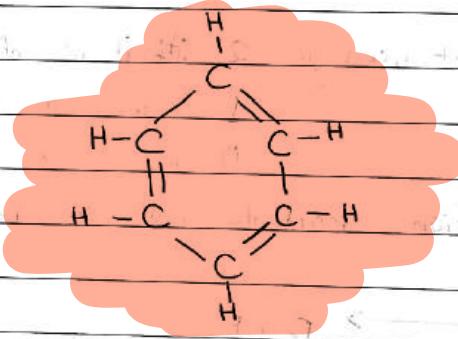


Organic Chemistry

Structure of Benzene

It is a hydrocarbon with molecular formula C_6H_6 . Benzene itself and its derivatives are called aromatic organic compounds. At room temp., id-id Benzene exists as a liquid. It is a non polar molecule with strong temporary dipole-dipole interaction. The high strength of the intermolecular forces between benzene molecules is due to presence of large number of electrons in their molecules.

The first realistic structure of benzene was proposed by Kekulé in the mid 19th century. He stated that the carbon atoms in Benzene molecule forms a cyclic hexagon where they have alternatingly ~~Carbon~~ ^{Carbon} C-C single bond and C=C double bond.

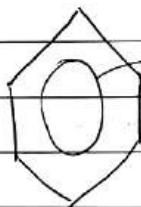
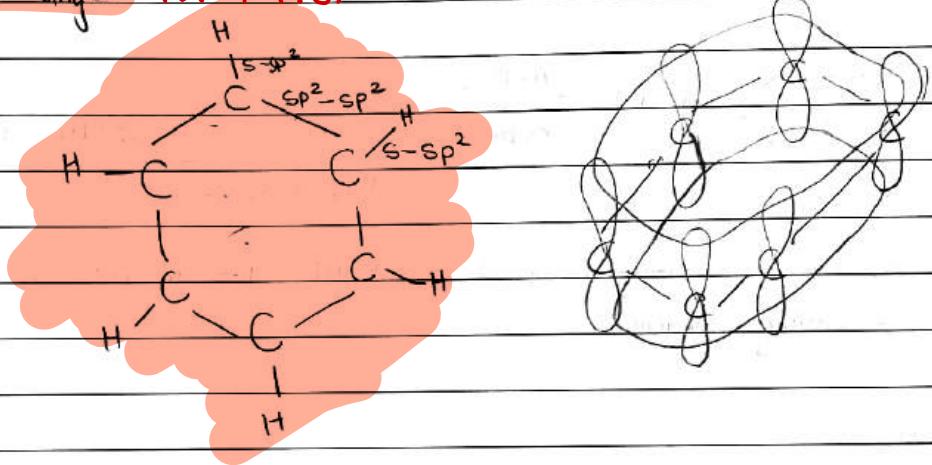


Limitation in Kekulé's structure

- If his structure was correct then just like alkene, benzene will also go through addition reaction. However, ^{unlike alkenes} benzene does not participate in any ^{electrophilic} addition reaction unless the condition is harsh.
- The actual shape of benzene molecule is a regular hexagon but according to Kekulé's structure as benzene has C=C double and C-C single bonds, the bond lengths must differ causing it to have irregular hexagonal shape.

Actual Structure of benzene.

All the carbon atoms in benzene have sp^2 hybridized ~~out~~ orbital where each carbon atom forms a sigma bond with two of its adjacent carbon atom and 1 hydrogen atom. All this causes all the carbon atom to have 120° bond angle. ... P.T.O.



→ delocalised electron ring of benzene

P.T.O

③ This causes all the bond angle 120° . Each carbon atom has a p orbital. The 6 p orbitals sideways overlap with each other to form a combined π -bonding system, consisting of 6 bonding electrons. The π -bonding systems form ring that is situated over & below the plane plain of all sigma bonds. Combinedly this π -bond system is much more stronger than the π -bond in alkene. This is the reason for benzene to not react by electrophilic addition reaction.

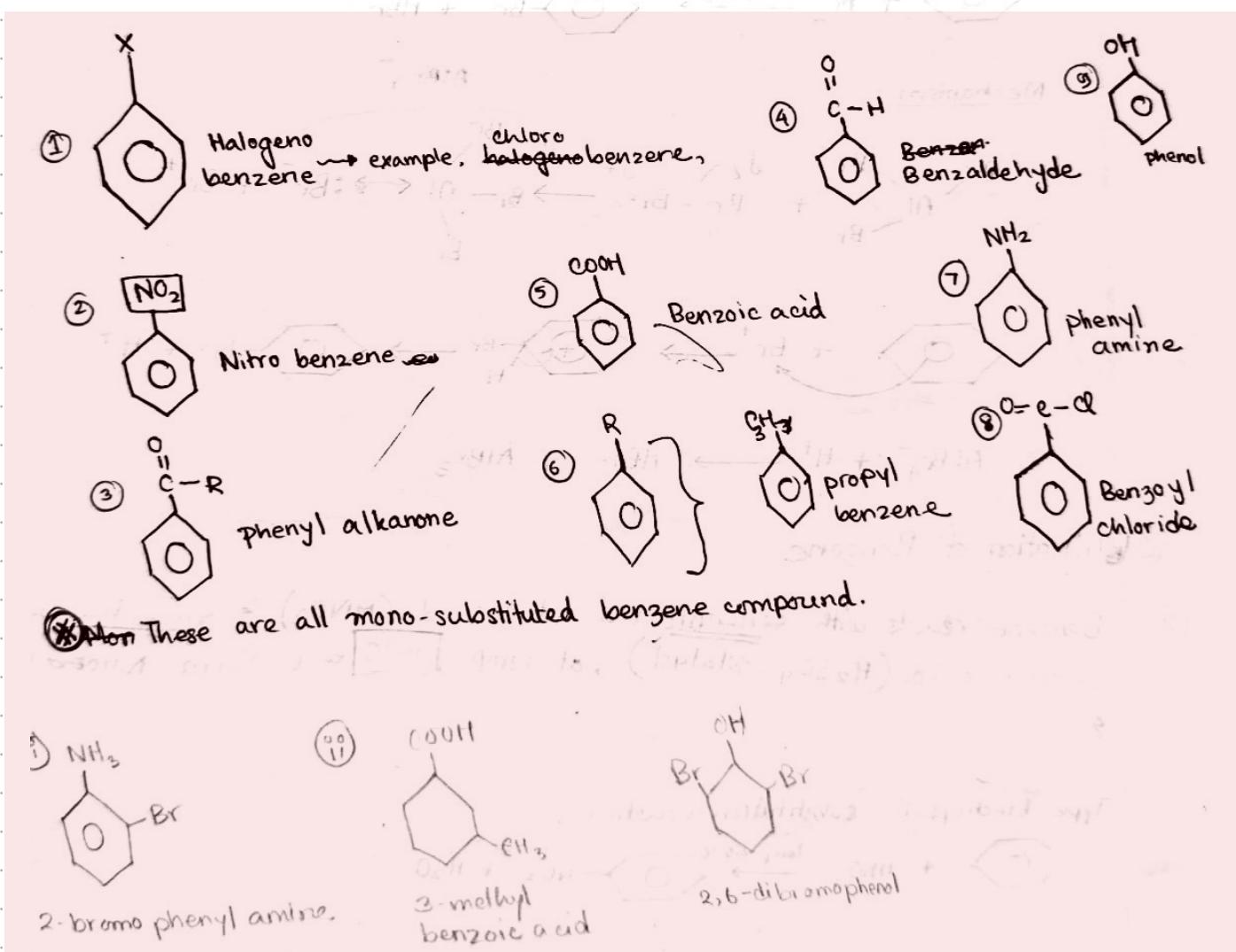
However, when the π -bonds are considered individually over each sigma-bond only one electron is involved in each π -bond. On the other hand a normal π -bond contains ≈ 2 electrons, thus individually the π -bond between each C-C single bond is weaker than the π -bond in $C=C$ double bond. This causes the the C=C bond in benzene to have an intermediate single & double bond characteristics.

