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**Electronic displacements
Part-2**

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Learning outcome

After studying this lecture, you shall be able to:

- ❖ Explain different types of electronic displacements in covalent bonds: inductive effects, resonance, hyperconjugation, and electromeric effects
- ❖ Discuss how these effects influence molecular stability and chemical reactivity.

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Introduction to Electronic Displacements in Covalent Bonds

- An electronic displacement occurs when electrons move toward one side or part of a molecule. Electronic displacements are often responsible for the chemical reactivity of some molecules and the relative inertness of others.

There are four different types of electronic displacements to consider:

- Inductive effect
- Mesomeric effect
- Hyperconjugation
- Electromeric effect

❖ ELECTROMETRIC EFFECT

- It is a **temporary effect** which occurs in the presence of attacking reagent.
- On removing the attacking reagent π electrons revert back to the original state.
- When a double or a triple bond is attacked by an electrophilic reagent then bonding electrons is completely transferred from one atom to the other. The atom that takes charge of the electron pair becomes negatively charged and the other becomes positively charged.
- It can be given as—



Thus, “The effect which causes to temporary polarization in the substrate molecule by shift an electron pair from one atom to the other under the influence of an attacking reagent is called electrometric effect.”

TYPES OF ELECTROMETRIC EFFECT

It is of two types

(a) +E EFFECT

When the complete transfer of π electron pair takes place away from the atom or group in presence of attacking reagent. For example:



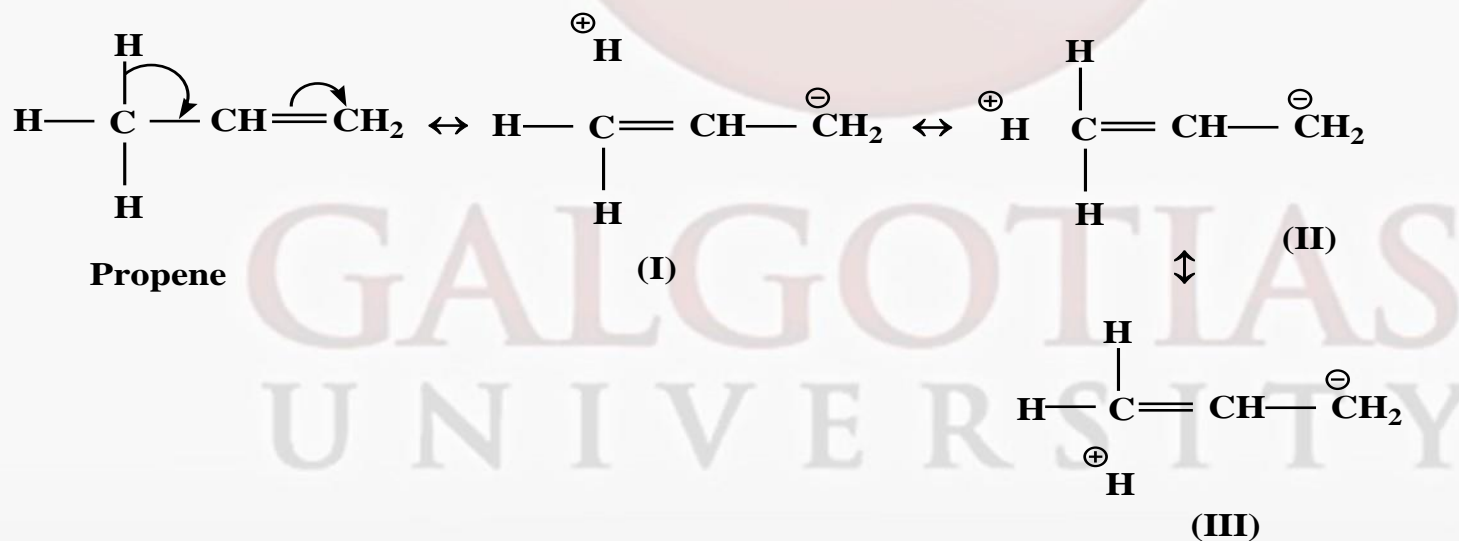
(b) -E EFFECT

When the complete transfer of π electron pair takes place towards the atom or group in presence of attacking reagent. For example:



❖ **HYPER CONJUGATION OR BAKER-NATHAN EFFECT OR NO-BOND RESONANCE**

- “Hyperconjugation involves the delocalization of sigma (σ) electrons through overlapping of p orbitals of a double bond with σ orbital of the adjacent single bond.”
- This effect is observed, when an unsaturated carbon atom is attached with the alkyl group having at least one α -H atom.



