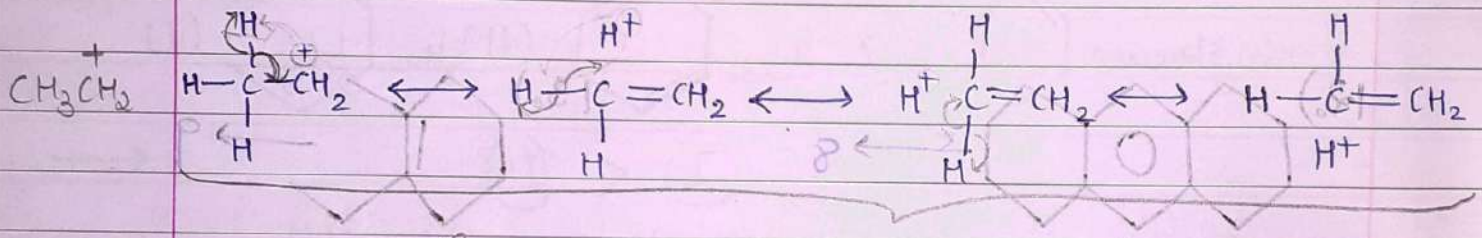
* 3.) Hyperconjugation effect:

- Complete transfer of electrons of C–H 'σ-bond' towards 'π-bond' or 'true charge' or 'free radical', is H-effect. (Permenant effect)
- Also known as 'No bond resonance'.

⟹ Conditions for H-effect:

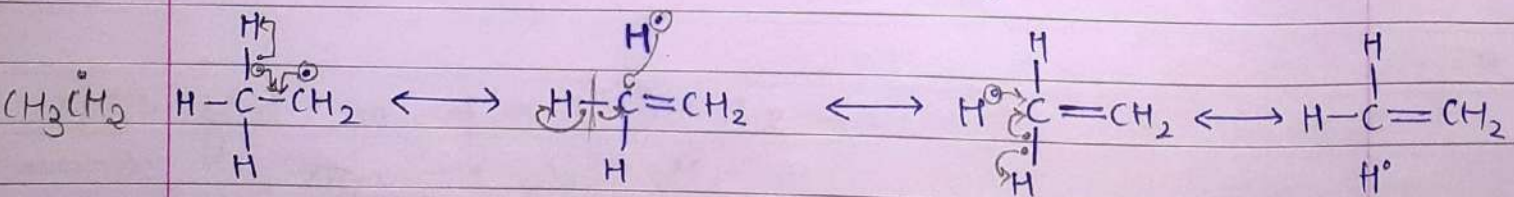
COND:I: If there is 1 C–H 'σ-bond' and 'true charge' at alternate position (in conjugation).



hyperconjugation structure / canonical structures.

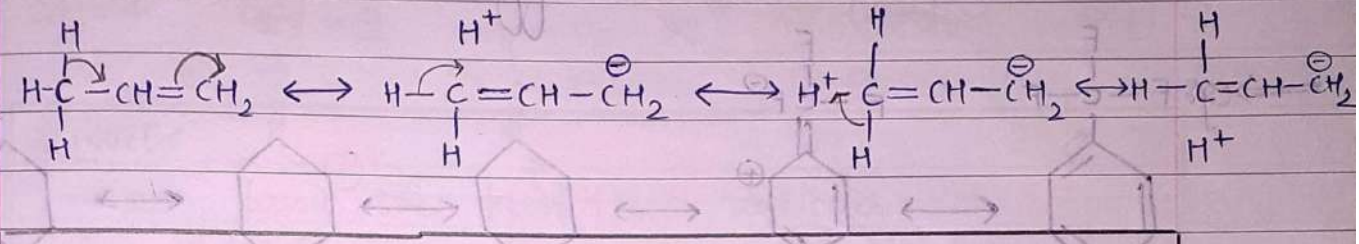
No. of α-H (↑)	H-Effect (↑)	Stability of carbocation (↑)

COND:II: If there is one C–H 'σ-bond' and a 'free radical' at alternate position (in conjugation).



No. of α-H (↑)	H-effect (↑)	Stability of free radical (↑)

CONT:III: If there is one C–H 'σ-bond' and a 'π-bond' at alternate position (in conjugation).



