Electronic Displacements

Presented
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- **Inductive Effect**
- **Mesomeric Effect**
- **Electromeric Effect**
- **Steric Effect**

Inductive Effect (I-effect)

- It originates due to electronegativity difference
- Distance dependent
- Permanent effect
- Operates in both saturated & unsaturated systems
- Two types--

  (+)I-effect (positive inductive effect)

  (-)I- effect (negative inductive effect)

Depending upon the electronic factors the functional groups are divided in two terms

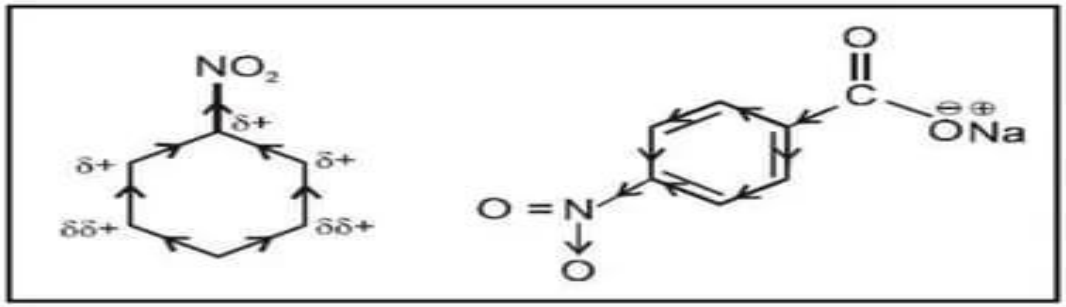
1. Electron donating groups (E.D.G.)

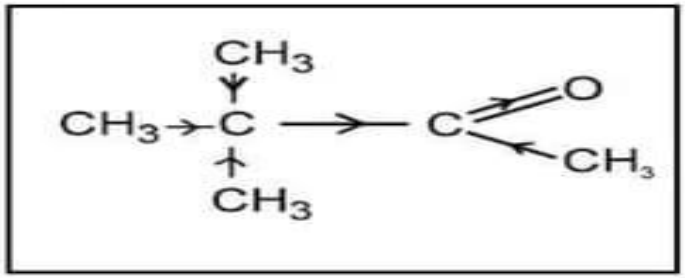
   e.g. RO(-), COO(-), CR_3, T, D etc.

2. Electron withdrawing groups (E.W.G.)

   e.g. COOR, COOH, F, Cl, Br, SR, SH, OH etc.

E.D.G. shows (+I) effect & E.W.G. shows (-I) effect





Application

- Acidic strength:

  Order of acidity---$H_3C\text{-}CO_2H < CF_3CO_2H$

Since F has strong (-I) effect so it will pull electrons of O-H bond towards itself. So that H(+) liberate easily

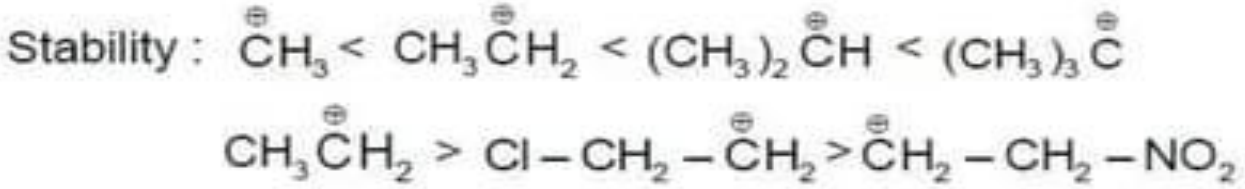
- Basic Strength:

  Order of basicity--- $C_6H_5NH_2 < NH_3$

Since sp2 carbon atom of Ph-ring attracts electron pairs of N atom towards itself. So tendency of donation of electron pair decreses

- Stability of carbocation:

Carbocations are electron deficient species. So they are stabilized due to (+I) effect & (-I) effect destabilizes them



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Carboanions are electron rich species, so due to (-I) effect it will stabilized & because of (+I) effect it will destabilized

