

G1OC organic Reaction

Reactant
(old bonds are broken)

product
(new bonds are formed)

Substrate
(Species on which reagent
is attacking)

Reagent
(Species which
attacks on
Substrate)



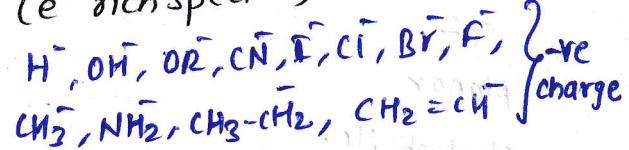
Substrate Reagent

nucleophile

(nucleus lover)

(+ve charge lover)

(e⁻ rich species)

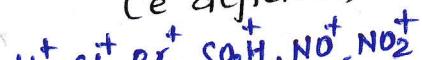


Electrophile

(e⁻ lover)

(-ve charge lover)

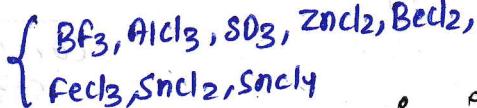
(e⁻ deficient)



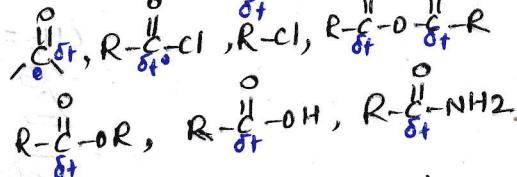
free charged
electrophile



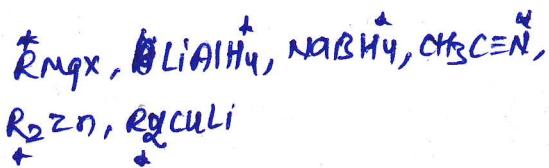
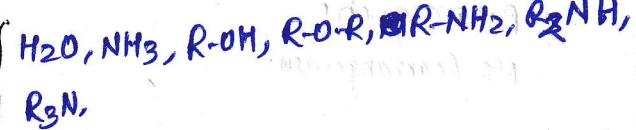
e⁻ def.
(Lewis acid)



e⁻ def.



Lewis
base
e⁻ rich



- free radical is also a electrophile,
- H_3O^+ & NH_4^+ are not electrophile

complete
octet.

Bond cleavage

Homolytic

Bond pair e^- is equally distributed
to both atoms & free radical forms



condition

- High temp
- presence of heat or UV rays
- peroxide
- nonpolar solvent
- Substrate

Heterolytic

Bond pair e^- shifts toward
more electronegative atom &
cation/anion forms.



condition (given B is more en)

- Low temp
- presence of Polar Substrate
- Polar solvent

Reaction Intermediate

- Carbon free radical
- Carbocation
- **Carbanion**
- Carbene
- Nitrene } *
- Benzyne

Carbon free radical



Homolytic cleavage

Incomplete octet



$+M, +H, +I \rightarrow$ stable

sp^2

planar

electrophile

paramagnetic

NO Rearrangement

Carbocation



Heterolytic

Incomplete octet



$+M, +H, +I \rightarrow$ stable

sp^2

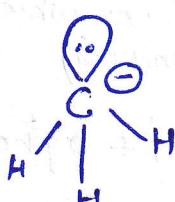
planar

Lewis acid / electrophile

Diamag—

Rearrangement possible.

Carbanion



Heterolytic

Complete octet



$-M, -H, -I \rightarrow$ stable

sp^3

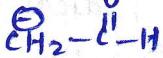
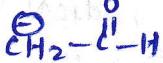
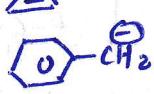
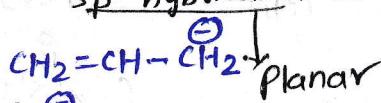
non planar
(pyramidal)

Lewis base / nucleophile

Diamag—

NO Rearrangement

Carbanion can be
 sp^2 hybridized also



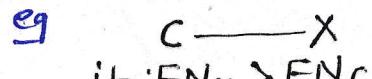
Electronic displacement effect

- ① Inductive effect
- ② Resonance or mesomeric effect \rightarrow Permanent effect
- ③ Hyperconjugation effect
- ④ Electromeric effect \rightarrow Temporary effect

Inductive effect

- Shifting of σ electron towards more electronegative atom's I effect
- it only works for σ bond not π bond.
- effective upto 3 carbon (distance dependent) • I effect \propto distance

\rightarrow I effect

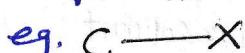


if $EN_x > EN_c$

X shows -I effect

(e^- withdrawing grp)