$$C-C = 350$$

$$C=C = 610$$

$$C\cdots C = 520$$

Benzene is a non-polar molecule & has high strength T.D.B.F acting between their molecules causing it exist as liquid at room temperature

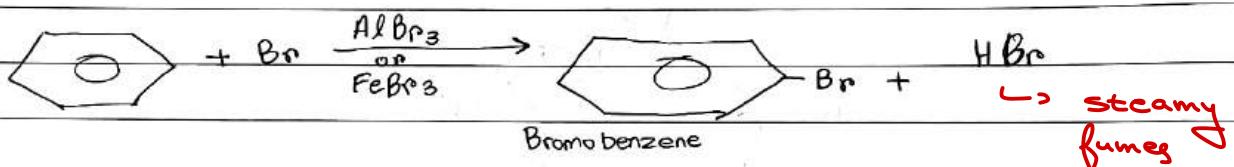


Reactions of Benzene

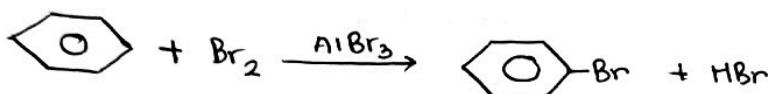
FeX_3

1 Benzenes react with halogens in presence of iron(III)halide / Al halide as catalyst to form halogeno benzene and HX.

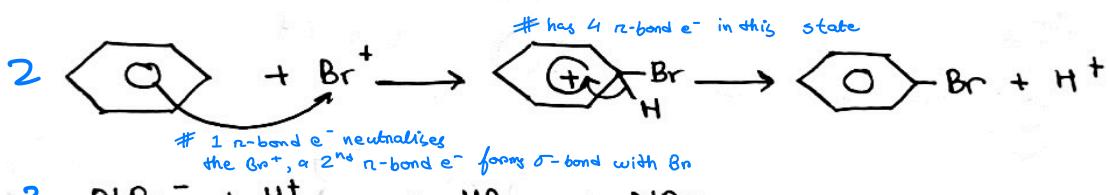
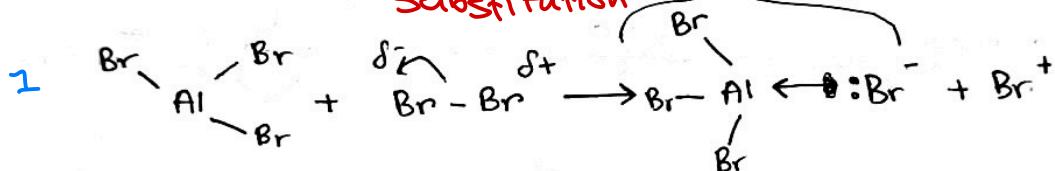
Type of reaction: Electrophilic substitution reaction.



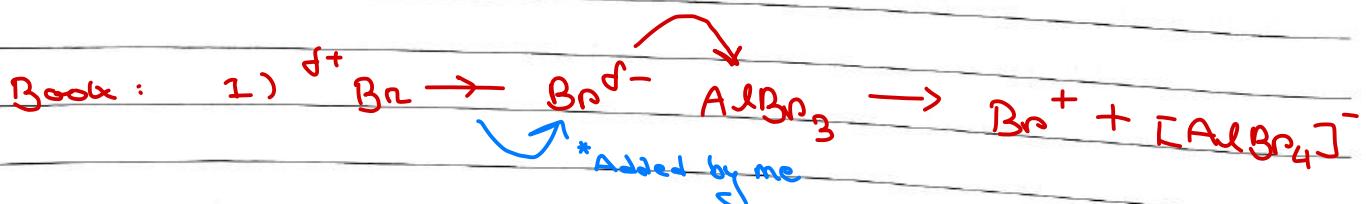
Benzene is a very powerful nucleophile due to presence of 6 electrons in its π -bonding system



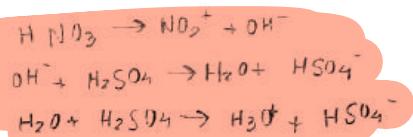
Mechanism : Electrophilic Substitution



Catalyst regenerated at the end

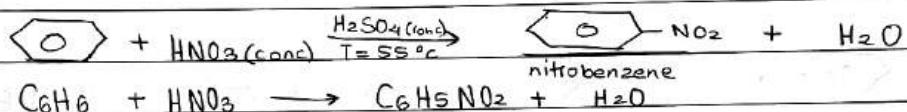


Gap in Benzene ring should face the direction of the C atom where the halogen atom is added

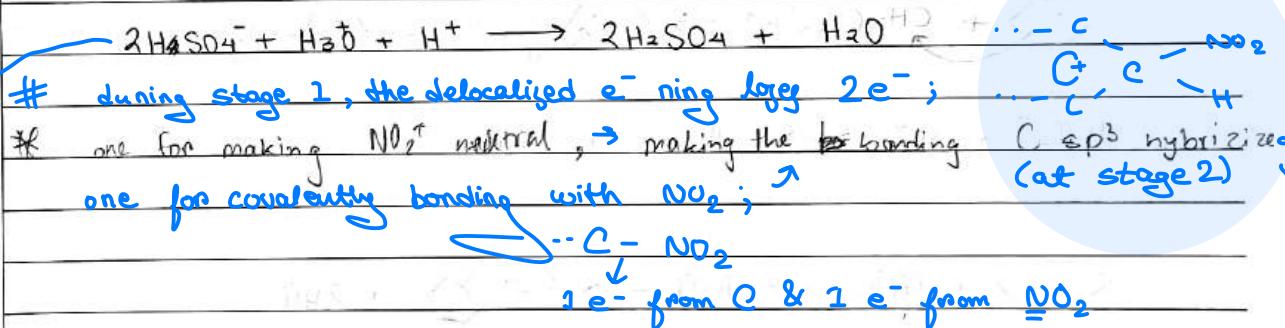
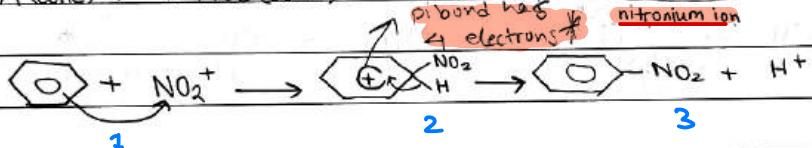


2. (Nitration of Benzene) Benzene reacts with concentrated nitric acid in presence of concentrated H_2SO_4 as catalyst at 55°C to form nitrobenzene and water as by product $\rightarrow 328\text{K}$

Type of reaction: Electrophilic substitution reaction.



Mechanism



This leaves the π -bond with only $4e^-$.

During stage 2, C-H is broken heterolytically, $1e^-$ goes to the π -bond system as the delocalized e^- of the bonded C atom. The other e^- goes to the π -bond system to compensate for the extra π -bond e^- that was //removed during stage 1.

