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Where Minds Pollinate

Class 12
Chemistry

Chapter 8
Hydrocarbons
Handwritten Notes

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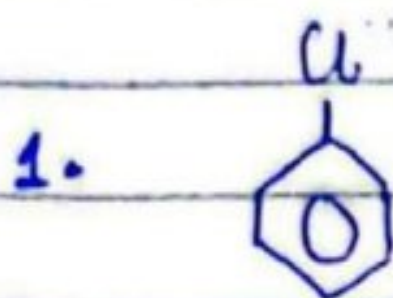
Chap: 8

"Hydrocarbons"

Hydrocarbons:- Organic compound containing carbon and hydrogen only are called hydrocarbons.

e.g:- Alkanes, Alkenes, Alkynes, Benzene

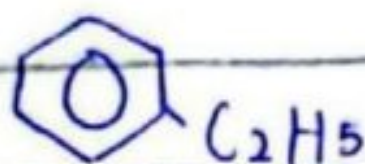
Nomenclature of Benzene and their derivatives:-



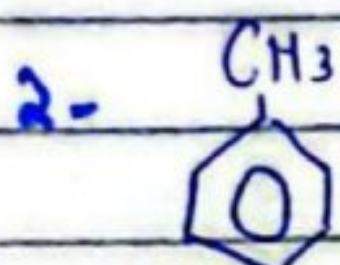
Chlorobenzene



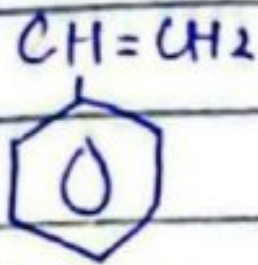
Nitrobenzene



Ethylbenzene



Toluene



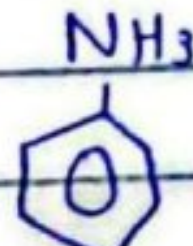
Styrene

Also vinyl benzene

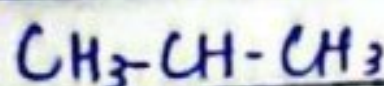


Phenol

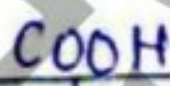
(Carbolic acid)



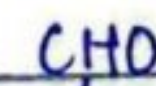
Aniline



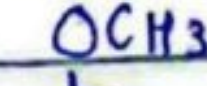
Cumene



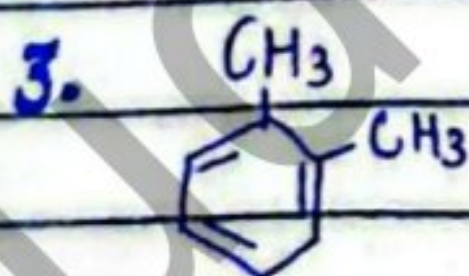
benzoic acid



Benzaldehyde



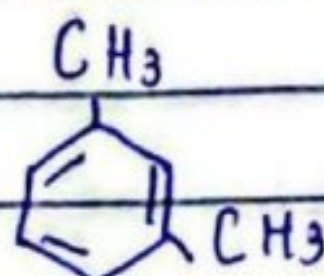
Anisole



1,2 position - meta to methyl

ortho-xylene (C.N) or o-xylene
or

1,2-Dimethylbenzene (IUPAC)



m-xylene (C.N)
or

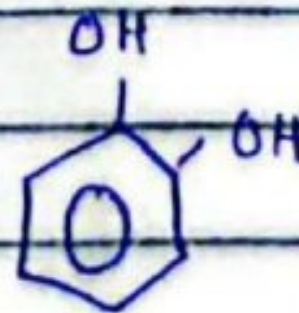
1,3-Dimethylbenzene



CH₃

p-xylene or p-Dimethylbenzene (C.N)

1,4-Dimethylbenzene



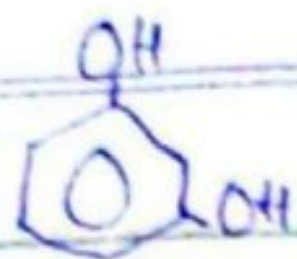
(IUPAC)

1,2-Dihydroxybenzene

Catechol

o-Dihydroxybenzene

} C.N



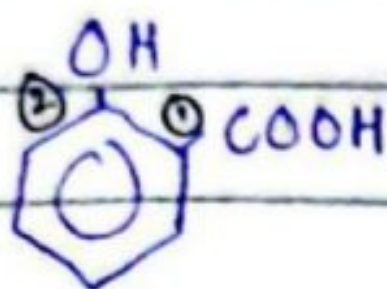
1,3-Dihydroxybenzene
(Resorcinol)



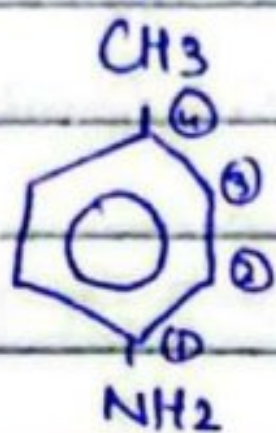
1,4-Dihydroxybenzene
(Hydroquinone)

4- Priority Order of different functional groups

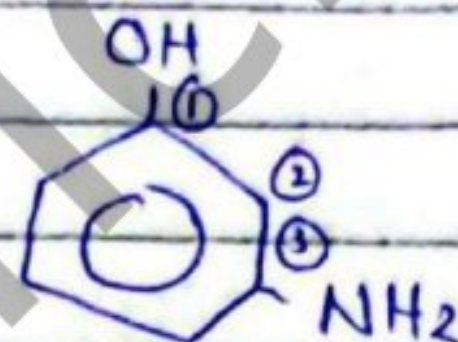
$-\text{COOH}$, SO_3H (sulphonic group), $-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{H}$, $\text{R}-\overset{\text{O}}{\underset{\text{||}}{\text{C}}}-\text{R}$, $-\text{OH}$, $-\text{NH}_2$, $-\text{OR}$, $-\text{R}$



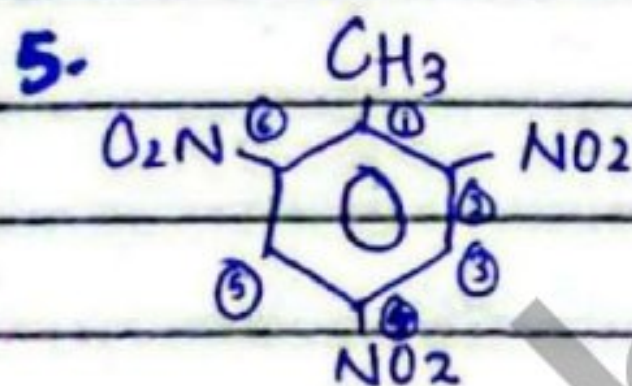
2-Hydroxybenzoic acid
or o-Hydroxybenzoic acid



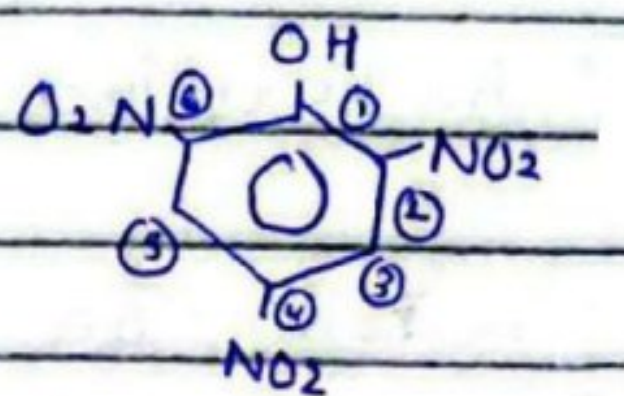
4-Methylaniline



3-Aminophenol



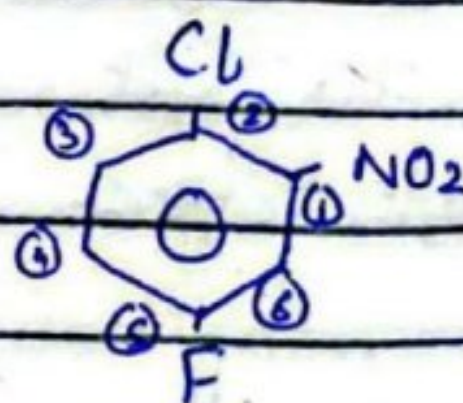
2,4,6-Trinitrotoluene
(TNT)



2,4,6-Trinitrophenol
(Picric acid)

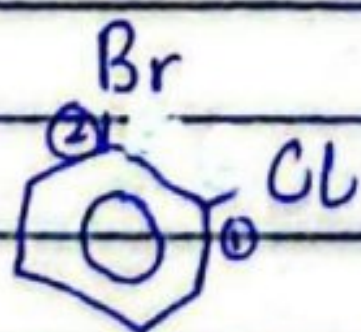


2-Bromo-3-chloroiodobenzene

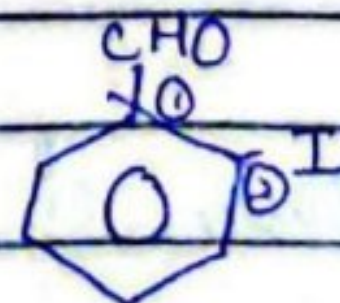


2-chloro-5-fluoronitrobenzene

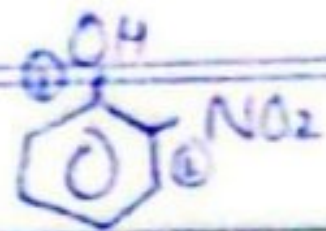
8.1



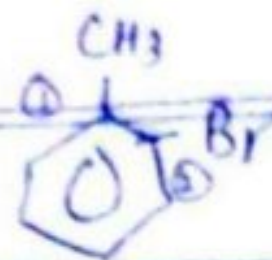
2-Bromochlorobenzene



2-Iodobenzaldehyde



2-nitro phenol



2-Bromo Toluene

Structure of Benzene:-

Discovered by = Michael Faraday in (1825)

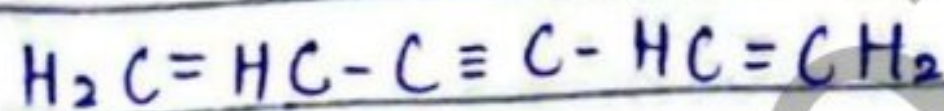
Molecular formula: C_6H_6

Molecular weight: 78 amu.

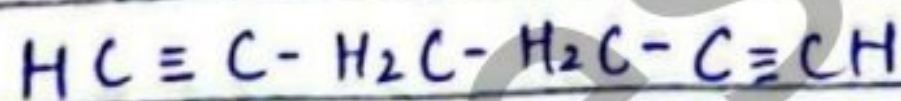
Empirical formula: CH

Special features: ① Resonance ② Electrophilic substitution reaction

There are two possible open chain structure of benzene:-



1,5-Hexadiene-3-yne



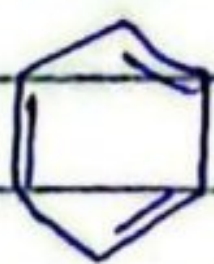
1,5-Hexadiyne

These structure are practically not possible due to different property of benzene. 40 years later (1865) structure of benzene was proposed by "Kekule."

According to Kekule benzene has cyclic hexagonal planar structure containing 3 alternate double and 6 single bond b/w carbon atoms and 6 carbon-H single bond.



↔
resonance
arrow



≡
hybrid



Kekule

Robinson Structure

Drawback of Kekule Structure:- Kekule structure failed to explain why:-

- 1) It has low heat of formation
- 2) It is more stable and less reactive

3) All carbon-carbon bond lengths are equal that is $1.397 \text{ \AA} \approx 1.4 \text{ \AA}$

4) It has dual nature i.e. it gives addition as well as substitution reaction but favours substitution rxn more.

