DR. MADHUKARRAO WASNIK P.W.S. COLLEGE OF ARTS, COMMERCE & SCIENCE, NAGPUR

Subject : Chemistry

Class : B.Sc. 1st Year Semester II

Paper II : Organic Chemistry

Unit I: Structure and Bonding

TOPIC : Types of effect

Inductive effect

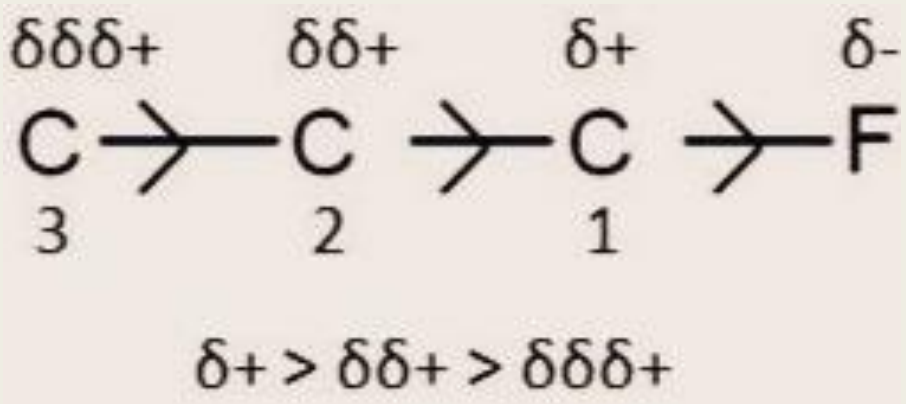
- The displacement of share to electron pair (Sigma bounded) along with chain in the molecule is called as inductive effect.
- **Properties of inductive effect:**

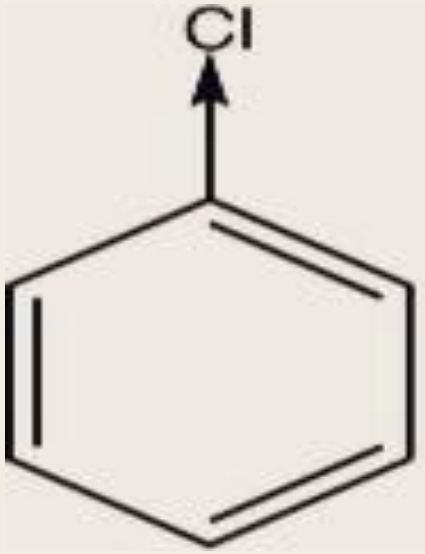
1 This effect goes on decreasing when we move in chain away from the electronegative atom.

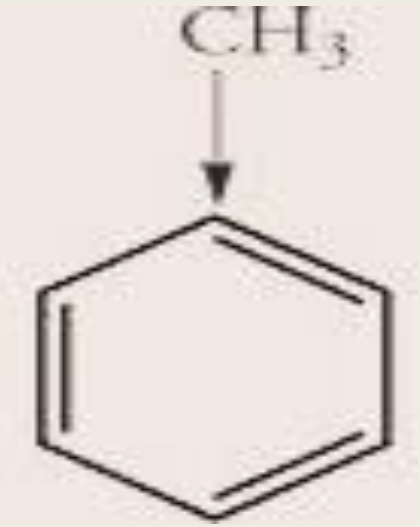
2 This effect is of permanent nature.

3 If an atom or a group attach to C-atom **attracts** the shared electron paired **towards itself** then the effect is to be **negative** or **–I effect**.

4 if an atom or group attach to C-atom **repel** the shared electron paired **away from it** then the inductive effect to be **positive** or **+I effect**.

