







(Section B)

Q. No. 2 Part (i) **Calculation of Cell Potential E°**

Given:

$Fe^{+3} + \bar{e} \longrightarrow Fe^{+2} (E^\circ = +0.77V) \rightarrow ①$

$Zn^{+2} + 2\bar{e} \longrightarrow Zn (E^\circ = -0.76V) \rightarrow ②$

The equation 2 has lower reduction potential as compared to 1. So by reversing eq ②

$Zn \longrightarrow Zn^{+2} + 2\bar{e}$ (Oxidation)

$Fe^{+3} + \bar{e} \longrightarrow Fe^{+2}$ (Reduction)

$Zn + Fe^{+3} \longrightarrow Zn^{+2} + Fe^{+2}$ overall reaction.

$E^\circ = E^\circ_{cathode} - E^\circ_{anode}$

$E^\circ = 0.77V - (-0.76)V$

$E^\circ = 1.53V$

The cell potential of Zn/Fe^{+3} is 1.53V.

Q. No. 2 Part (ii) **Bicarbonate act as Buffer**

Biccarbonate maintain the PH of blood at 7.35 — 7.45. Bicarbonate formed by the reaction of CO_2 and H_2O in Red blood cells. $CO_2 + H_2O \rightleftharpoons H_2CO_3$ → Carbonic acid

$H_2CO_3 + H^+ \rightleftharpoons H^+ + HCO_3$ → biccarbonate

Neutralization of Acid: When there is increase in H^+ or decrease in PH, biccarbonate act as base and react with acid to form neutralize it.

$HCO_3 + H^+ \xrightleftharpoons[\text{anhydrase}]{\text{carbonic}} H_2CO_3$

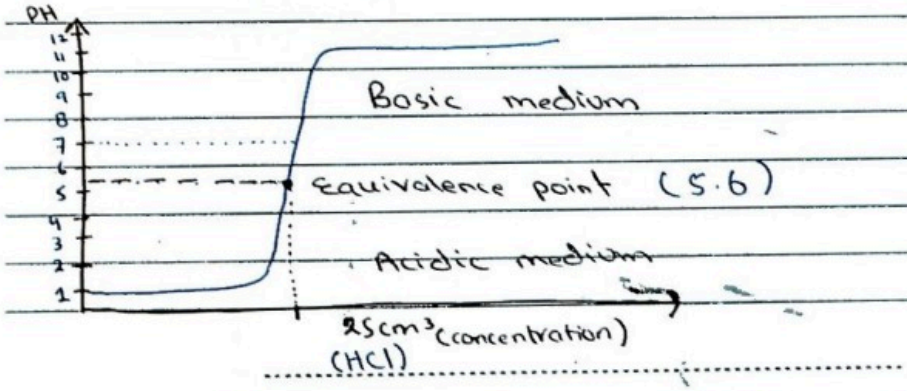
Neutralization of Base: When there is increase in PH, biccarbonate act as acid and neutralize it.

$HCO_3 + 2OH^- \rightleftharpoons H_2CO_3 + O_2$

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Q. No. 2 Part (iii) **Weak base Strong Acid Titration Curve**

The weak base when added to conical flask containing strong acid (HCl), neutralization occur. The reaction of NH_3 which is weak base with H^+ produce NH_4^+ which is still acidic, so equivalence point is less than 7 and nearly 5.6.



Q. No. 2 Part (iv) **Ionization Energy of Group IA and Group IIA Elements**

The ionization energy of group IIA element is larger than IA element. This is because group II element have smaller size and strong interaction between valence electron and nucleus. So it is difficult to remove $\bar{e}$ from valence shell of II element while group I element is larger in size and can loss $\bar{e}$ due to weak interaction of nucleus and valence $\bar{e}$. So Group I is more reactive and have less ionization energy.

* $Ca + H_2O \longrightarrow Ca(OH)_2 + H_2 \rightarrow$ bubble H_2
* $K + H_2O \longrightarrow KOH + H_2 \rightarrow$ catches fire.

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Q. No. 2 Part (v) **Uses of Group II Element**

Group 2 element is widely used in different methods in and mean Trend

* **Industry:**

Calcium carbonate is an important building material. Cement is $CaCO_3$ which is formed by heating $CaCO_3$ in kilns to form carbon CaO and CO_2

$$CaCO_3 \xrightarrow{\text{heating}} CaO + CO_2$$

CaO is mixed with clay to form cement which is used in building material.