Molecular Orbital treatment of benzene: V.V. Imp

Q. Discuss stability of benzene on basis of MOTB?

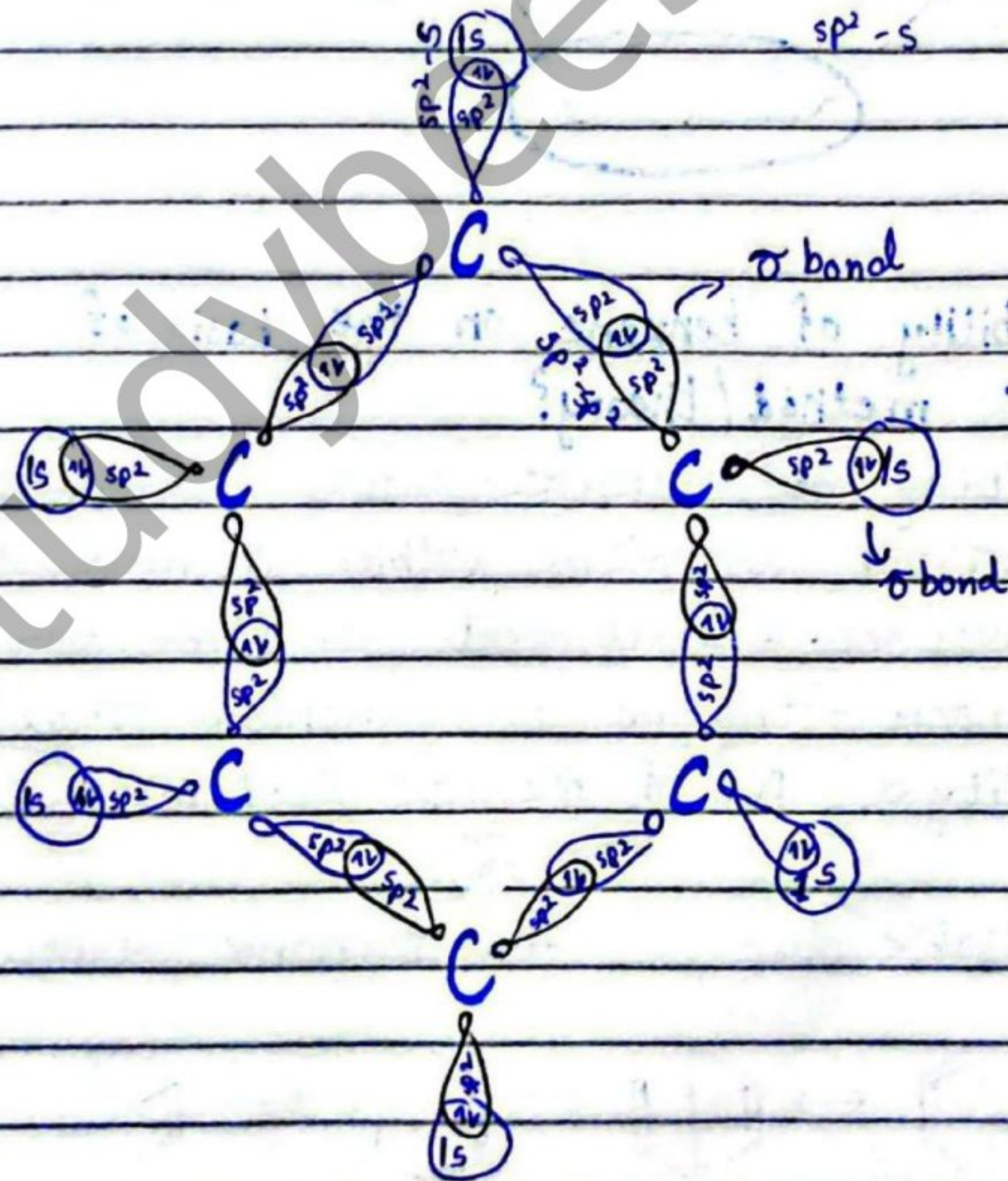
Ans. In Benzene each carbon is sp^2 hybridized.

Each carbon has 3 hybrid orbitals and one unhybrid orbital. Hybrid orbitals form sigma bond.

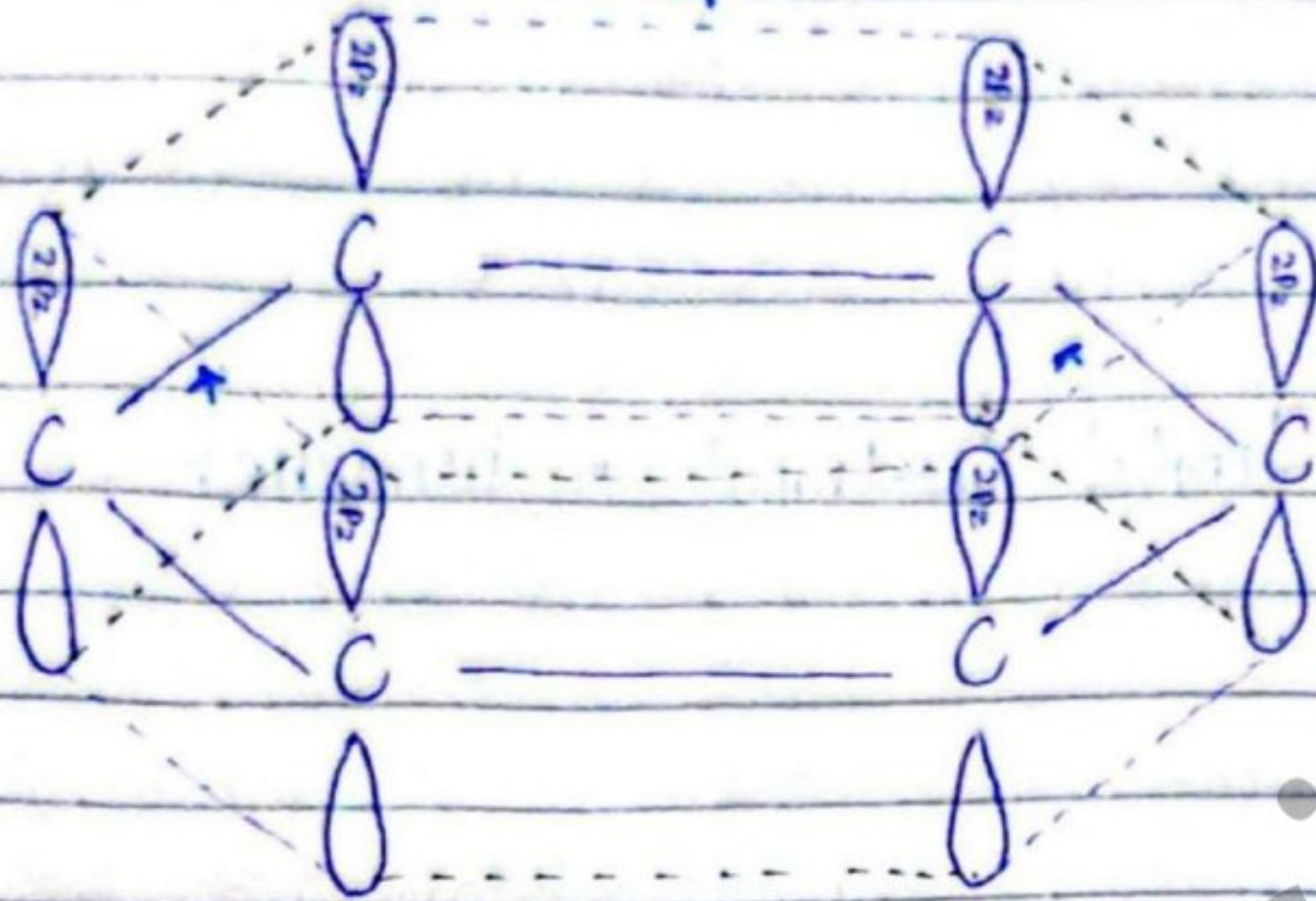
In benzene there are 12 sigma bonds. Unhybrid orbitals form pi-bond. In benzene there are

3 π -bonds which are delocalized. Benzene is stable due to delocalization of pi-electrons.

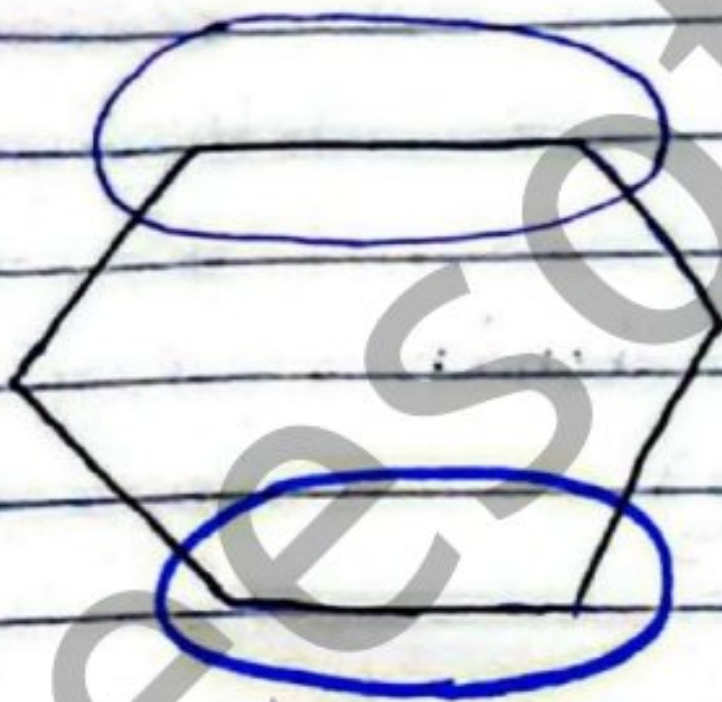
Formation of sigma bond:- $sp^2-sp^2 = 6\sigma$
 $sp^2-s = 6\sigma$ } 12 σ bonds



Formation of π bond:-



Delocalized P_z orbitals:-

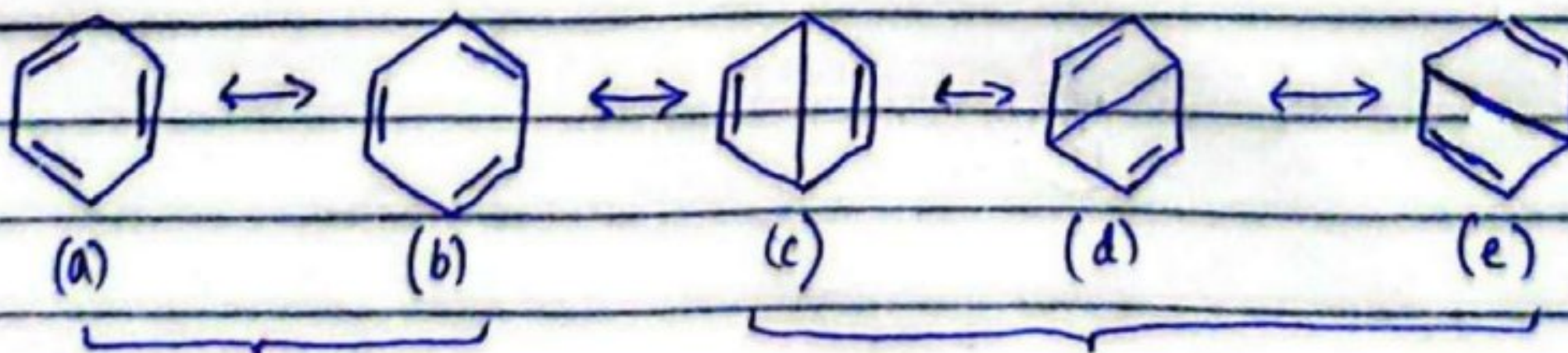


Q. Discuss stability of benzene on the basis of Resonance method/theory?

Resonance:- Possibility of different pairing scheme of valence electron of an atom within a molecule is called resonance, and different structures obtained are called resonance structure or canonical structure.