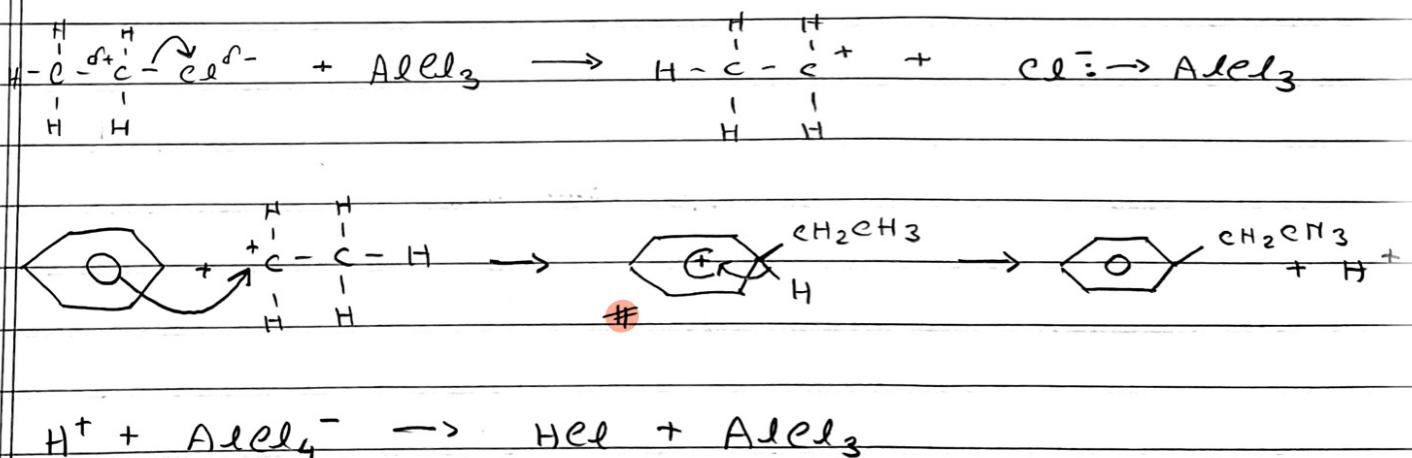
Reaction 3 : Friedel Crafts Reaction

i) Alkylation of Benzene : Benzene reacts with halogenoalkanes in presence of AlCl_3 on FeCl_3 catalyst to form alkyl benzene and HCl

Type of Reaction : Electrophilic Substitution



Mechanism

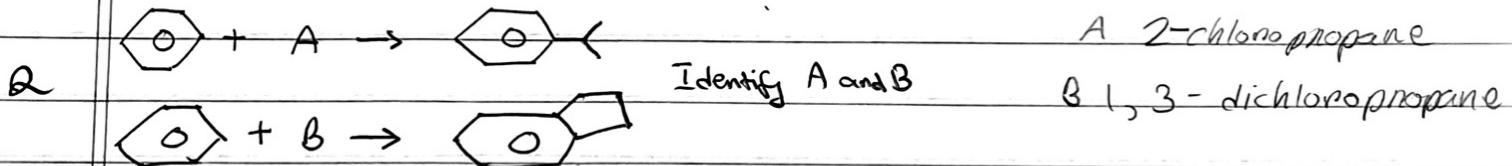
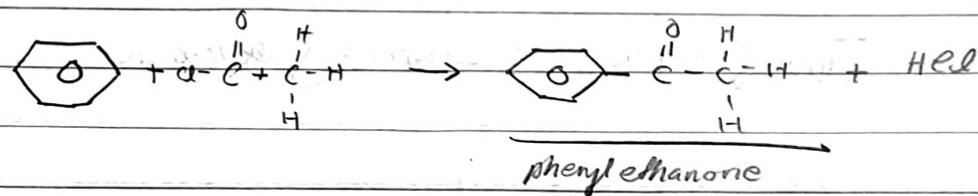


gap in the benzene ring must face the C atom that going the electrophile

X

ii) Acylation of Benzene: Benzene reacts with acyl chloride in presence of AlCl₃ on FeCl₃ of catalyst to form phenyl ketone and HCl

Type of Reaction: Electrophilic Substitution

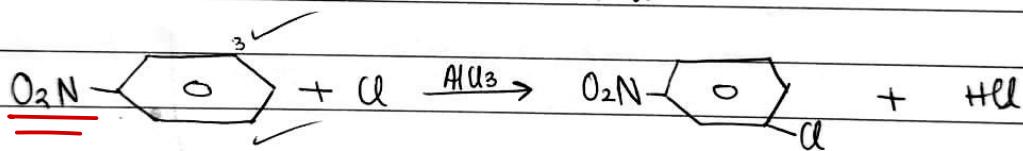
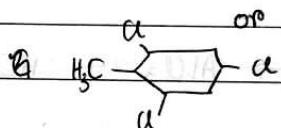
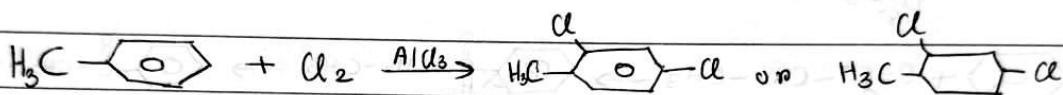
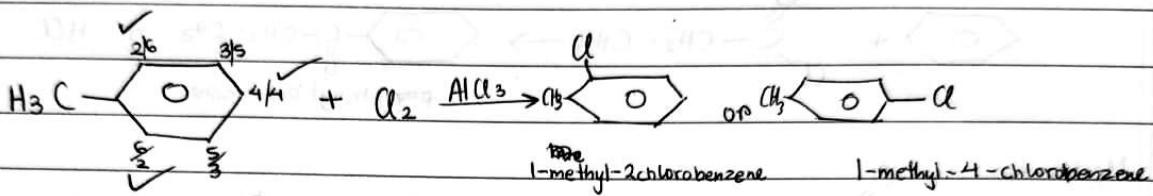


When Qq asks to no NAME the reacⁿ, write Friedel-Crafts Reaction (specify whether its Alkylation or acylation of Benzene)

on Cl

Activation of Carbon atoms in the benzene ring

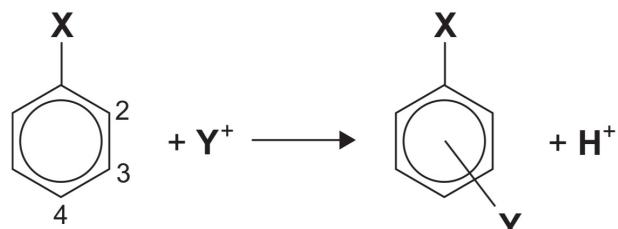
When an electron donating group such as alkyl or OH is attached initially attached to the benzene ring it will activate 2 or 4 position in the benzene ring. On the other hand when an electron withdrawing group Cl is attached to the benzene ring initially it will activate 3 or 5 position. **except Cl**



— N₂O is an e^- withdrawing group

The orientating effect of groups in aromatic substitution reactions.

The position of the incoming group, Y, is determined by the nature of the group, X, already bonded to the ring, and not by the nature of the incoming group Y.