***NOTE:**

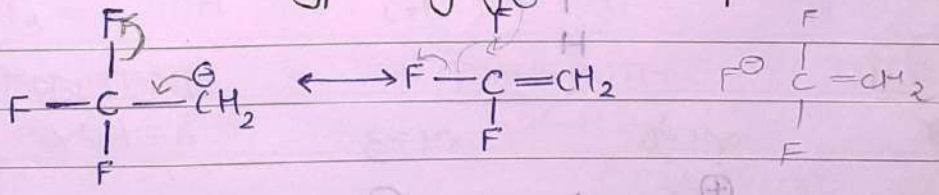
- in hyperconjugation, delocalisation of 'σ-electrons' to an adjacent 'π-bond' takes place.
- in hyperconjugation, overlapping of 'σ' and 'p-orbital' takes place.

Q:16 Why does carbanion show no hyperconjugation?

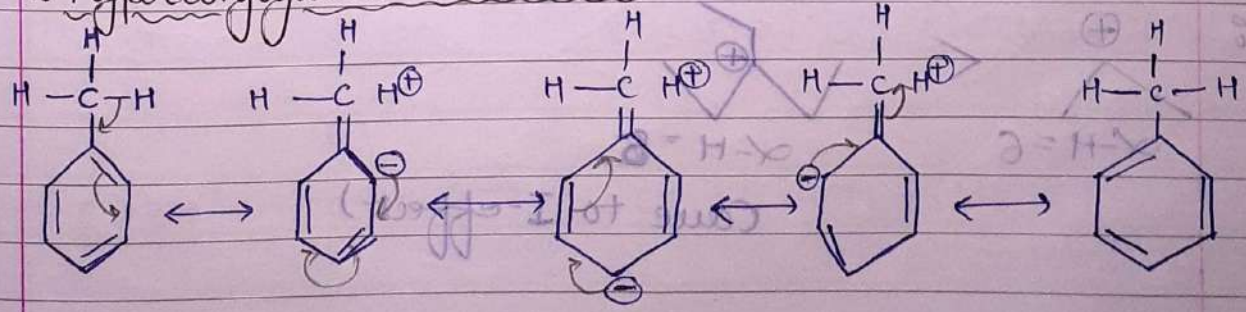
→ carbanion's octate is fully-filled, making no empty orbital for the entry of σ-electron of any C–H bond.

Q:17 $CF_3\overset{\ominus}{C}H_2$ shows hyperconjugation. Explain.