Stability $\propto$ No. of resonance structure

Benzene is stable due to five resonance structure.



Kekulé Structure

Dewar structure

In actual structure of benzene, contribution of Kekule is 80% and contribution of Dewar is 20%. Therefore, structure of benzene is denoted by Kekule structure.

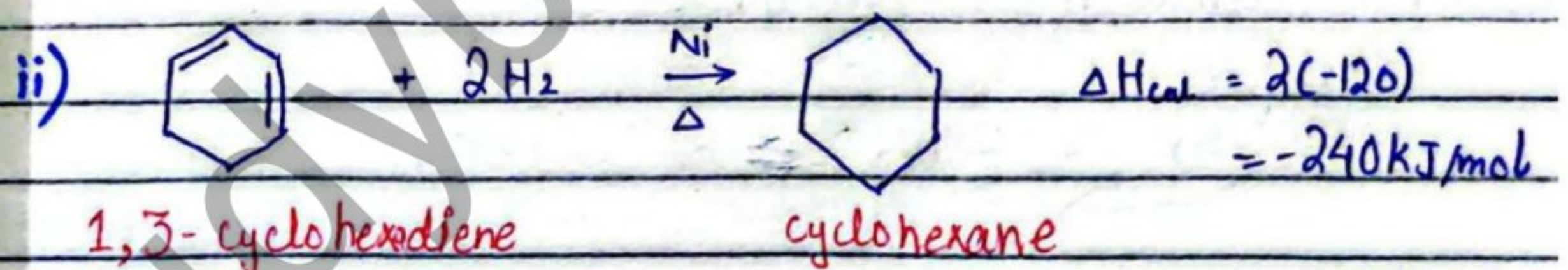
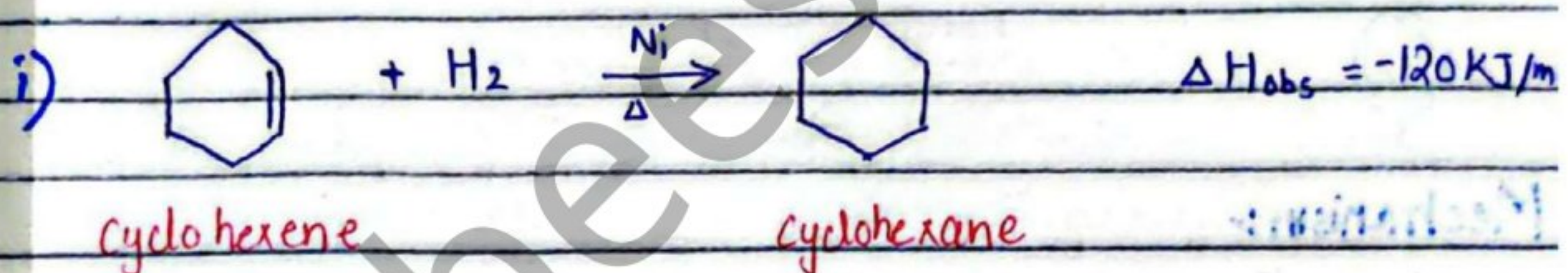
Q. Discuss stability of benzene on the basis of Resonance energy?

Resonance energy:- Decrease in energy due to resonance is called resonance energy.

Formula:- Resonance energy = $\Delta H_{\text{calculated}} - \Delta H_{\text{observed}}$

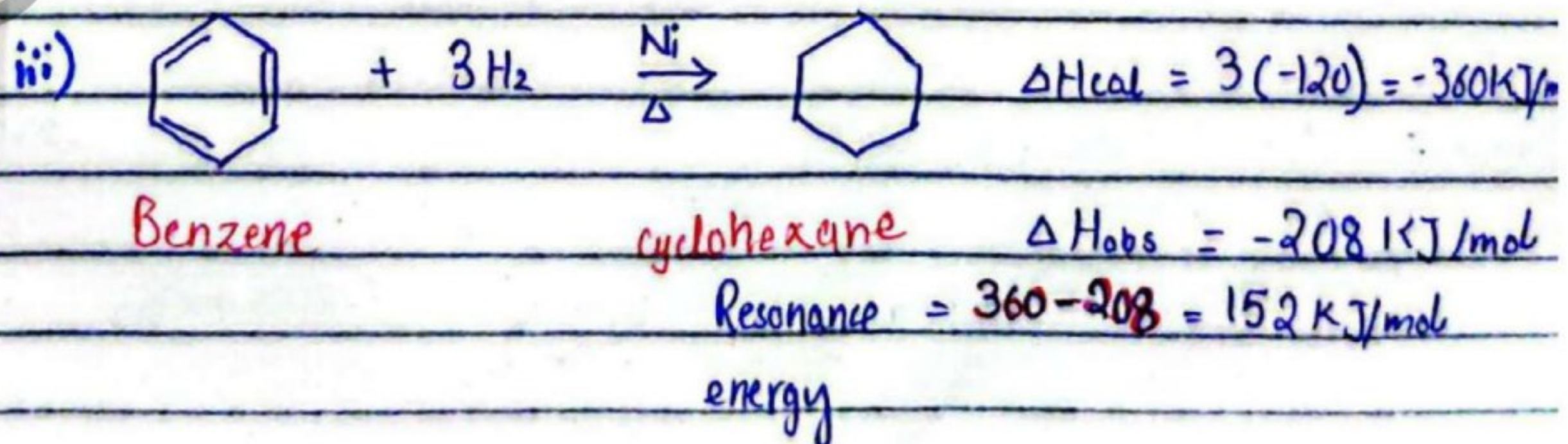
Stability of molecule $\propto$ Resonance energy

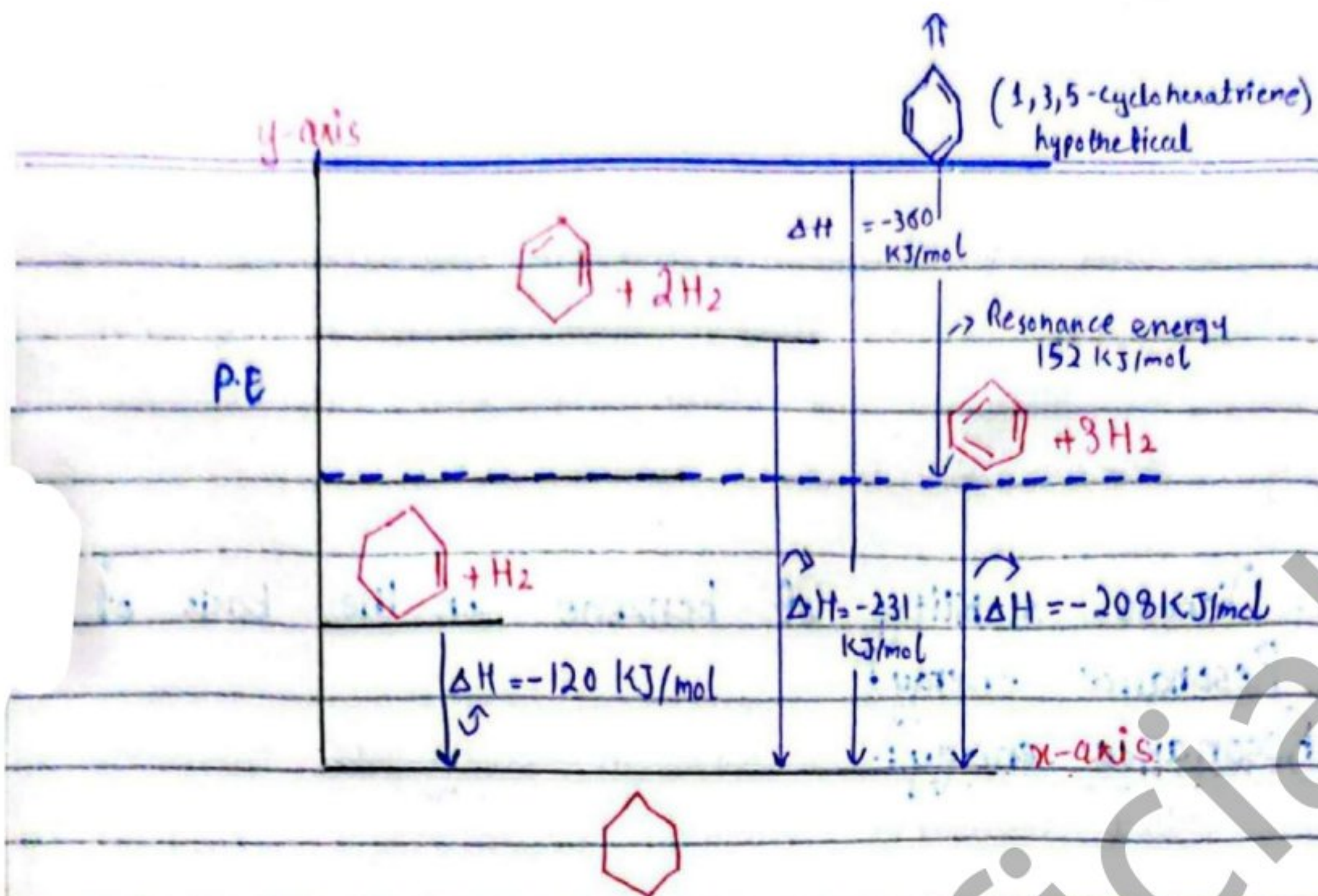
Benzene is stable due to high resonance energy that is 152 kJ/mol



$$\Delta H_{\text{obs}} = -231 \text{ kJ/mol}$$

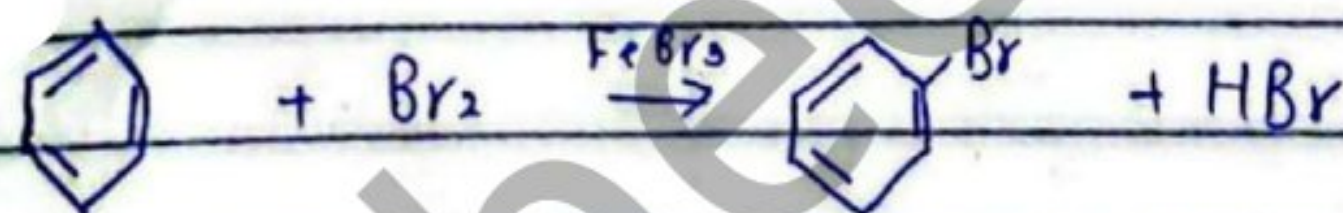
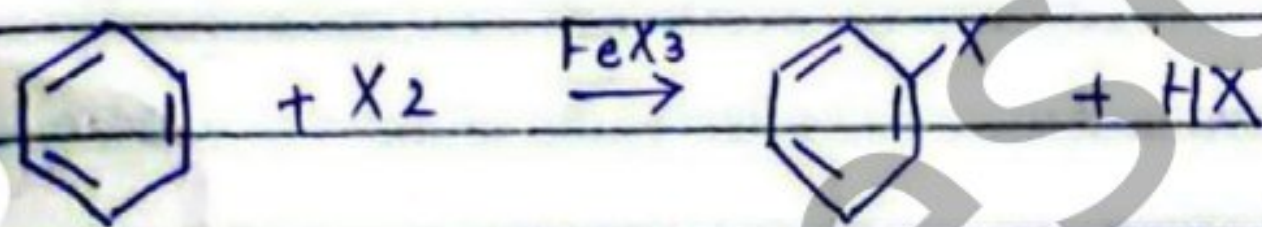
$$\text{Resonance energy} = 240 - 231 = 9 \text{ kJ/mol}$$





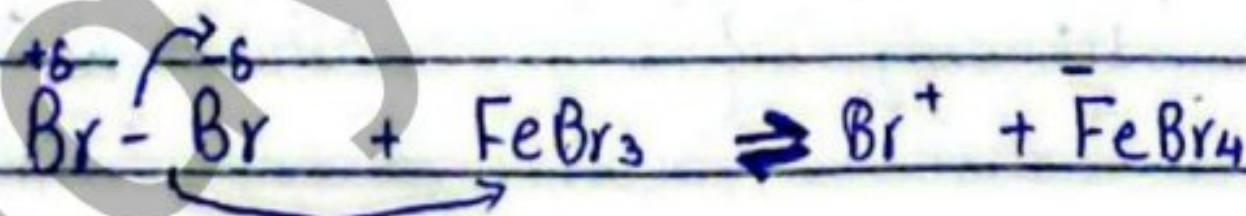
Electrophilic Substitution rxn of benzene:-

1) a) Halogenation:- Replacement of hydrogen atom by halogen is called halogenation.

