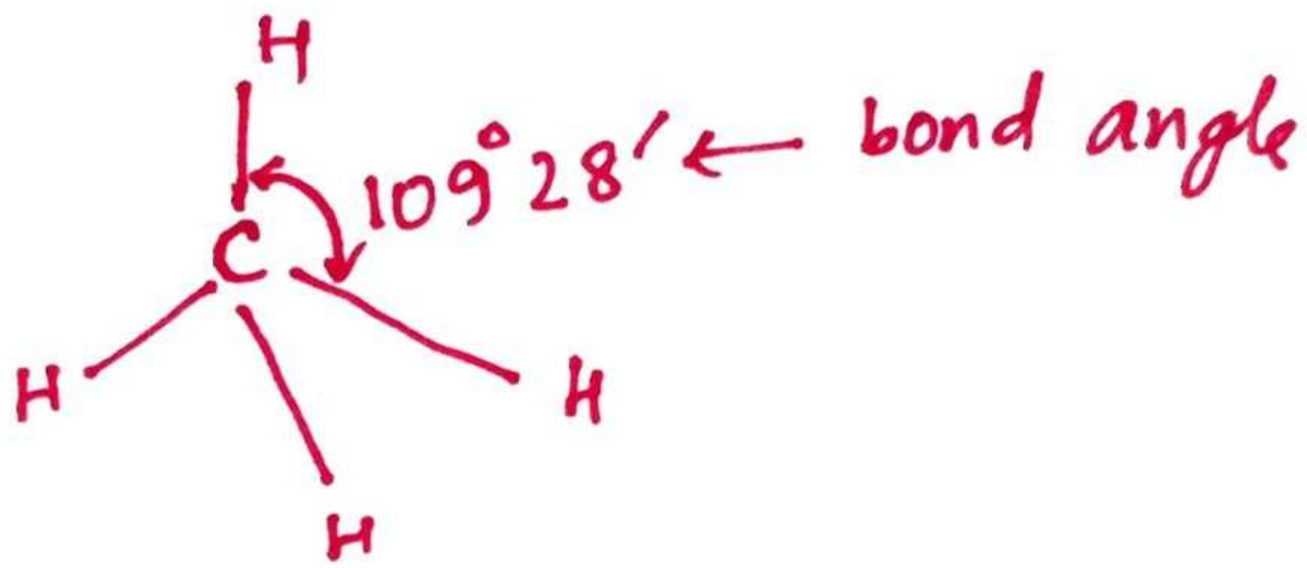
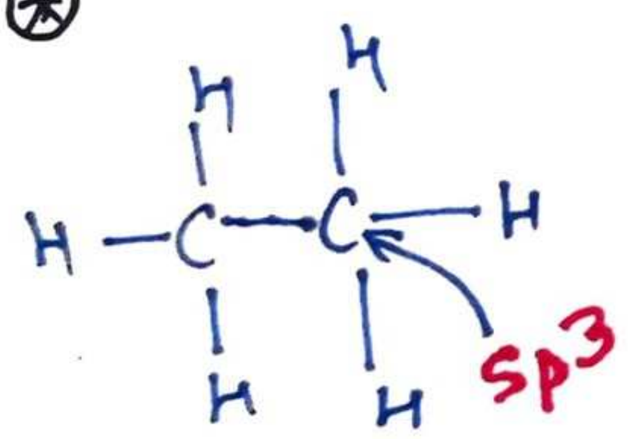
Basics of Organic Chemistry

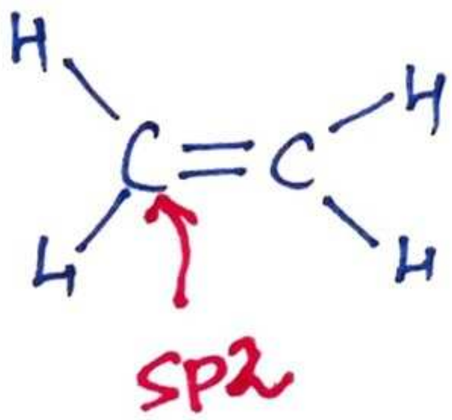
⊛ Influence of hybridization on Bond Angle-

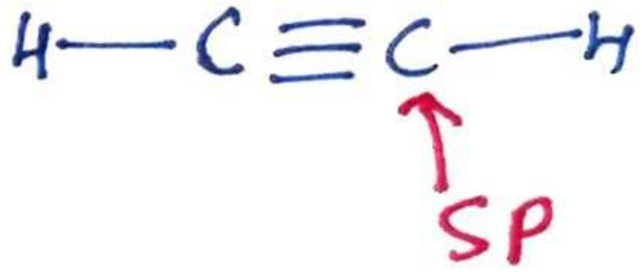
The average angle between the two covalent bonds made by the same central atom is known as bond angle.