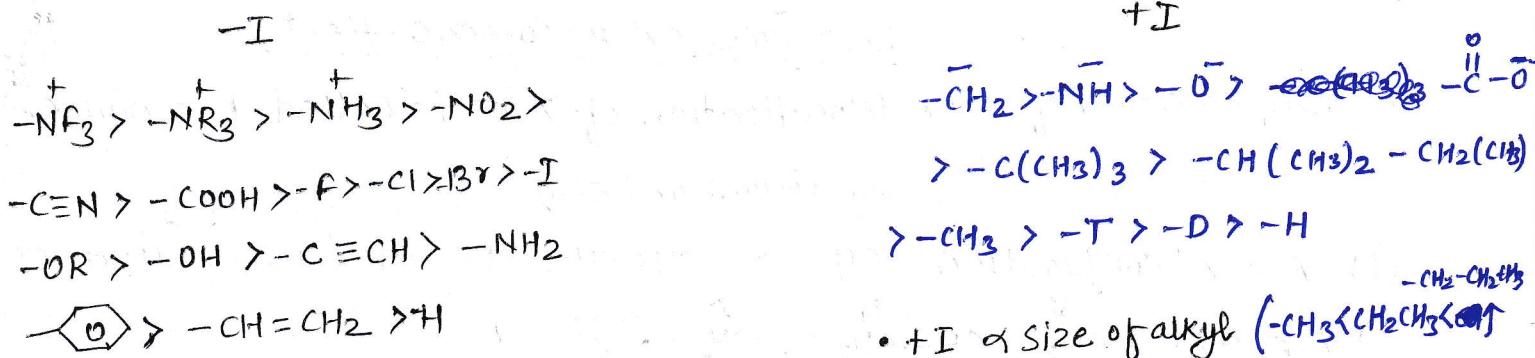
+I effect



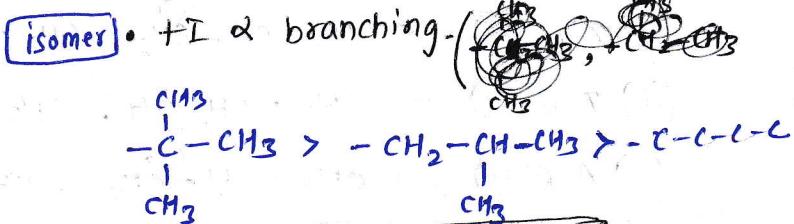
if $EN_x < EN_c$

X shows +I effect.

(e^- donating grp)

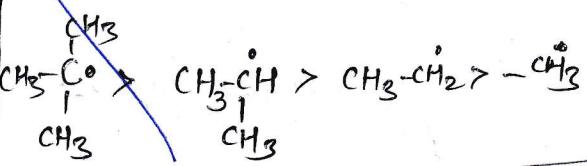
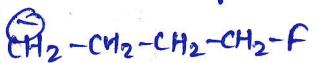
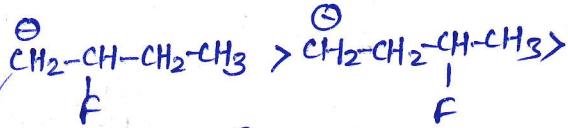
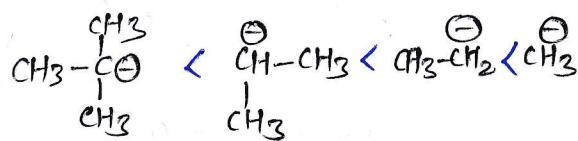
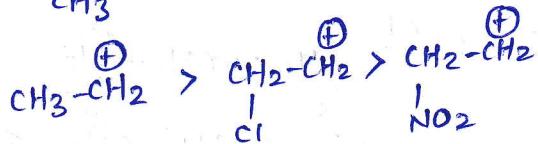
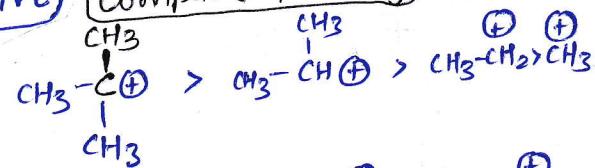


$$\text{EN} \left\{ \begin{array}{l} \text{sp}^3 \text{C} \rightarrow 2.5 \\ \text{sp}^2 \text{C} \rightarrow 2.75 \\ \text{sp C} \rightarrow 3.25 \end{array} \right.$$

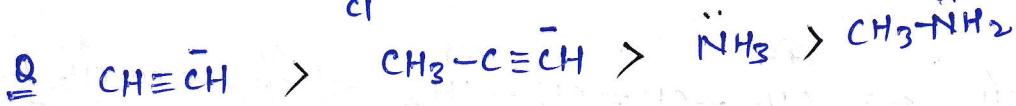
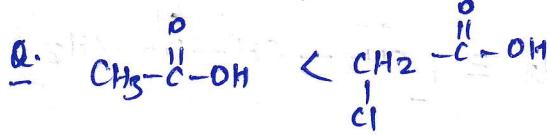
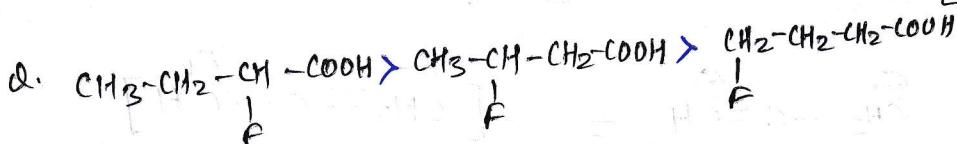
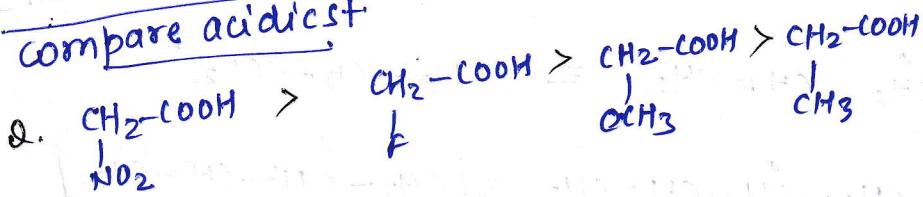


Application of inductive

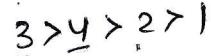
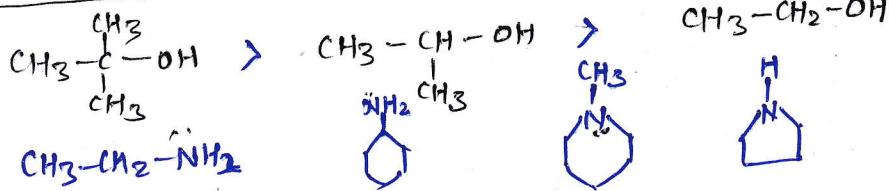
Compare stability