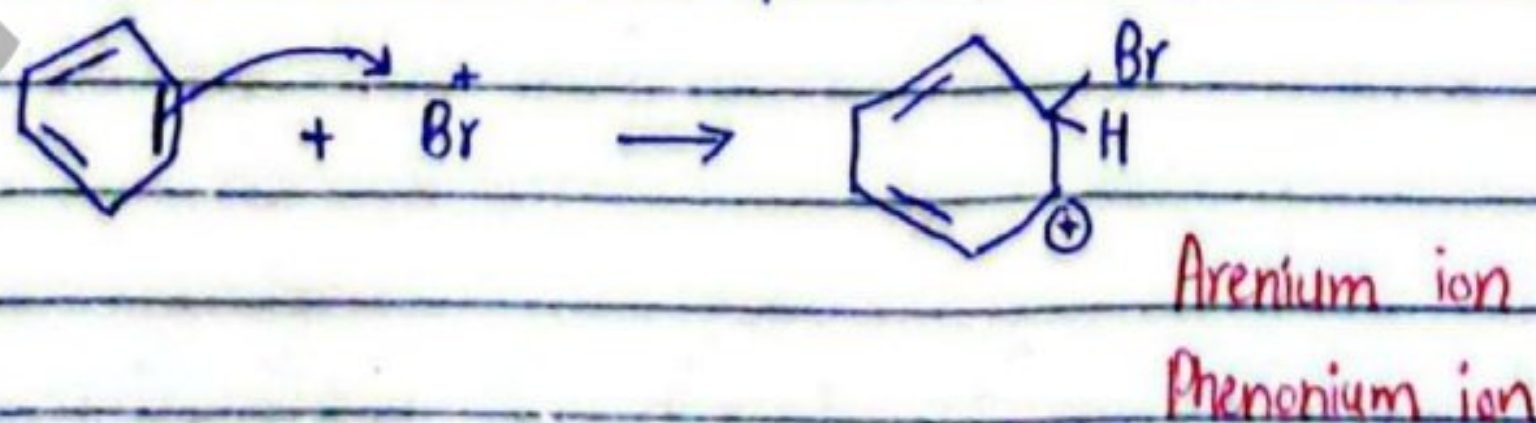


Mechanism:-

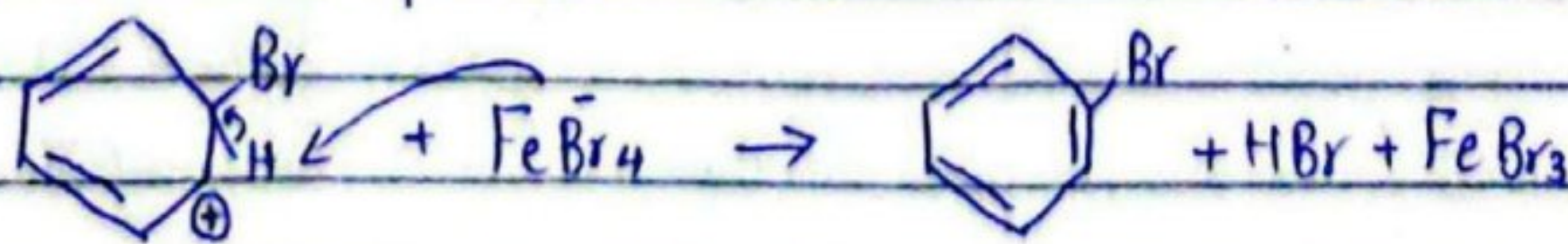
Step:1 Formation of electrophile



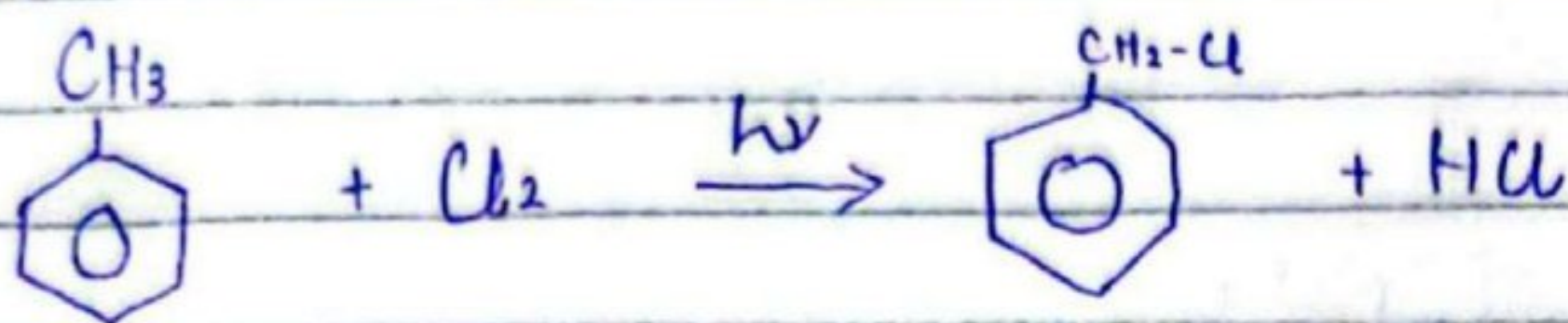
Step:2 Attack of electrophile



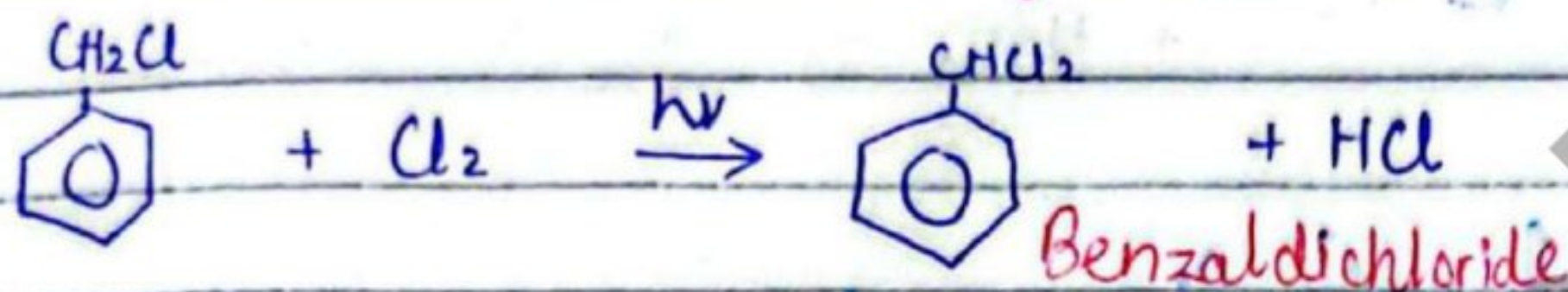
Step:3 loss of proton



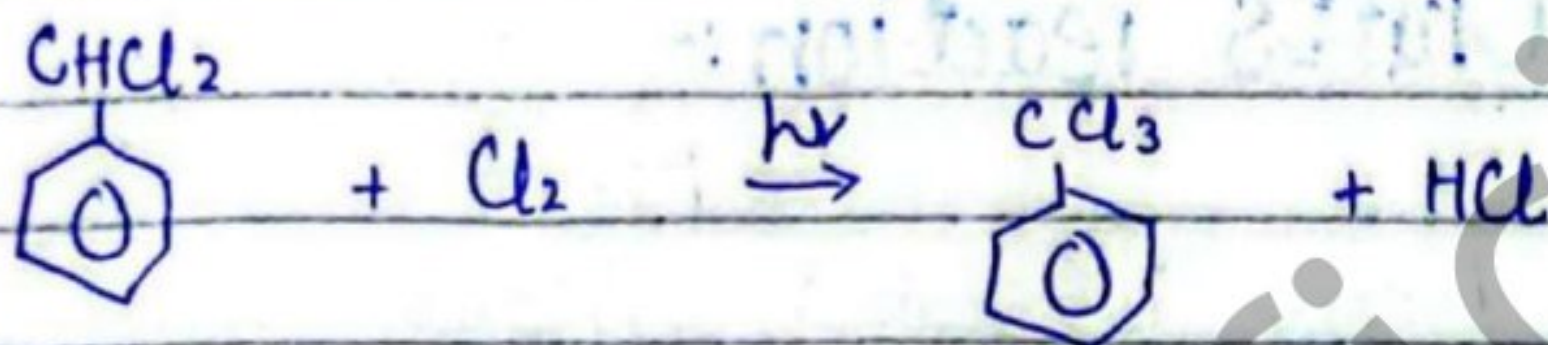
b) Halogenation of Alkyl benzene:- or Side Chain halogenation



