

TDC-I Paper-II Organic Chem.

Inductive Effect

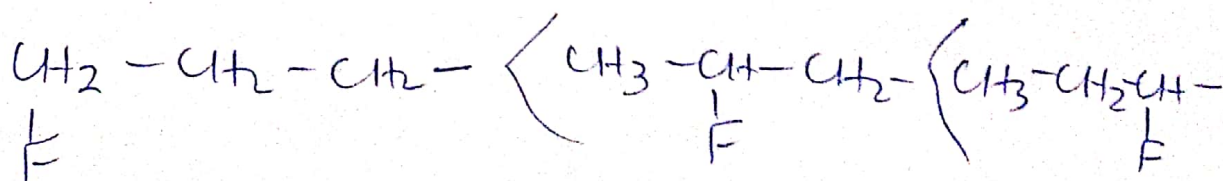
When an atom or group is attached to carbon chain, then polarity developed in carbon chain due to the shifting of σ -bond electron as a result of electronegativity difference is called Inductive effect.

- It is a permanent effect which operates along σ -bond



- It is distance dependent effect as distance from source atom increases the intensity of I-effect decreases

magnitude of I-effect $\propto \frac{1}{\text{distance}}$



I-effect due to F-atom is -I-effect

Types of I-effect

(i) +I-effect \Rightarrow A group or atom is said to have +I-effect if it pulls electron less strongly than H-atom.

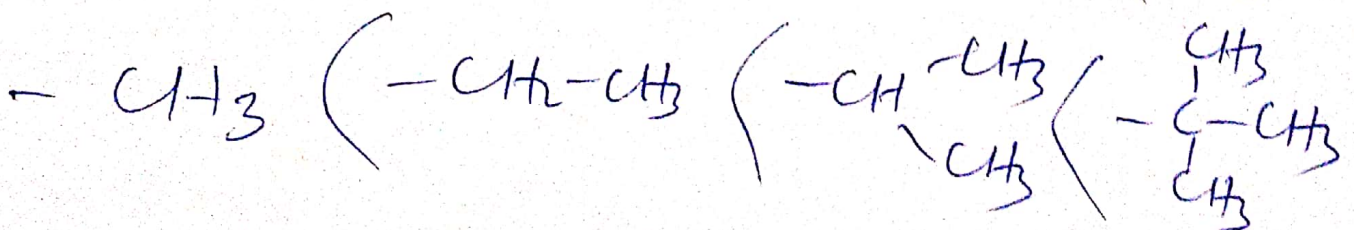
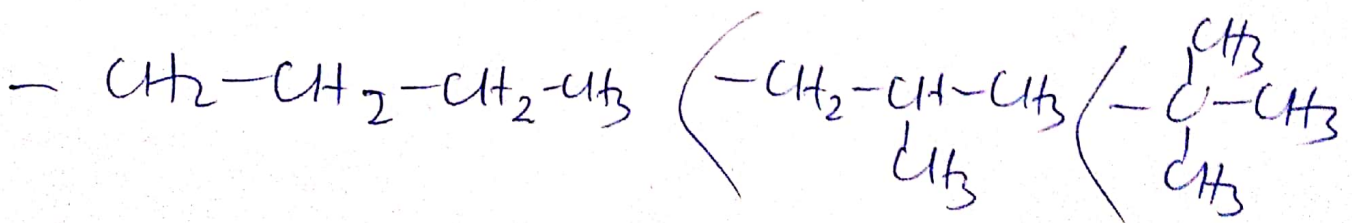
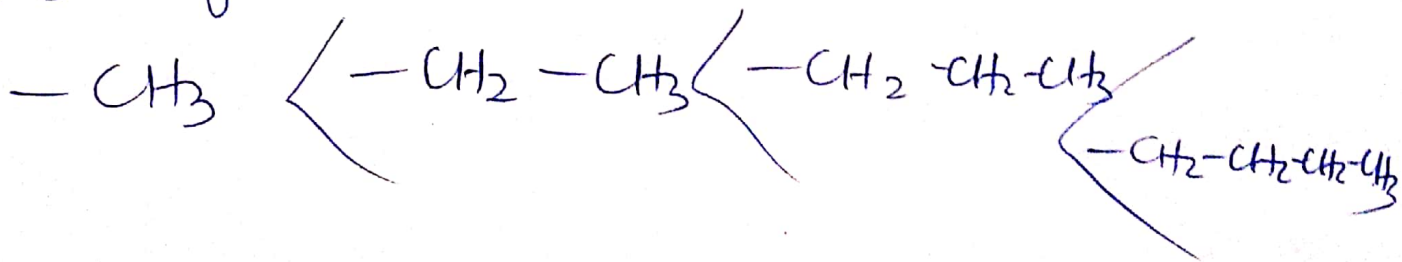
\rightarrow C-H bond is said to have zero I-effect

Due to +I-effect, electron density increases on carbon chain.