Compare acidic st



Compare basic st



amine gas



aq phase



Resonance or mesomeric effect

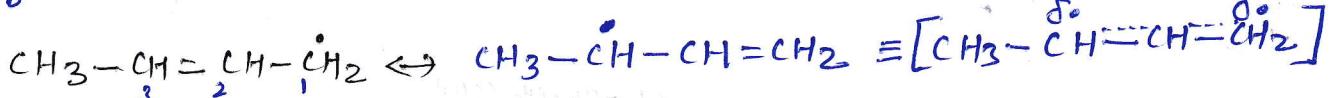
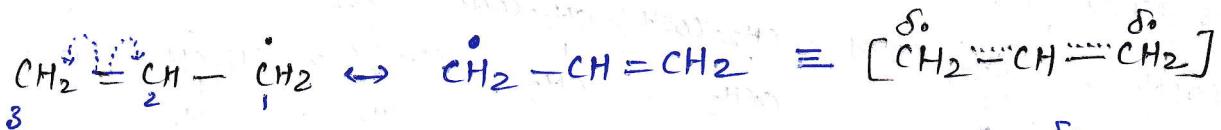
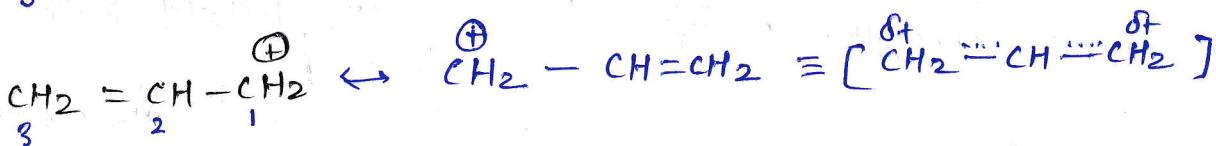
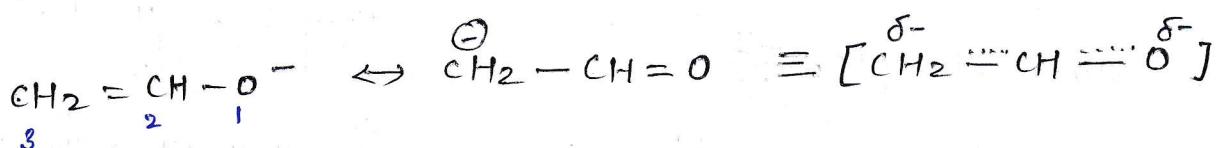
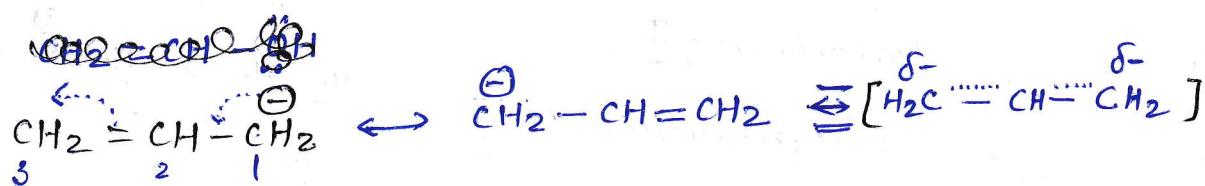
- Complete transfer or delocalization of πe^- is called Resonance.

Condition for Reso

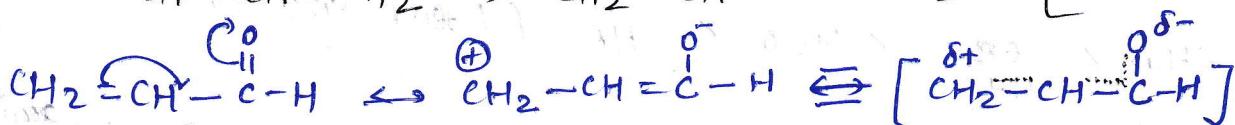
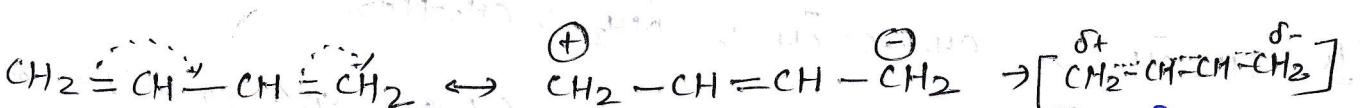
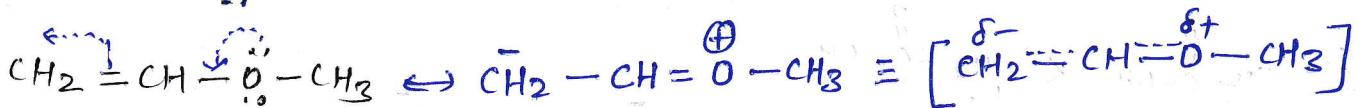
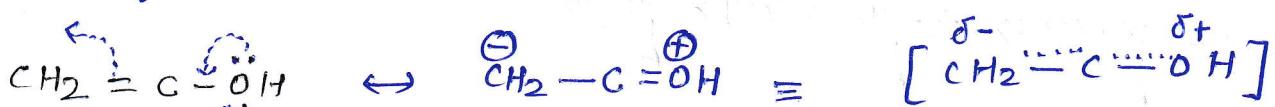
- ① $\pi \sigma \pi$ Conjugation $\rightarrow \text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2, \text{CH}_2=\text{CH}-\overset{\oplus}{\text{C}}-\text{H}, \text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}_2$
- ② $\pi \sigma \oplus \ominus$ $\rightarrow \text{CH}_2=\text{CH}-\overset{\oplus}{\text{CH}}_2, \text{CH}_2-\overset{\oplus}{\text{C}}-\text{H}$
- ③ $\pi \sigma \ominus \ominus$ $\rightarrow \text{CH}_2=\text{CH}-\overset{\ominus}{\text{CH}}_2, \text{CH}_2=\text{CH}-\overset{\ominus}{\text{O}}$
- ④ $\pi \sigma \ominus \oplus$ $\rightarrow \text{CH}_2=\text{CH}-\overset{\ominus}{\text{O}}\text{H}, \text{CH}_2=\text{CH}-\overset{\ominus}{\text{O}}-\text{CH}_3, \text{CH}_2=\text{CH}-\overset{\oplus}{\text{C}}$
- ⑤ $\pi \sigma \ominus \ominus$ $\rightarrow \text{CH}_2=\text{CH}-\overset{\ominus}{\text{C}}\text{H}_2, \text{CH}_3-\text{CH}=\text{CH}-\overset{\ominus}{\text{C}}\text{H}_2$
- ⑥ $A-\overset{\oplus}{\text{B}}/\overset{\ominus}{\text{B}} \rightarrow A=B$ eq. $\text{CH}_2-\overset{\oplus}{\text{O}}\text{H} \rightarrow \text{CH}_2=\overset{\oplus}{\text{O}}\text{H}$