Benzyl Chloride

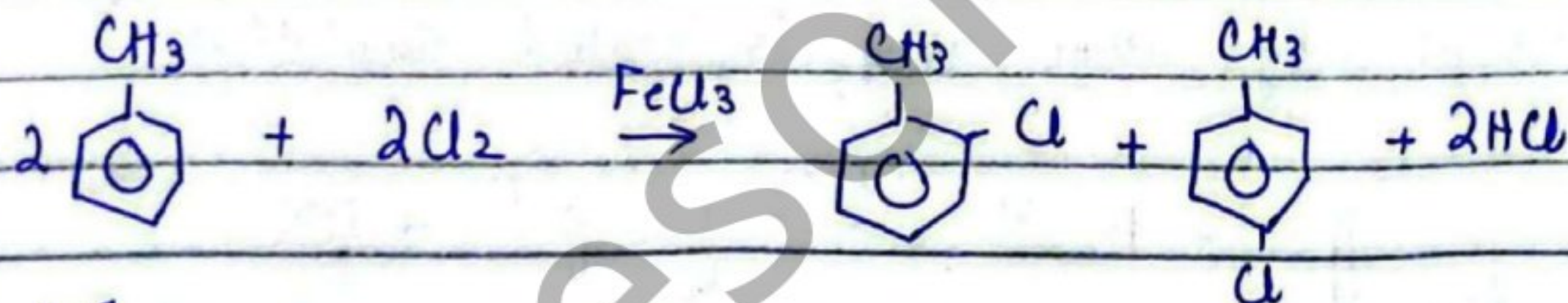


Benzaldichloride



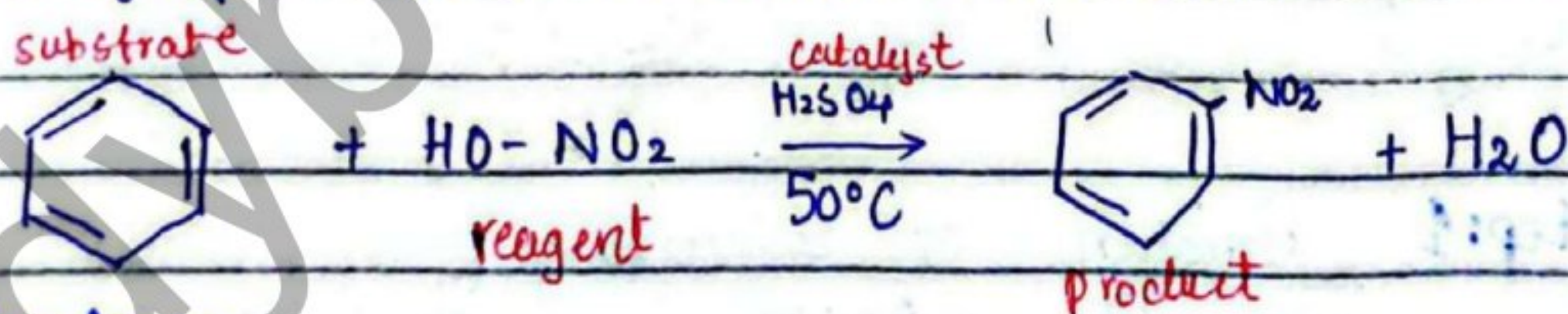
Benzotrichloride

OR



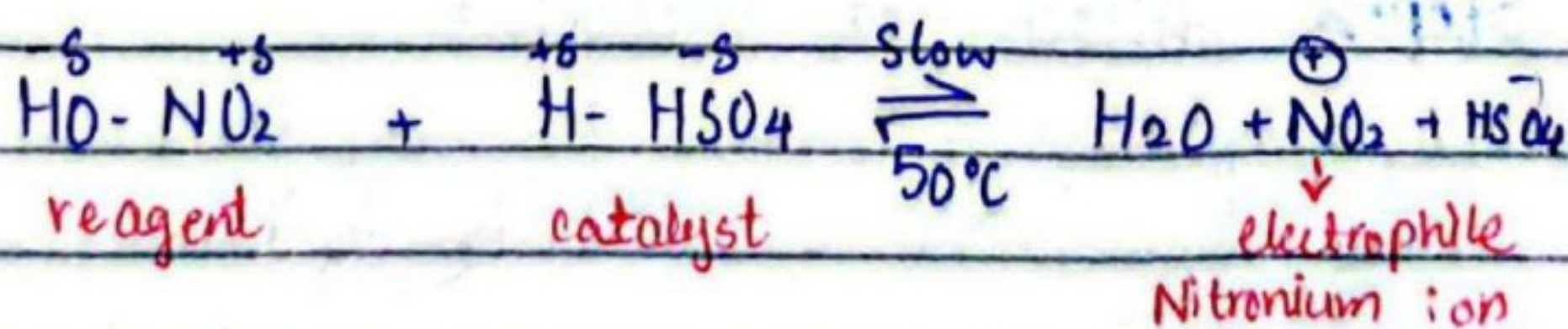
F.B 2017

2- Nitration :- Replacement of hydrogen atom by nitro group ($-\text{NO}_2$) is called nitration.

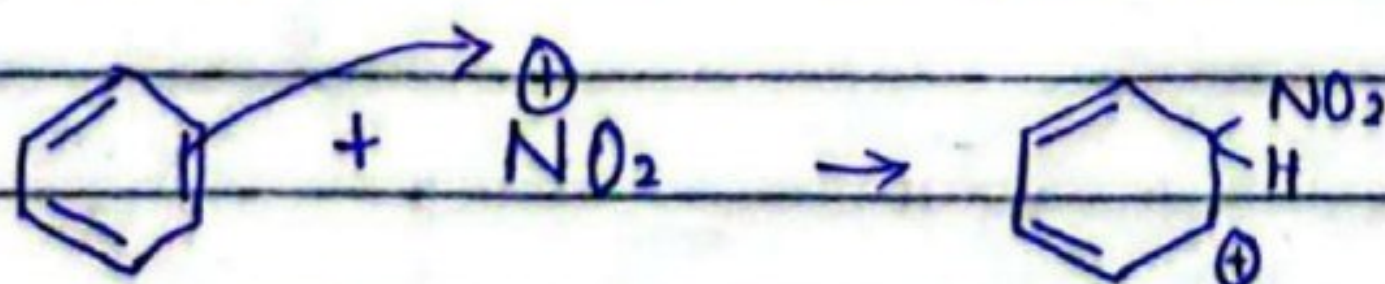


Mechanism:-

Step:1 Formation of electrophile



Step:2 Attack of electrophile

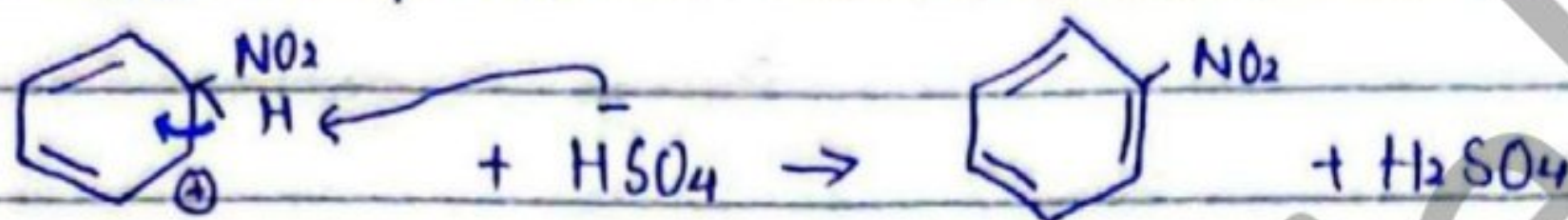


Arenium ion / Phenonium ion
carbocation / Benzenonium ion



Resonance stabilization of Arenium ion

Step: 3 Loss of proton

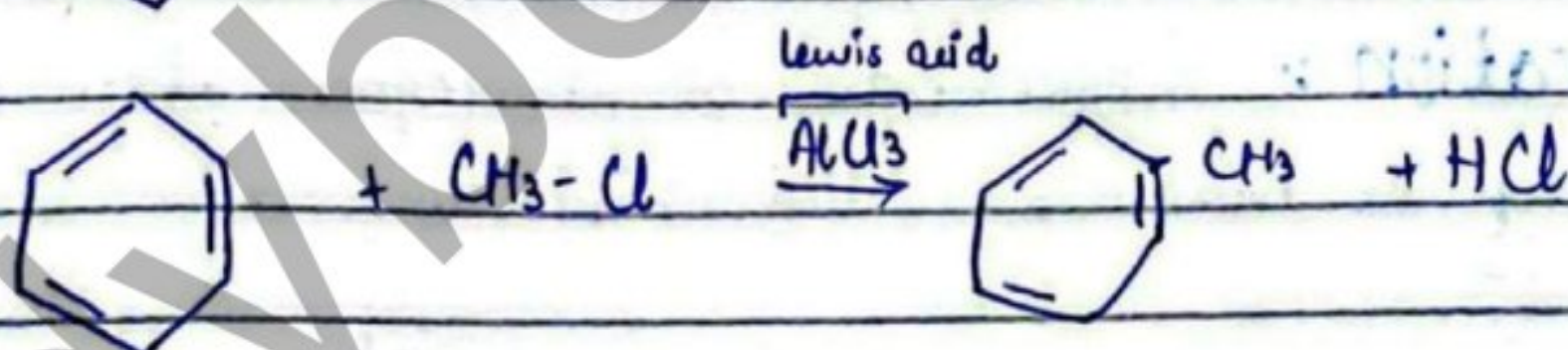
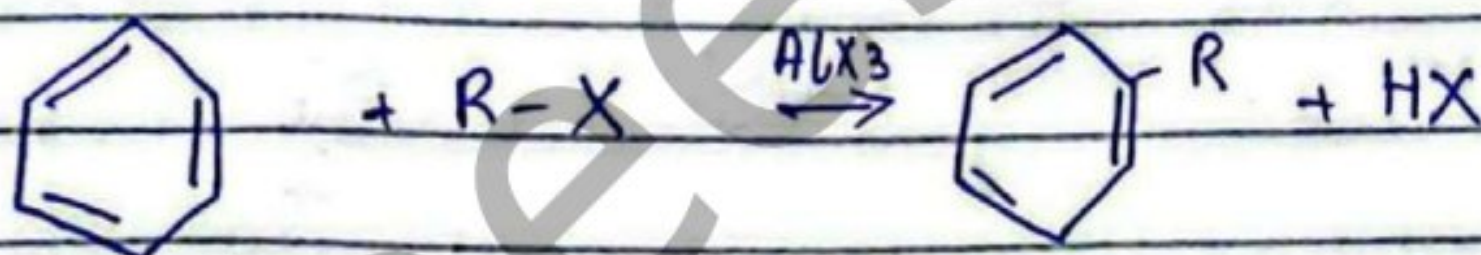


Very imp

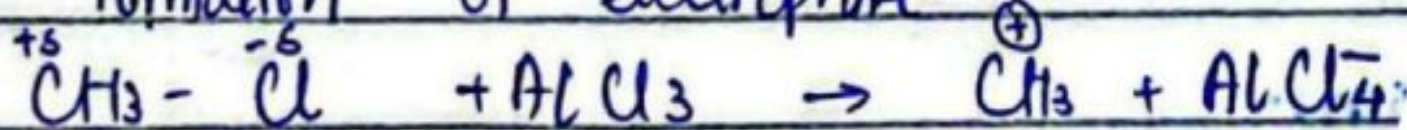
Friedel - Crafts reaction:-

Alkylation and acylation of benzene is called Friedel - Crafts reaction

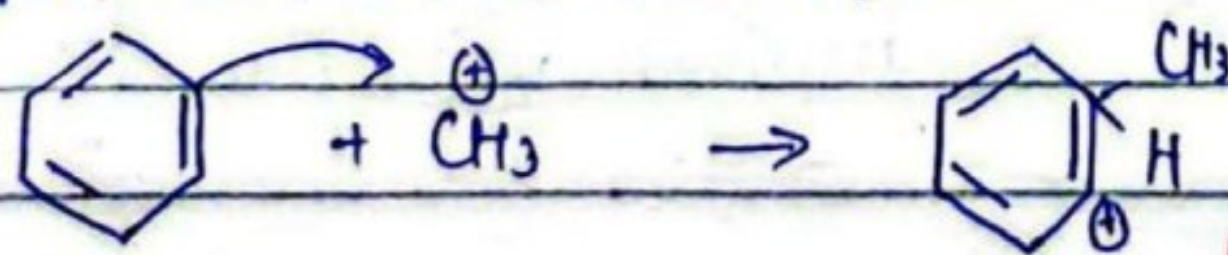
3- Friedel - Crafts Alkylation:- Replacement of hydrogen atom by alkyl group is called alkylation.



