HYPERCONJUGATION

No Bond Resonance (σ-P)

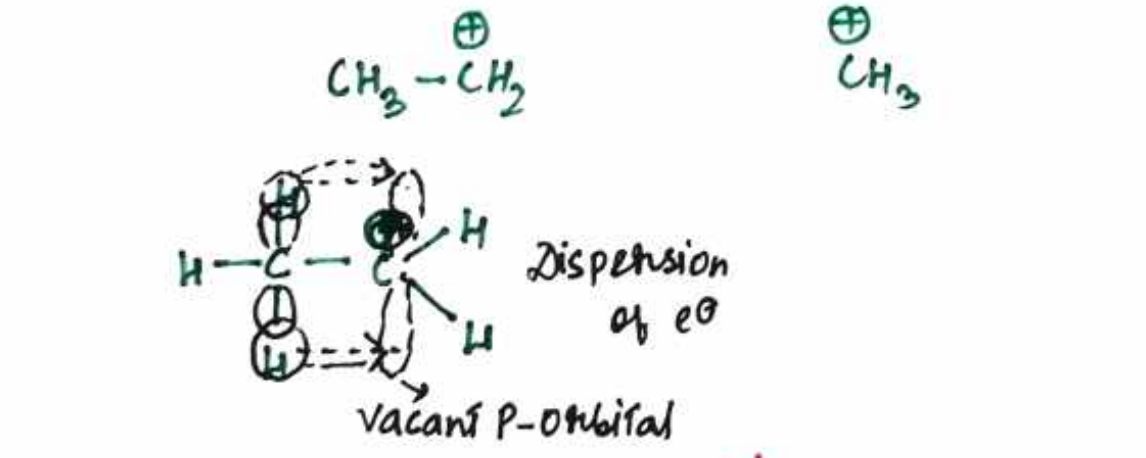
⊛ This effect occurs → Carbocation
Free radical
alkenes.
Carboanion.

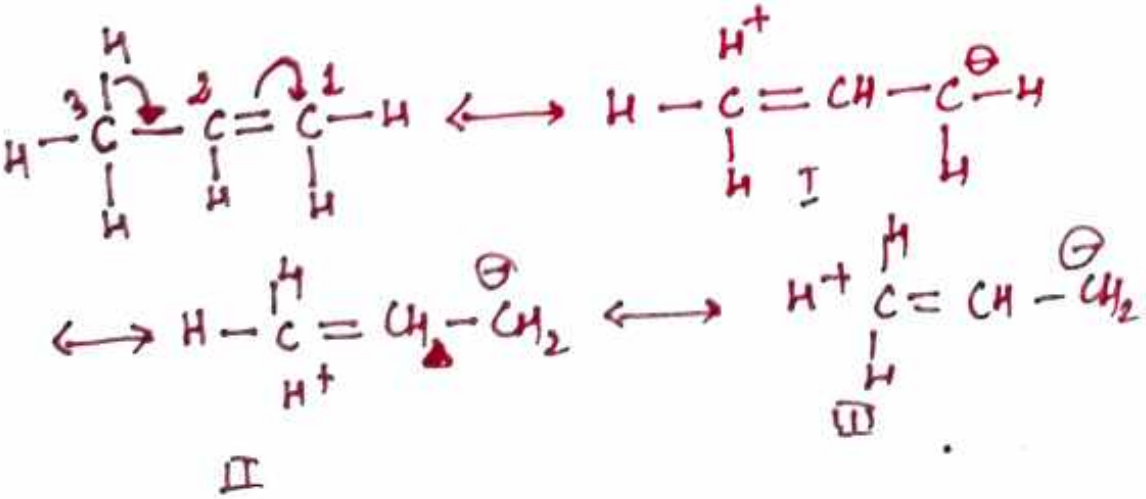
⊛ By applying hyperconjugation, we can determine the more stable compound.

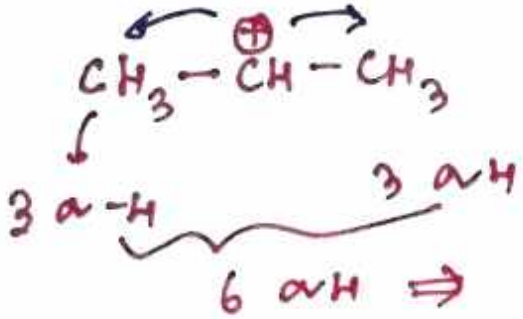
More hyperconjugation → more stability

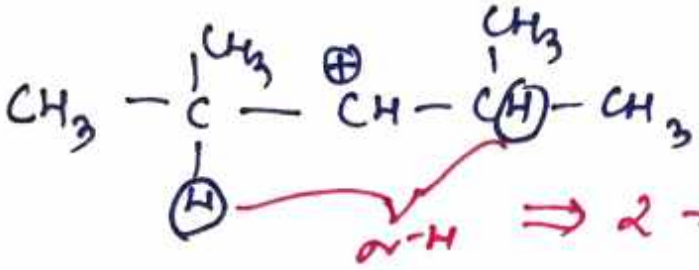
⊛ This is a kind of resonance or delocalisation, which takes place through overlap between a σ-orbital and a p-orbital or a π-orbital.