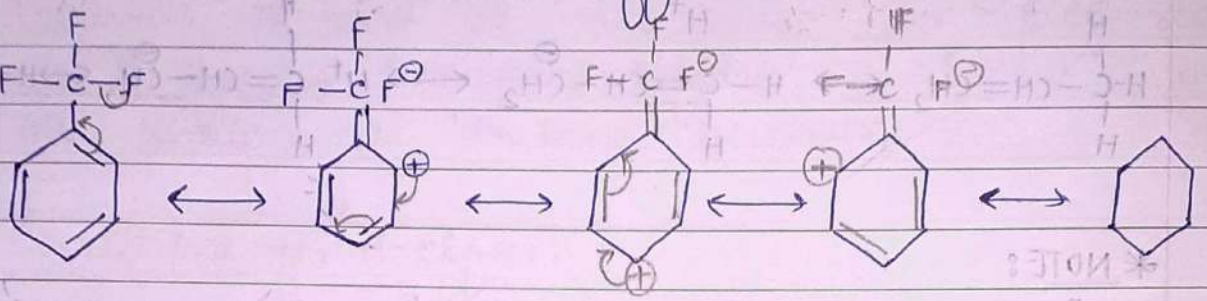
→



***Hyperconjugation in Toluene:**



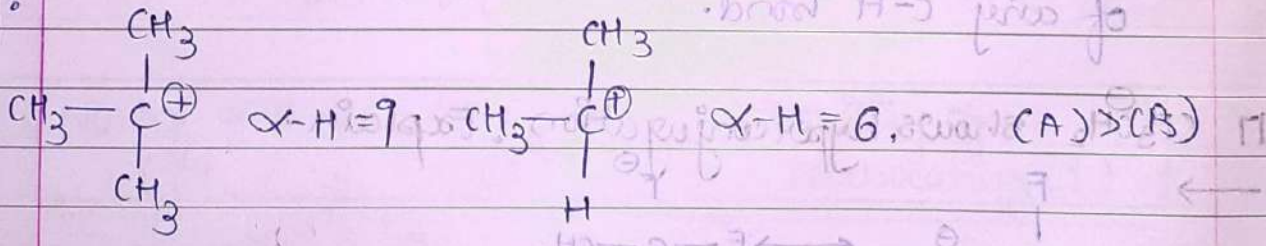
* in Toluene, methyl is ortho-Para directing group (activated group) due to hyperconjugation. (it isn't a mesomeric effect.)

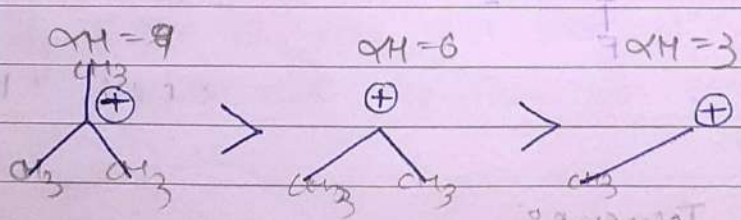
⟹ eg: 

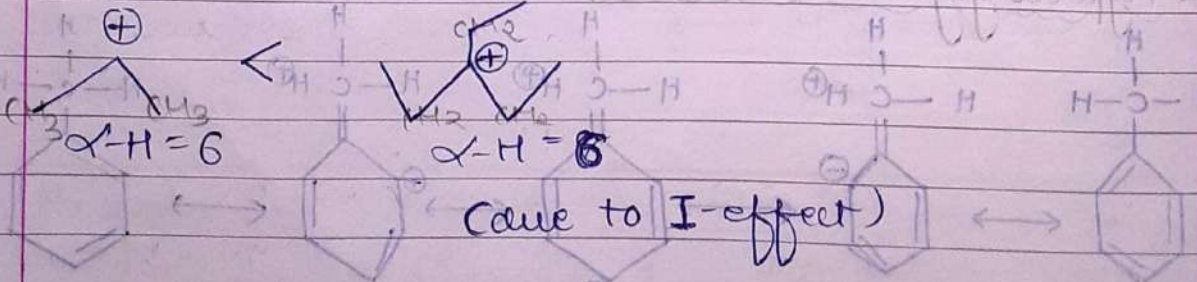
* here, CF_3 group is meta-directing group (deactivated group) due to hyperconjugation.

⟹ Application of H-effect:

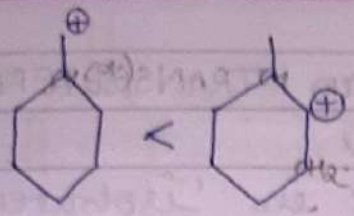
A⟹ Stability of carbocation

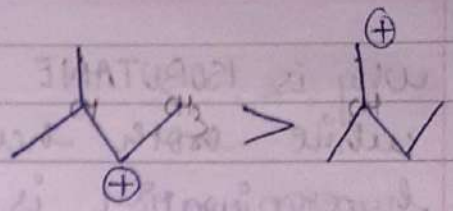
eg: 

eg: 

eg: 

(due to I-effect)

eg:  $\alpha H = 1$ $\alpha H = 3$

eg:  $\alpha H = 4$ $\alpha H = 1$

***NOTE:**

- apply same trick for free-radicals.
- $-CH_3$ $\Rightarrow$ $-CD_3$ (deuterium)

$+I$ effect $> -H$

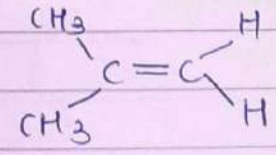
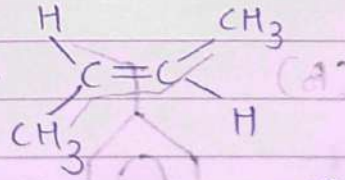
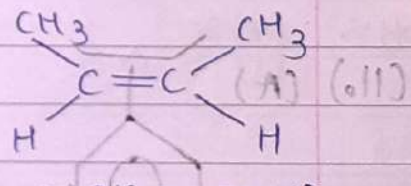
H-eff $= -H > -D$ (for σ bond breakage)

- hyperconjugation is less effective in case of deuterium due to strong binding between C–D unlike C–H.

