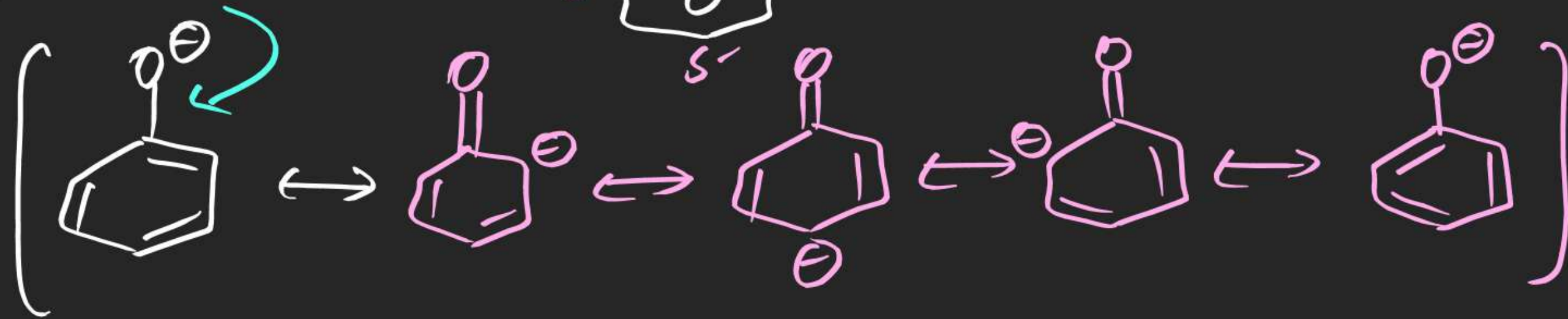


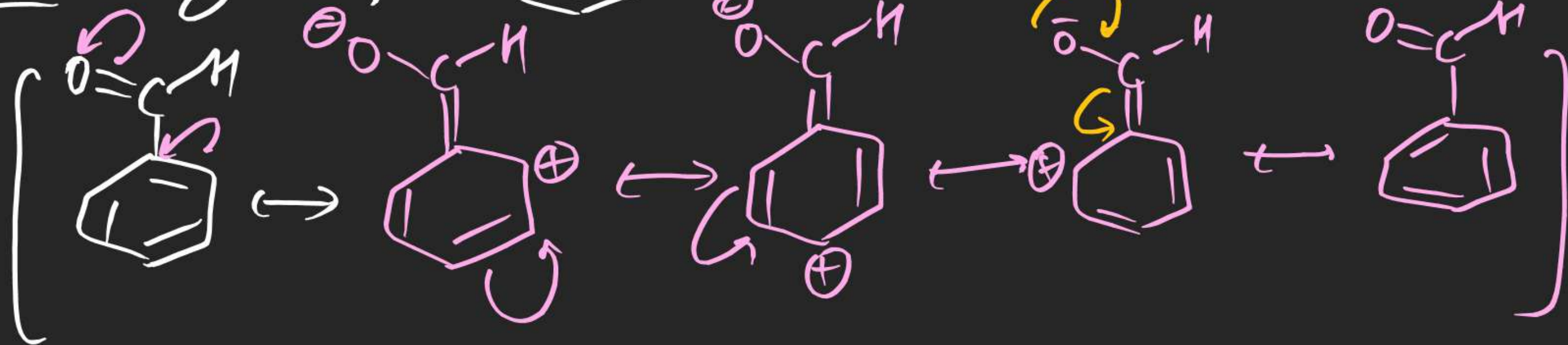
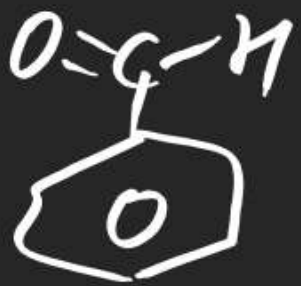
Ex! Phenoxide Ion



Note

+R series

Ex! Benzaldehyde



- R series :



⇒ Order of Rate of electrophilic attack.



Activating Compounds: All compounds which show higher rate of electrophilic substitution than Rate of electrophilic substitution of Benzene, are known as Activating Compounds.

Highly Activating Groups  
 $-\text{NR}_2, -\text{NHR}, -\text{NH}_2, -\text{OH}, -\text{O}^\ominus$   
 $-\text{CH}_2^\ominus, -\text{OR}$  FR

Moderately Activating Groups  
 $-\text{N}(\text{H})-\text{C}(\text{H})_2-\text{CH}_3$  /  $-\text{O}-\text{C}(\text{H})_2-\text{CH}_3$   
FR

Weakly Activating Group  
 $-\text{CH}_3, -\text{CH}_2-\text{CH}_3, -\text{C}(\text{CH}_3)_3$   
 $-\text{C}(\text{CH}_3)_3$  FR



Note:

EDG



( $\sigma^- e^-$  +  $\pi^- e^-$ )

I effect    R effect

EDG:

+R & +I

Compound Activating

[+R > -I]

+R & -I

Compound Activating

-R & -I

Compound deactivating

-R & +I

Compound deactivating (Hypothetical Combination)

\* \* \* \*

\* [ +R < -I ]

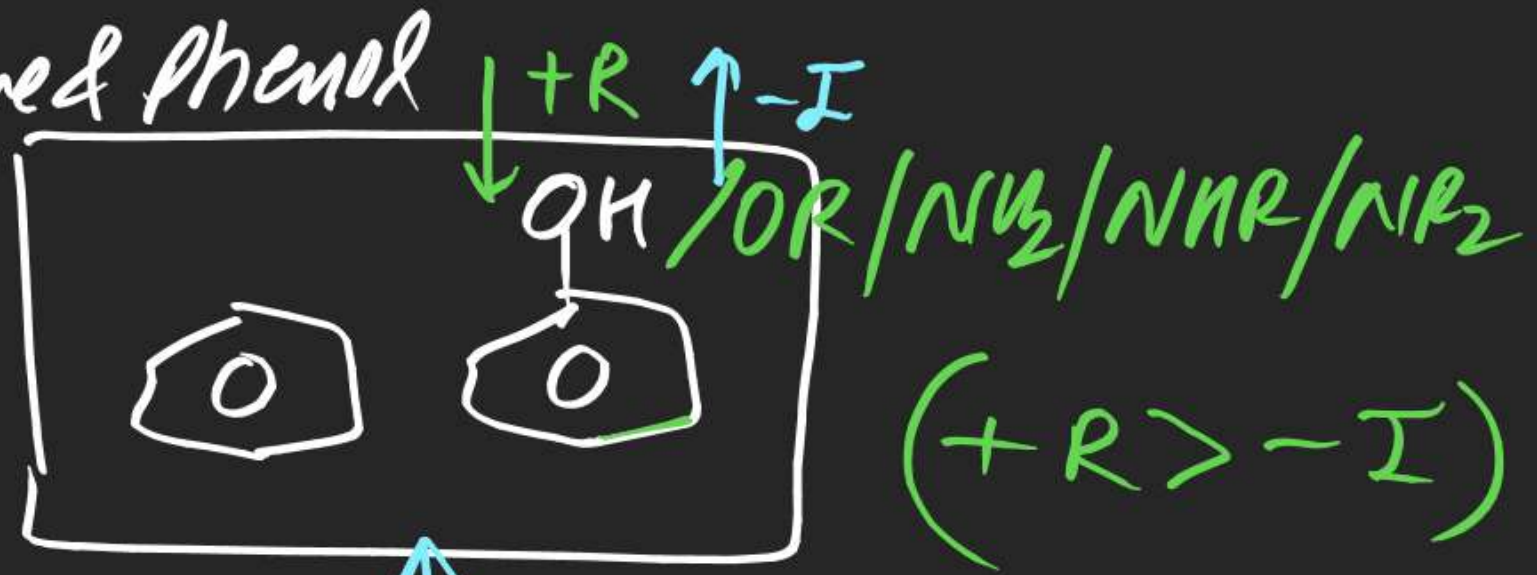
+R & -I

Compound Deactivating

(In Case of halogens)