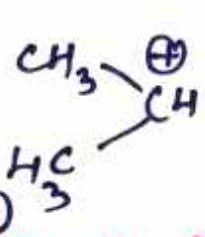
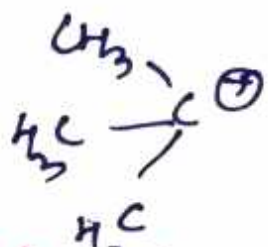
⊛ Hyperconjugation in carbocation :









(*) $CH_3^{\oplus} < CH_3-CH_2^{\oplus} <$  < 

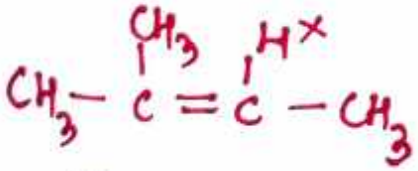
Stability order → more no. of hyperconjugating structures, more stability.

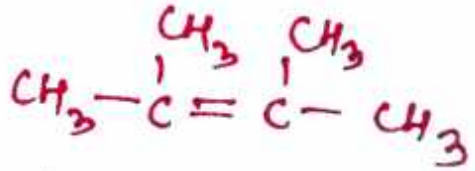
Significance of hyperconjugative effect :-

(a) Stability of alkenes :-

(I) $CH_2=CH_2$ no α-H

(II) $CH_3-CH=CH_2$ 3 α-H

(III)  9 α-H

(IV)  12 α-H

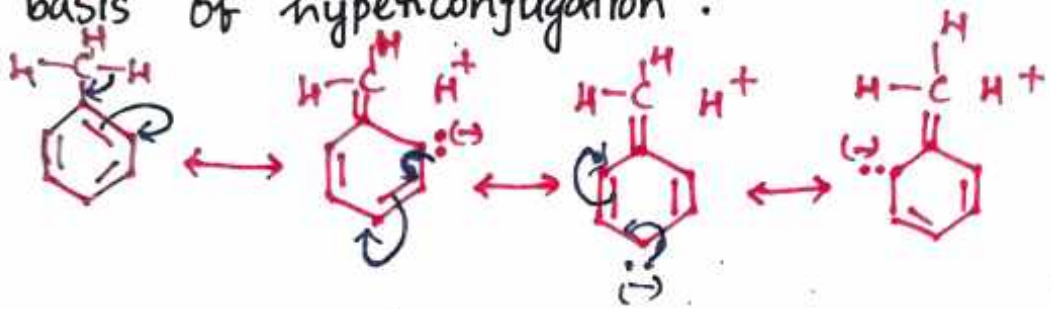
So, stability order –

I < II < III < IV

⊛ Significance of hyperconjugation effect –

⇒ Directive influence of alkyl group :-

CH_3- and other alkyl group exert o- and p- directive in case of electrophilic substitution reactions of Toluene and alkyl benzenes. This can be explained on the basis of hyperconjugation.

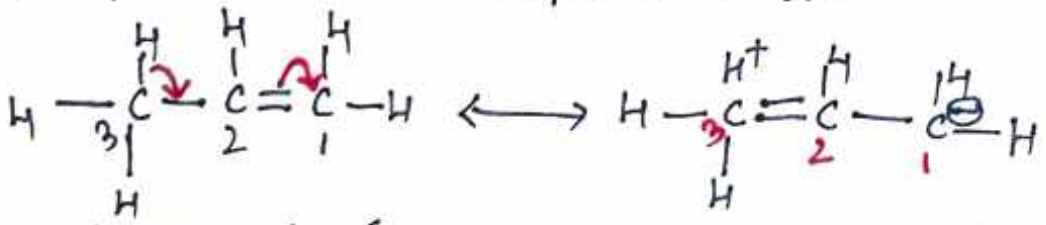


⊛ As a result of hyperconjugation, the electron density at o- and p- positions w.r.to the $-CH_3$ group increases. Therefore, electrophilic substitution happens at o- and p- positions.

⊛ Shortening of C-C single bonds adjacent to multiple bonds

↳ This is due to hyperconjugative effect.

e.g. propene can be represented as –



etc.

Due to hyperconjugation, C_2-C_3 single bond acquires some double bond character and hence is little shorter than single bond.

⊛ Stability of carbocation and free radicals :-

The stability order → Tertiary > secondary > primary

This can be also explained on the basis of hyperconjugation.