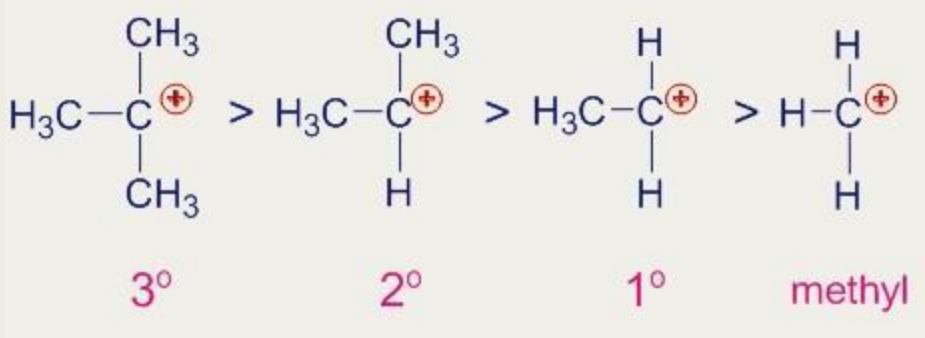






- **Applications of inductive effect :**

1. **Reactivity of alky halide:** with increasing +I effect in alkyl group of alkyl halide it make the molecule more reactive.



2. **Acidic strength of –COOH:** if –COOH group can loose H^+ easily then it is acidic in nature. With increasing +I group in carboxylic acid it's acidic strength also decreases.

$$CH_3COOH<HCOOH<Cl_3COOH$$

1. **Basic nature of amines:** Amines are basic in nature due to availability of loan payers of electrons on nitrogen atom. Due to +I effect the nitrogen Centre becomes rich in electron density and so its becomes more and more basic in nature.

$$NH_3<CH_3NH_2<(CH_3)_2NH<(CH_3)_3N$$

Electromeric effect

- The complete transfer of a electron payer towards one of the bonded items during the course of reaction is called as electromeric effect.
- **Properties of electromeric effect:**

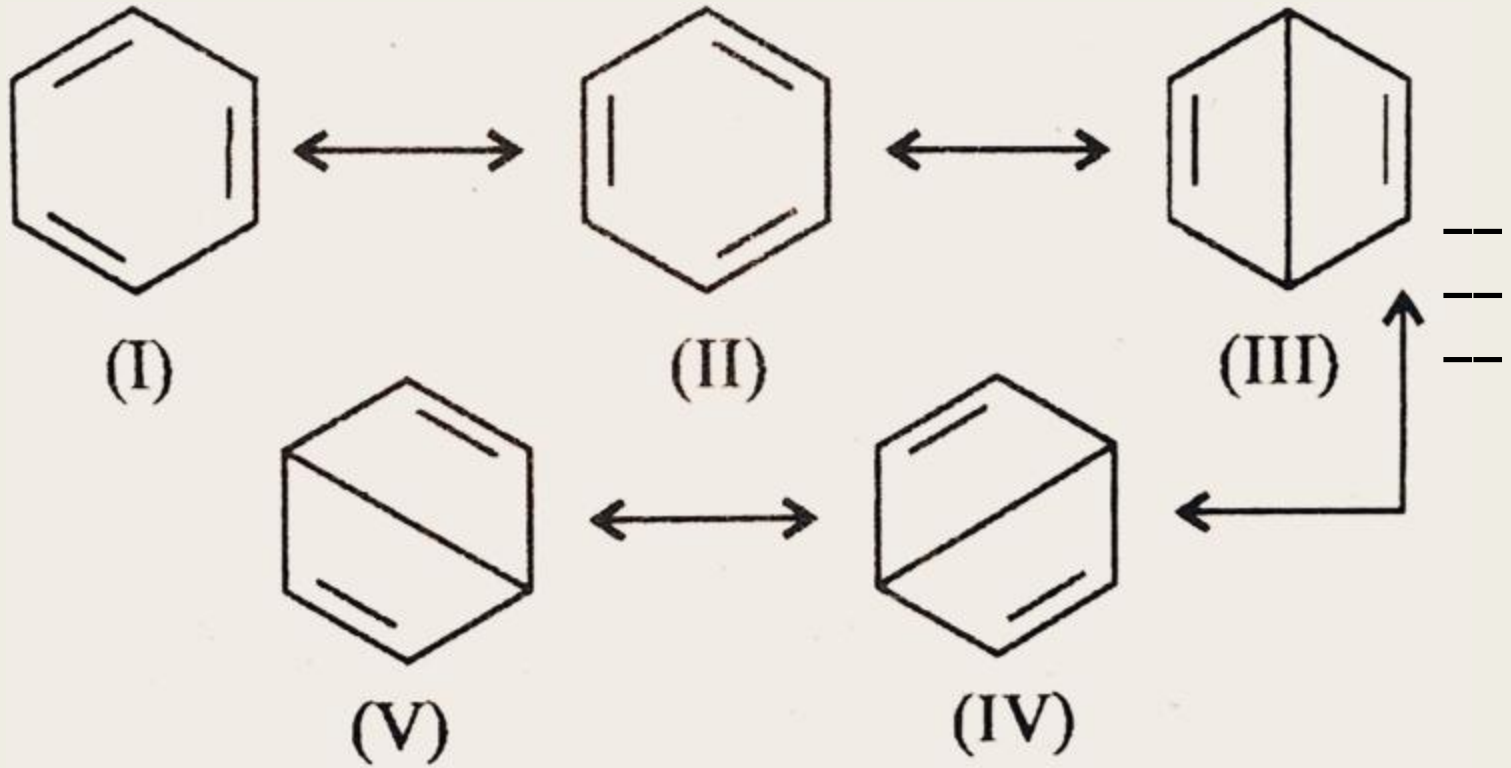
1. This is temporary type of effect observed only in the presence of attacking reagent.
2. As the electron pair is completely transferred towards electronegative atom, unit positive and unit negative charges developed on the bonded atoms.
3. This effect play important role in explaining mechanism of various organic reaction.