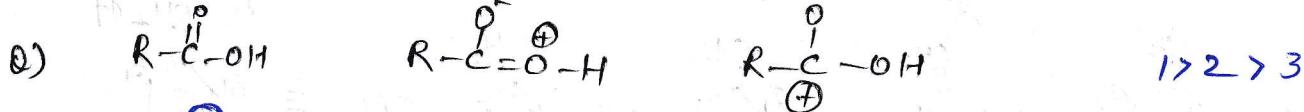
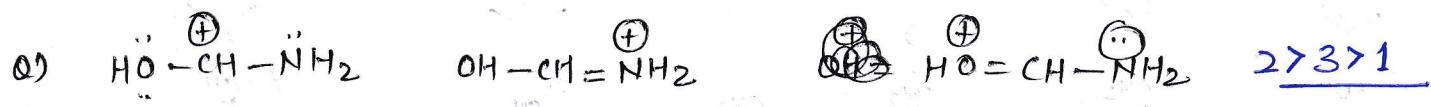
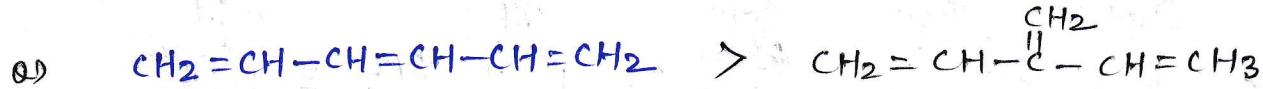
Rules to draw Resonating str

Case 1

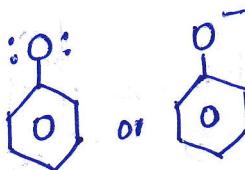


Case 2





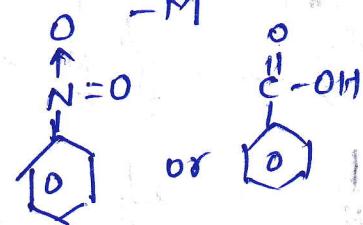
Mesomeric effect



Electron releasing group

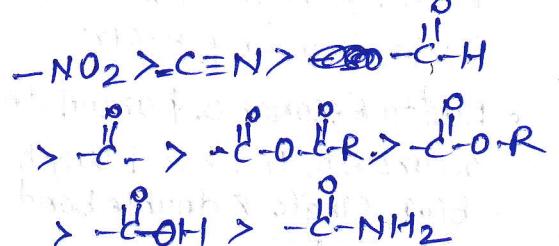
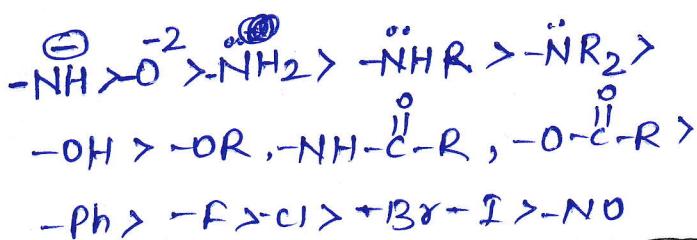
$\uparrow e^-$ density of Ring