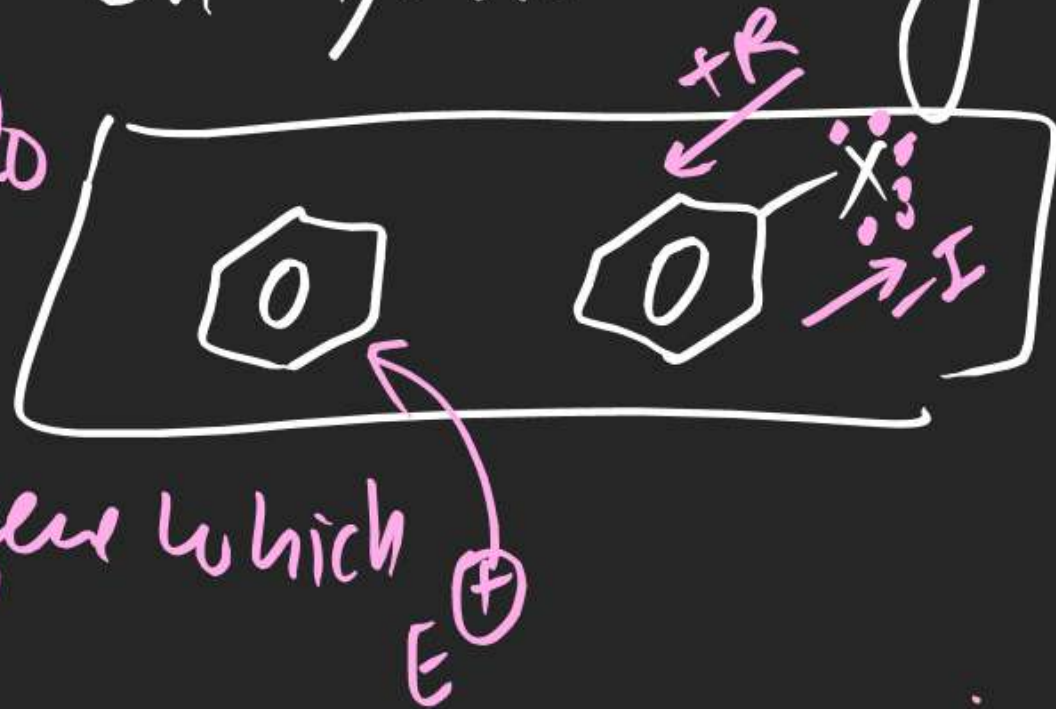
\* \* \* \*

(ii) out of Benzene & Phenol  
Electrophile  
prefer to  
attack on  
phenol, it means



$+R$  effect of  $-OH$  is dominating over  $-I$  effect of  $OH$

(iii) out of Benzene & halo  
Benzene, Electrophile  
prefer to attack on Benzene which  
means

