Electronic Displacement

Inductive Effect

Resonance

Hyperconjugation

Steric effect

By an effect is understood some influence which alters the the distribution of electrons in a molecule. It may be classified as polarisation effect which is permanent effect and polarisability effect which is temporary effect.

Permanent Effect	Temporary Effect
1. Inductive Effect (IE)	4. Inductomeric Effect
2. Mesomeric Effect (ME)	5. Electromeric Effect
3. Hyperconjugation (hc)	

Characteristics of inductive effect:

a. It is a permanent effect.
b. It is operated only in sigma (σ) bonds.
c. Only σ electrons are involved.
d. In inductive effect electrons are partially displaced.
e. IE is transmitted along the chain.
f. As length of the chain increases the IE decreases.

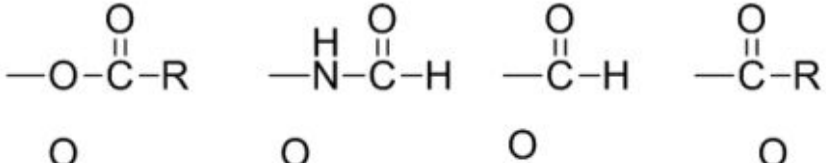
Inductive effect is the permanent polarisation of single bond. It may be classified as electron withdrawing inductive effect or -I effect and electron releasing inductive effect or +I effect.

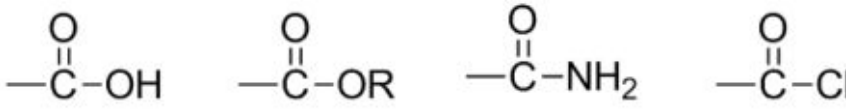
+I and –I Inductive effecting groups

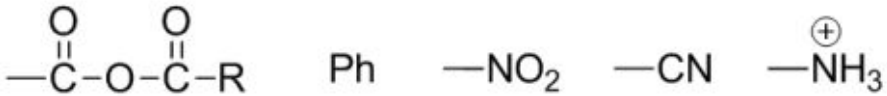
–ve Inductive effect group (-IE)

—F —Cl —Br —I —OH

—OR —OAr $—NH_2$ $—NR_2$ —NHR



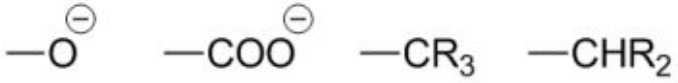




Ph $—NO_2$ —CN $—\overset{\oplus}{N}H_3$

$—\overset{\oplus}{N}R$ halogens, O, N containing groups and cations.

+ve Inductive effect group (+IE)

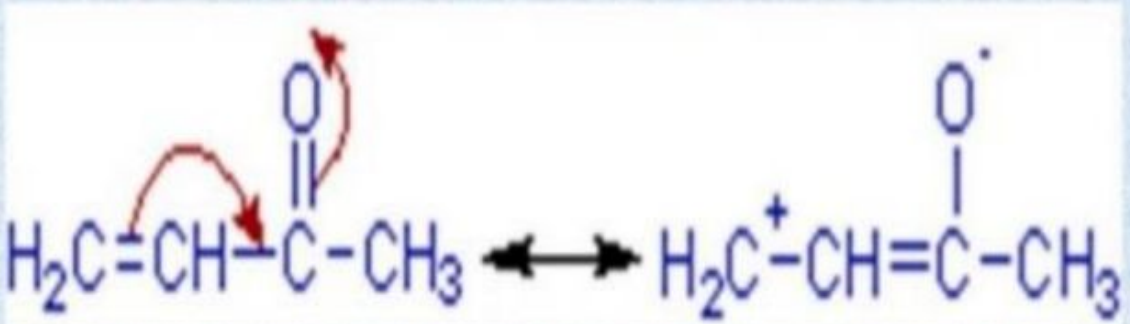


$—CH_2R$ $—CH_3$ anions and alkyl groups.