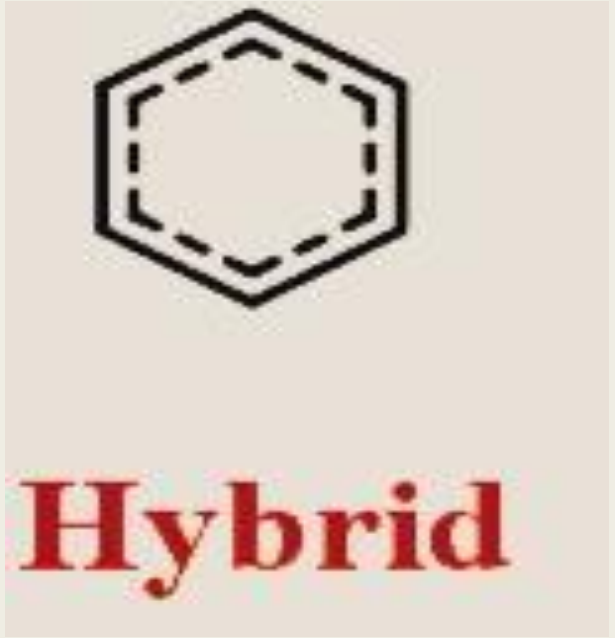
Application of electromeric effect:

1. Any polar reagent attacks on C=C or C=O double bond, there is shifting of pi-electrons towards one of the bonded atoms. It makes attack of incoming reagent more facile.

Resonance Effect

- The actual structure of the molecule contributed by the different structure Of that molecule which differ in arrangement of electrons, they are called as canonical forms and phenomenon is called as resonance.
- Actual structure of the molecule is assume to be resonance hybrid of the contributing structures.