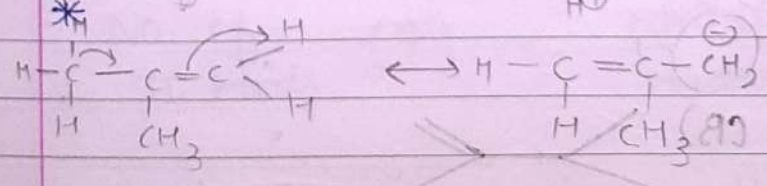
B ⟹ Stability of alkenes:

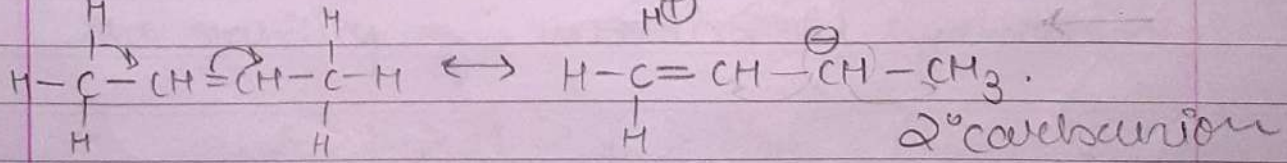
eg: $CH_3-\underset{\alpha}{CH}=CH_2$ (3) α-H = 3 $>$ $CH_2=CH_2$ α-H = 0

repulsion ↑ : stability ↓

eg:  (1) ISOBUTENE α-H = 6 $>$  (2) TRANS BUTENE α-H = 6 $>$  (3) CIS BUTENE. αH = 6.

(cis more repulsive than Trans)

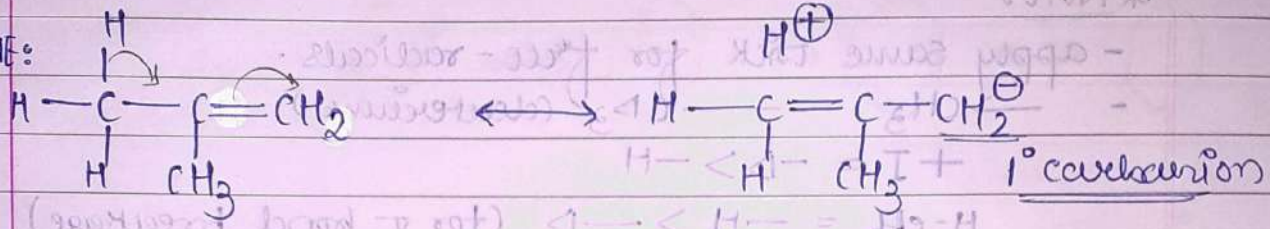
(I) 

(II) 

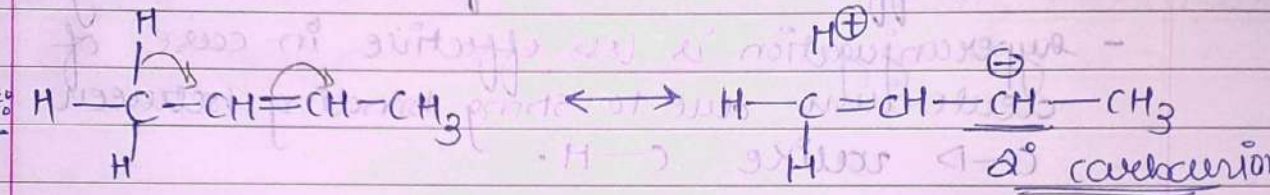
Q:18 Why is ISOBUTANE more stable than TRANSBUTENE while both have 6 α-Hydrogen?

→ hyperconjugation is more effective in 'isobutene' as 1° carbocation (~~is~~ formed during its hyperconju.) is more stable as compared to 2° carbocation.