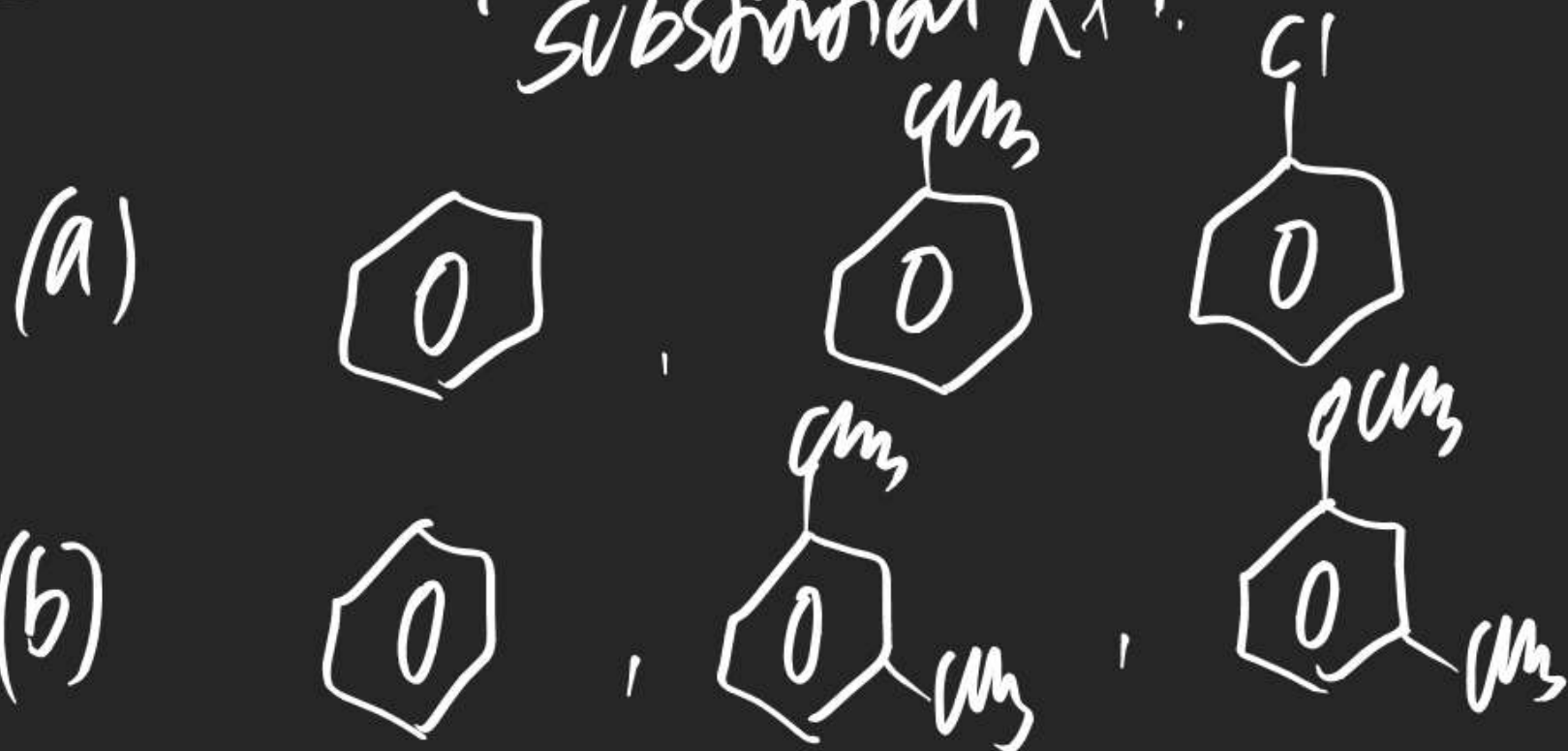




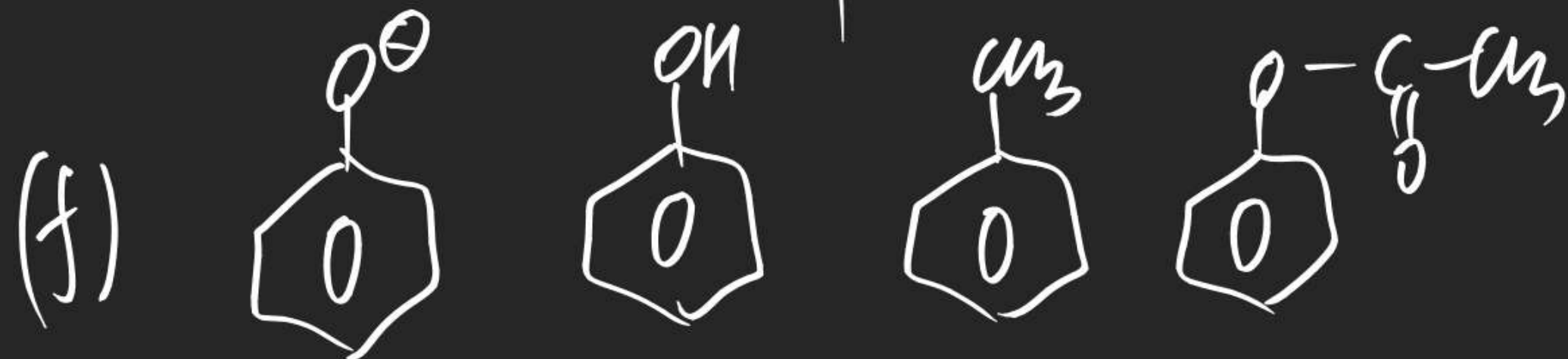
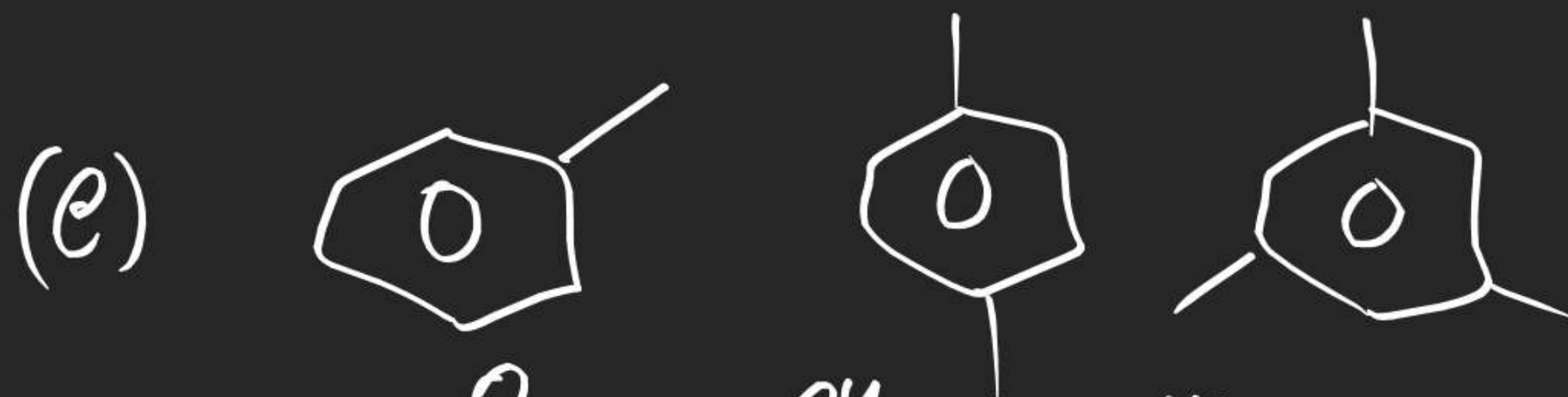
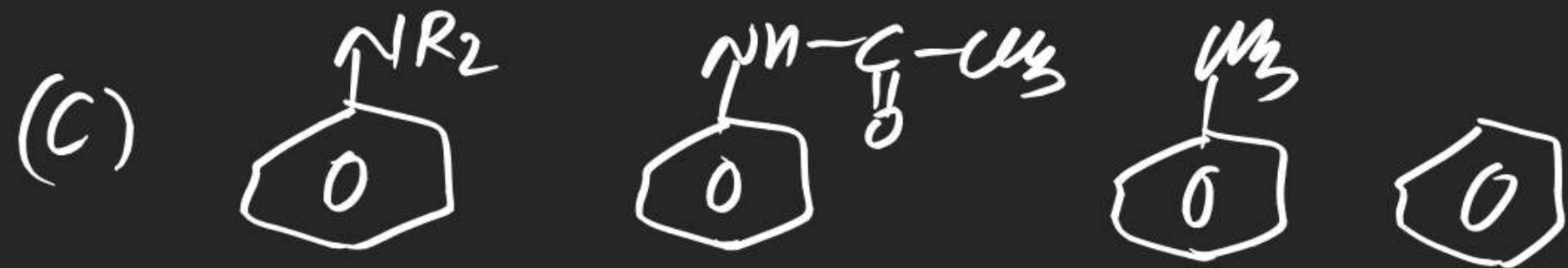
For haloBenzene:

$-I \text{ effect of "X"} > +R \text{ effect of "X"}$  For rate of Electrophilic Substitution  
 $+R \text{ effect of X} > -I \text{ effect of X}$  For orientation of electrophile

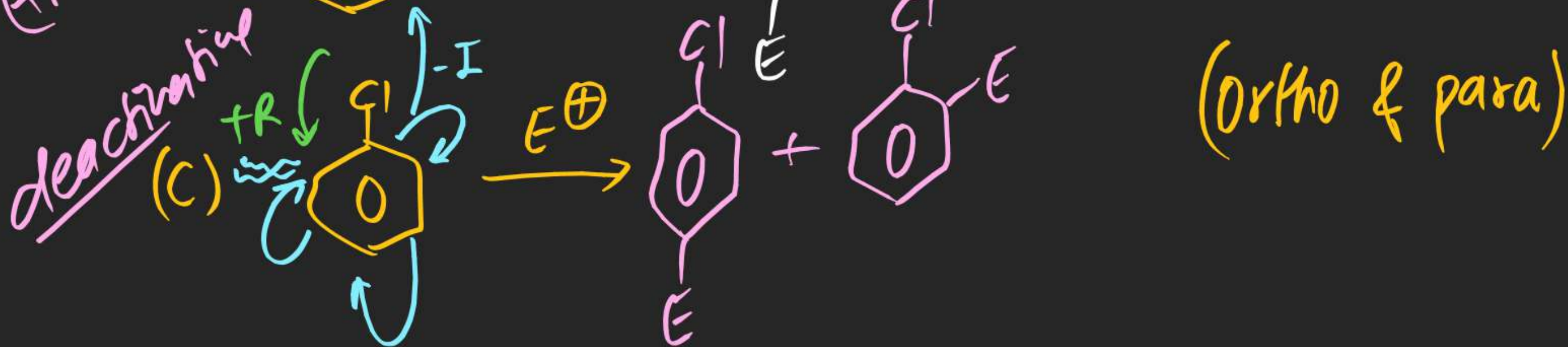
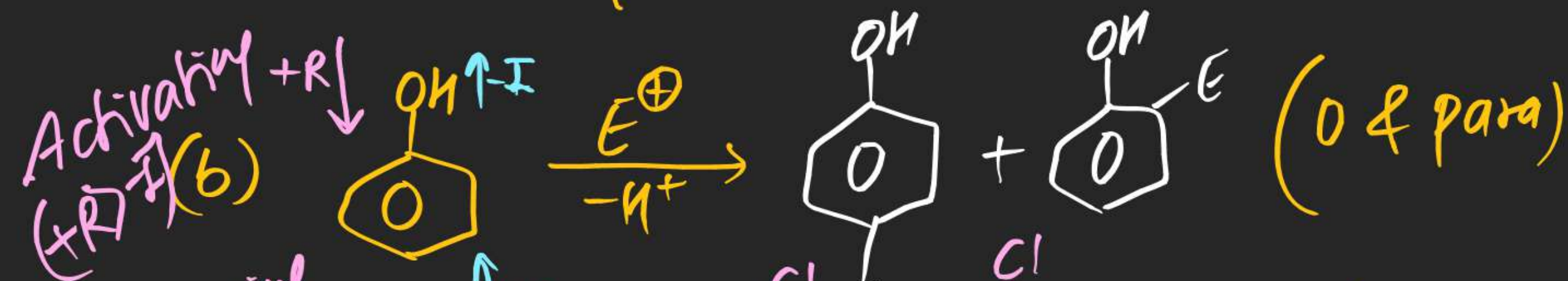
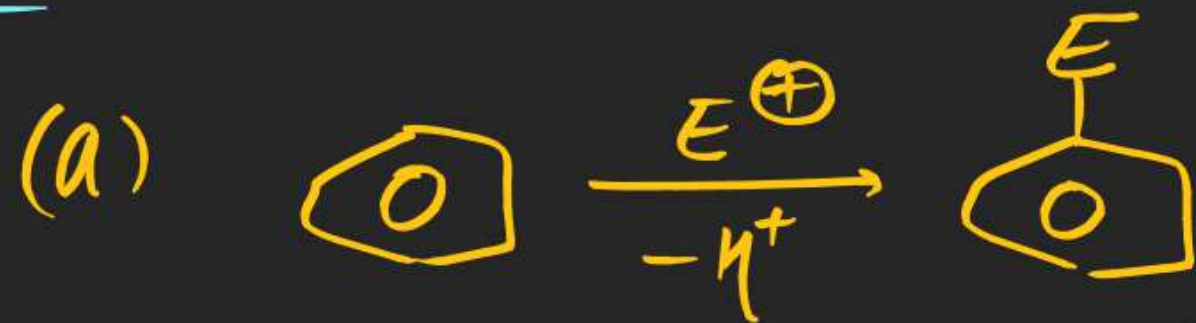
Ex: ① Arrange following in decreasing order of rate of electrophilic substitution Rxn.