* **Agriculture:** Calcium hydroxide increase soil PH by combining with H^+ to increase soil fertility.

* **Medicines:** Barium sulphate absorbs X-ray and used as diagnostic element for stomach and intestine disord

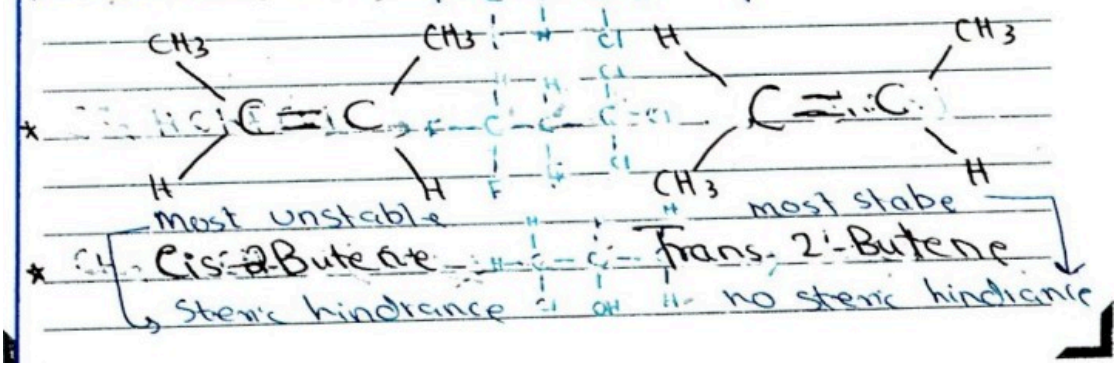
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Q. No. 2 Part (vi) **Cis-Trans Isomer of 2-Butene**

Cis Isomer **Trans Isomer**

- Cis means same side Trans means opposite.
- Atoms (same) or group same atom or group of same atom attach same of atom present on to same adjacent Carbon opposite side to

* atom. adjacent carbon atom.



* Most unstable most stable

* Cis-2-Butene Trans-2-Butene

Steric hindrance no steric hindrance

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Q. No. 2 Part (vii) **Chiral and Achiral**

Chiral → Molecule bonded to four different atoms or group of atoms called chiral.

Achiral → Molecules bonded to same group of atoms or atom called Achiral.

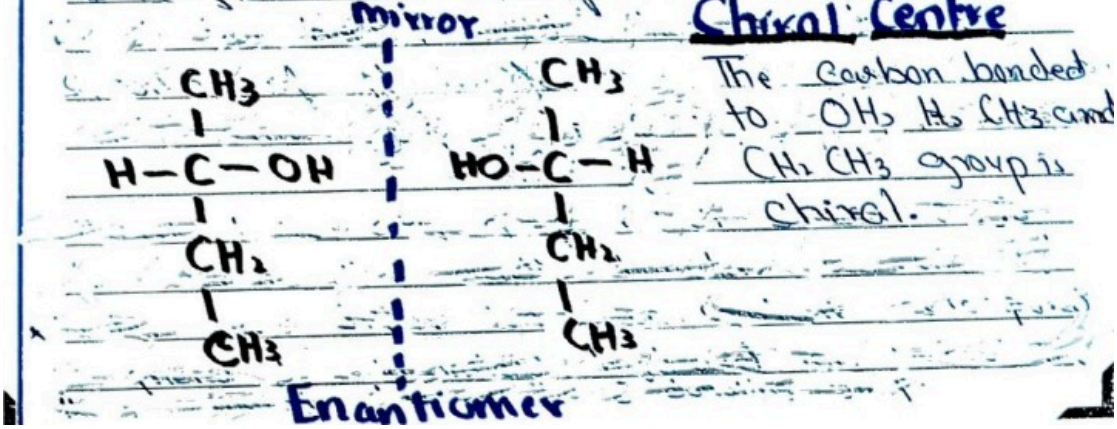
a) $CF_3CH_2CCl_3$ → Achiral

b) $CF_2HCHFCCl_3$ → Chiral

c) $CH_2ClCH(OH)CH_3$ → Chiral

Q. No. 2 Part (viii) **Enantiomers of 2-Butanol.**

- The enantiomers are non superimpusable mirror image of one another.
- They have same physical and chemical property but different biological activity.