O/P directing



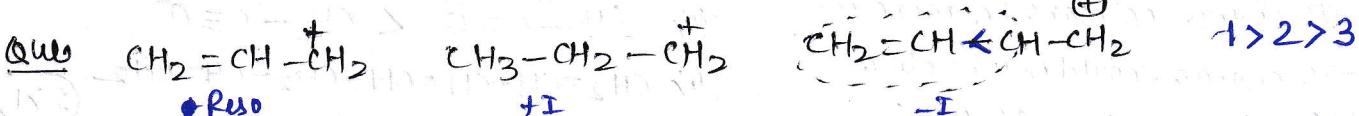
e^- withdrawing group

$\downarrow e^-$ density of Ring
meta directing

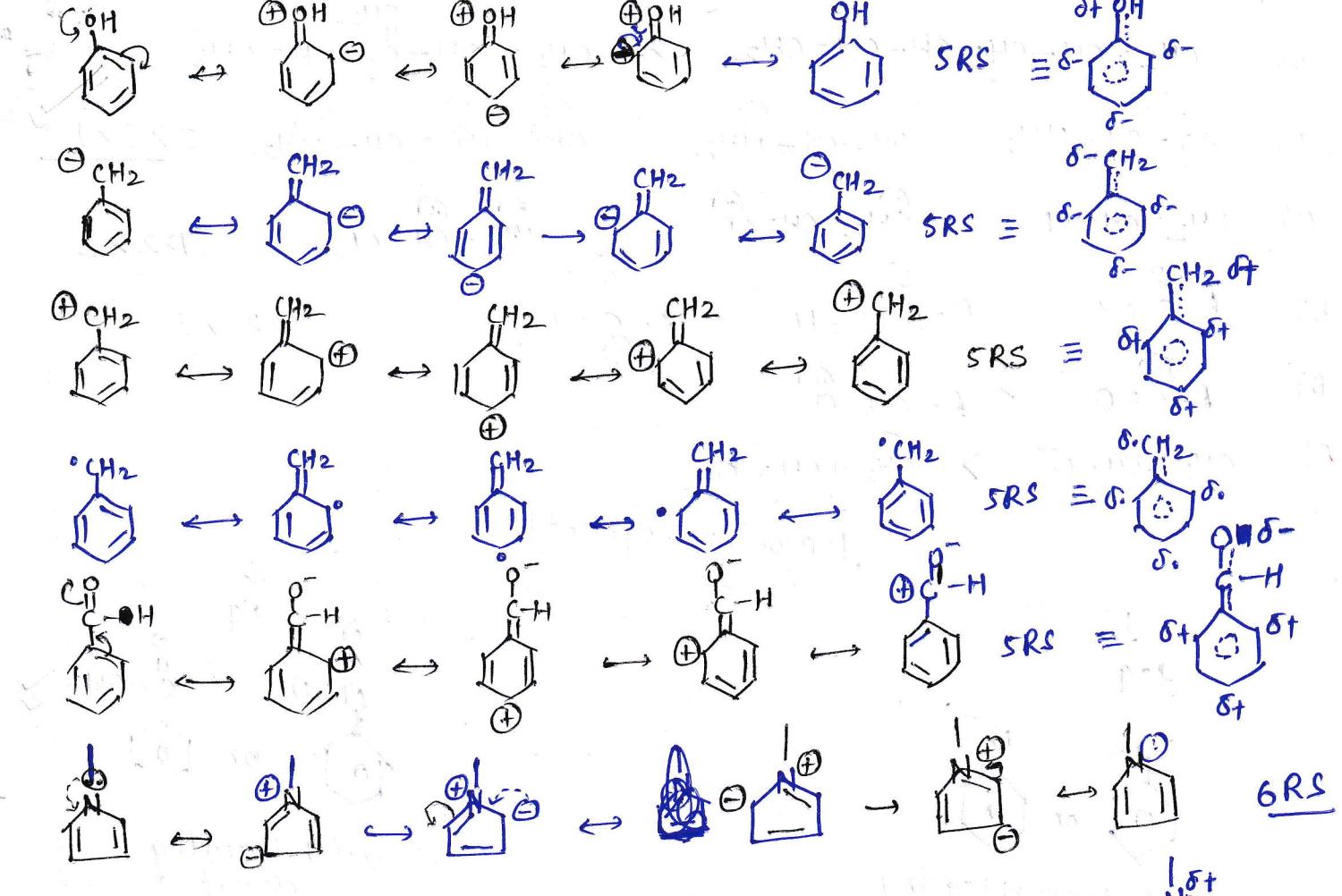


Application of Mesomeric

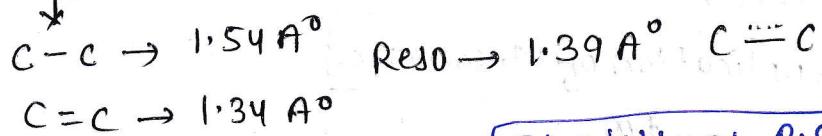
- ① Stability of Carbocation $\alpha \frac{+m}{-m}$
- ② " " Carbanion $\alpha \frac{-m}{+m}$
- ③ " " Carbon free radical $\alpha \frac{+m}{-m}$
- ④ Acidic str $\alpha \frac{-m}{+m}$
- ⑤ Basic str $\alpha \frac{+m}{-m}$



$2 > 1 > 3$



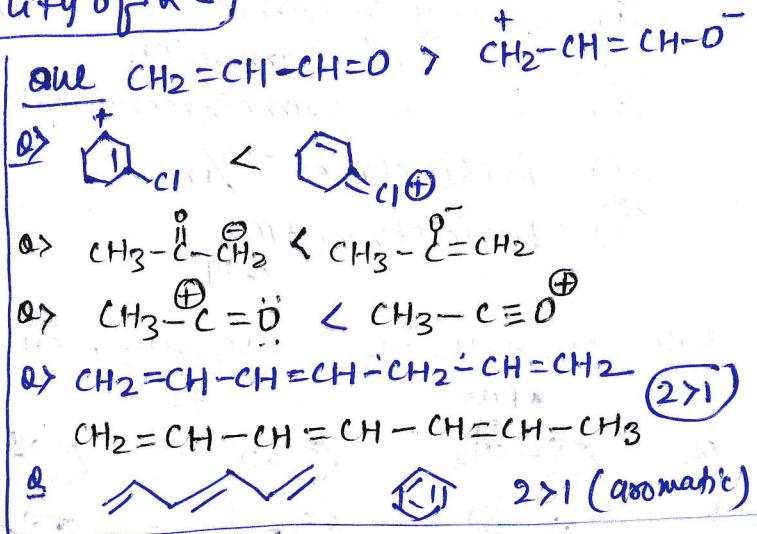
- Resonating str are hypothetical
only Resonance hybrid is real.
- Resonance hybrid is more most
stable than any R-Str
- Due to Resonance partial double bond
occurs. So, the bond length lies
b/w Single & double bond.

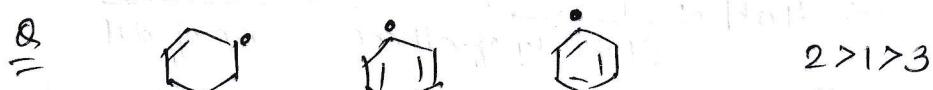


Stability of R-S

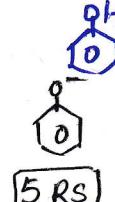
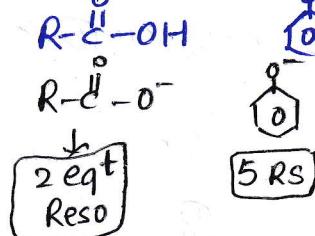
PION

- ① more pi bond more stable RS.
- ② octet complete "
- ③ Neutral "
- ④ -ve charge on more En more .."
- ⑤ { 2 -ve charge should not be close
2 +ve "
- ⑥ 2 opposite when more closer is more stable,
- ⑦ more conjugation is more stable
- ⑧ for equal conjugation aromatic is more stable. ⑧ Linear conjugation is more stable than cross.