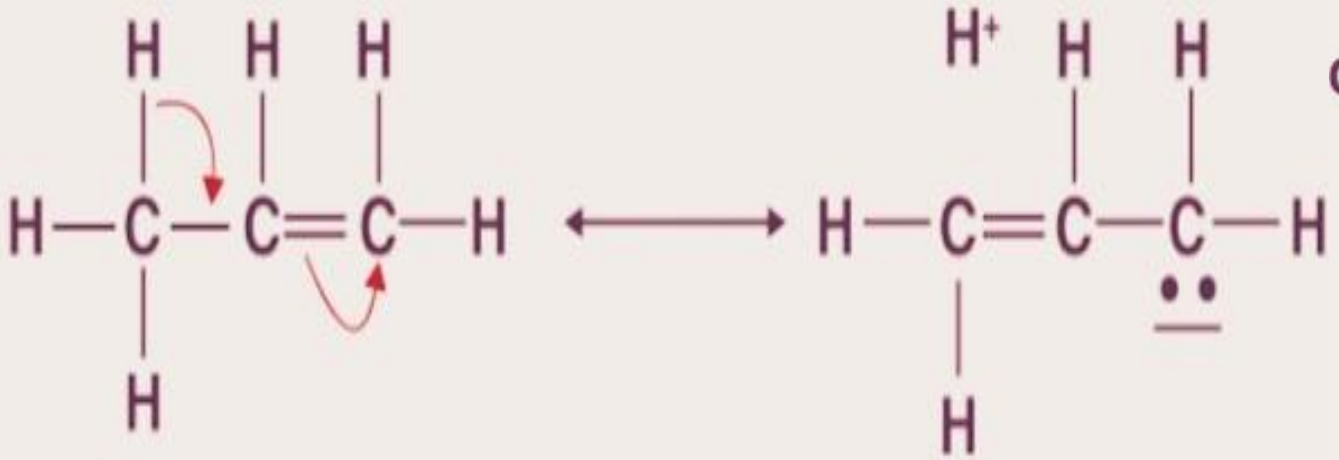


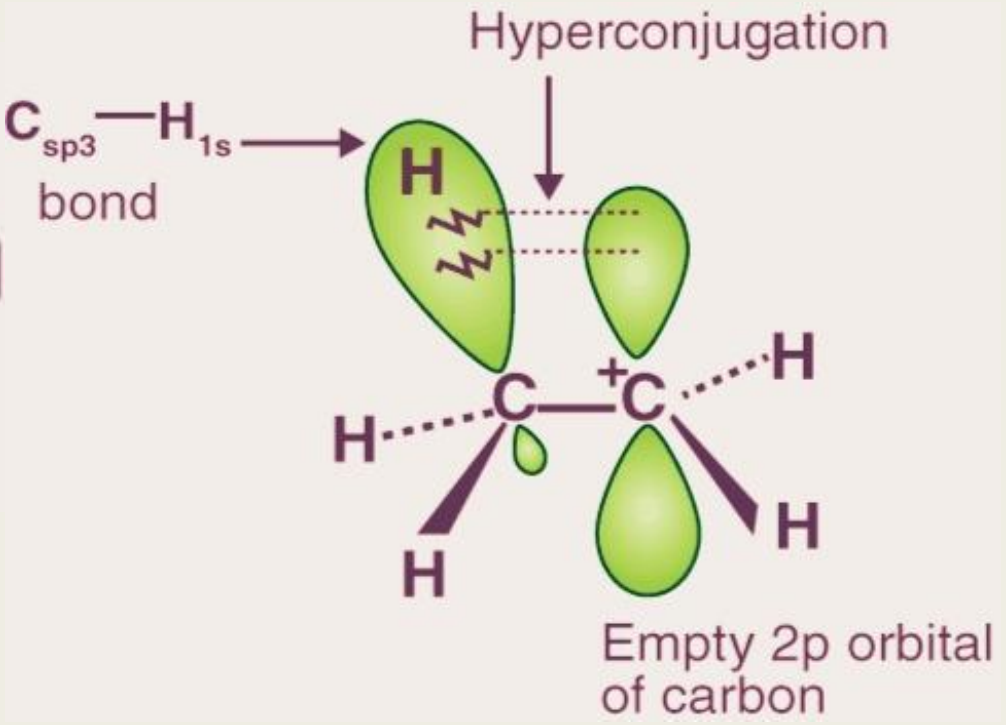
- **Properties of resonance**

1. More stable structure contribute more to the resonance hybrid.
2. More is the number of covalent bonds in Canonical form more is its stability.
3. All the canonical form should have comparable energy.
4. The resonance hybrid is more stable than any of the contributing structure.
5. Resonance can offer only when the atoms in a molecule are in same plane or nearly same plane.