+I-effect \propto size of alkyl group

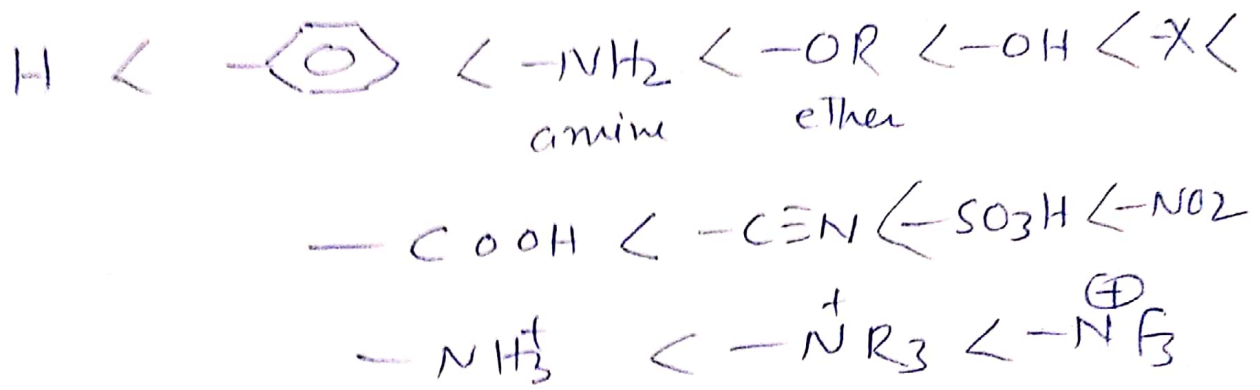
$\propto \frac{1}{\text{Electronegativity of Carbon}}$

Order of +I-effect strength

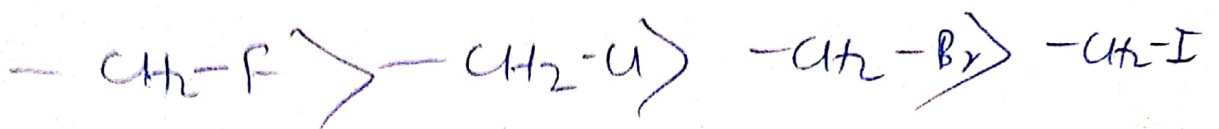
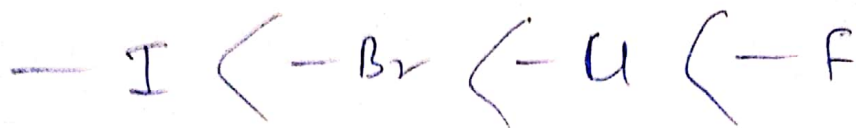


-I effect \Rightarrow A group or atom is said to have -I-effect if it pulls electron more strongly than H-atom

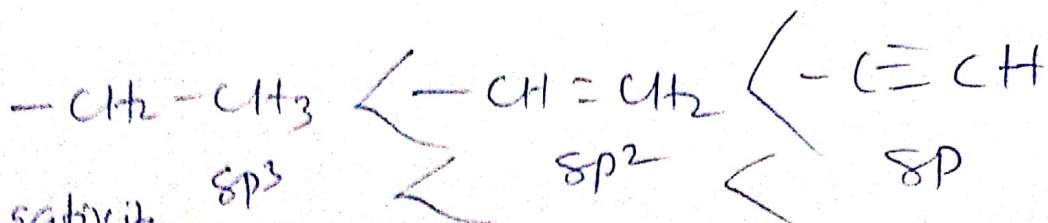
\rightarrow Due to -I-effect positive charge develops over carbon chain or carbon chain becomes electron deficient