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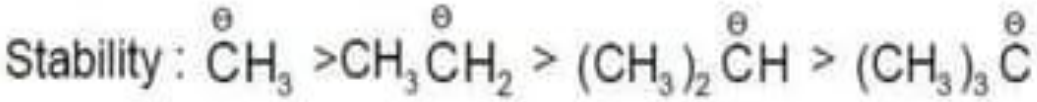
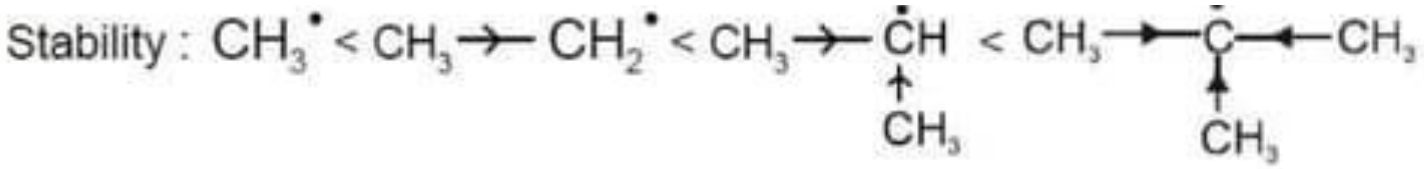
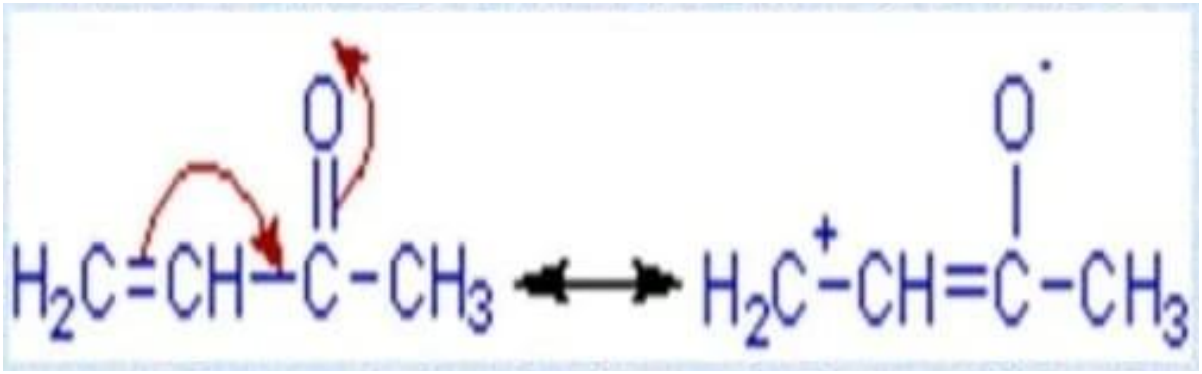


They are stabilized by (+I) effect



Mesomeric Effect

- Permanent effect
- Operates only in unsaturated system
- Distance independent effect
- It is also known as Resonance effct



- It refers to the polarity produced in a molecule as a result of interaction between two pi bonds or a pi bond & lone pair of electrons

- Two types---

Positive Mesomeric (+M) Effect

Groups donate electron density so that electron density of molecular entity increases