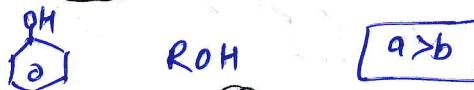


que Compare Acidic str

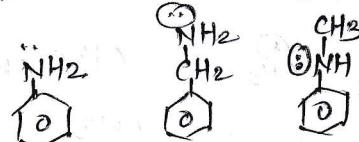


$\boxed{1 > 2}$

que Compare A. str

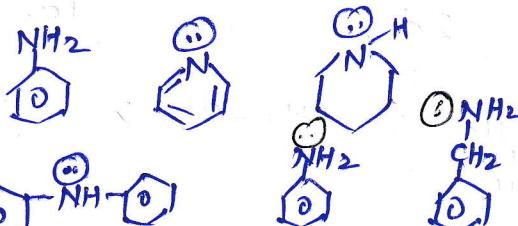


que compare Basic str



$2 > 3 > 1$

que



$3 > 2 > 1$

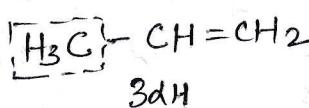
que



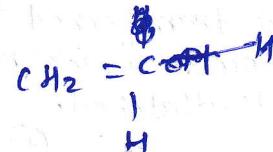
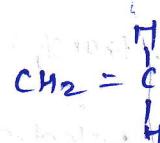
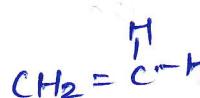
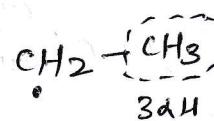
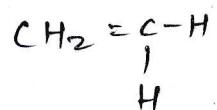
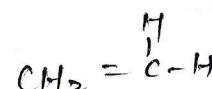
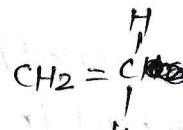
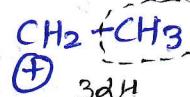
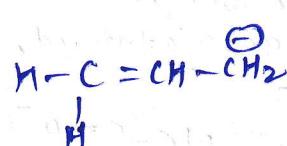
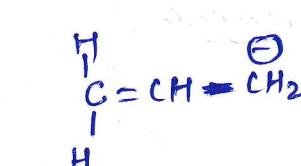
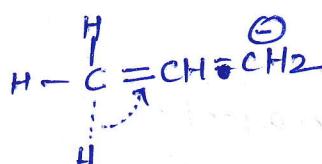
$3 > 2 > 1$

Hyperconjugation

• Complete transfer of C-H bond or electron towards \oplus , \bullet , Pibond's H-C effect
• dH must be present.



3dH



no of dH = no of H-C str

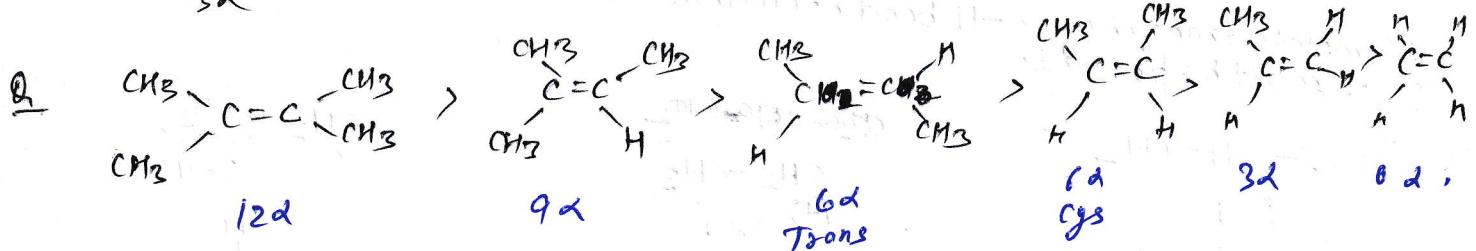
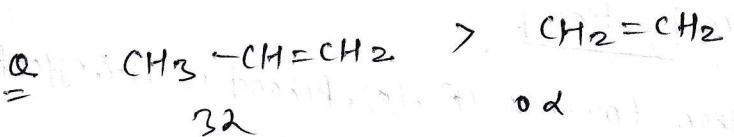
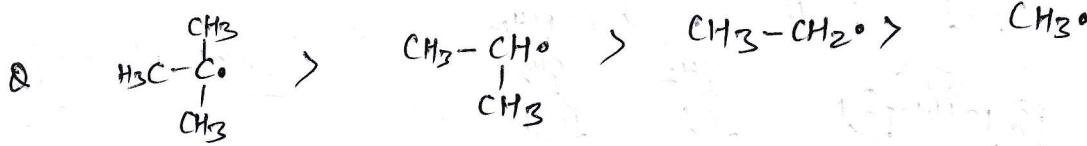
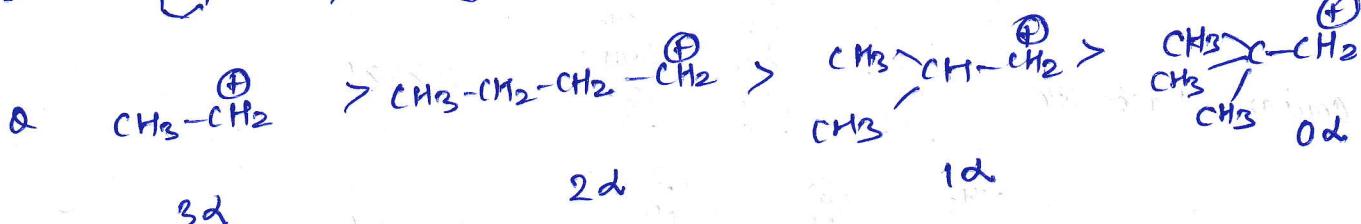
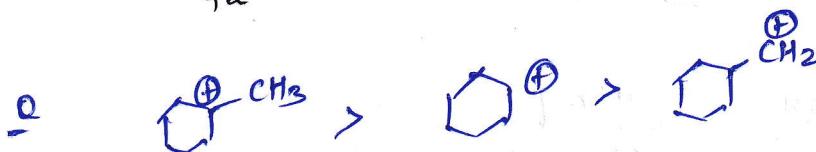
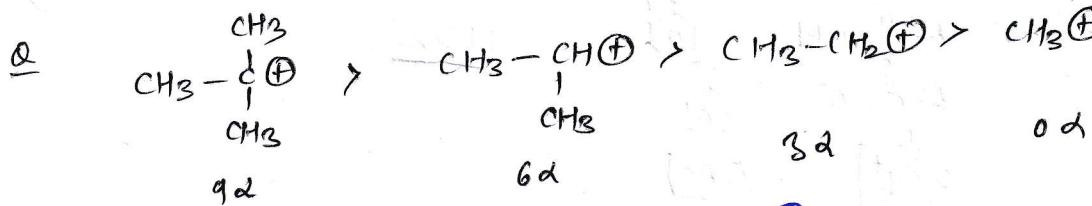
more dH more stability.