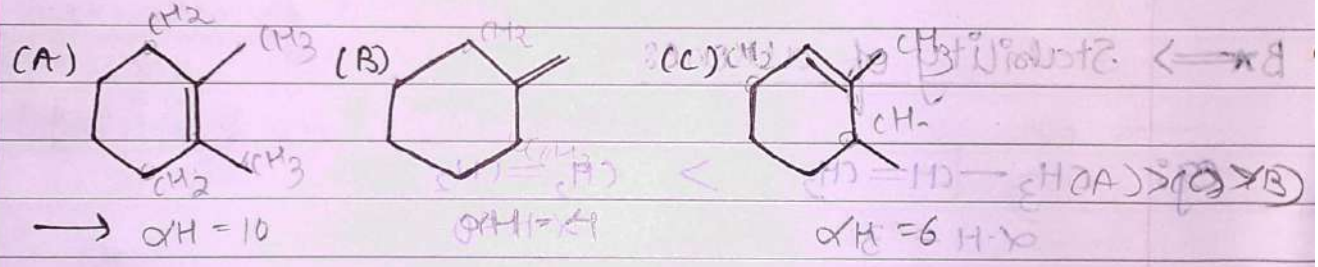
ISOBUTENE:



TRANSBUTE:

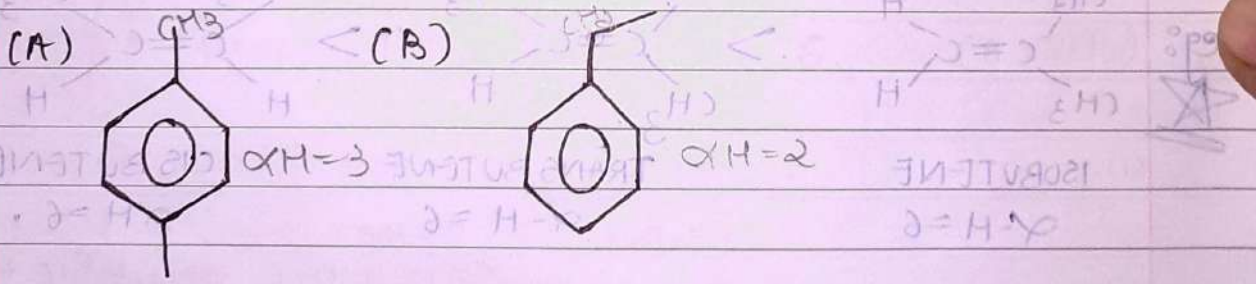


Q:19 (I.)



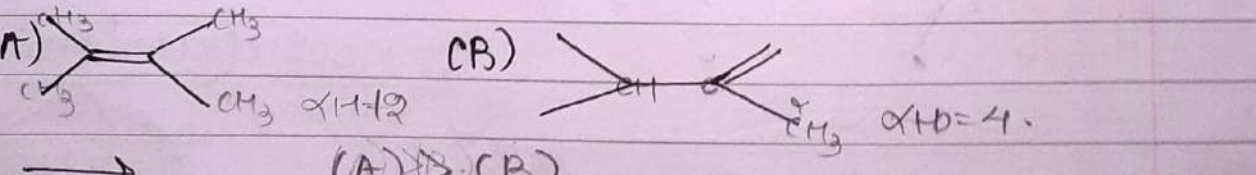
→ αH = 10 αH = 4 αH = 6 (A) > (C) > (B)

(II.)

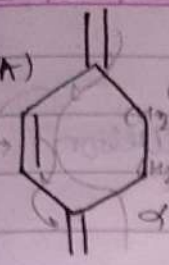


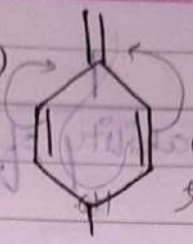
→ αH = 3 αH = 2 (A) > (B)

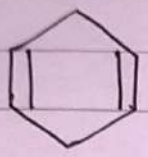
(III.)