Order of Intensity of -I-effect



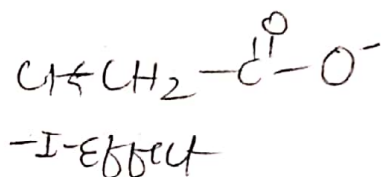
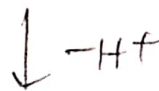
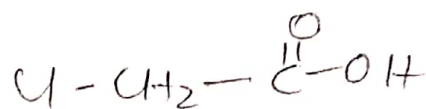
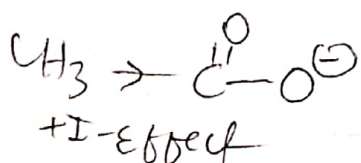
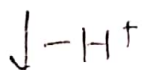
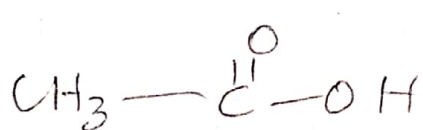
order of -I-effect



Electronegativity \propto %s-character of carbon

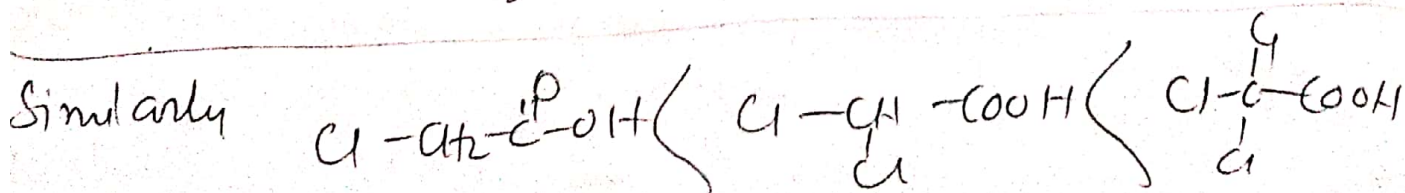
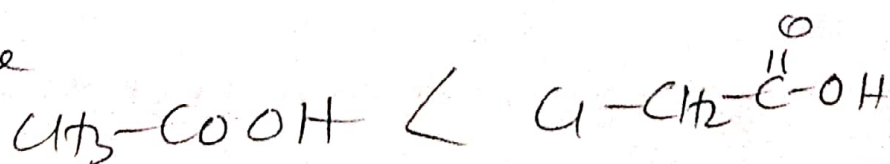
Application of Inductive Effect

Ex- Chloroacetic acid is stronger acid than Acetic acid



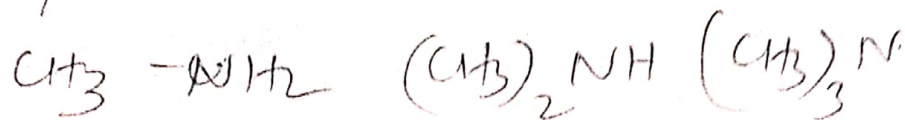
Since greater the stability of conjugate base, greater will be acidic strength. As conjugate base of ~~acid~~ chloroacetic acid is more stable due to presence of -I-effect (Cl) bearing carbon atom. +I effect of CH_3 -group destabilises the stability of Anion.

Hence



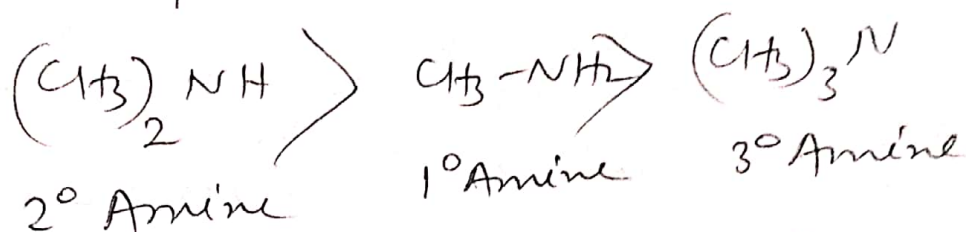
-I-effect is additive property hence combined effect of -I-effect increases acidity

Explain The Basicity Order in aqueous solution.



— Given amines are 1° , 2° and 3° Amines respectively.

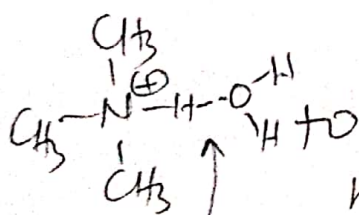
— The correct order of Basic Strength in aqueous solution is



3° Amine is less basic Amine among given Amines. ~~It~~ due to following reasons

(i) Steric factor: In (R_3N) 3° Amine

Three alkyl (methyl) groups attached to N-atom are bulkier & causes hindrance for protonation



(ii) Solvation effect - The protonated 1° -amine can form H-bond with water molecule at one point therefore less stable conjugate acid. While

in protonated 2° Amine can form H-bond with two ~~point~~ ~~at~~ two points hence stabilises conjugate acid

