

UG: Chemistry Honours

B.Sc. Part. I (Hons.)
Organic Chemistry.

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Reaction Mechanism:

Q. What do you mean by mechanism of the Reaction?

A. A detailed step by step description of a chemical reaction showing how the reactants change into products is called mechanism of the reaction.

Organic reaction involve the breaking and making of covalent bonds. The covalent bond is generally represented as a dash (-). The movement of a pair of electrons is shown by a curved arrow (\curvearrowright), The tail of the curved arrow indicates where an electron pair moves from and the head of the arrow where it move to.



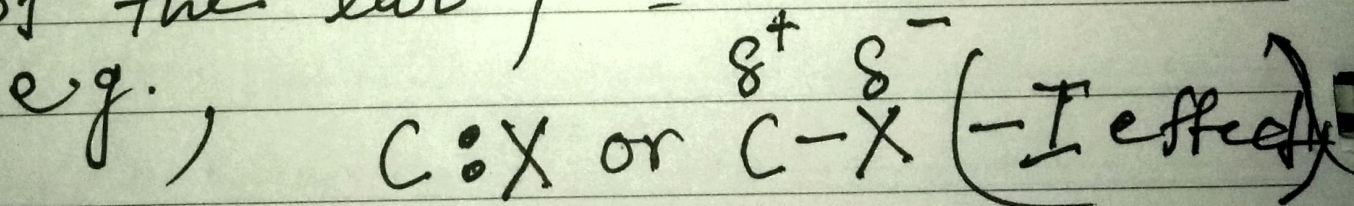
Electronic displacement in covalent bonds

The following four types of electronic effects operates in covalent bonds :

- (i) Inductive effect
- (ii) Mesomeric and Resonance effect.
- (iii) Electromeric effects
- (iv) Hyperconjugation .

Inductive effect :

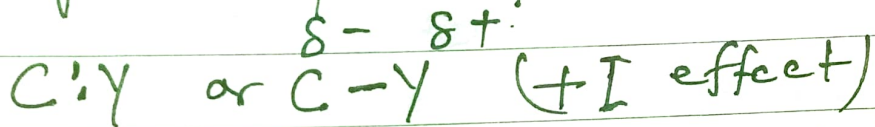
In a covalent bond between the two dissimilar atoms, the electron pair forming the bond is never shared absolutely equally between the two atoms but is attracted a little more towards the more electronegative atom of the two ,



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On the other hand, in compounds like $C-Y$, where Y is an electropositive element or group i.e., C is more electronegative than Y , the electron pair forming the $C-Y$ bond is somewhat displaced towards the carbon atom and thus C and Y attain partial negative and partial positive charges respectively.



The inductive effect causes certain degree of polarity in the bond which in turn renders the bond much more liable to be attacked by other charged atoms or groups.

Examples of I effect groups.

(a) $(-I)$ effect gr. (electron attracting)

$$^+NH_3 > NO_2 > CN > COOH > F > Cl,$$

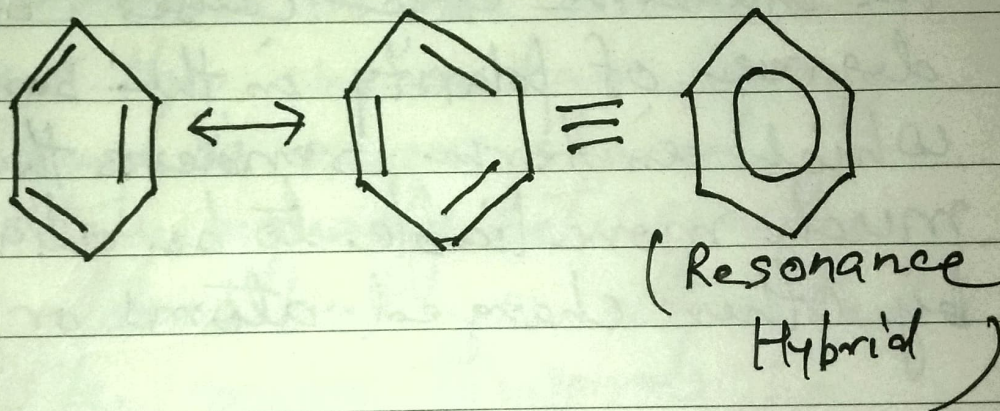
(b) $(+I)$ effect - group (electron repelling)

$$C_6H_5O^- > COO^- > R_3C > CHR_2 > CH_2R$$

Resonance or Mesomeric Effect:

The phenomenon in which two or more structures, involving identical position of atoms, can be written for a particular compound, is called resonance.

The benzene molecule can be expressed as a resonance hybrid of the two contributing Kekule structures.



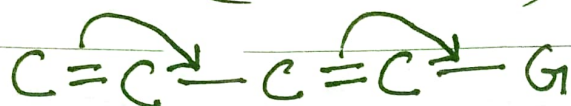
This canonical structure of a system is a set of various structures which are sufficient to define all the possible electron distributions.

(ii) (-M effect):

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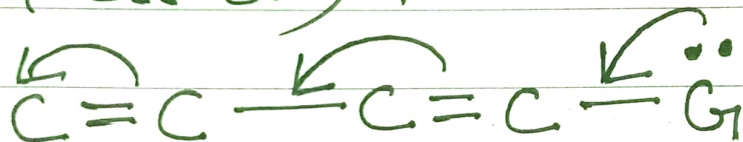
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Conjugated systems, attached to electron deficient atom with vacant p-orbital. (-M effect)

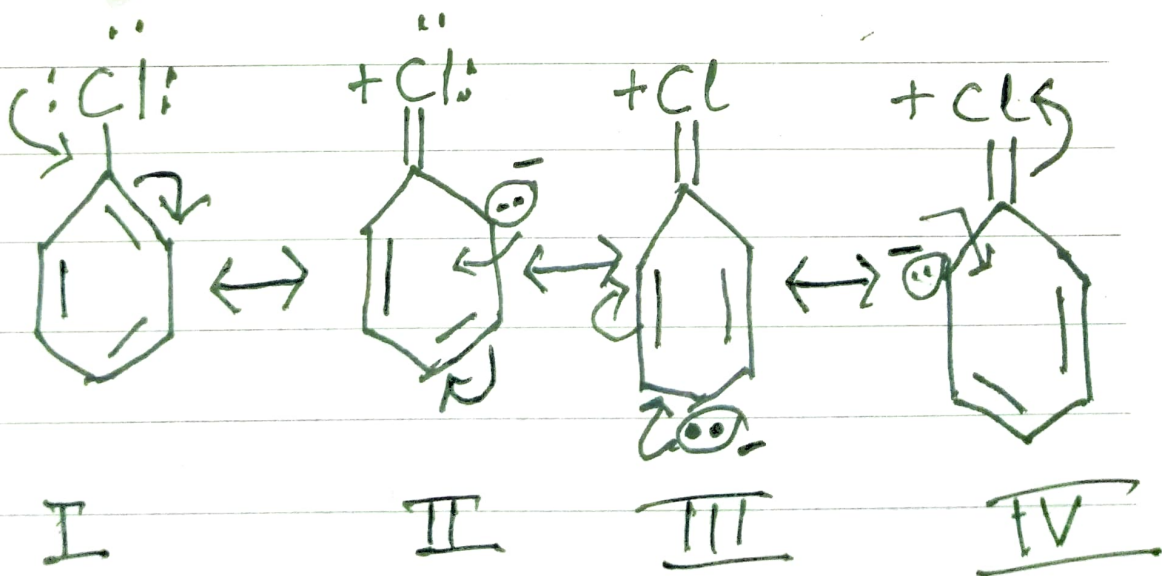


(ii) (+M effect);

conjugated system attached to electron rich atom or that atom should have filled orbital or free lone pair. (+M effect).