6. All the contributing structures should have identical relative arrangement of atoms.

Hyperconjugation

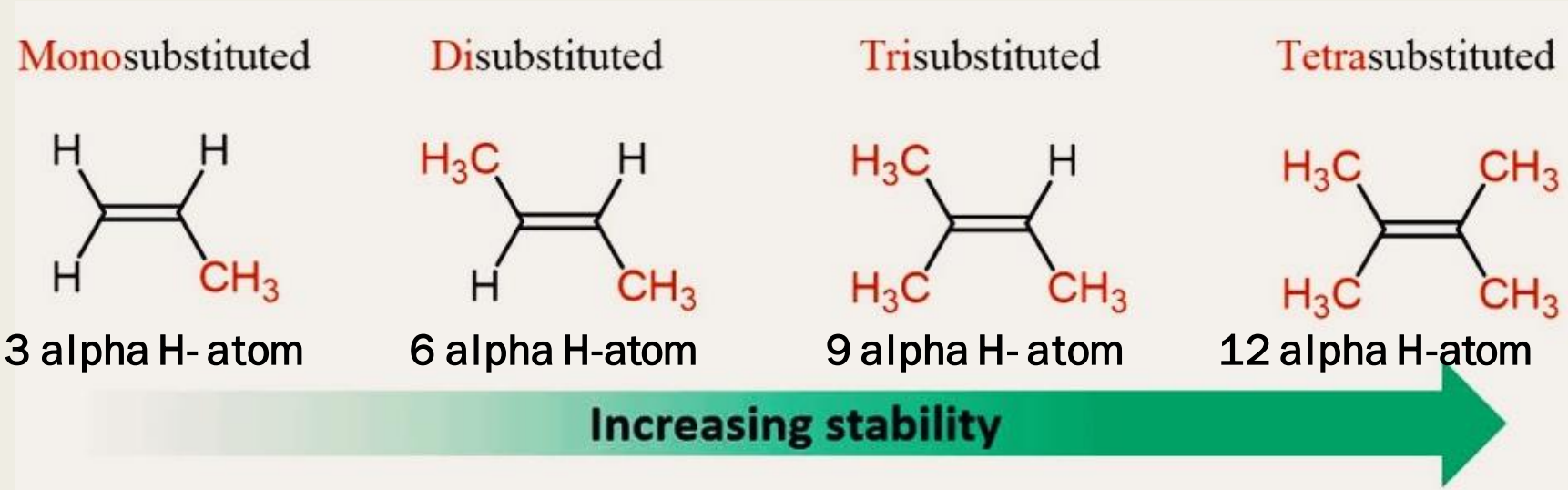
- If there is conjugative mechanism between Sigma and pi bonds such mechanism is called as hyperconjugation or Sigma-pi conjugation.
- When C-H bond of carbon adjacent to double bonded carbon atom, the adjacent carbon hydrogen i.e. alpha hydrogen has a tendency to release Sigma electrons Showing hyperconjugation.
- More is number of Alpha hydrogen atom, greater would be hyperconjugative effect.



