Hyperconjugation

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Hyperconjugation

• The hyper conjugation is a modification of resonance (mesomeric) effect. It is a permanent effect observed even at ground state of the molecule and it influences the physical and chemical properties of the molecule.

• The resonance / mesomeric effect involves:

  Delocalization of ‘\(\Pi\)' and non-bonding electrons. whereas hyperconjugation involves delocalization of ‘\(\Sigma\)' electrons.
We have already seen that the alkyl groups are electron donating groups. and the magnitude of inductive effect is in the following order.
• But if the alkyl groups are attached to a C=C bond, the order is found to be exactly opposite. This change in behavior is explained by hyperconjugation. The delocalisation of Sigma electrons of Ca-H bond takes place as shown in fig. 1.6.

• The H atom from C does not become completely free or it does not change its place. It remains in the close vicinity of the carbon to which it was attached.
Here we have shown hyper conjugation of only one of the Ca-H. Similar to this other two hydrogens can show hyper conjugation.

As we go on in the series methyl, ethyl, isopropyl, t-butyl, the number of hydrogens go on decreasing. Therefore for methyl group (CH3-) we can write maximum number of hyper conjugative structures and none for t-butyl group. It is for this reason the electron donating effect is reversed as mentioned above.
• Thus, hyperconjugation is electron donating resonance effect but involving a electrons of Ca-H bond. The hyperconjugation effects also accounts for greater thermodynamic stability of more substituted alkene than, which contain a terminal double bond.
In structure I there are nine (1-H atoms and hence nine hyper conjugative structures are possible; while in structure II there are only five (1-H atoms and hence only five hyper conjugative structures are possible. More the number of hyper conjugative structures more is the stability for alkene.
Thank You