Chiral Centre

The carbon bonded to OH, H, CH_3 and CH_2CH_3 group is chiral.

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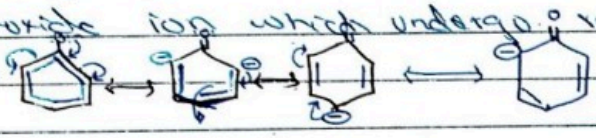
Q. No. 2 Part (ix) **Comparing Acidity**

*The acidic character can be determined by stability of conjugate base and Pka value.

*The acidity of Phenol, ethanol and water is: Phenol > water > ethanol

Pka 1.3×10^{-10} 1.8×10^{-16} 1.26×10^{-16}

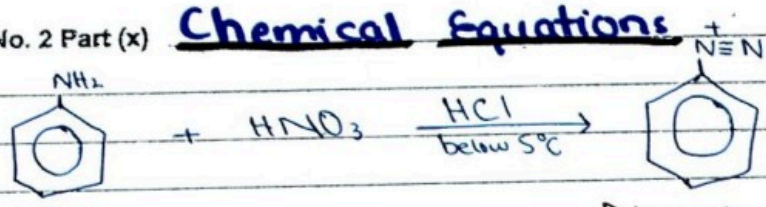
- Phenol has greater acidic character due to stable phenoxide ion which undergo resonance stabilization.



- Water has no resonance structure so less acidic than phenol. $\ddot{O}H^-$
- Ethanol has e⁻ donating alkyl group which decrease its acidity. $CH_3 - CH_2 - \ddot{O}:^-$

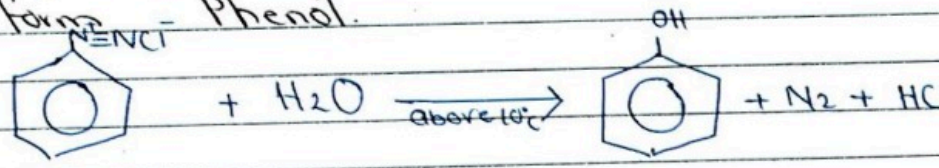
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Q. No. 2 Part (x) **Chemical Equations**



Aniline Diazonium chloride

Hydrolysis of Diazonium chloride above 10°C forms Phenol.



Diazonium Chloride Phenol

(Section B)

Q. No. 2 Part (xi)

Addition Polymers:

→ Polymers formed by adding monomer to 'C=C' is known as addition polymers.

→ Addition polymers are saturated, non polar and unreactive.

→ Not decompose by action of microorganism.

e.g. PVC, ethylene

Condensation Polymer

→ Polymers formed by adding monomers with removal of H_2O, HCl etc is condensation Polymer.

→ Mostly unsaturated and reactive.

→ Decompose by action of microorganism.

e.g. Polypeptide, Kevlar

Q. No. 2 Part (xii)

Molecular Ion Peak: The fragment of ion in mass spectrograph which show highest m/z is known as molecular ion peak. It is denoted by M^+. The molecular mass is equivalent to M^+. molecular ion peak of Cl - 35 is $M^+ = 35 m/z$

Base ion Peak: The fragments of ion in mass spectrograph which show 100 % abundance called base ion peak.

• It is most stable ion fragments.

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Q. No. 2 Part (xiii) **Mobile Phase:** The phase of chromatography which runs over stationary phase called mobile phase. It separates substance.

R_F Value: The distance of solute travelled by solute to the distance travelled by solvent called R_F value. It is the ratio of distance travelled by solute and solvent.

$$R_F = \frac{\text{distance travelled by solute}}{\text{distance travelled by solvent}}$$

.....

Q. No. 2 Part (xiv) **Types of fertilizers**

Fertilizer are of three types.

1) **Nitrogen fertilizers:** These are essential at middle phase of plant cycle for keeping plant growing and increase yield. Important nitrogen fertilizers are ammonium nitrate, calcium ammonium nitrate, Urea.

2) **Phosphorus fertilizers:** These are essential for reinf plant root and stem. Increase flowering seed productio and fruit. e.g → Triphophate, Trisuperphosphate diammonium phosphate, ammonium dihydrogen phosphate.