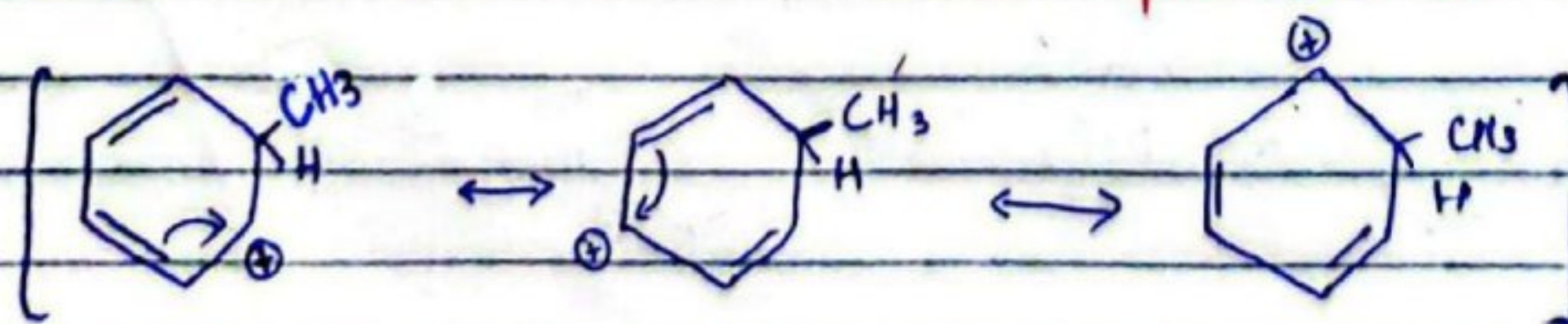
Step: 1 Formation of electrophile



Step: 2 Attack of electrophile

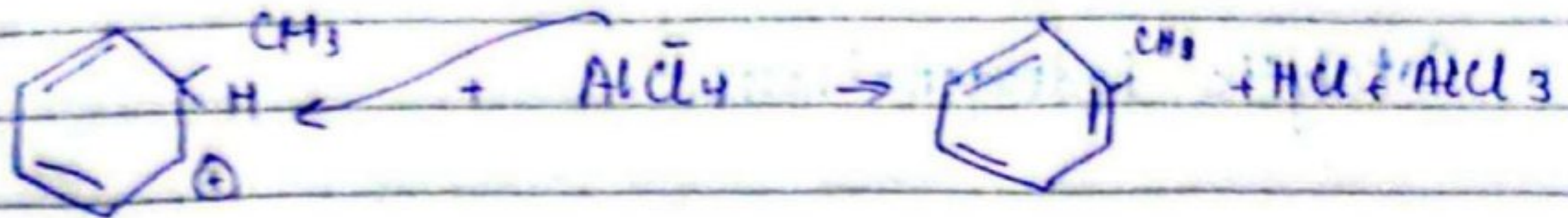


Arenium ion or phenonium ion

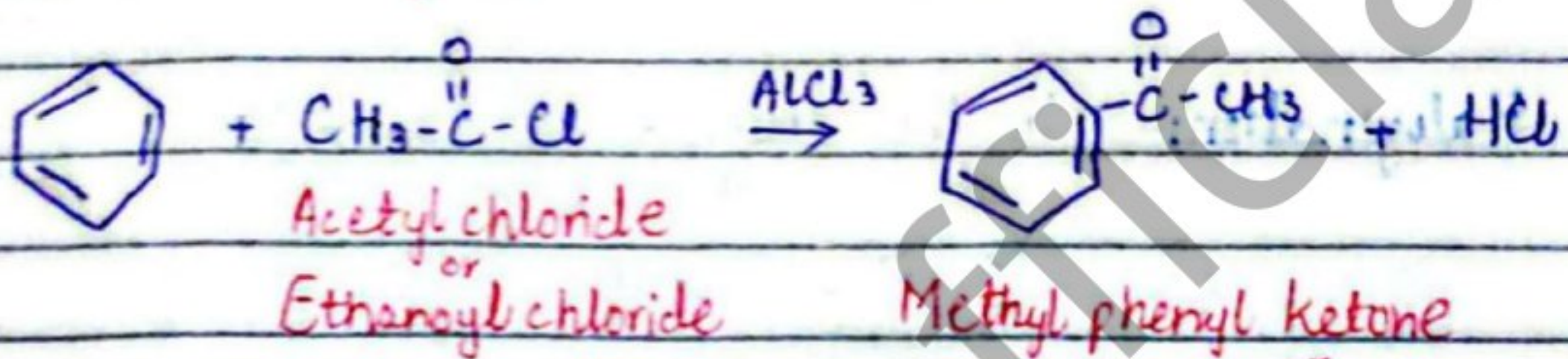
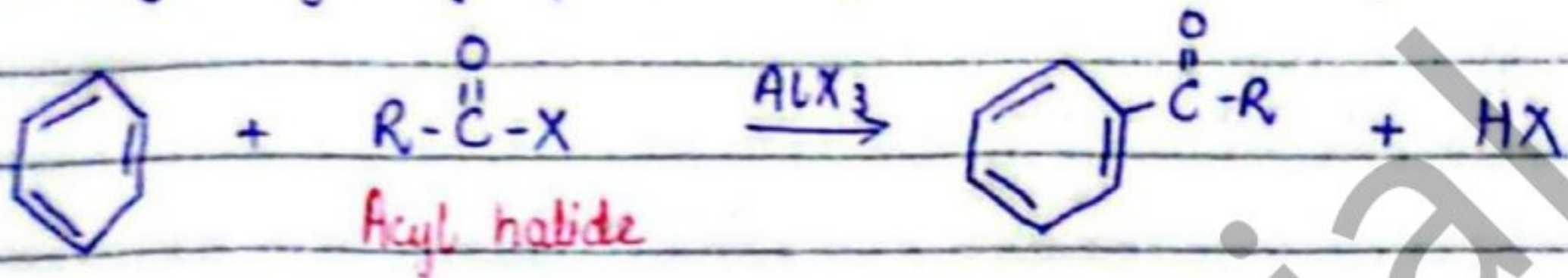


Resonance stabilization of Arenium ion

Step: 3 Loss of proton



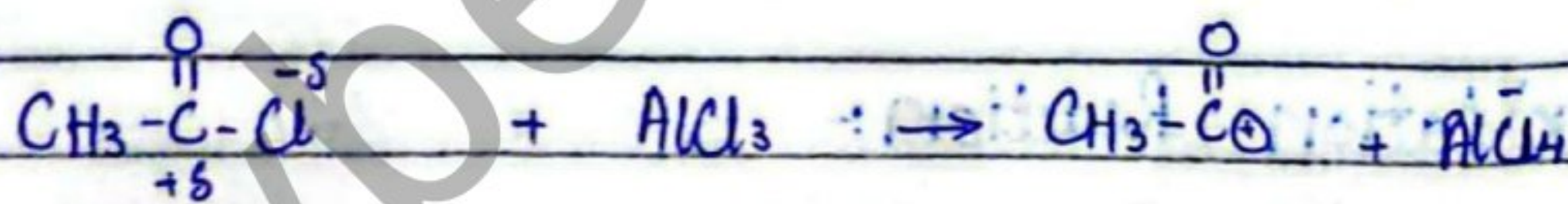
4- Friedel-Craft Acylation:- Replacement of hydrogen atom by acyl group ($-\text{C}(=\text{O})-\text{R}$) is called acylation.



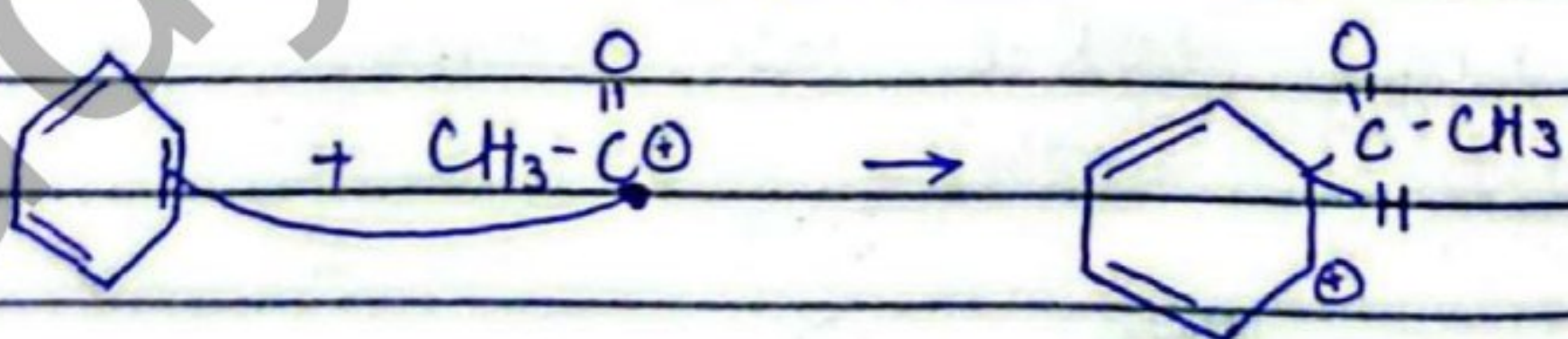
Methyl phenyl ketone
or
Acetophenone
or
Phenyl ethanone
branch
kiaz cyclic long chain