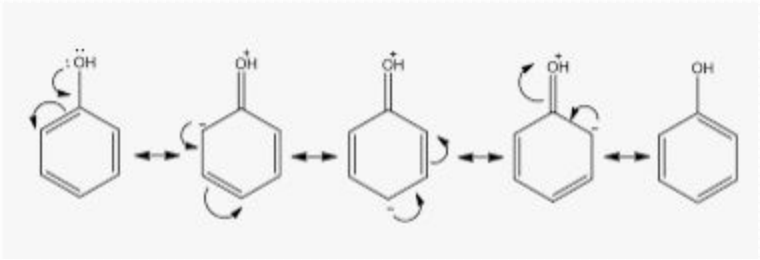
Resonance is a permanent polarisation of multiple bond. This is a polarisation effect.

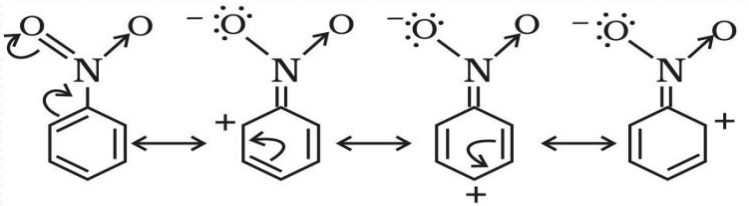
RESONANCE EFFECT OR MESOMERIC EFFECT :

The mesomeric effect is defined as the polarity produced in the molecule by the interaction of two π bonds or between a π bond and lone pair of electrons present on an adjacent atom. It is symbolized by M or R.

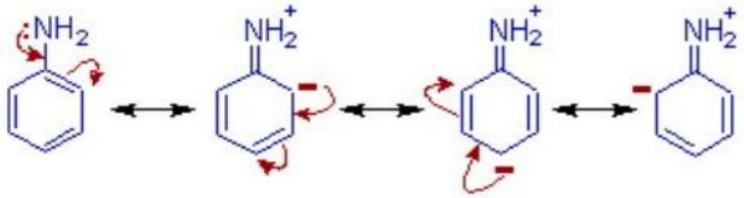


Resonance/Mesomeric effect may be classified as +R/+M and –R/-M effect.
eg. –OH group is having +R effect and activate the benzene ring in phenol. While –NO2 group provides –R effect and deactivate the benzene ring in nitrobenzene.

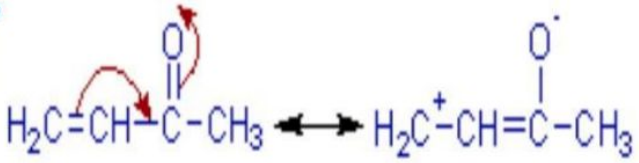




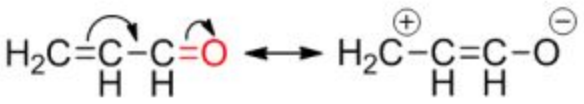
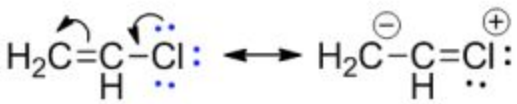
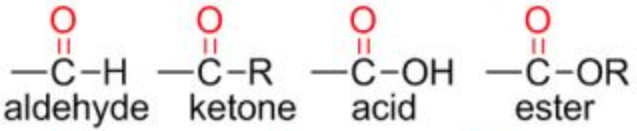
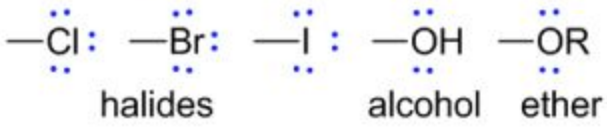
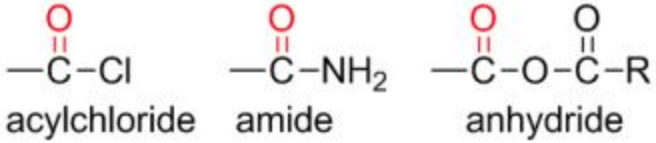
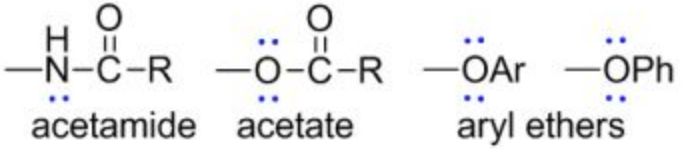
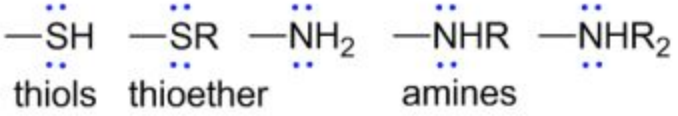
- The -NH_2 group in aniline also exhibits +R effect. It releases electrons towards benzene ring through delocalization.