3) **Potassium Fertilizers:** These are essential for development of root and maintaining photosynthe lack of K cause leave falls.

e.g → KNO_3, KSO_4

(Section C)

Q. No. 3 (Page 1) **Thermal Stability of Group II Carbonate and Nitrates**

The decomposition of compound into two or more simple substance by heating is known as thermal decomposition. The group II carbonates and sulphates undergo thermal decomposition. The stability of these carbonate and sulphate can be given by energy of enthalpy change, which can be explain by polarizing power. The large carbonate ion can be polarise by small dense charge cation. The size of cation of group II is increase down the group.

$$Mg^{+2} < Ca^{+2} < Sr^{+2} < Ba^{+2}$$

Small cation having dense charge easily polarize the anion. Such as Mg^{+2} has very small size but dense charge attract the $\bar{e}$ density and distort the CO_3 ion. This make the bond easily covalent character.

So Polarizing power of group II cation is.

$$Mg^{+2} > Ca^{+2} > Sr^{+1} > Ba^{+2}$$

(Section C)

Q. No. 3 (Page 2)

The greater the polarizing power it is easy to weaken C–O bond and it is easily decompose to metal ion and CO_2.

So Thermal Stability of Carbonate and Sulphates of group II can be given as:

$MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

$Mg(NO_3)_2 < Ca(NO_3)_2 < Sr(NO_3)_2 < Ba(NO_3)_2$

$BaCO_3$ and $Ba(NO_3)_2$ has highest thermal stability due to weaker less polarizing power.

Group II carbonate decompose to form metal ion and CO_2

Example.

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

$$MgCO_3 \xrightarrow{\text{heat}} MgO + CO_2$$

$$SrCO_3 \xrightarrow{\text{heat}} SrO + CO_2$$

Group II Nitrites decompose to form metal ion and toxic nitrogen dioxide.

Example:

$$Mg(NO_3)_2 \xrightarrow{\text{heat}} MgO + N_2 + O_2$$

(Section C)

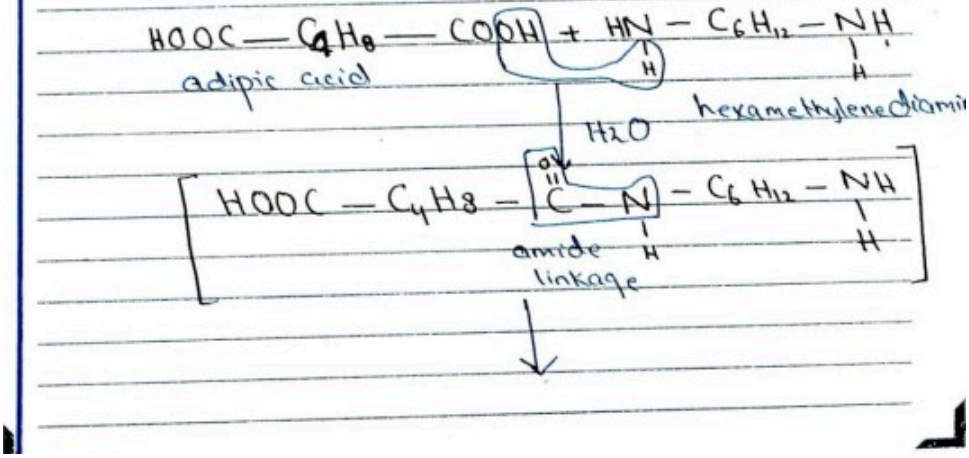
Q. No. 3 (Page 3)

The nitrogen dioxide produce is brown in colour and toxic.

(Section C)

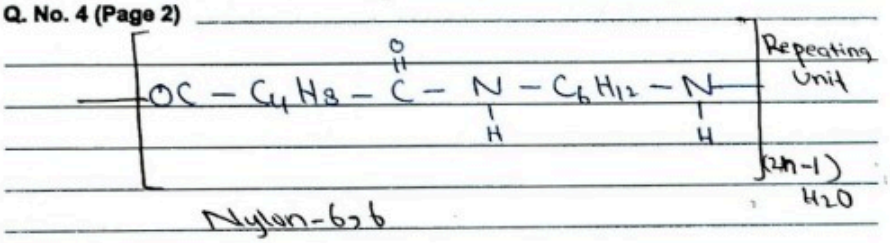
Q. No. 4 (Page 1) **Preparation of Nylon-6,6**

* Nylon-6,6 is formed by condensation of adipic acid (1,4-dioic acid) and hexamethylene diamine) at 200°C.
* Nylon-6,6 get its name from its starting material adipic acid and hexamethylene diamine which contain 6 carbon.
* Each adipic acid and hexamethylene diamine contain COOH and NH_2 group respectively.
* OH from carboxylic group react with H in amino group of hexamethylene diamine to form water.
* As a result bond is formed between carbonyl group and amine group, this linkage is amide bond.