→ αH = 12 αH = 4. (A) > (B)

IV.) (A)  equal resonance, $\alpha H = 4$

(B)  cross resonance, $\alpha H = 1$ → (A) > (B)

V.) (A)  (B)  → (B) > (A)

H-effect R-effect

(★) **Heat of hydrogenation order:**

- when one more of any unsaturated hydrocarbon is hydrogenated then some amount of energy is released which is known as heat of hydrogenation (HOH). (exothermic).

eg: $CH_2=CH_2 + H_2 \xrightarrow{Ni/Pt} CH_2-CH_2 + Energy\ (HOH)$

$CH\equiv CH + 2H_2 \xrightarrow{Ni/Pt} CH-CH + Energy\ (HOH)$

- if an alkene is more reactive towards hydrogenation then it will evolve more energy.

- No. of π bonds (↑) Heat of Hydrogenation (↑) αH (↓) Stability (↓)

- when numbers of 'π-bond' is equal then compare the stability of unsaturated hydrocarbon.

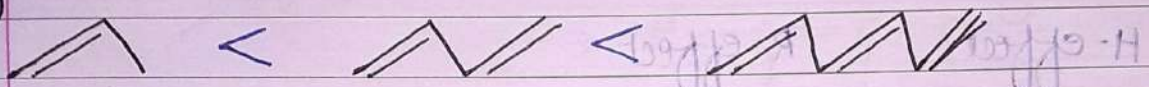
A > R > H > I > AA.

aromatic resonance HOH inductivity anti-aromatic

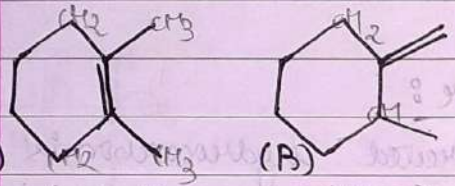
$$HOH \propto \frac{1}{\text{Stability of resact. H-caveleon.}}$$

Q&20 compare HOH:

(I.)



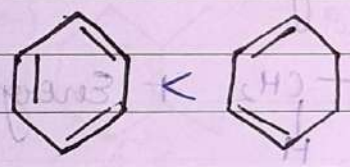
(II.)



(A) α-H = 10 (B) α-H = 3 (C) α-H = 6

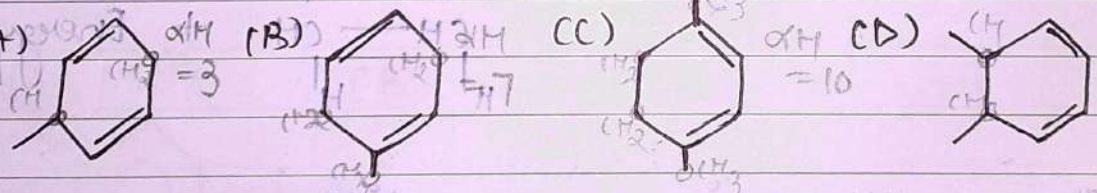
$\Longrightarrow$ (B) > (C) > (A)

(III.)



b'coz. Benzene being an aromatic compound with high stability.

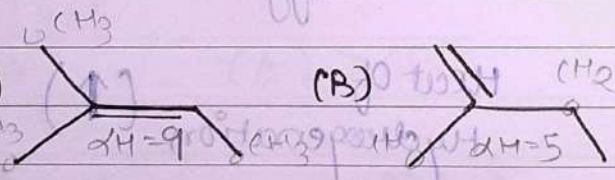
(IV.) αH ↑ HOH ↓



(A) αH = 3 (B) αH = 7 (C) αH = 10 (D) αH = 2.

$\longrightarrow$ D > A > B > C

(V.)

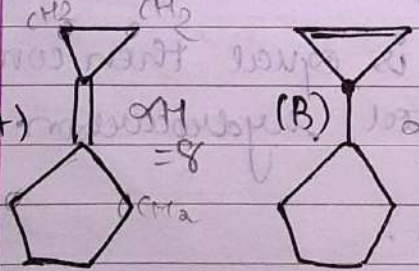


(A) αH = 9 (B) αH = 5

$\Longrightarrow$ A < B

Bond JT

(VI.)



(A) αH = 8 (B) αH = 1

$\Longrightarrow$ B > A

AA < I < H < R < A