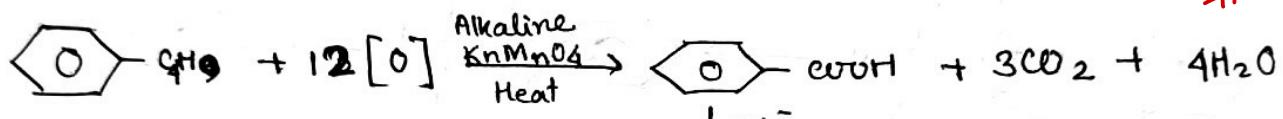
e^- donating group	e^- withdrawing group
X-groups that direct the incoming Y group to the 2- or 4- positions	X-groups that direct the incoming Y group to the 3- position
$-\text{NH}_2, -\text{NHR}$ or $-\text{NR}_2$	$-\text{NO}_2$
$-\text{OH}$ or $-\text{OR}$	$-\text{NH}_3$
$-\text{NHCOR}$	$-\text{CN}$
$-\text{CH}_3, -\text{alkyl}$	$-\text{CHO}, -\text{COR}$
$-\text{Cl}$ * exception	$-\text{CO}_2\text{H}, -\text{CO}_2\text{R}$

Whether a group is e^- donating or withdrawing is not fixed. It depends on its ability to donate or withdraw e^- relative to the ability of the group to which it is attached.

→ only heat under reflux reacⁿ
for benzene

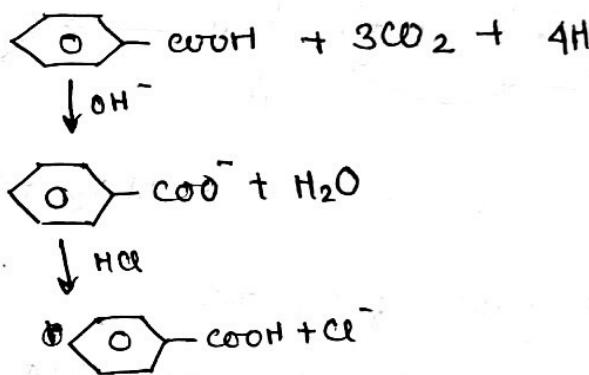
Oxidation of side-chain of Benzene

- ④ The side chain of any Benzene molecule can be oxidised by reacting with alkaline Potassium Manganate on heating under reflux, followed by mineral acid (HCl OR H_2SO_4) to form benzoic acid & other bi-product.



Type of reaction: Oxidation

This reacⁿ is NOT an electrophilic substitution reacⁿ



bi-product are H_2O and CO_2 (unless it is methyl benzene)

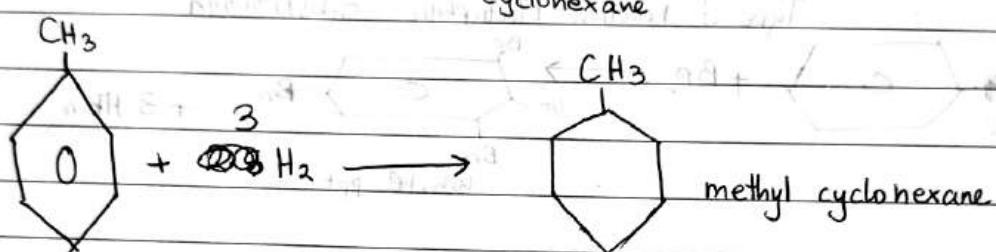
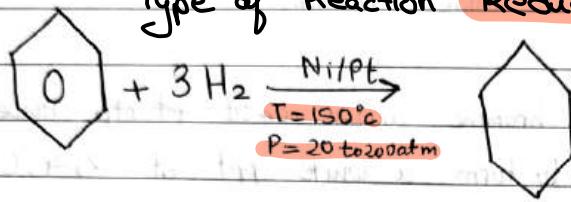
→ Regardless of the no. of C atoms in the sidechain of benzene, the main product will always be benzoic acid. The remaining C atoms will be balanced giving CO_2 as product

Hydrogenation of Benzene:

Benzene is reacted with H_2 in presence of Ni/Pt as catalyst at $150^\circ C$ (high temp) and ~~a~~ pressure ~~high pressure~~ $* 20 - 200 \text{ atm}$ to form cyclohexane.

$120^\circ C$ Mechanism of Reaction: ~~Electrophilic Addition~~

Type of Reaction: Reduction



REDUCTION
(electrophilic ADDITION)

Hydrogenation : $120^\circ C + 20 - 200 \text{ atm pressure} \uparrow$

Nitration : $55^\circ C$

Oxidation : heat under reflux + alkaline \uparrow

OXIDATION

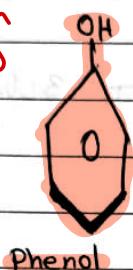
Phenol

Phenol has relatively high melting and boiling point due to presence of both hydrogen bonding and strong Vander Waal's force.

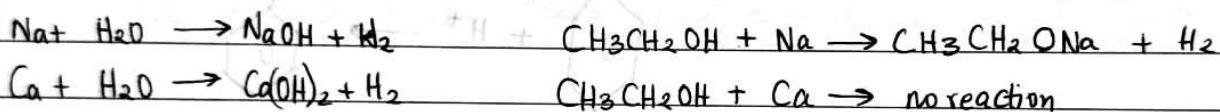
Despite having H bonds phenol is slightly soluble in Water.

This is due to presence of large non polar benzene ring *that doesn't allow water molecules to interact with the polar part ($\delta - \delta^-$)

establish hydrogen bonds with H_2O molecules



* which acts as an obstacle between H_2O molecule and phenol

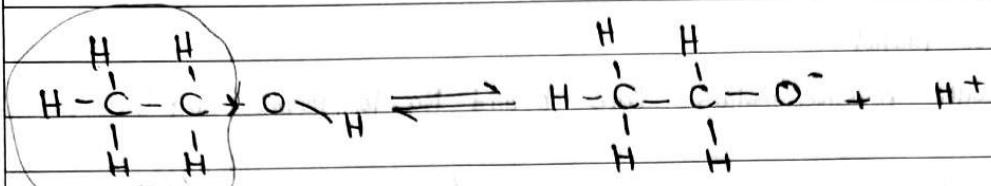


H_2O	$\text{H}_2\text{O} \rightleftharpoons \text{OH}^- + \text{H}^+$	14.0
$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{OH} \rightleftharpoons \text{CH}_3\text{CH}_2\text{O}^- + \text{H}^+$	16.0
Phenol	$\text{C}_6\text{H}_5\text{OH} \rightleftharpoons \text{C}_6\text{H}_5\text{O}^- + \text{H}^+$ ↓ phenoxide ion	10.0

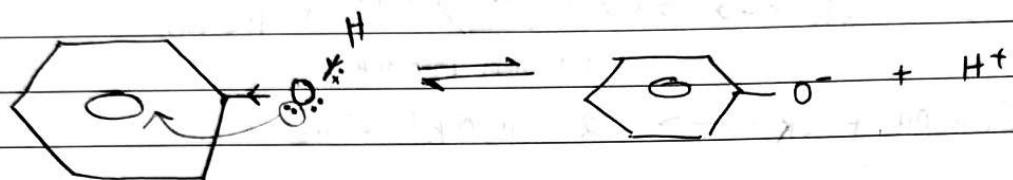
Q Despite being less soluble than any alcohol in water why is the pH value of phenol greater than water and alcohols?

Phenol > Water > Alcohol

acidic strength decreases



electron donating
alkyl group



Why is ethanol less acidic compared to phenol?