(Section C)

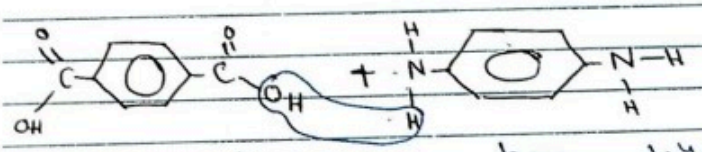
Q. No. 4 (Page 2)



Nylon-6,6

Polymerization in Kevlar:

- Kevlar is polyamide which is formed by condensation polymerization.
- Kevlar is formed from monomers benzene 1,4 dioic acid and benzene 1,4 diamine.
- Water is remove during condensation. OH from carboxylic acid reach with H in amino group to form water. As a result the amide linkage is formed between Benzen 1,4 dioic acid and benzene 1,4 diamine.



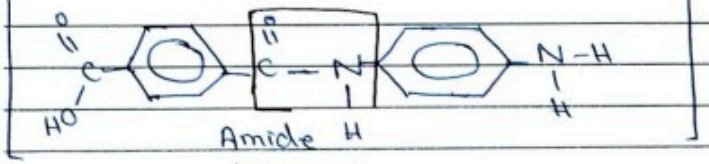
benzene 1,4 dioic acid

benzene 1,4 diamine

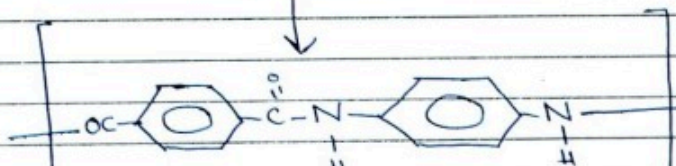
H_2O is removed

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Q. No. 4 (Page 3)



linkage



Repeating units form Polymers

(2n-1) H_2O

Kevlar -

(Section C)

Q. No. 5 (Page 1) **Acidic Strength**

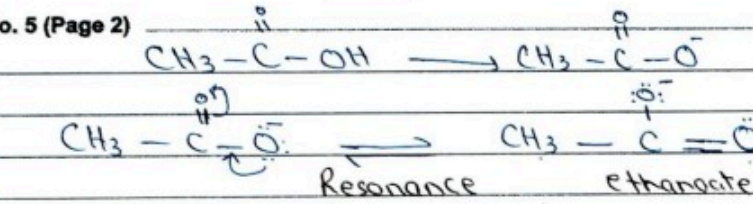
The ability of a substance to donate proton (H^+) is called acidic character/ strength and the substance that donate proton called acids.
The Strength of acid can be determine by the stability of conjugate base and PKa value. Smaller will be the PKa value stronger will be the acid.
The stable conjugate base increase acidic strength.
The order of acidic strength in ethanoic acid, Phenol and ethanol is given as.

Ethanoic acid > Phenol > ethanol.

Ethanoic acid:
It has 4.7 PKb value. The ethanoic acid form ethanoate ion by lossing proton. Ethanoate ion under go resonance stabilization. The resonance in ethanoic acid is equivalent and negative charge present on high electronegative atom.
This makes ethanoic most acid due to conjugation or equivalent resonance.

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Q. No. 5 (Page 2)



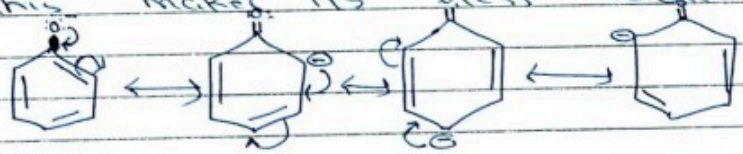
Resonance ethanoate

Phenol:

Phenol has PKa value about 10. It is less acidic that ethanoic acid.

Phenol form phenoxide ion by lossing proton.

