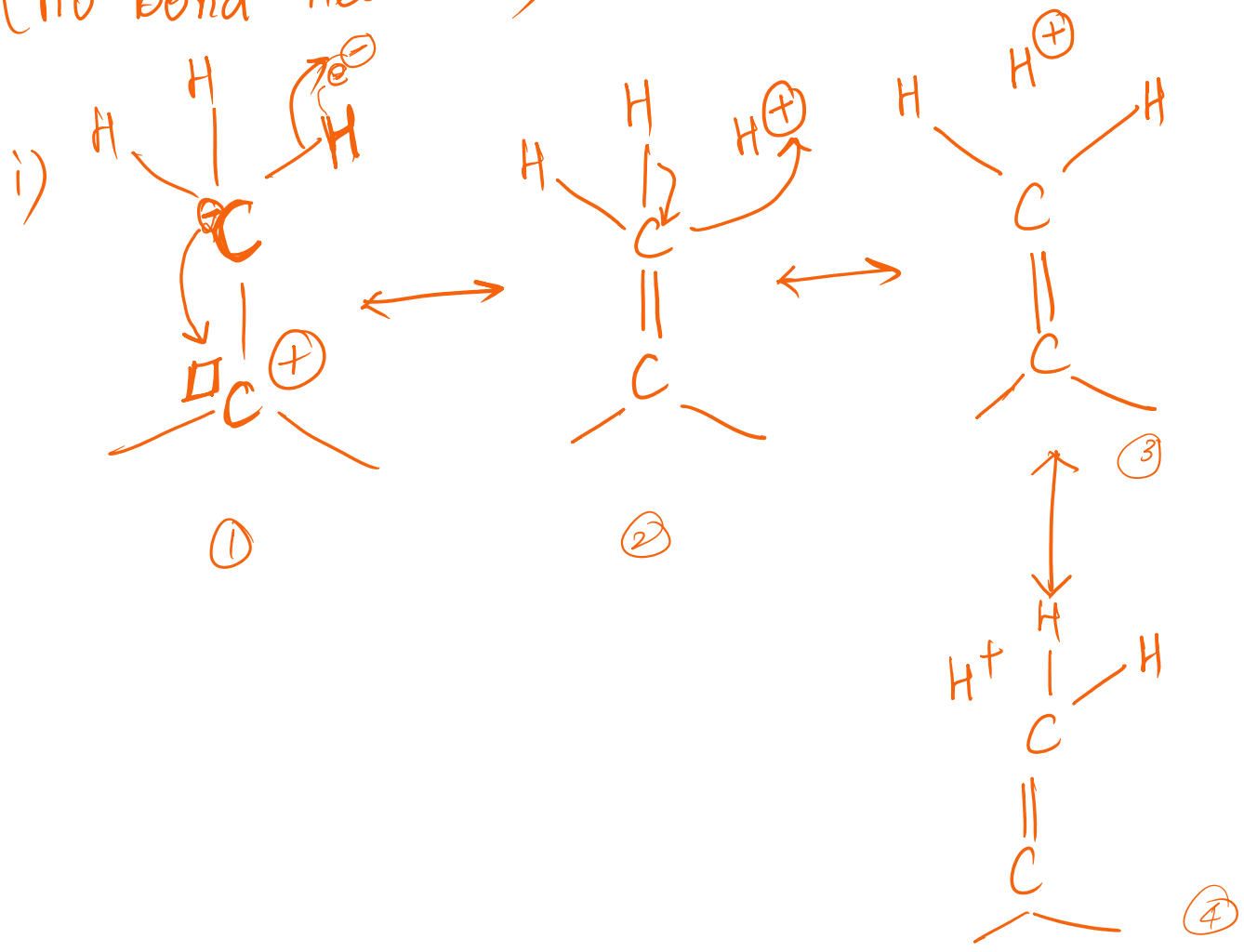


Acidic Strength: (v) > i) > ii) > iv > iii

3) Hyperconjugation: (H) ⇒ Temp.