⊛







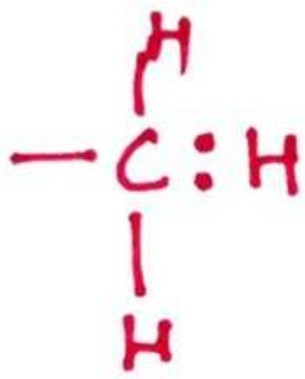
$109°28' < 120° < 180°$

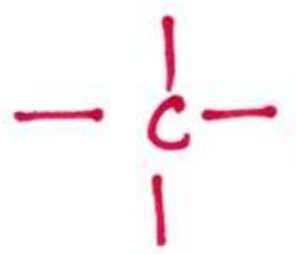
⇒ With increase in s- character, bond angle increases.

⊛

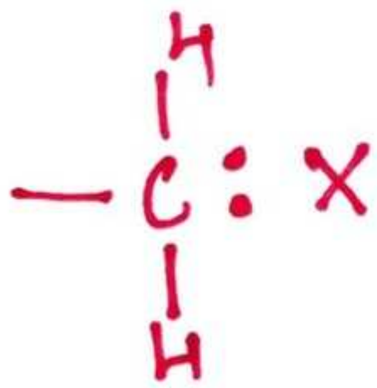
⊛ Electron displacement in a molecule :-