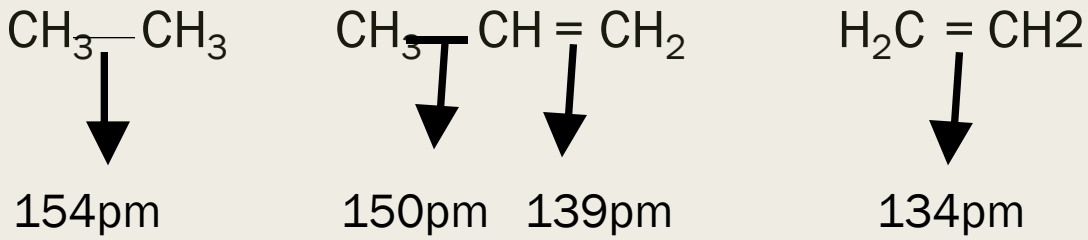


■ Applications of hyperconjugation

1.Stability of Alkenes: stability of alkenes goes on increasing from non substituted molecule to Tetra substituted molecule. Means more is the Alpha carbon of alpha H-atom more hyperconjugation observed.

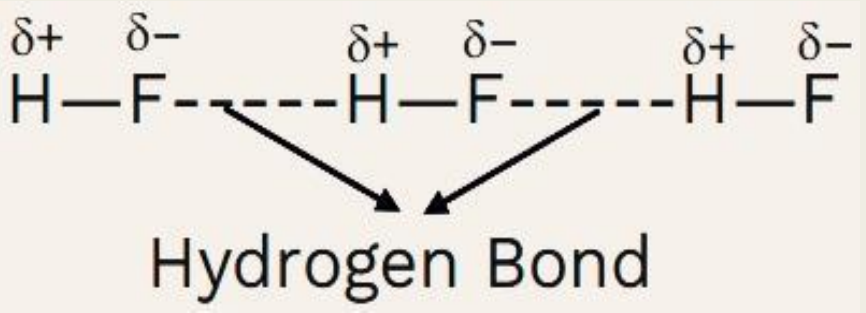


2. Bond length in Alkenes: Due to hyperconjugation, the C-C single bond acquires some double bond character while C=C double bond acquire some single bond character. Hence, the bond lengths get affected.



Hydrogen bonding

- The force of attraction which binds hydrogen atom of one molecule with the highly electronegative atom of another molecule of the same substance is called as hydrogen bond.
- Consider a molecule H-F. Here F- is more electronegative than



H-atom due to this electron pair of bonding get attracted towards

F-atom it produced H Delta + --- F Delta -.then –vely charged

F- atom attract the +vely charged H-atom of other H-F molecule. Thus in such way H-bonding take place.

Types of hydrogen bonding

1. **Intermolecular H-bond:** The hydrogen Bond that exist between atoms of two or more molecules of same substance is called intermolecular hydrogen bond.

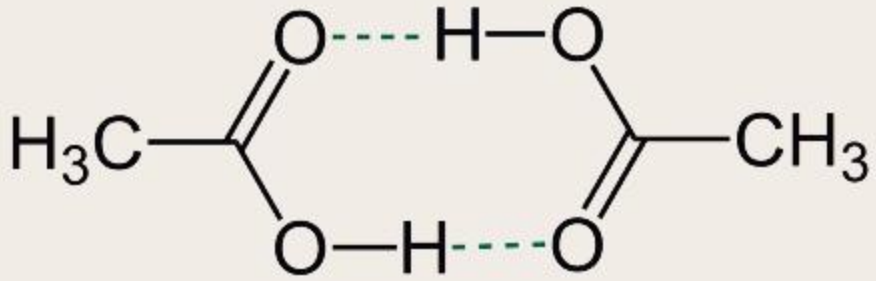


Fig: Intermolecular H- bonding in carboxylic acid

2. Intermolecular H-bond: The hydrogen Bond that exist between two atoms of the same mole details is called intra molecular hydrogen bond.

it is possible only if the hydrogen and more electronegative atom are present in the same molecule.