It releases electrons of carbon-hydrogen single bond (C–H) towards the multiple bond in the following manner–

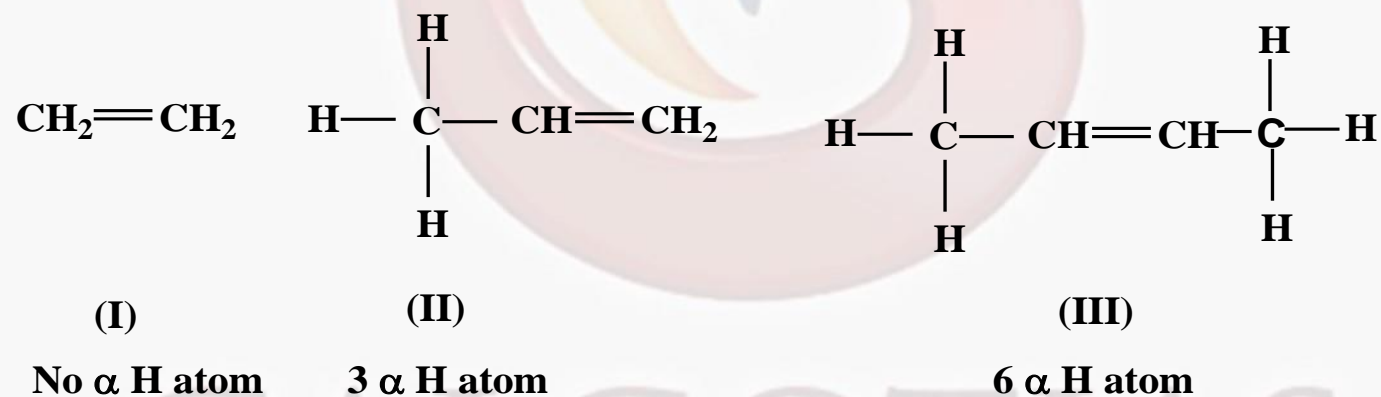
- (i) The hyper conjugation effect is similar to resonance effect. Since there is no bond between the α -carbon atom and one of the H-atom. So the hyper conjugation is also called no-bond resonance.
- (ii) The H^+ ions are not free to move, since they are still bound quite firmly to the π electron cloud.
- (iii) The hyperconjugation occurs through α -H atom present on α -carbon atom i.e. carbon atom adjacent to the double bond.
- (iv) The higher the number of α -H atoms, the higher is the hyperconjugation effect. Then the order of hyper conjugation will be.



APPLICATIONS OF HYPER CONJUGATION

(a) STABILITY OF ALKENES

Larger the number of α -hydrogen's in an alkene, more is the number of hyper conjugative structures and greater is the stability. Then the order of stability of alkene is as follows—



In this example alkene I has No α -hydrogen, alkene II has 3 α -hydrogen & alkene III has 6 α -hydrogen therefore there will be larger hyper conjugation is alkene III and will be more stable than alkene II & I. The order of stability of alkene is—



(a) **STABILITY OF CARBOCATION AND FREE RADICALS**

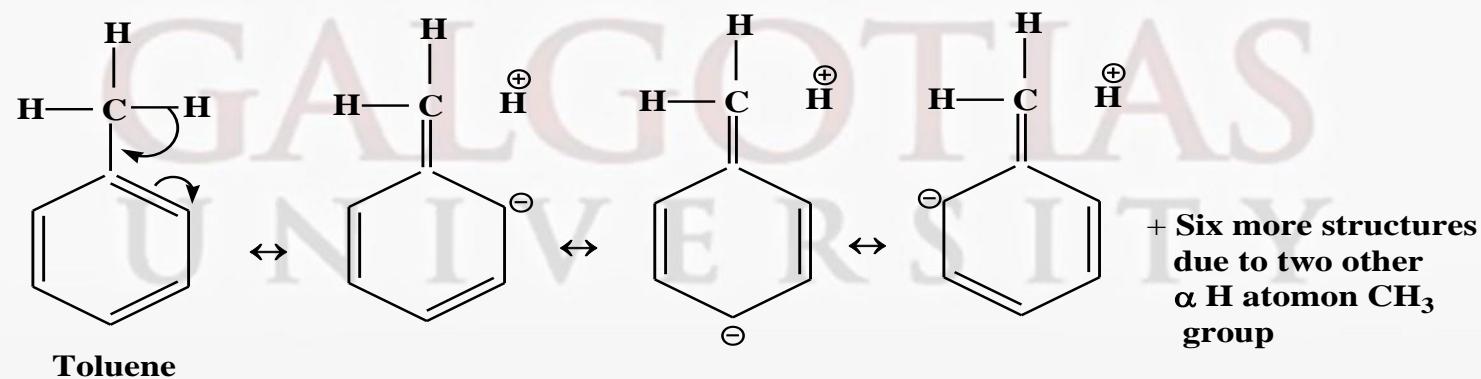
The stability of carbocations & free radicals follows this order–

Tertiary > Secondary > Primary alkyl > Methyl

This order of stability can be explained on the basis of hyper conjugation more the number of hyper conjugative structure of species, higher is the stability.

(b) **DIRECTIVE INFLUENCE OF ALKYL GROUP**

The aromatic alkyl benzenes can be explained by hyper conjugation for e.g. Toluene can be represented by all ten structures in which electrons density is maximum at either ortho or para positions. Hence methyl (or any alkyl) group is ortho and para - directing in electrophilic substitution reactions in aromatic alkyl benzenes.



References

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School of Basic and Applied Sciences

Course Code : BSCC2001

Course Name: Organic Chemistry I

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Thank You

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