Mechanism:-

Step: 1 Formation of electrophile reagent + catalyst

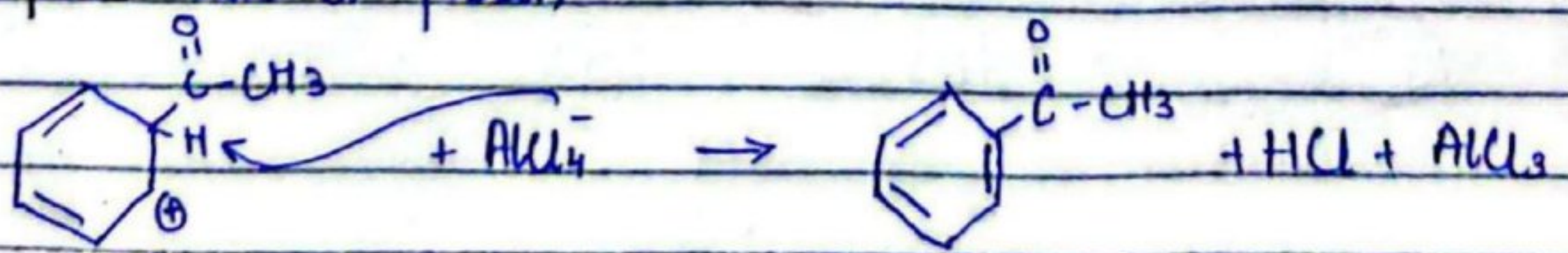


Step: 2 Attack of electrophile



Arenium ion or
Phenonium or
Benzenonium ion

Step: 3 Loss of proton



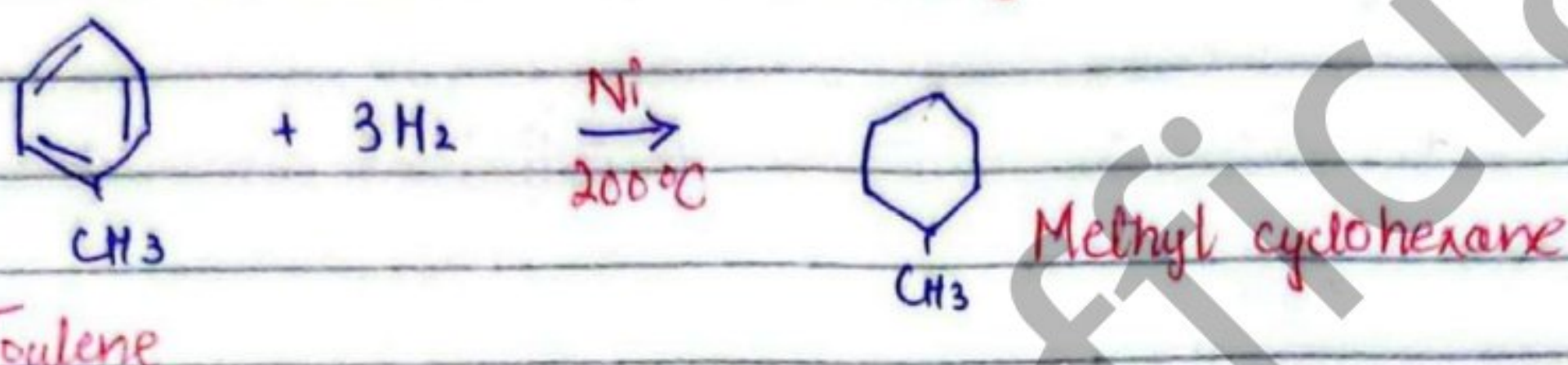
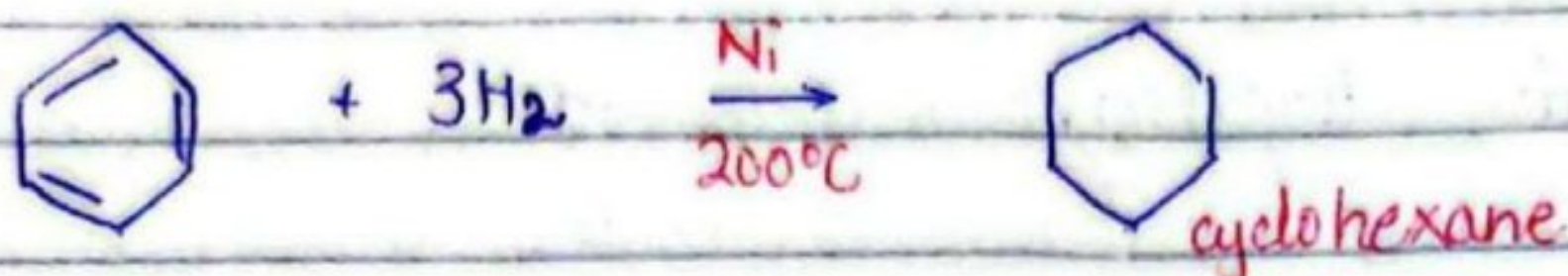
↑
no attack

here π bond delocalization

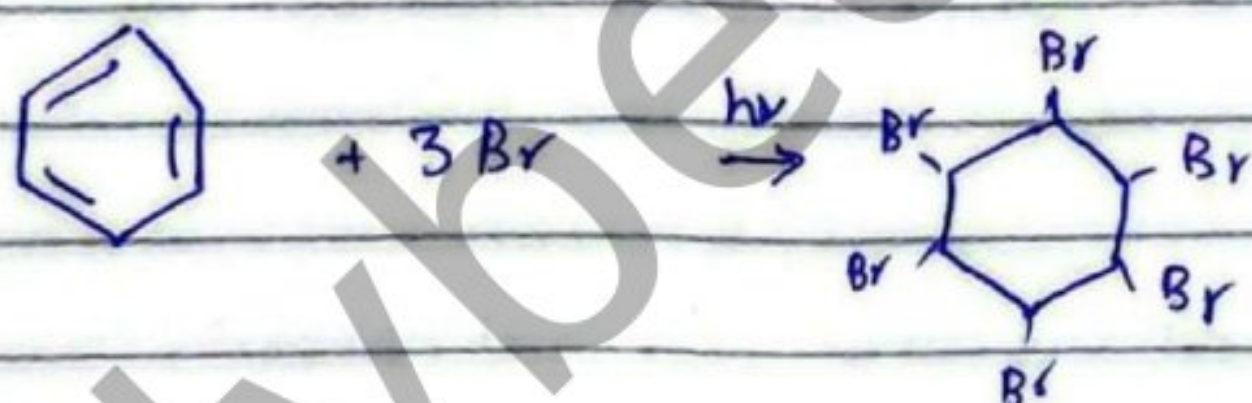
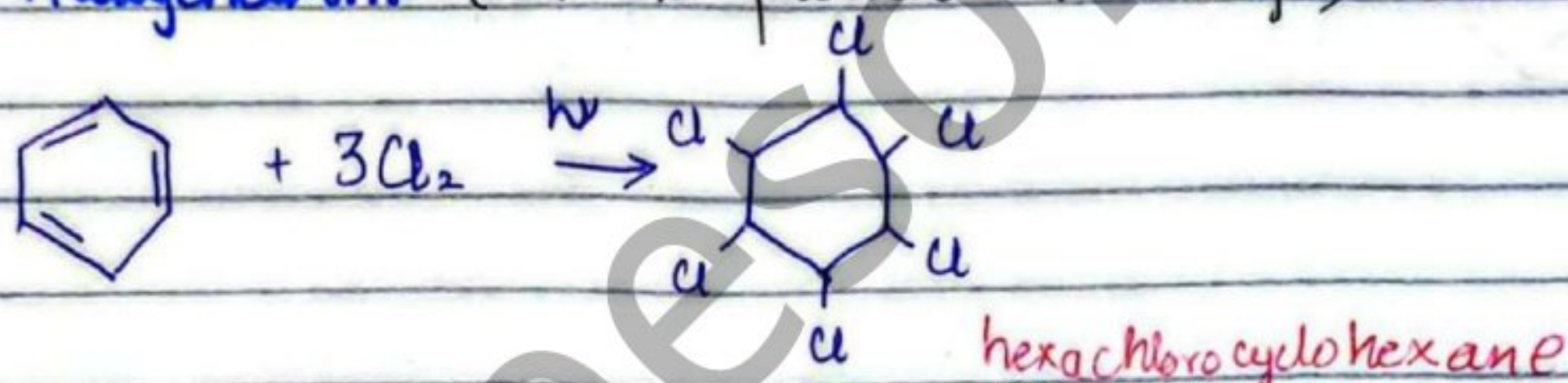
Q. Give rxn of benzene in which it behave as unsaturated?

B) Addition reaction of Benzene:-

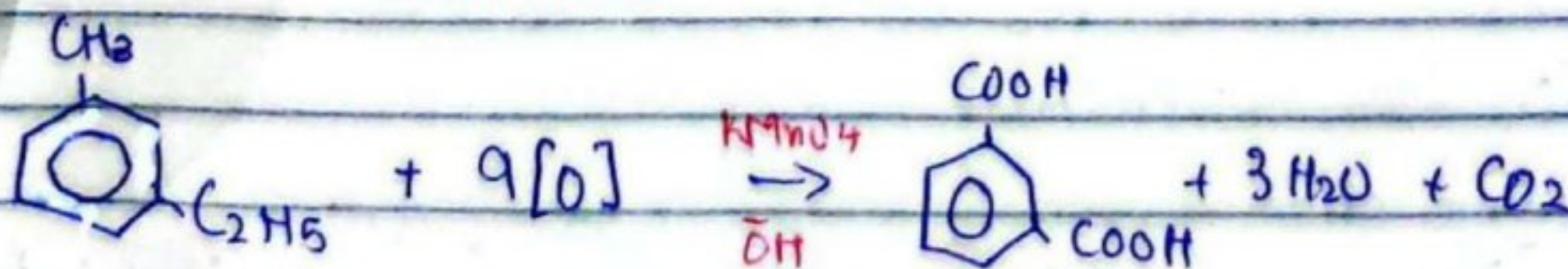
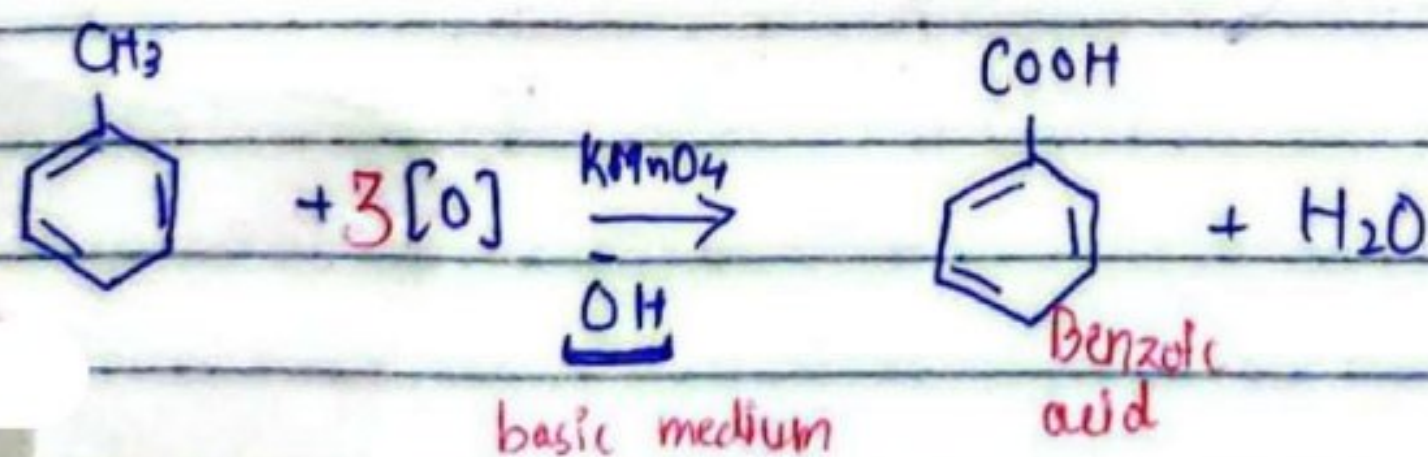
1. **Catalytic hydrogenation:-** Addition of hydrogen in molecule is called hydrogenation.

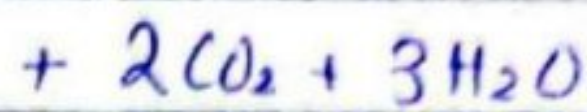
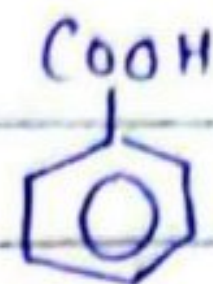
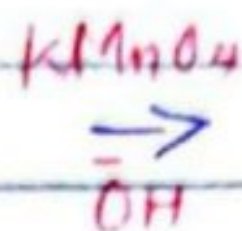
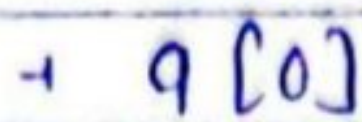
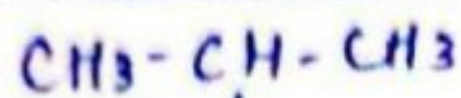


2. **Halogenation:-** (In the presence of sunlight)



C) **Oxidation Reaction:-** Benzene does not oxidize with strong oxidizing agent like KMnO_4 or $\text{K}_2\text{Cr}_2\text{O}_7$ however, alkyl group present on benzene ring is oxidized into carboxylic group.