$II > I > III$



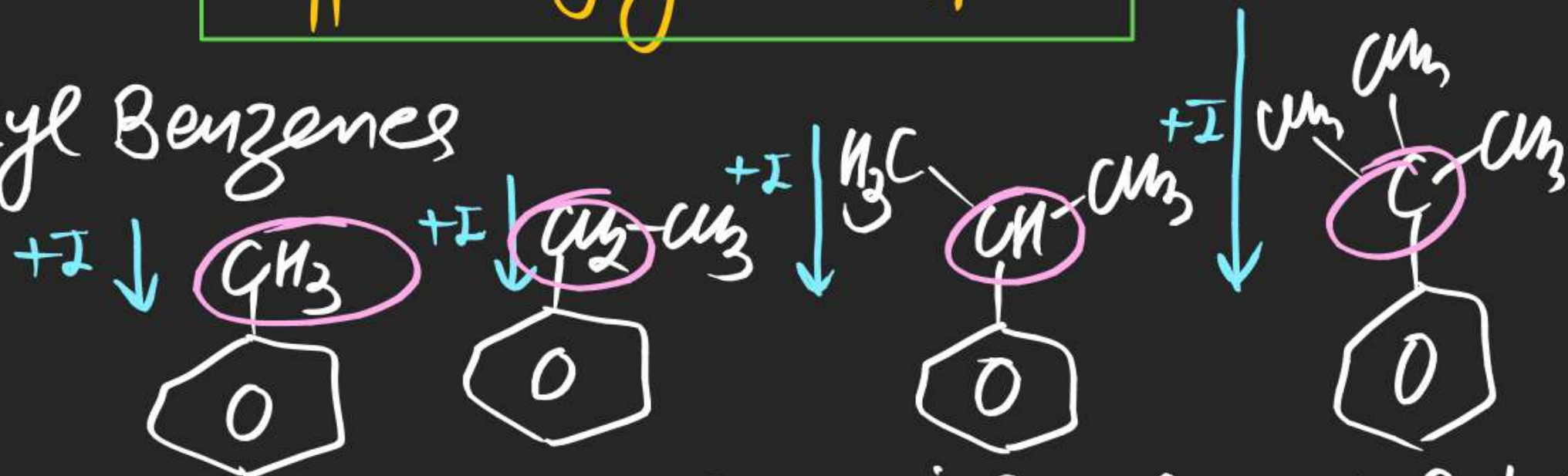
Ex-2 write product of following Reaction





# HyperConjugation effect

for alkyl Benzenes



Nathan  
Baker

Toluene  
(A)

Ethyl  
Benzene  
(B)

i-Propyl  
Benzene  
(C)

t-Butyl  
Benzene  
(D)

order of rate of electrophilic substitution should be

जितना <sup>29</sup> ~~X~~ D > C > B > A [Acc. to +I effect]

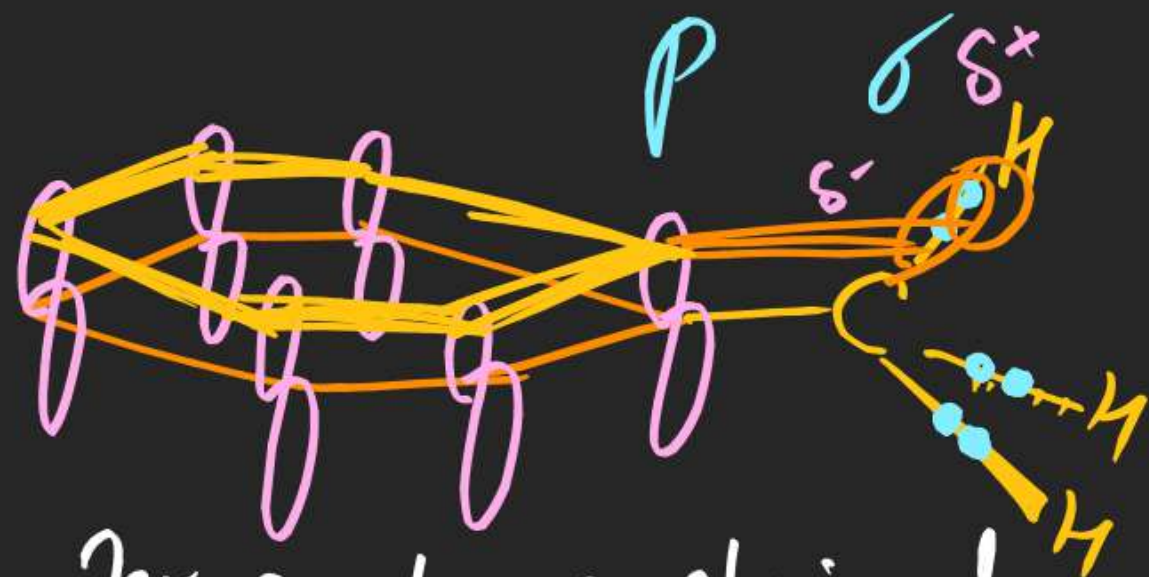


⇒ But Experiment shows actual order  
of Rate of electrophilic attack is

सही है



(due to effect)