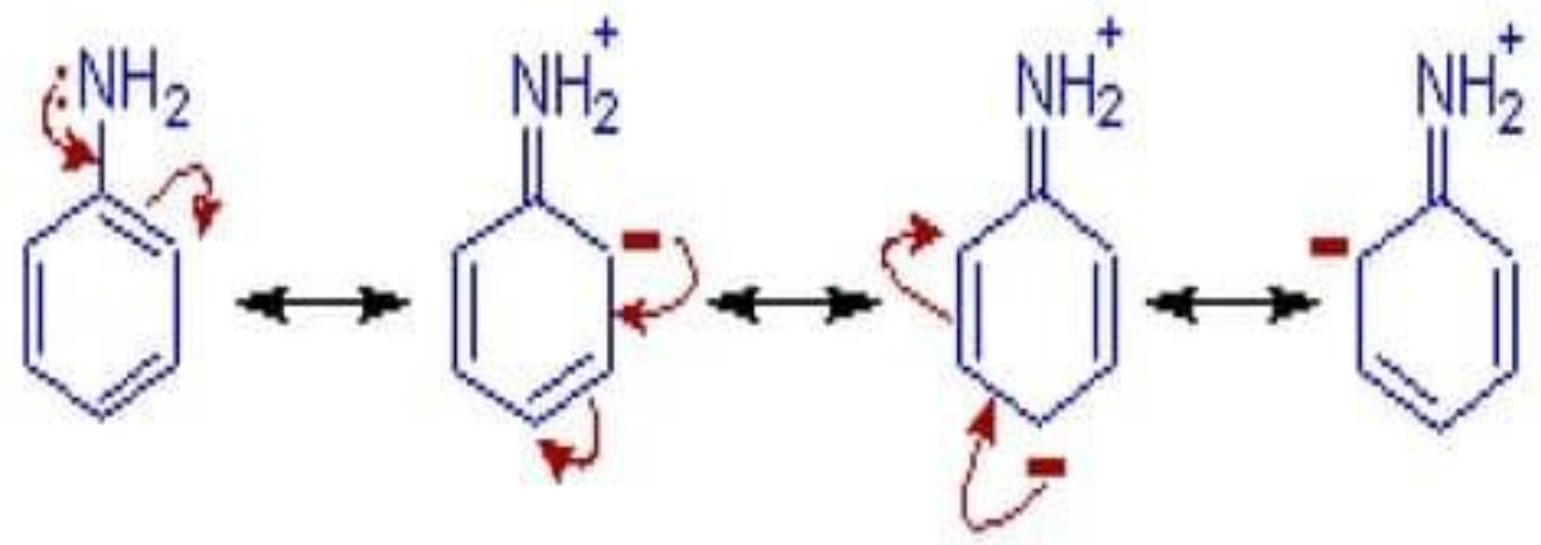
e.g. OH, OR, SH, SR, NH_2, NR_2 etc.

Negative Mesomeric (-M) Effect

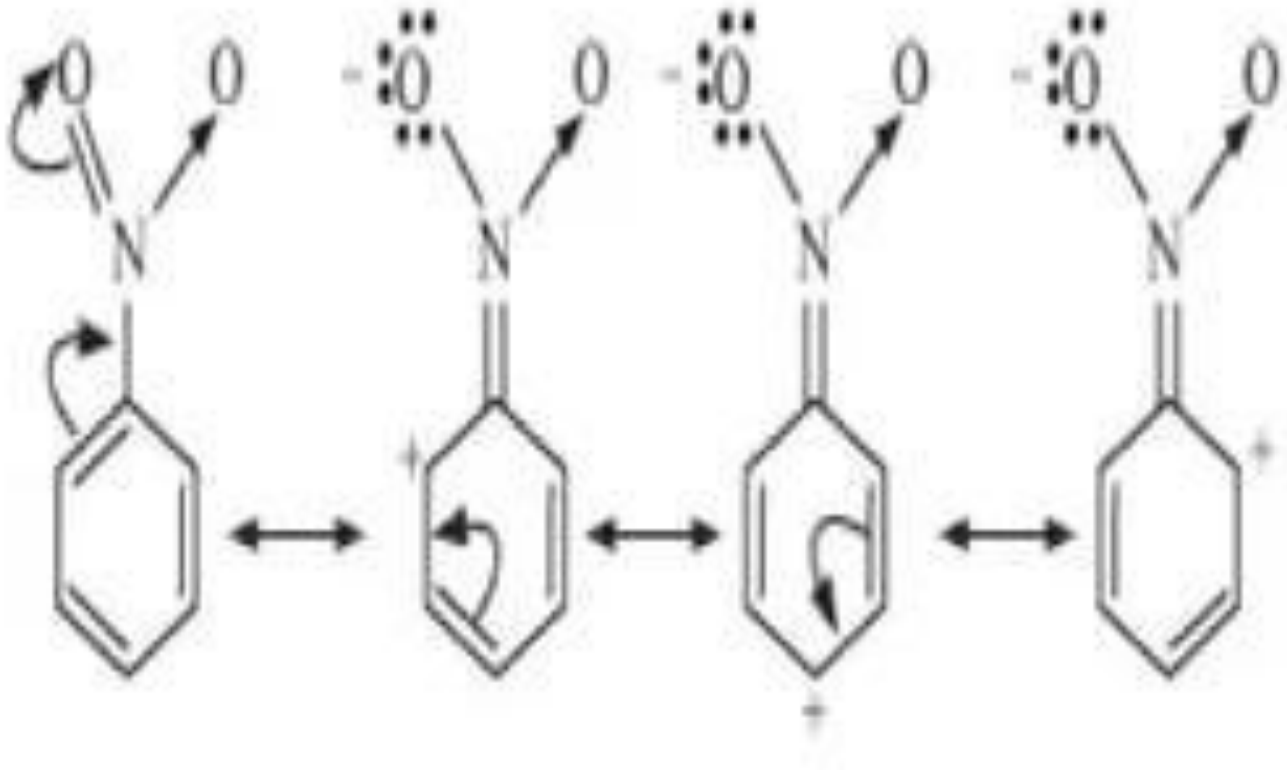
Groups accepts electron density so that electron density decrease of molecular entity