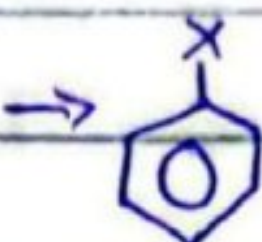




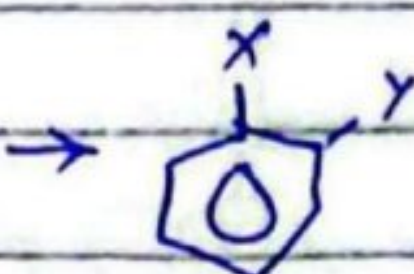
Cumene

Effect of Substitution on benzene:- OR

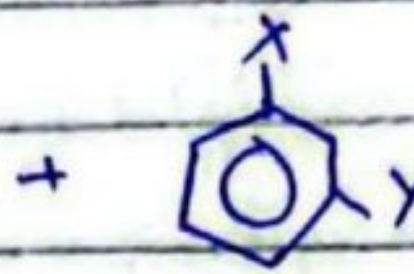
Orienting effect



Monosubstituted



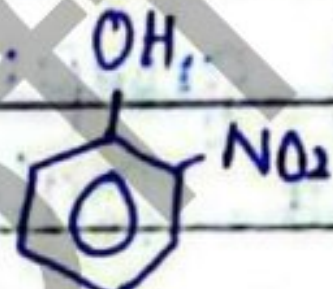
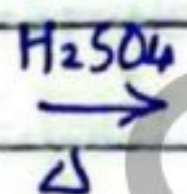
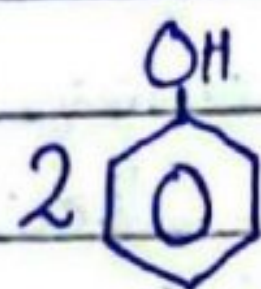
Ortho



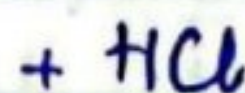
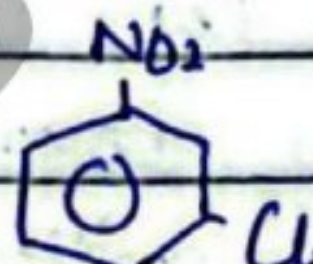
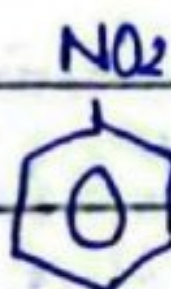
Meta



Para



$+ 2\text{H}_2\text{O}$

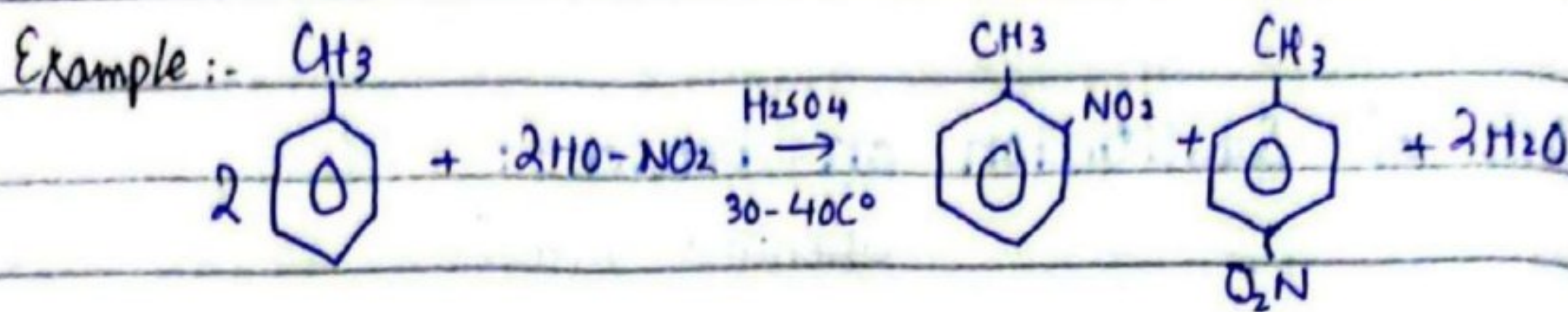


Ortho-para directing group:- Group which direct incoming group to ortho and para position are called ortho-para directing group. These are electron donating group. They donate electron to benzene ring, benzene ring become electron rich at ortho and para position. Therefore, incoming electrophile attack at ortho and para position.

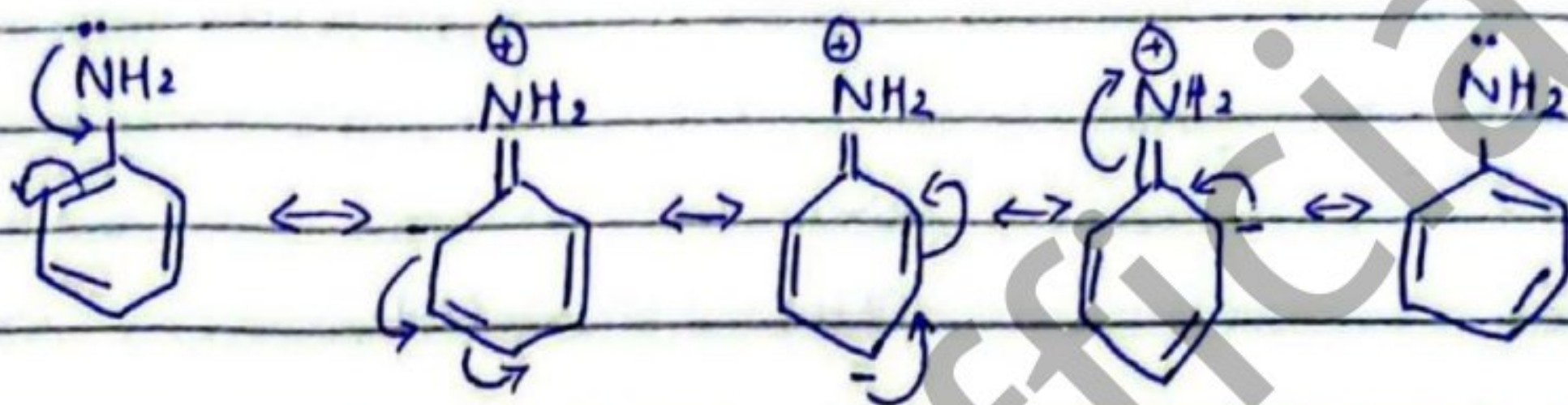
Rule:- If directly bonded atom with carbon of benzene ring is more electronegative than other bonded atom, ^{then} group is called ortho para directing group.

for eg In case of phenol oxygen is more electronegative than H, therefore -OH group is ortho-para directing group.

$-R, -OH, -NH_2, -NHR, -NR_2, -OR,$ Activators
 $-F, -Cl, -Br, -I,$ partially deactivator

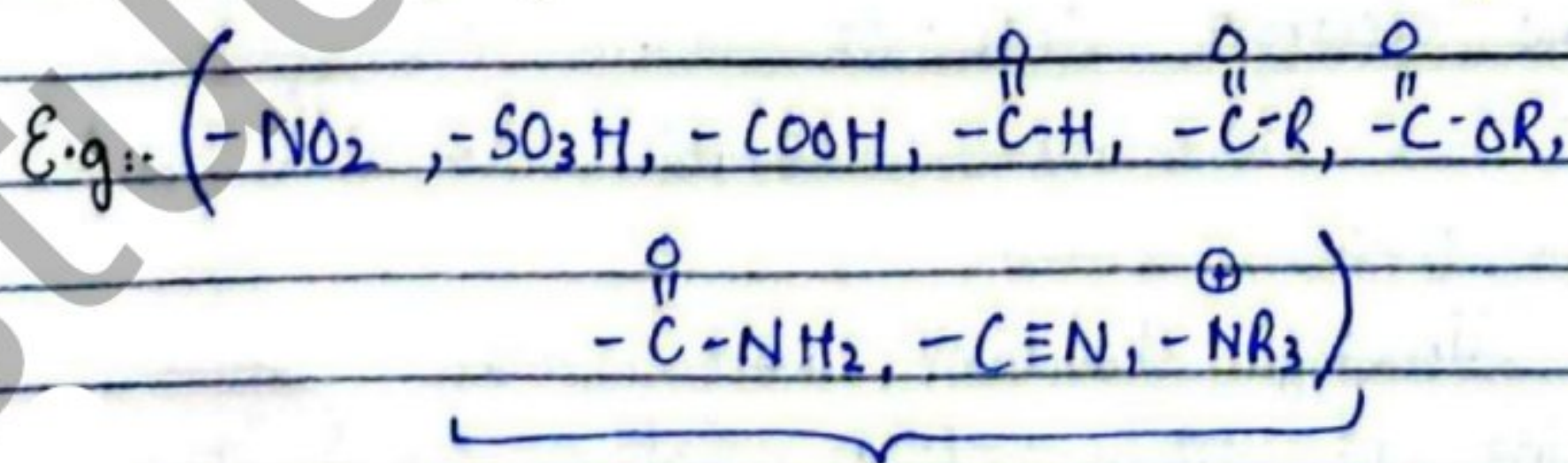


Proof NH_2 is O.P.O

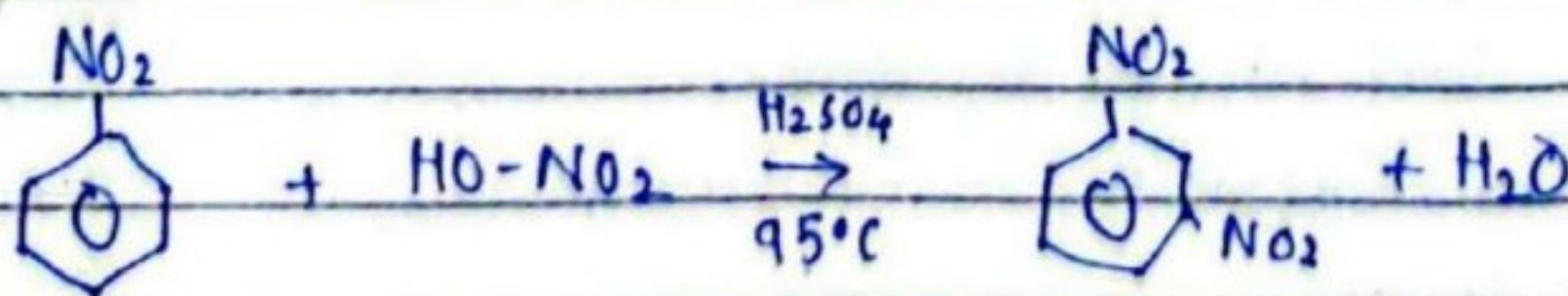


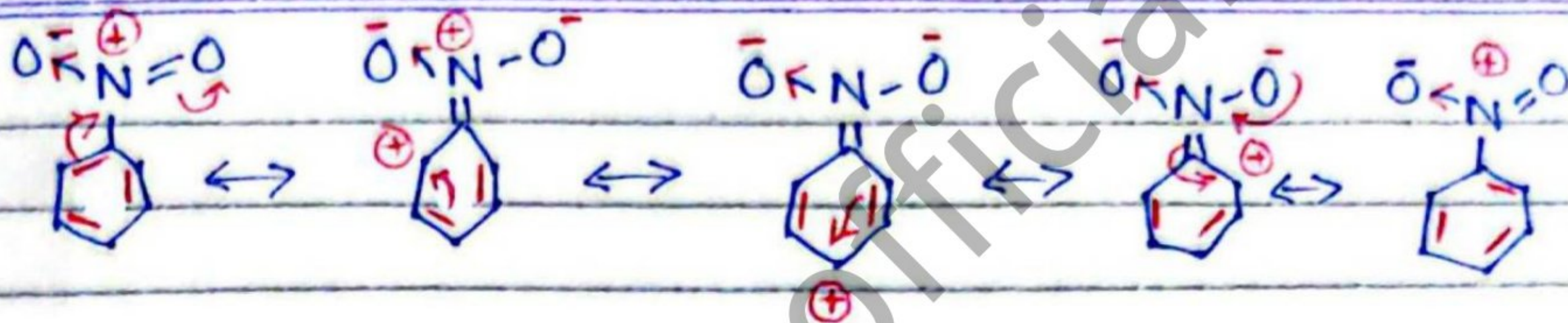
Meta directing group:- Groups which direct incoming group to meta position are called meta directing groups. These are electron attracting or electron withdrawing group. They attract electron from benzene ring. Benzene ring become electron deficient at ortho and para positions. Therefore, incoming electrophile attack at meta position.

Rule:- If directly bonded atom with the carbon of benzene ring is less electronegative than other ^{bonded} atom, then that group is called metadirecting.



Deactivator





MCQs:-

i. b

ii. b

iii. c

iv. a

v. b

vi. b. Hexagonal planar ring

vii. b

viii. a

ix. b

x. b

xi. a

xii. b

xiii. a