Application of H⁺ conjugation

• Stability of Carbocation → more dH → more stable



• Heat of Hydrogenation → $H_oH \propto \frac{1}{\text{Stability of alkene}} \propto \frac{1}{\text{no of dH}}$

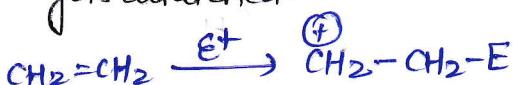


(Electromeric effect)

complete transfer of πe^- of multiple bond in presence of reagent

↓
taelectromeric

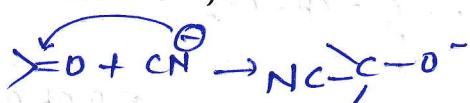
πe^- of multiple bond
are transferred to that
atom to which reagent
gets attached.

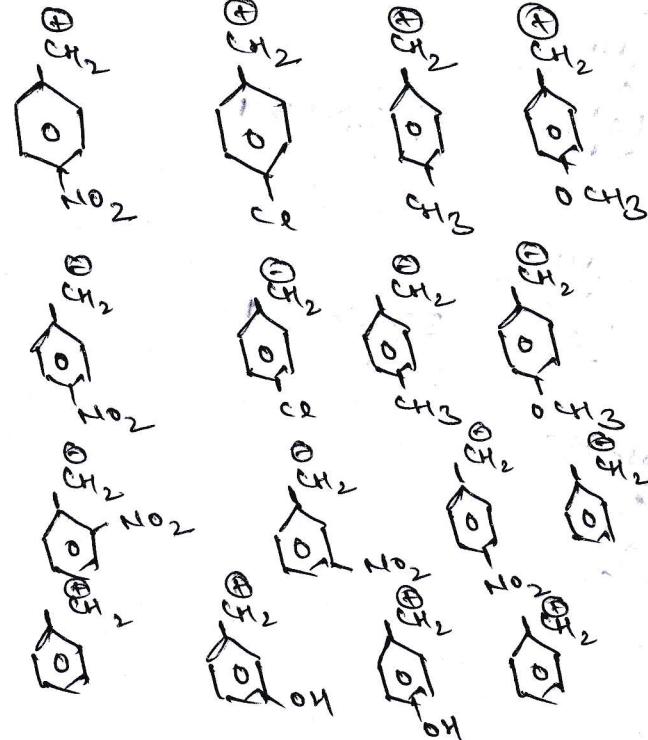


→ electromeric

πe^- of

to which reagent
donot gets attached.





Stability order.