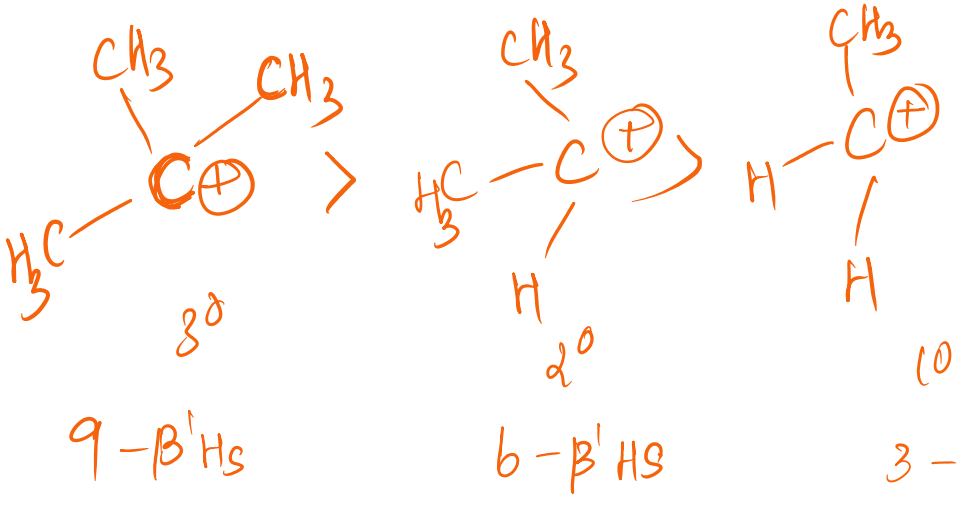
"The delocalisation of σ electrons"

(no bond Resonance)