- In the case of phenol the lone pair of e^- over Oxygen atom gets delocalised into the benzene ring this decreases weakens O-H bond and H^+ ions can be formed easily. In case of ethanol the O-H bond is bonded to an electron ~~to~~ donating alkyl group this increases the availability of bonding pair of electrons over O-H bond thus strength of O-H bond is greater and so H^+ causing less formation of H^+ .

Reverse Argument: ← I prefer

- In case of ethanol the O^- in ethoxide ion is bonded to electron donating alkyl group. Which will increase the negative charge density of O^- causing it to pull H^+ ions easily. On the other hand in phenoxide ion the electrons of O^- ~~are~~ ^{gets} delocalised into the benzene ring ~~thus~~ * H^+ ions cannot be pulled easily by O^- .
 ↳ which causes -ve charge to spread throughout the molecule (-ve charge density of O^- decreases), they
- # Write either I, not both

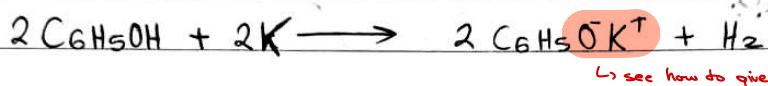
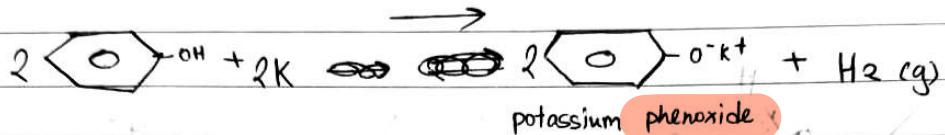
Acidic Reactions of phenol

1 Phenol reacts with reactive metals like K and Na to form salt (metal phenoxide) and H₂ gas.

NOT Neutralisation

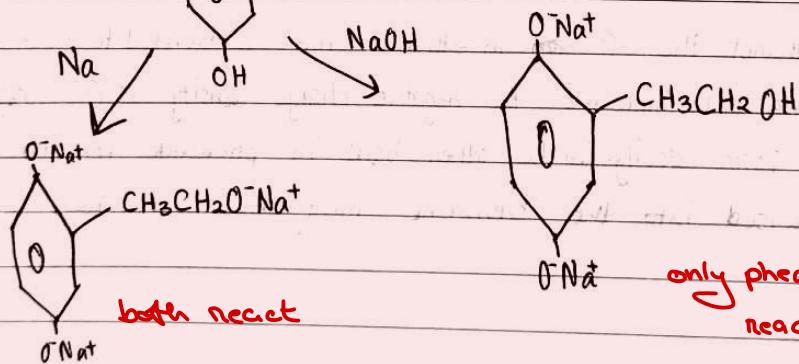
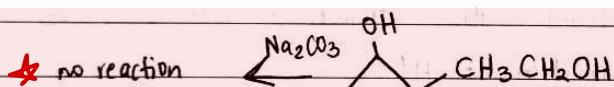
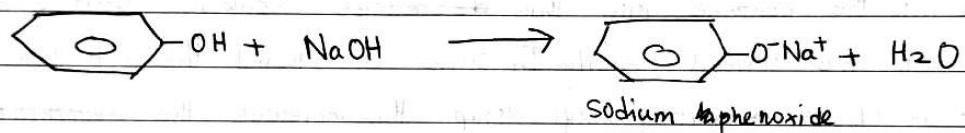
* Neutralisation reaction can never be redox reaction

Type of reaction :- Redox reaction (Acid-Metal Reaction)



2 Phenol reacts with strong alkalis like KOH or NaOH to form salt and H₂O(l)

Type of Reaction:- Neutralization Reaction



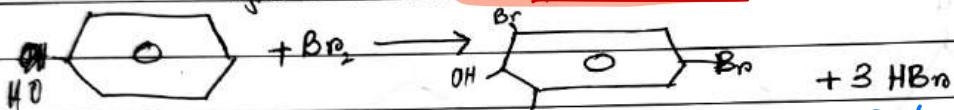
* Phenol or alcohol both do not react with metal carbonates

Reaction of Benzene Ring in phenol

As the lone pair of electron on the O_α atom gets delocalized into the benzene ring, the negative charge density of the benzene ring increases causing it to behave as a more powerful nucleophile. Thus phenol reacts with the same reagents as benzene but at milder conditions.

1. Benzene will never react with bromine water at rt. However phenol will easily decolorize bromine water to form a white ppt. of 2,4,6-tribromo phenol

Type of Reaction: Electrophilic substitution



Observations: i) white ppt

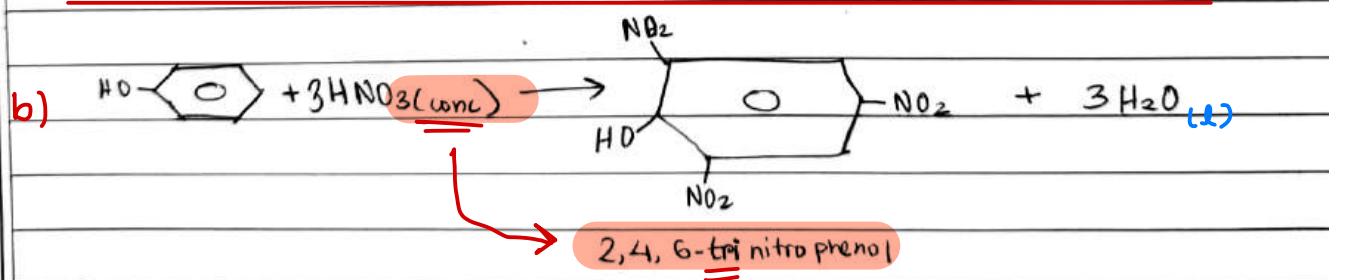
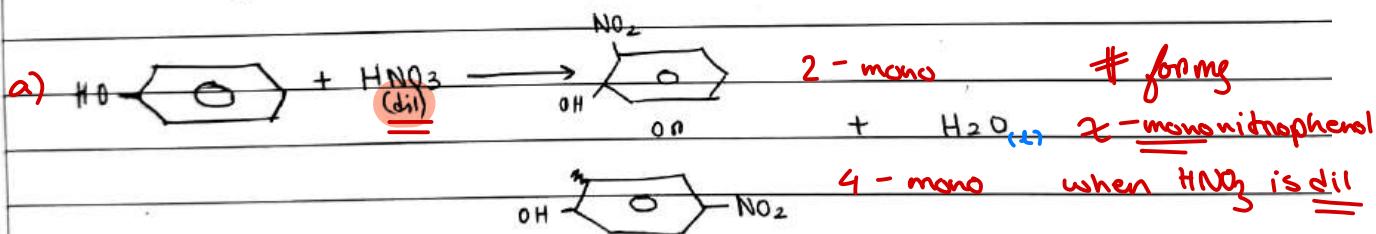
iii) \hookrightarrow steamy fumes

ii) Bromine water decolorised

(Nitration of phenol)

2. Phenol can be nitrated by reacting with dil HNO_3 at rt to form mononitrophenol and water and conc HNO_3 to form 2,4,6-trinitrophenol

Type of reaction: Electrophilic Substitution Reaction



forming 2,4,6-trinitrophenol only when HNO_3 is conc ppt. or soln

H_2SO_4 (conc) catalyst NOT required for either reaction



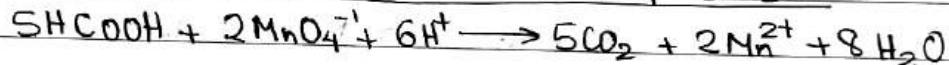
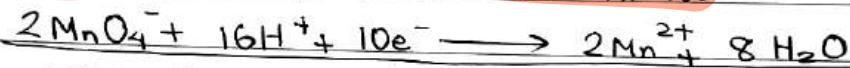
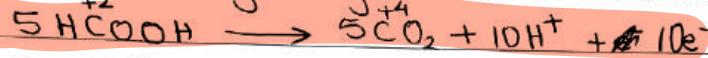
Carboxylic acid and Acyl Chloride