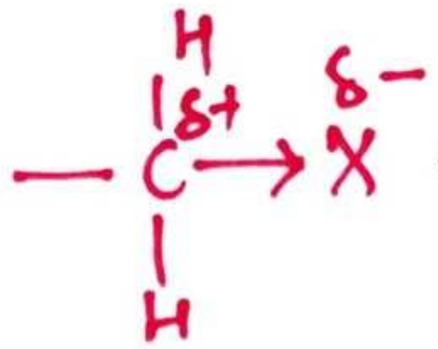
① Inductive Effect :-



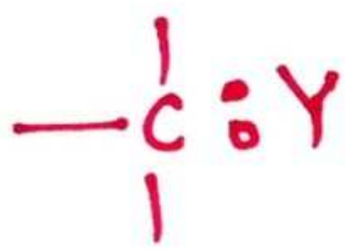


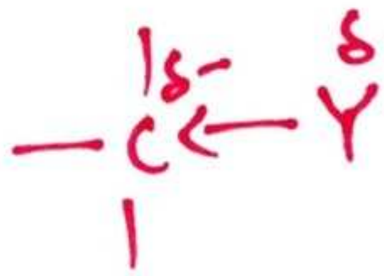
→ symmetrical between C and H



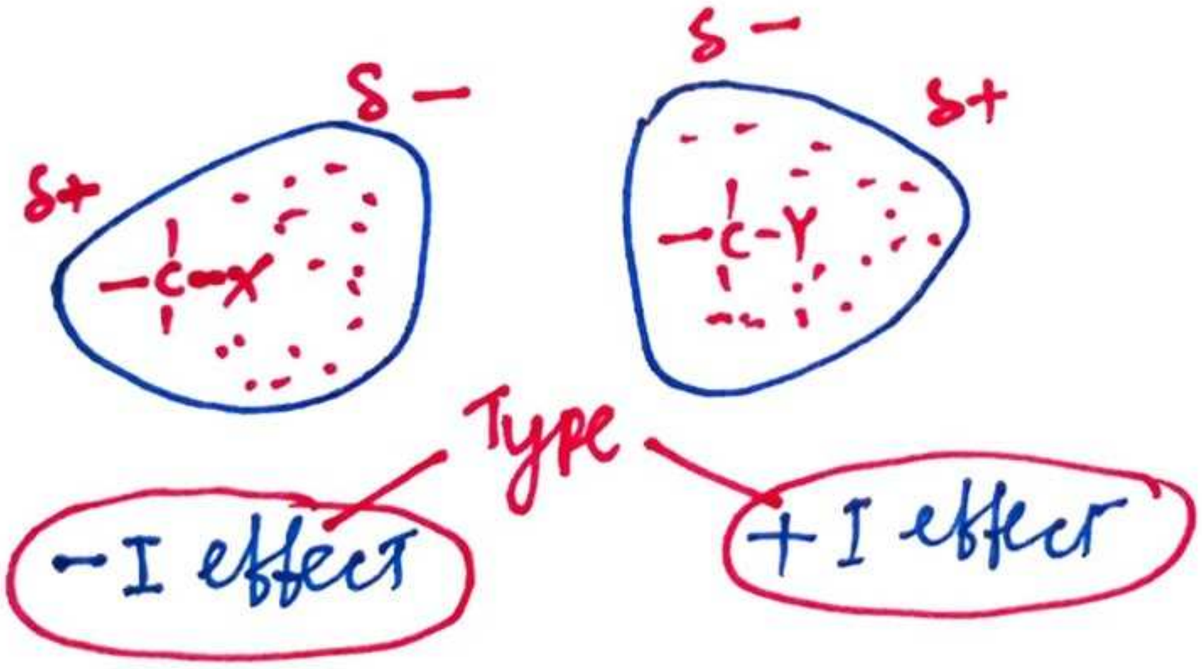


→ (X is more electronegative
−I effect)





→ (Y is electropositive
+I effect)



Definition

The permanent displacement of the shared electron pairs in a carbon chain towards the more electronegative group is known as the inductive effect.

-I effect :-

If a group is more electronegative than hydrogen, then the group withdraws electrons from the C-chain towards itself, it is said to have -I effect.

The various groups with -I effect is are given in decreasing order below-

$$-\overset{\oplus}{N}(R)(R)(R) > -\overset{\oplus}{N}H(H)(H) > -NO_2 > -SO_2R > -CN$$

$$> -\overset{O}{\overset{\|}{C}}-OH > -F > -Cl > -Br > -I > -OC_6H_5$$

$$-COOR > -OR > -OH > -C\equiv CH > -C_6H_5 > -C=CH_2$$

+I Effect

If a group attached to the carbon is less electronegative than hydrogen, it donates electrons to the C-chain. It is called +I effect.

The various group in decreasing order -

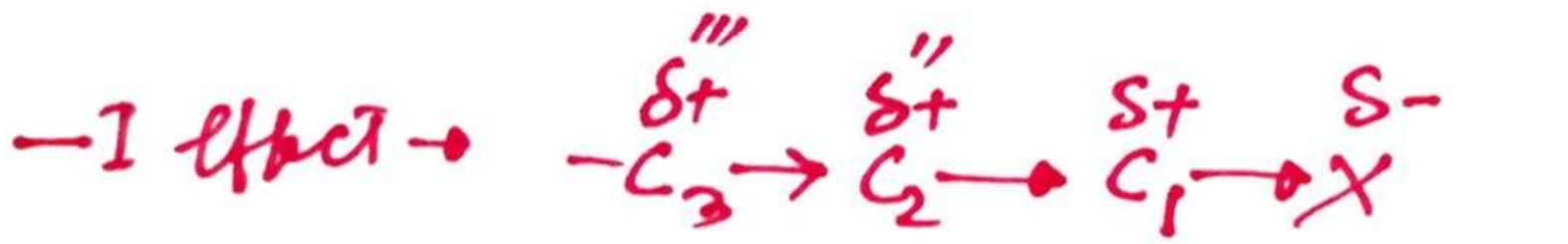
$$-O^- > -COO^- > -\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_3 > -\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-H > -CH_2CH_3 > -CH_3$$

⊛ Characteristics Of Inductive effect:

① Inductive effect involves a single bond.

② Inductive effect is permanent and irreversible.

③ The effect decreases along a chain as shown below -



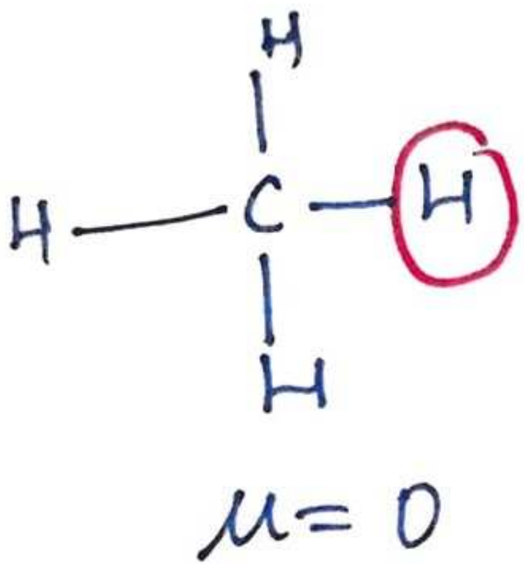
It is almost negligible after two C-atoms.