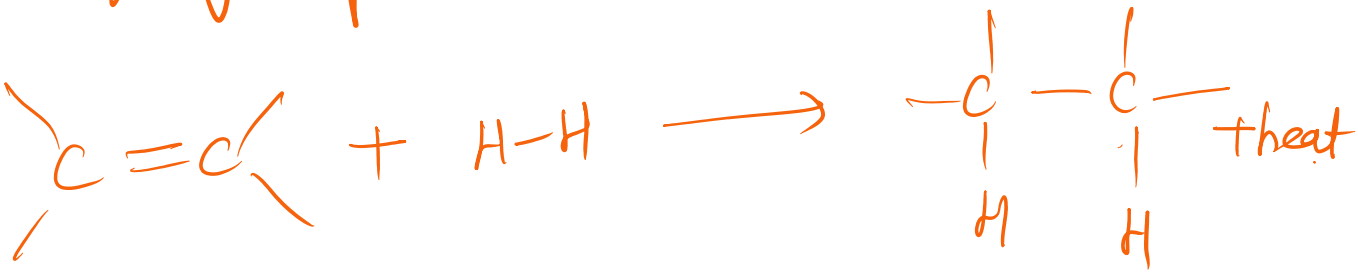


More the no. of hyperconjugative structure more the stability

no. of hyper. structure = no. of β H's + 1

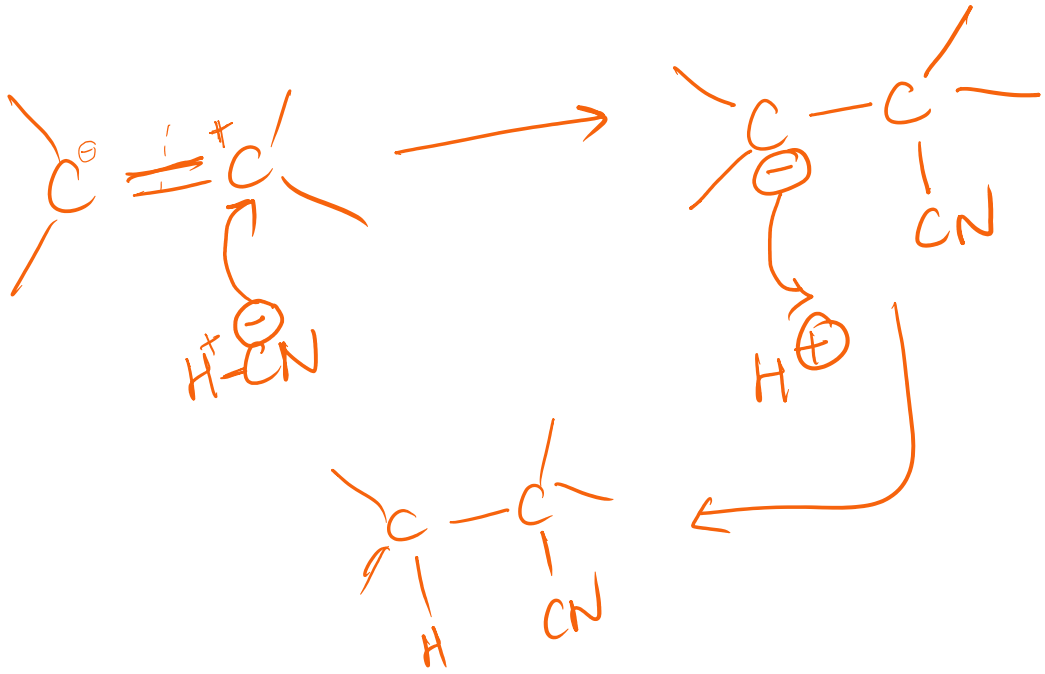


Heat of hydrogenation:



Stability $\propto \frac{1}{\text{Heat of hydrogenation.}}$

(4) Electromeric effect: depend on ~~the~~ attacking species



"The temp displacement of π electrons in the presence of a polar reagent"

Aromaticity:

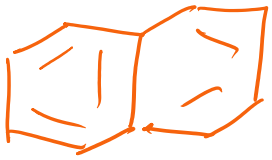
Conditions:

1. Cyclic, planar Structure
2. delocalisation of π electrons (Conjugated System)
3. Huckel's rule: $(4n+2)\pi e^-$

$n = 0, 1, 2, 3 \ldots$ $\quad \pi e^- = 2, 6, 10, 14 \ldots$

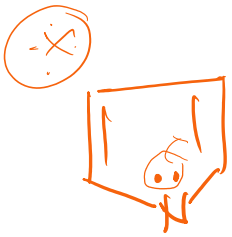
Eg:

Aromatic



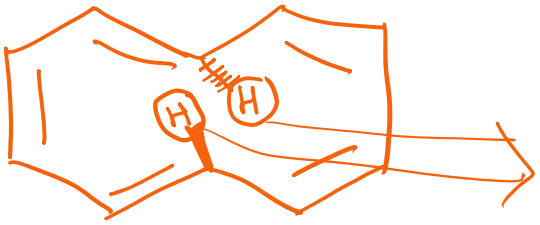
naphthalene

cyclo propenyl cation.



pyrrole

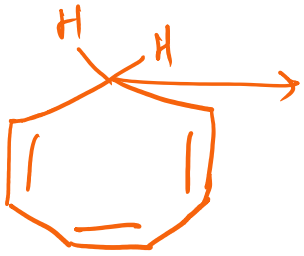
pyridine.



because of H-repulsion.
not in the plane.

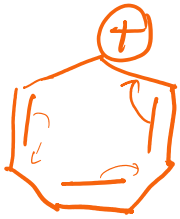
[10] Annulene (non-planar)

Non-Aromatic



sp^3 hybridised.

Non-Aromatic



Tropylium cation.

Cyclo heptatrienyl cation.
Aromatic.

Anti-Aromatic:

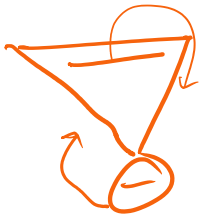
i) Cyclic, planar

ii) Delocali... of πe^-

iii) Huckel rule : $4n\ \pi e^-$

$n = 0, 1, 2...$ $\quad \pi e^- = 4, 8, 12..$

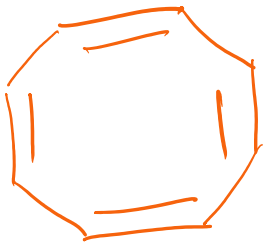
Eg :



Anti-aromatic

Aromatic > Non-aromatic > Anti-aromatic

H.W



Cyclo octatetraene