Oxidation of carboxylic acids → Neither has to be heated under reflux
There are few carboxylic acids that can be further oxidised. In our syllabus we have methanoic acid and ethanoic acid

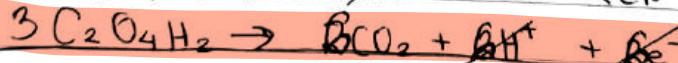
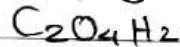
Methanoic acid can be oxidised by reacting with the mildest oxidising agents like Fehling's soln (blue to brown red) and Tollen's Reagent ($Ag^+ \rightarrow Ag$) (silver mirror)



Methanoic acid is oxidised by reacting with acidified $KMnO_4$ (n/t) (n/t)



Ethanoic acid can also be oxidised but by reacting with strong oxidising agents like $KMnO_4$ or $K_2Cr_2O_7$

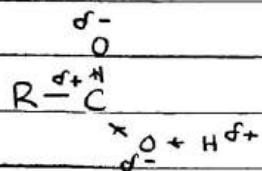


In case of ethanoic acid the reaction has to be warmed

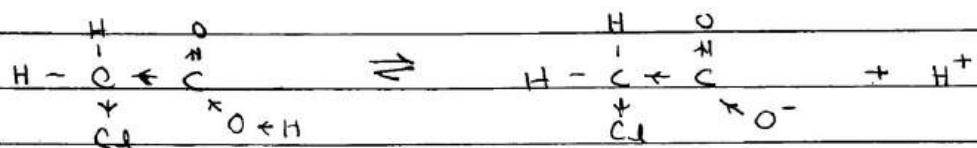
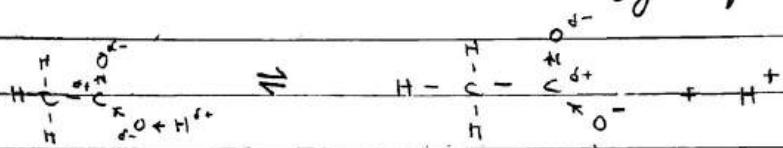
each mol of acid gives 2 mol of e^-

↪ not heat under reflux

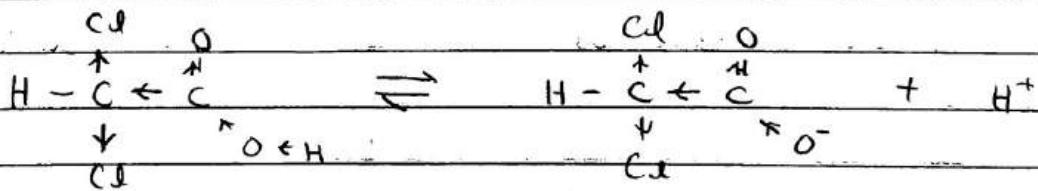
Strength of Carboxylic acids - Comparing Acidity of Carboxylic Acids



In Carboxyl functional group the bonding pair e^- are withdrawn from the $-\text{OH}$ group. Thus the O-H bond can be completely comparatively broken down easily, forming H^+ ion.



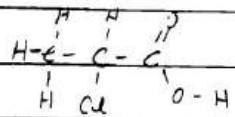
In the chlorocarboxylic acid, the e^- group in the O-H bond is being pulled away by two paths, $\text{O}=\text{C}-\text{O}^-$ and $\text{Cl}-\text{C}-\text{C}-\text{O}^-$, compared to only one path in a regular carboxylic acid, $\text{O}=\text{C}-\text{O}^-$, thus the availability of the bonding e^- in the chlorocarboxylic acid is less and thus the O-H is weaker thus more H^+ is formed.



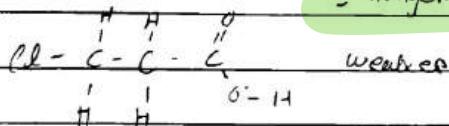
With increase in no. of e^- withdrawing Cl atom, the availability of bond pair e^- in the O-H bond decreases, so O-H bond becomes weaker, thus H^+ ion can be formed easily, causing acid to be stronger. Thus equilibrium will shift in forward direction.

Alternate Reason Argument: With increase in the no. of e^- as withdrawing Cl atom the -ve charge density of the O^- ion in the carboxylate group decreases. Thus H^+ ion cannot be attracted easily and equilibrium will not shift in the backward direction. Thus strength of acid increases.

in the carbon chain



Stronger, Cl elongates the carboxyl group. Thus elongates the O-H bond, and thus its e^- withdrawing ability has a "Mangen effect" on the bond pair e^- , making O-H bond weaker.



weaker

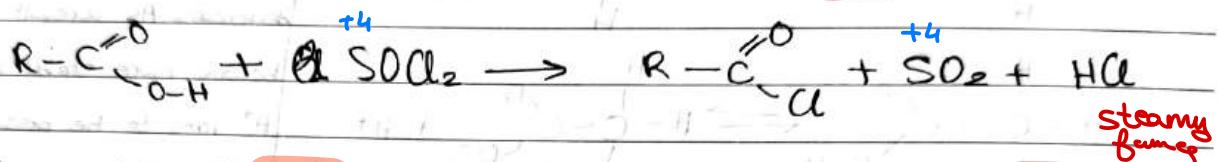
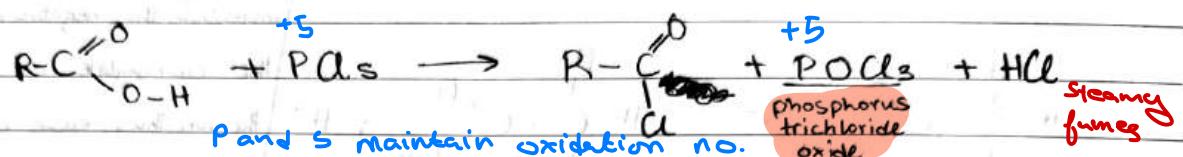
↑ Next mark question

↳ Compare using K_a value

Formation of Acyl Chloride

-COOH reacts with PCl_5 or SOCl_2 at rtf to form Acyl Chloride

Type of Reaction - Nucleophilic Substitution

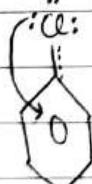
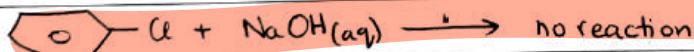
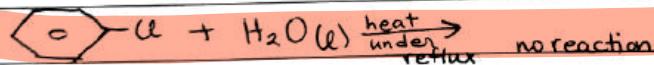
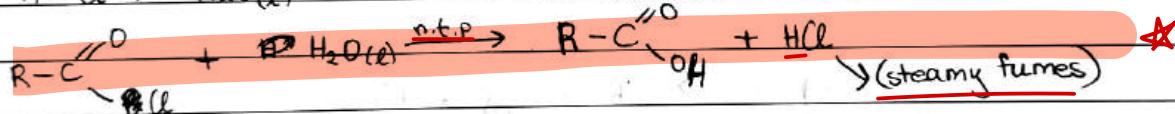
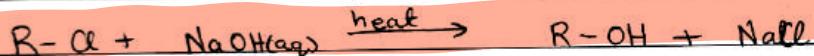
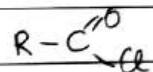
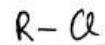
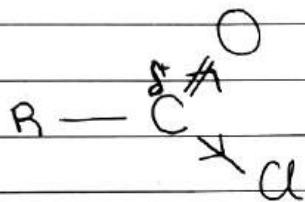