④ The displacement electrons donot leave their orbitals. Only the orbital is deformed a bit and this causes polarization.

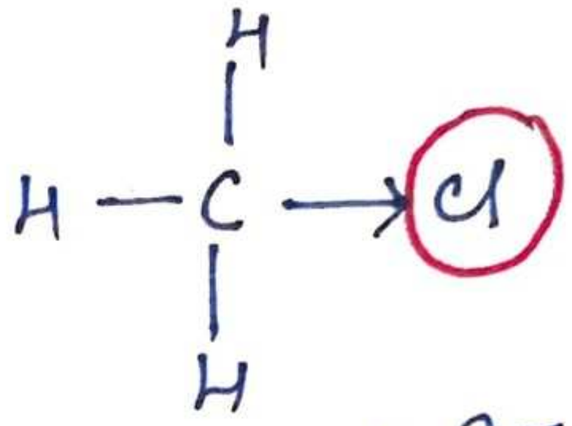
⑤ Different groups cause polarity to different extent.

⊛ Applications Of Inductive effect

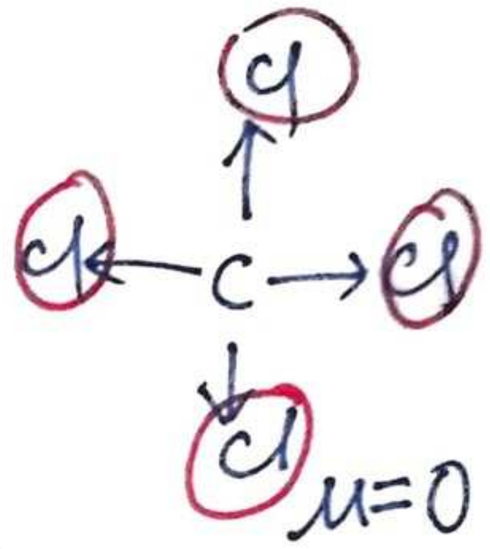
① It explains the polarity of covalent bonds in organic compounds -



$\mu = 0$



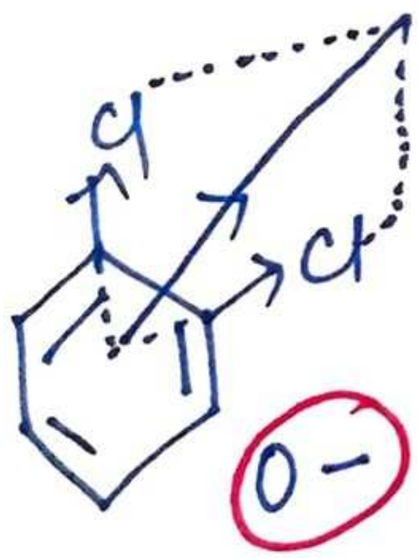
$\mu = 1.87\ D$



$\mu = 0$

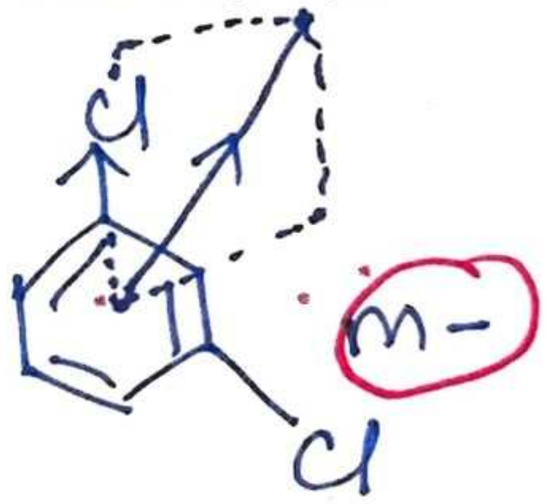
⊛ The substitution of a H-atom in methane by Cl-atom to form methyl chloride produces a dipole moment in the molecule and explain its polar character.

(X)



$\mu = 2.30\ D$

more polar



$\mu = 1.48\ D$

less polar.

$\mu = 0$

least polar

Dipole moment $\mu = \sqrt{(\mu_1)^2 + (\mu_2)^2 + 2\mu_1^2 \cos\theta}$

So, more the angle, lesser is the value of net dipolement.