1) The negative resonance effect (-R or -M) of carbonyl group is shown below. It withdraws electrons by delocalization of π electrons and reduces the electron density particularly on 3rd carbon.



Following are some groups exhibiting –M and +M effects

- Mesomeric Effect (-ME) π electrons are involved	+ Mesomeric Effect (+ME) non-bonding 'n' electrons are involved
	
 aldehyde ketone acid ester	 halides alcohol ether
 acylchloride amide anhydride	 acetamide acetate aryl ethers
 nitriles nitro sulfonic acid	 thiols thioether amines

Order of - Mesomeric Effect (-ME) electron withdrawing groups:
$-NO_2 > -CN > -S(=O)2-OH > -CHO > -C=O > -COOCOR > -COOR > -COOH > -CONH_2 > -COO^-$

Order of + Mesomeric Effect (+ME) electron donating groups:
$-O^- > -NH_2 > -NHR > -OR > -NHCOR > -OCOR > -Ph > -F > -Cl > -Br > -I$

Hyperconjugation

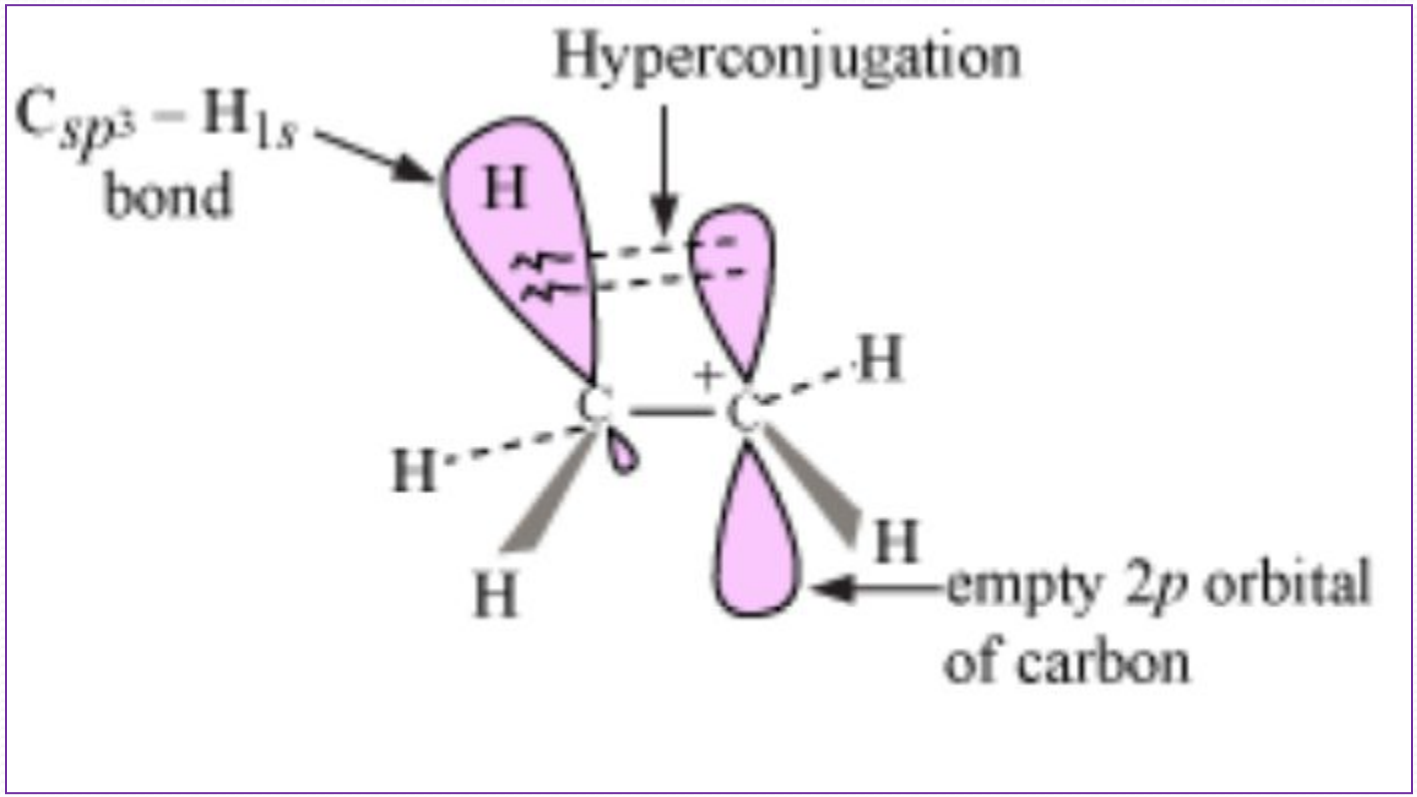
The electrons of the sigma bond between C and H are involved in delocalization.