PCl_3 also reacts with R-COOH but on heating under reflux to form acyl chloride and H_3PO_3 acid



Reactivity and Reactions of Acyl Chloride

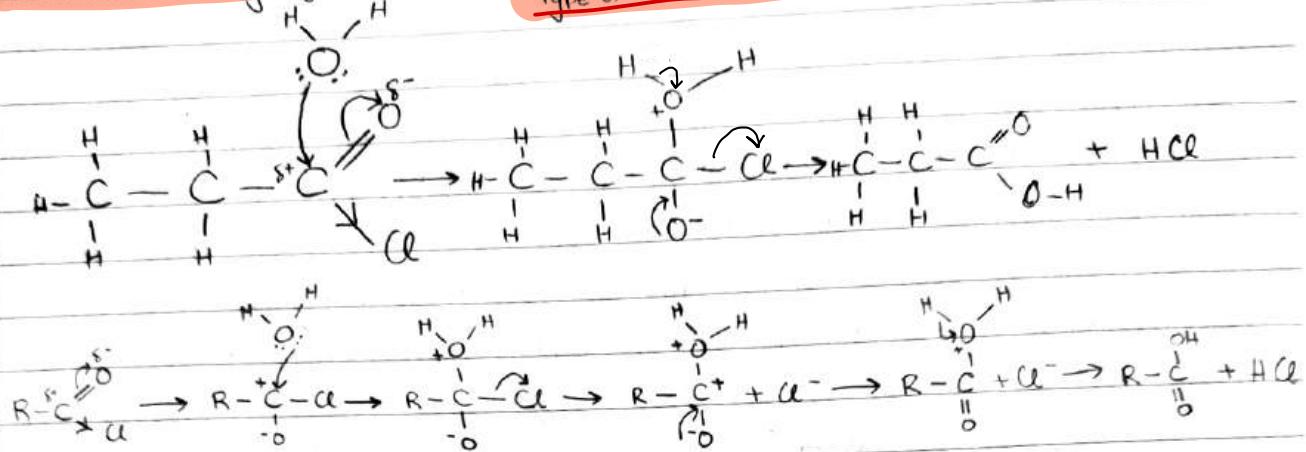
Acyl Chloride is a derivative of Carboxylic acid however it is more reactive than Carboxylic acids. The carbon atom in the functional group of acyl chloride is bonded to two highly electronegative atoms, (Chlorine and Oxygen) both can withdraw electrons from the carbon atom giving it a comparatively larger partially positive charge. This causes it to act as a very strong electrophile, and even the weakest nucleophile can also attack it.



* Chlorobenzene does not react with NaOH even on heating under reflux as the lone pair of e^- of the Cl atom gets delocalised into the benzene ring. This causes the C-Cl bond to be stronger due to presence of an intermediate double bond characteristics.

* compared to C-Cl bond in regular halogenoalkane

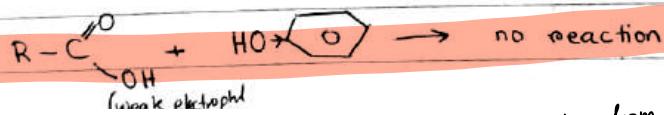
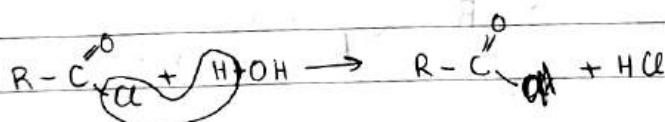
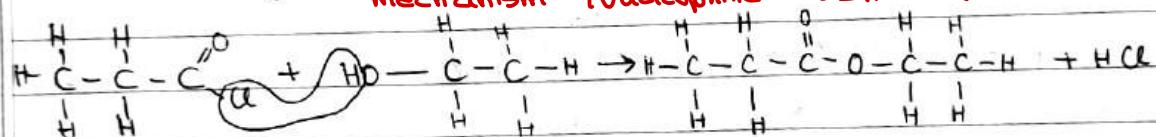
Mechanism of hydrolysis of acyl chloride at n.t.p.
 Type of mechanism \rightarrow (Add + E_i) = Condensation



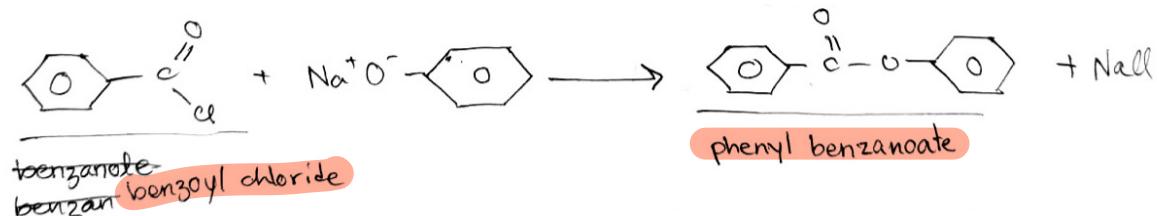
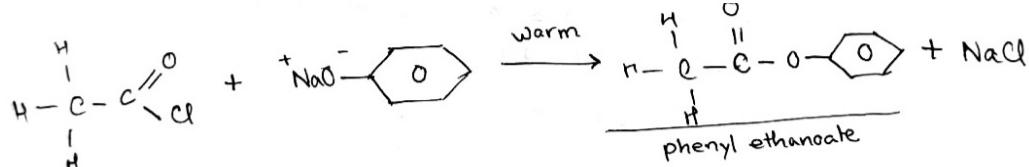
Acyl Chloride reacts readily with alcohol to form ester and HCl # no heat under reflux required

Type of reaction = Condensation

mechanism - Nucleophilic Substitution

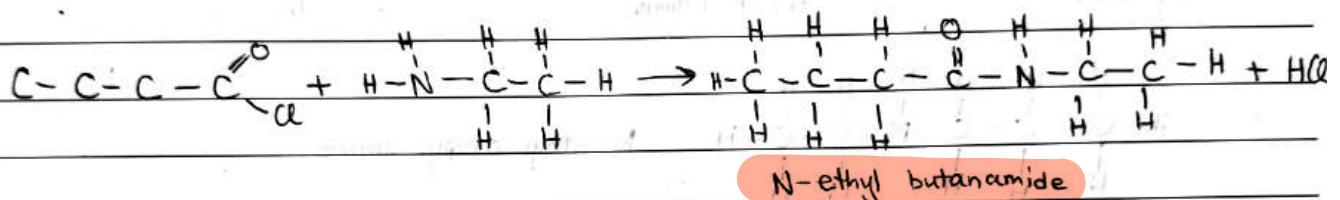
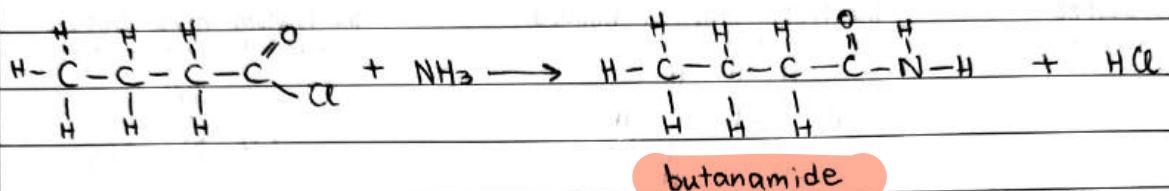