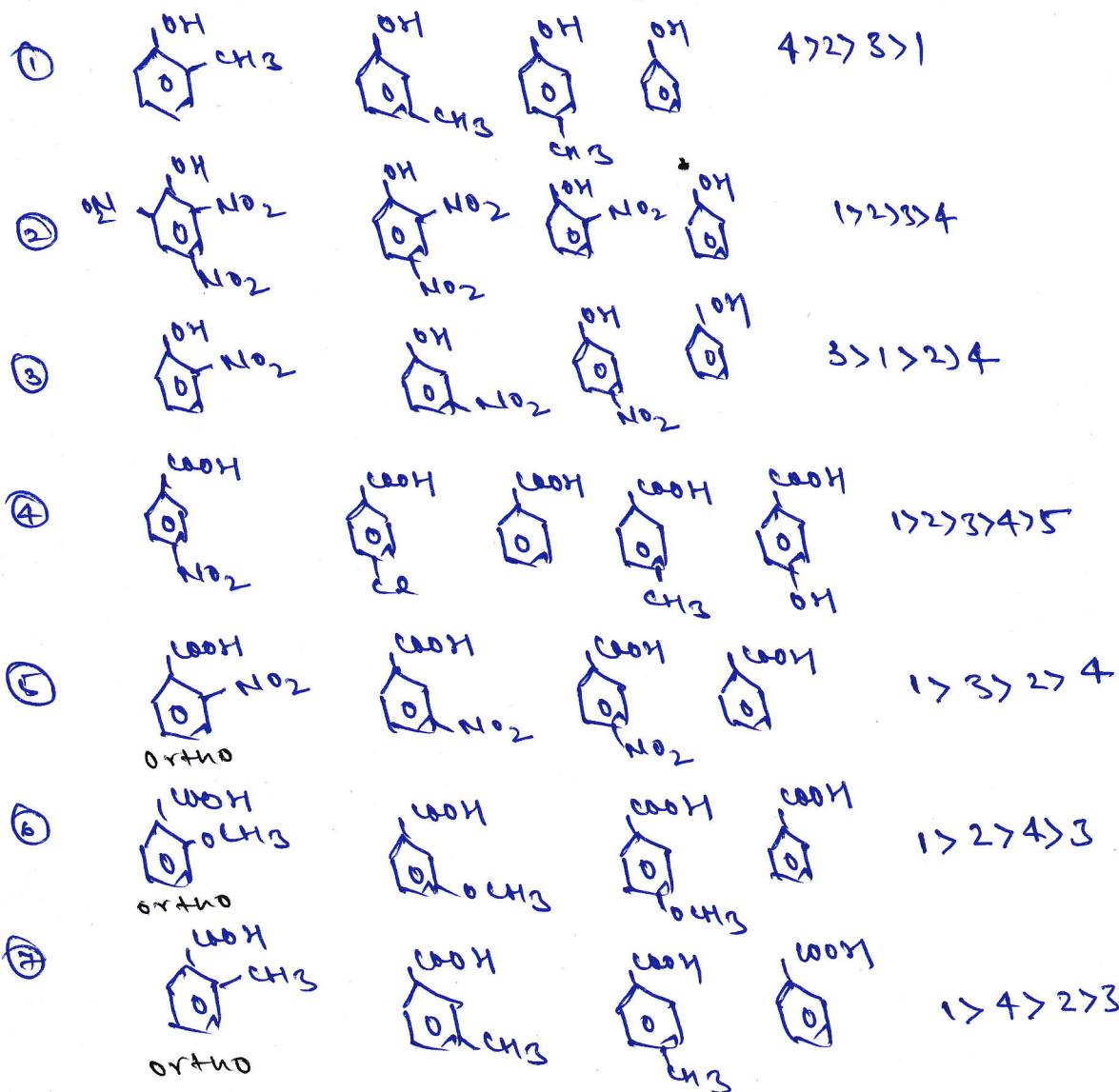
4 > 3 > 2 > 1

1 > 2 > 3 > 4

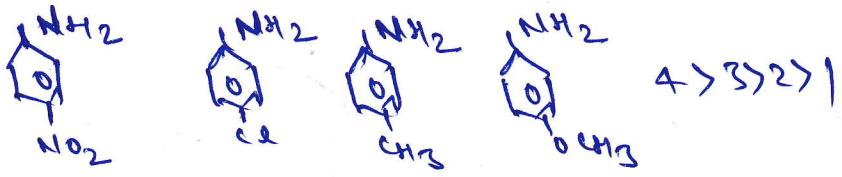
1 > 3 > 2 > 4

3 > 1 > 4 > 2

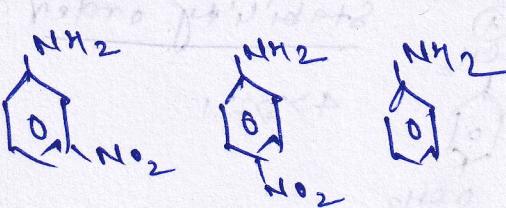
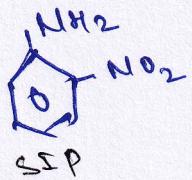
* compare acidic strength.



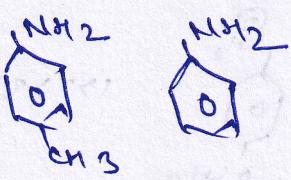
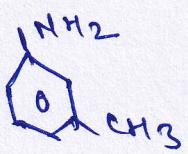
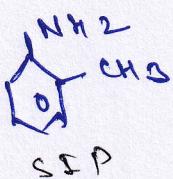
* compare basic strength.



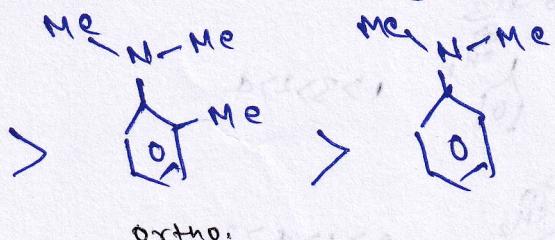
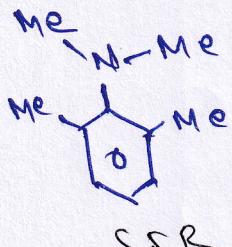
4 > 3 > 2 > 1



4 > 2 > 3 > 1



3 > 2 > 4 > 1



Ortho.

Nitro group electron-withdrawing

1 < 2 < 3

100

100

100

100

200

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Aromatic

C
R
Op

- cyclic
- planar
- Complete Resonance in cycle
- Huckel's Rule
($4n+2\pi e^-$)
- $2\pi e^-$, $6\pi e^-$, $10\pi e^-$, $14\pi e^-$
1 pair 3 pair 5 pair 6 pair

Aromaticity

Anti Aromatic

Cyclic

Resonance

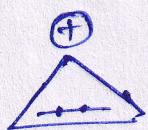
• $4\pi e^-$

• $4\pi e^-, 8\pi e^-, 12\pi e^-, 16\pi e^-$

— 2 pair 4 pair 6 pair 8 pair

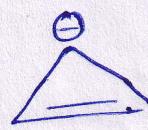
C
R
Op

~~Anti-Aro~~ Non-Aromatic \rightarrow Rest of them.



C
R
Op

Aro-



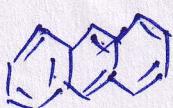
C
R
Op

AA



C
R
Op

AA



C
R
Op

Ar-



C
R
Op

Ar-



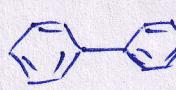
C
R
Op

Ar-



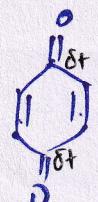
C
R
Op

Ar-



C
R
Op

AA



C
R
Op

AA



C
R
Op

AA



non Aromatic