In structure to the right: No bond between C and H due to migration of the sigma bond.

Hence Hyperconjugation is also called as 'NO BOND RESONANCE'.

This does not indicate that hydrogen is completely detached from the structure, but some degree of ionic character in the C – H bond and some single bond character between carbon – carbon double bond.

Orbital picture diagram of Hyperconjugation



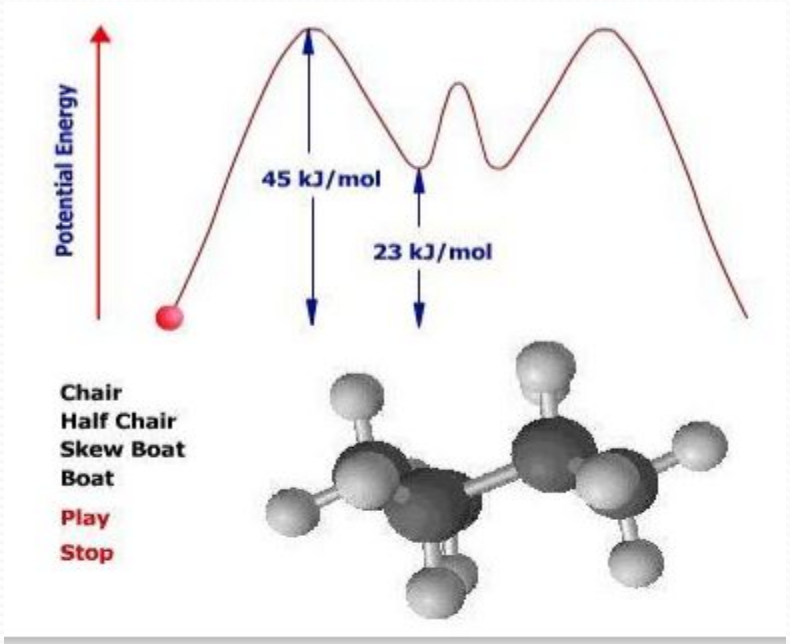
Difference between Hyperconjugation and Resonance

Hyperconjugation	Resonance
Hyperconjugation is the stabilization effect on a molecule due to the interaction between a sigma bond and a pi bond	Resonance is the stabilizing of a molecule through delocalization of bonding electrons in the pi orbital
Involves sigma bond orbitals and p orbitals or pi bond orbitals	Involves only pi bond orbitals
Causes the sigma bond length to be shortened	Has no effect on sigma bonds

Steric effect

When atoms in a molecule get too close together as parts of the molecule vibrate or rotate, electric repulsions between electrons may hinder some conformations and favor others (Steric effects).

Steric effects lead to conformations in which repulsions are minimized; this lowers the potential energy of the molecule (more stable).



Difference between Electronic effect and Steric effect

Electronic Effects	Steric Effects
Electronic effects are the effects of bonding electrons of a molecule on its structure and properties	Steric effects are the effects of nonbonding electrons of a molecule on its structure and properties
Bonding	Nonbonding
Influence the structure, reactivity, and properties of a molecule	Influence the conformation and reactivity