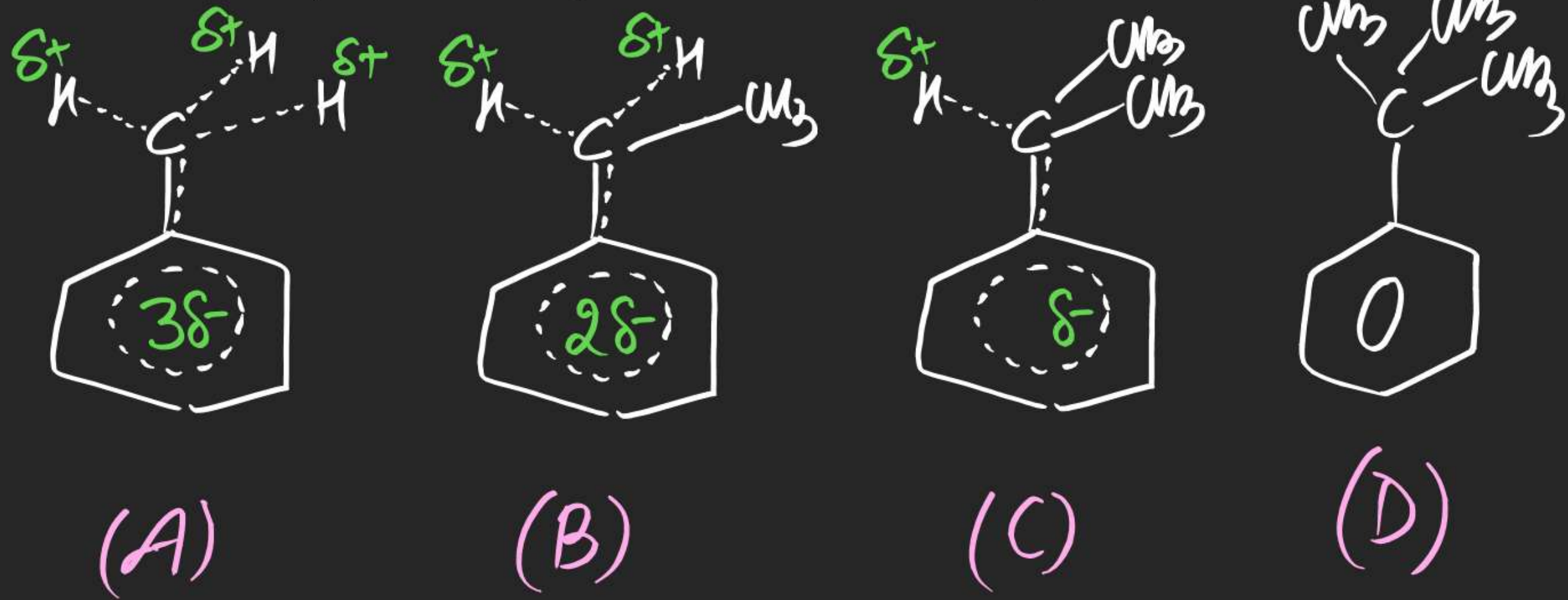


$$BO(C-H) \in (0, 1)$$

this order can be explained by overlapping b/w "p" orbital of Benzene with  $\sigma$  orbital of C-H Bond of directly attached alkyl group.