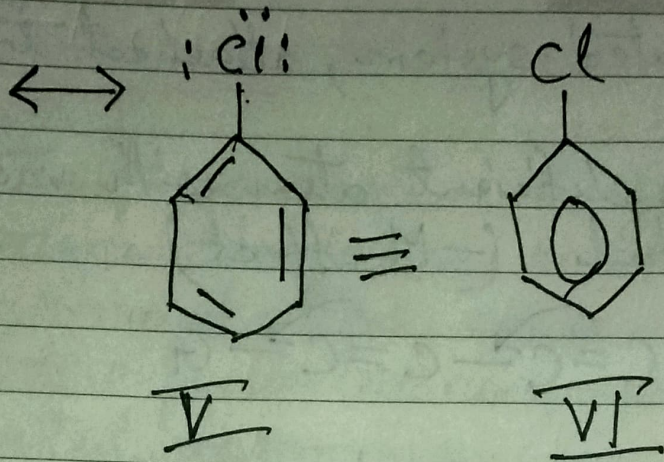
(iii) relative



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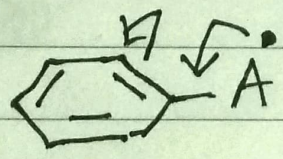
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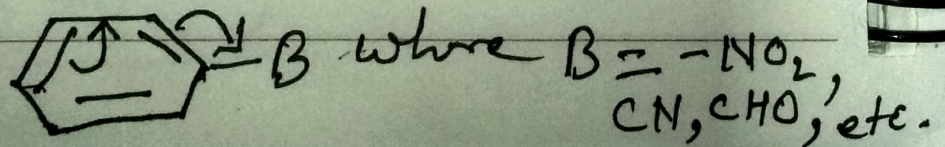
Structure I and V, are equivalent and have equal contribution in resonance hybrid (VI)

+M: When movement of electron starts from the gr. or toward the carbon chain.



A = -NH₂, -OH, X, etc.

-M: When the movement of electrons takes place towards the group (away from the carbon chain.)



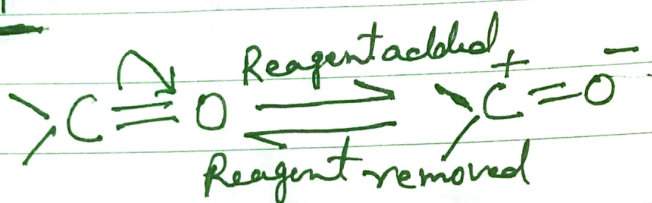
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Note: Mesomeric effect is permanent in nature.

Electromeric Effect:

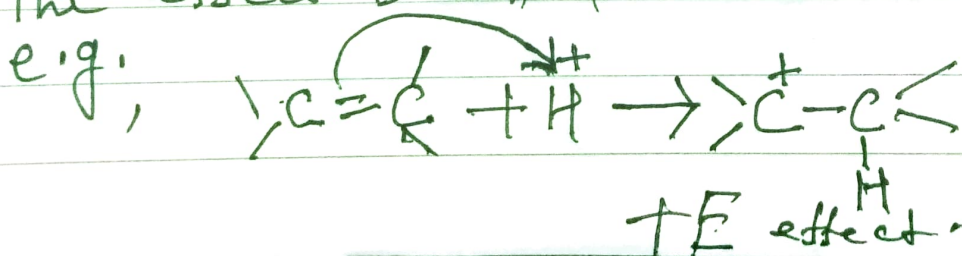
It involves the complete transfer of electrons of a multiple bond to one of the bonded atoms in presence of an attacking reagent. It is called -E effect.



This effect is temporary and takes place only in the presence of a reagent. As soon as the reagent is removed, the molecule reverts back to its original position.

+E effect →

If the electrons of the π bond are transferred to that atom of the double bond to which the reagent gets finally attached, the effect is called +E effect.



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-E effect:

The electrons of the double bond are transferred to an atom of the double bond other than the one to which the reagent gets finally attached, the effect is called -E effect.

e.g.,