Phenoxide undergo resonance stabilization reaction. The resonance is non-equivalent and negative charge resonance over the less electro-negative atom (carbon) in ring. This makes its less acidic.



resonance structure

Ethanol:

ethanol is less acidic than ethanoic acid and phenol due to alkyl group. Alkyl group donate ē to ethanol which decrease its acidic character.

Also ethanol do not have

(Section C)

Q. No. 5 (Page 3)

any reacting structure

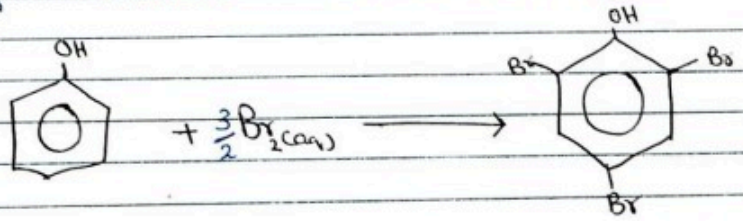
$CH_3CH_2OH \longrightarrow CH_3CH_2O^-$

(Section C)

Q. No. 6 (Page 1)

Reaction of Phenol and Bromine Water

- Phenol react with bromine water to give white precipitate of 2, 4, 6 tribromophenol.
- In this reaction the brown colour of bromine is decolourized.



2,4,6-tribromophenol

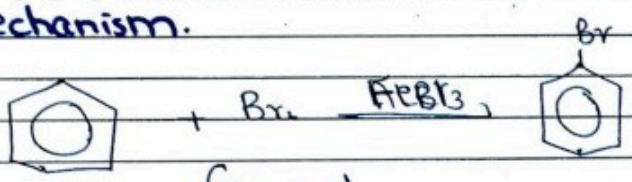
Bromination of Benzene

The addition halogen to benzene ring is known as bromination of benzene in which the hydrogen of benzene ring is substituted by halogen atom. This reaction is catalyze by iron halide (FeX_3).
The reagent is halogen molecule and benzene.
The product formed is halo benzene.

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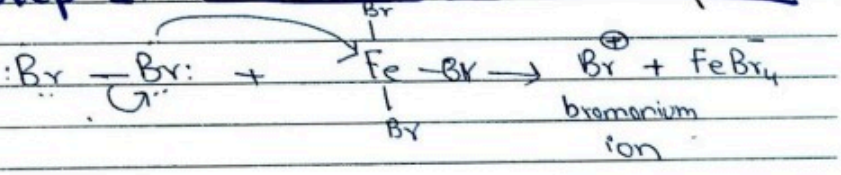
Q. No. 6 (Page 2)

Mechanism.



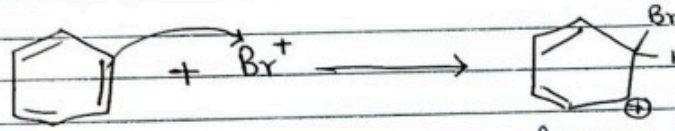
General.

Step I: Generation of Electrophile:



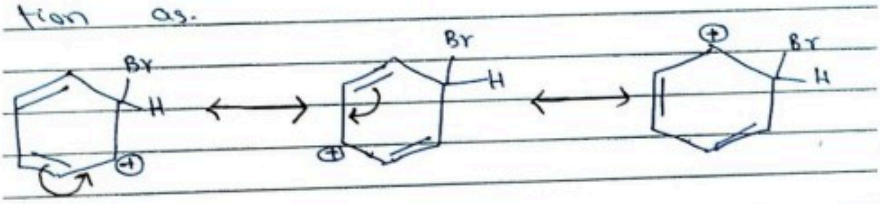
Step 2: Attack of electrophile on benzene ring

The bromonium ion attack on benzene ring to form an intermediate called arenium ion.



Arenium ion

Arenium ion undergo resonance stabilization as.

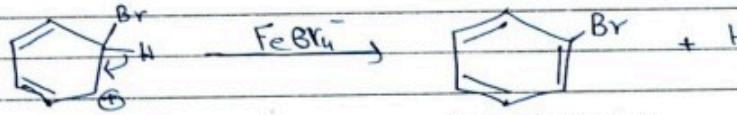


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Q. No. 6 (Page 3)

Step 3: Deprotonation / Regeneration of Catalyst

In this step the lewis acid ($FeBr_4^-$) abstract proton from arenium ion to form bromo benzene



bromobenzene

$$H^+ + FeBr_4^- \longrightarrow HBr + FeBr_3$$

catalyst.