higher the No. of such  $\text{>C-H}$  Bonds higher would be such



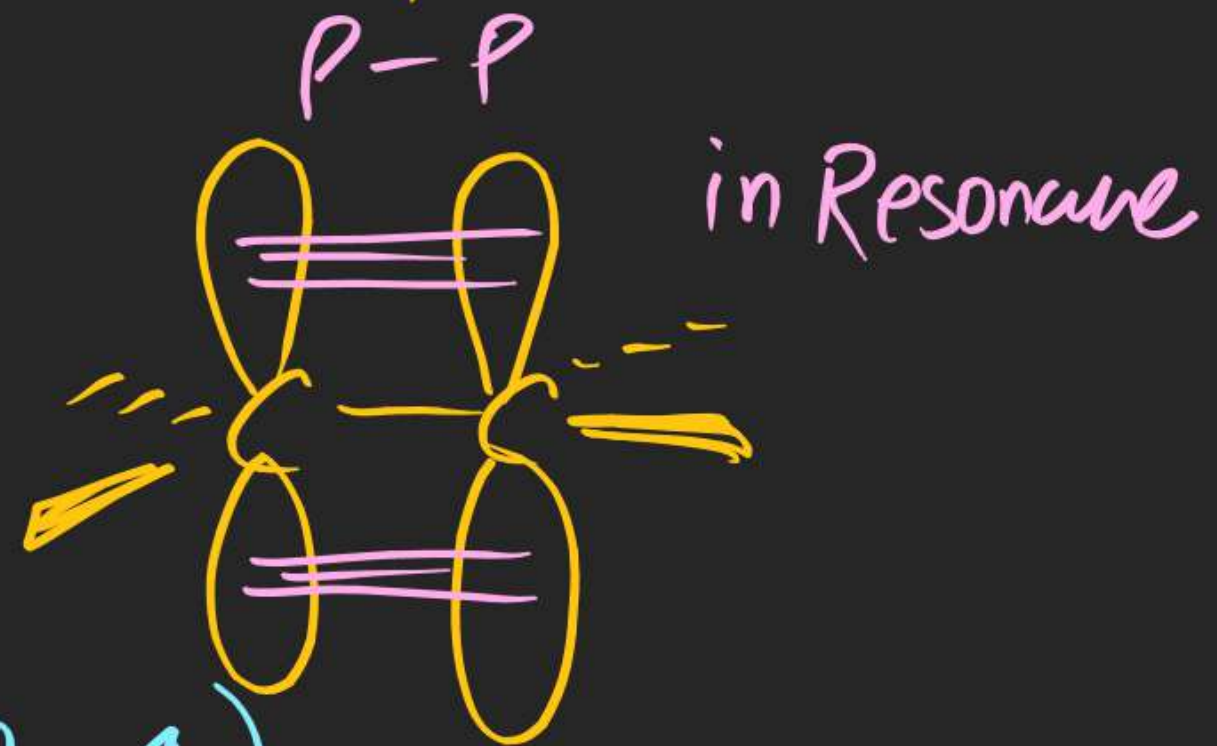
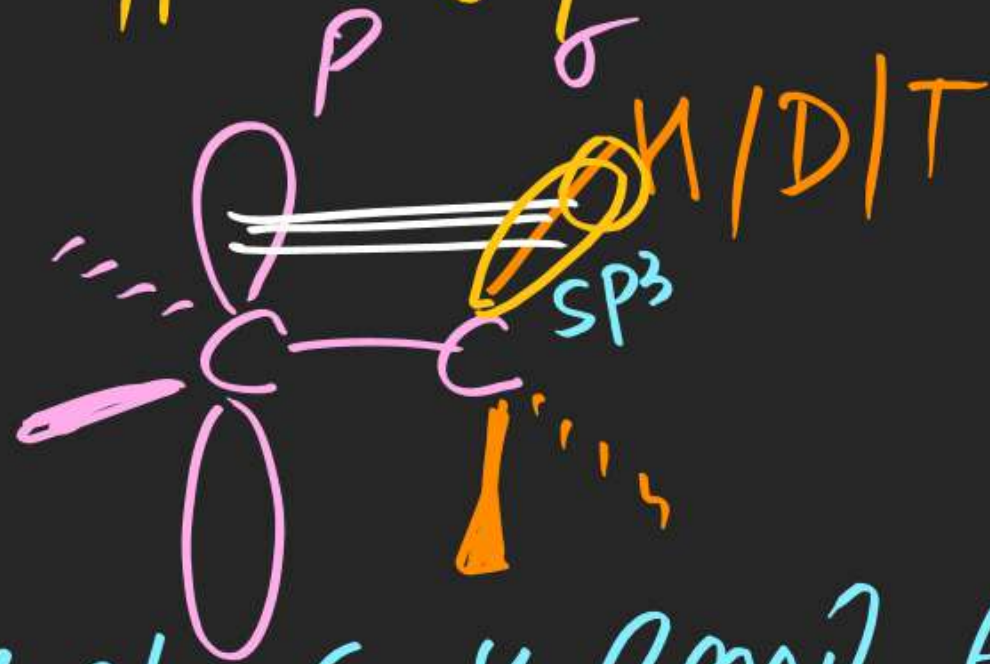
overlapping & higher wd be electron density in Ring.

Note  
(1) This phenomenon is known as hyperconjugation & effect is known as hyperconjugation effect.



(ii) hyperconjugation involves ( $\sigma$ -P) overlapping

(iii) Condition of hyperconjugation.



(iv) Bond angle of C-H Bond  $\approx$  (0.1)

(v) Also known as Nathan Baker effect.

(vi) H effect is stronger effect than Inductive effect (I effect)

(H > I)



(vii) H effect is weaker effect than R effect

$$R > H > I$$

(viii) Permanent effect.

(ix) Distance independent effect.