e.g. CO, CN, COOH, SO_3H, NO_2 etc.

Positive Mesomeric (+M) Effect



Negative Mesomeric(-M) Effect

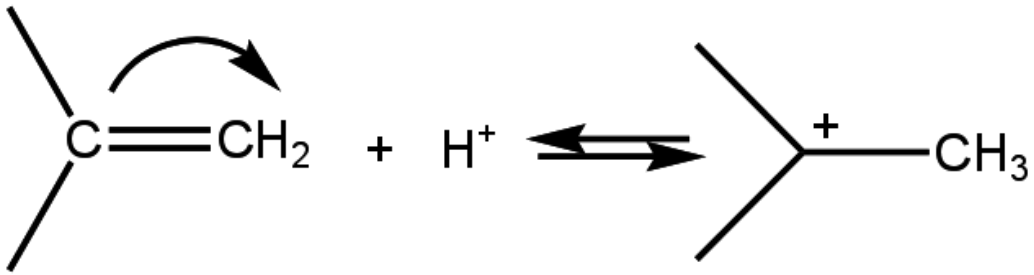


SIGNIFICANCE

- It describe the charge distribution in a molecule ,thus provide an effective way of determing the point of attack of electrophiles and nucleophiles.
- Useful in explaining physical characteristics
- i.e bond length,dipole moment.

Electromeric Effect

- Temporary effect
- It can observed in presence of solvent
- Complete transfer of pi electrons towards one of the bonded atom under the influence of reagent (say HCl)

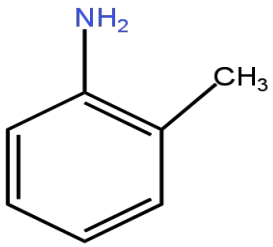


Steric Effect

- **Steric Inhibition of Resonance (SIR Effect)**
  - This effect increases the basicity
  - Applicable when both the groups are bulky

    e.g. CH3, NO2, Cl, Br, I etc.
  - Doesn't apply on H, F, OCH3, D, NH2

    Basicity order--- 2 >1



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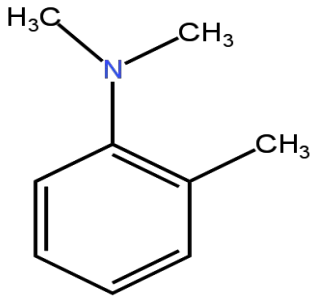

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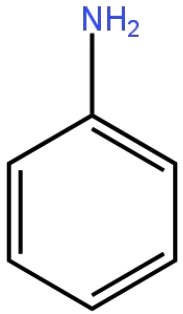
- **Steric Inhibition of Protonation (SIP Effect)**
  - This effect decreses the basicity
  - Applicable when only one group will be bulky

    Basicity order--- 1 > 2



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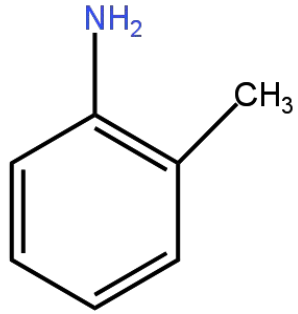

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THANK YOU