ELECTRON DISPLACEMENT EFFECTS

(1) INDUCTIVE EFFECT.

A covalent bond is formed by the equal sharing of electron between the two atoms. In case of a covalent bond between two similar atoms the electron pair of the bond occupies a centre position between the two nuclei of the concerned atom e.g. H:H, Cl:Cl. In a covalent single bond between unlike atoms, the electron pair forming the σ-bond is never shared absolutely equal between the two atoms. It tends to attracted a little more towards the more electronegative atom of the two. Thus in alkyl chloride, the electron density tends to be greater near chlorine than carbon. This is generally represented.

$$\equiv C \overset{\delta+}{-} Cl^{\delta-} \quad \text{or} \quad \equiv C \longrightarrow Cl.$$

Consider a carbon chain in which one terminal.

carbon atom is joined to a chlorine atom.

$-C_3-C_2-C_1-Cl$.

As chlorine has greater electron affinity than the carbon atom, the electron pair shared between C and Cl will be pushed towards chlorine. As a result of it chlorine atom acquires a small -ve charge.

$-C_3-C_2-C_1^{\delta+}-Cl^{\delta-}$

As C_1 is positively charged it attracts towards itself the electron pair shared between C_1 and C_2. This causes C_2 to acquire a small +ve charged but the charge is smaller than the charge one, which is almost neutralised.

$-C_3-C_2^{\delta-}-C_1-Cl^{\delta-}$

Similarly C_3 acquires a small +ve charge, which is less than on C_2.

This type of inductive electron displacement along a carbon chain is termed as "inductive effect". It is permanent effect and the effect decreases as the distance increases from Cl (source). For practical purpose, the effect is ignored after the second carbon atom. As the.

electron pairs permanently displaced donat leave the valence shell. the inductive effect may be represented as. follows:-

$\rightarrow C_3 \longrightarrow C_2 \rightarrow C_1 \rightarrow Cl$

For measurement of relative inductive effect atoms or groups, having greater electron affinity or electron attracking power than hydrogen are said to have (-) inductive effect whereas atoms or groups having lesser electron affinity than hydrogen are said to have +I effect (electron repelling). Groups having -I effect in order to their increasing effect.

$H - , C_6H_5 - , -OH, -OCH_3, -I, -Br, -Cl, -F, -COOH, -CN, -NO_2$.

Groups having +I effect in order to the increasing effect)

$-H, -CH_3, -CH_2R, -CHR_2, -CR_3, -COO$.

APPLICATION OF INDUCTIVE EFFECT.

(1). Strength of carboxylic acid. An acid is species that has the tendency to lose the proton. The strength of an acid depend upon the case with which an acid ionises to give proton.