Phenol does not react easily with carboxylic acid but phenol does react with alkaline acyl chloride in NaOH warming to form phenyl alkanoate $\approx \text{HCl} + \text{NaCl}$



Acyl Chloride reacts with NH_3 or alkyl amine to form amide compounds

Type of Reaction: Condensation



* Oxidation of ethanoic acid - warming
Esterification of acyl chloride - warming + alkaline
with phenol

→ more stable

Halogenobenzene + NaOH (aq) → no react

Carboxylic acid + Phenol → no react

→ weak electrophile

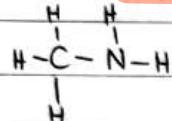
Amines

Primary
Amine

Secondary
Amine

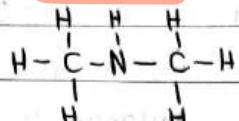
Tertiary
Amine

The Nitrogen must be bonded to 2 H atoms



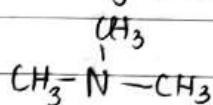
methyl amine

The Nitrogen must be bonded to 1 H atom

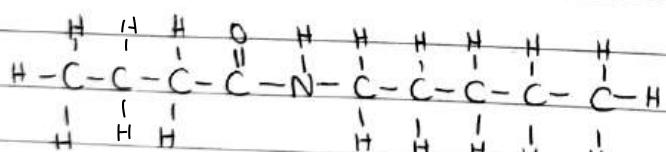
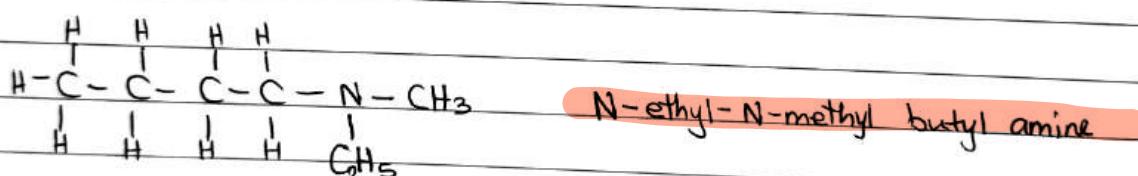
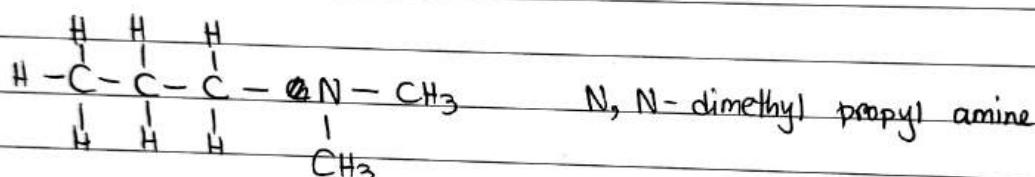
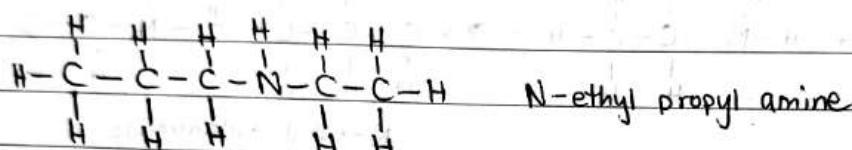


dimethyl amine

The Nitrogen must not be bonded to any H atoms



trimethyl amine



N-pentyl butanamide

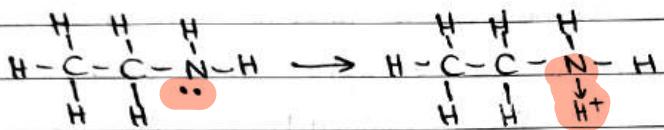
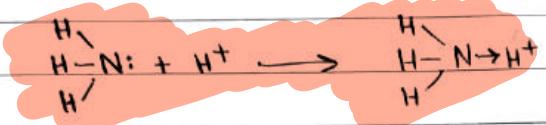
N is treated like a carbon no. when naming

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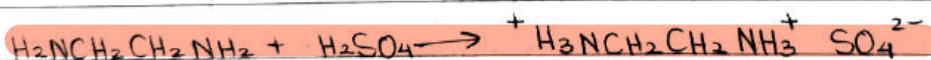
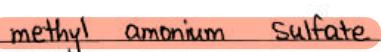
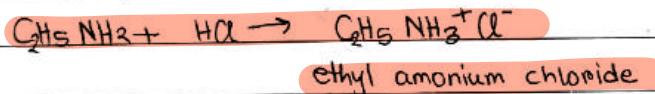


Basicity of Amines

The basicity of a compound depends on the ability to accept H^+ ion. Compounds that can accept H^+ ions easily are more basic.



Just like NH_3 , the N-atom in alkyl amine also has a lone pair of e^- thus it can also form coordinate bond H^+ ion. As a result it can accept H^+ ion causing it to behave as a base.

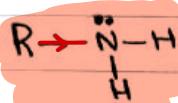


1,2-diamino ethane

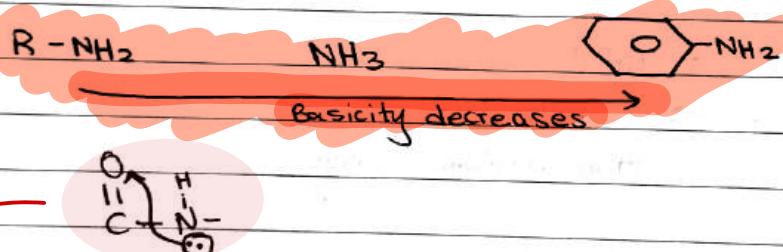
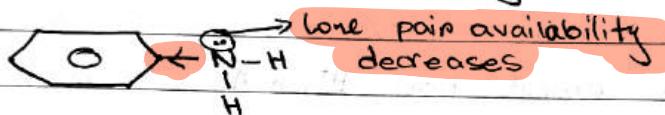
diamonium ethane sulfate ★



* Alkyl amines are stronger bases than NH_3 . This is due to presence of e^- -donating alkyl group in amines which increases the availability of the lone pair pair of e^- over N-atom. Thus H^+ ions can be accepted more easily.



* Compared to NH_3 , phenyl amine is a weaker base. The lone pair of e^- over N-atom in phenyl amine gets delocalised into the benzene ring. This reduces the availability of the lone pair. Thus H^+ ion cannot be accepted easily.



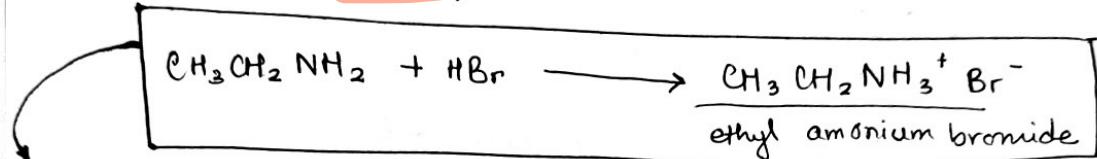
* Despite having a lone pair of e^- over N-atom, amide does not have only basic property. The lone pair of e^- gets delocalised into the π -bonding system of C=O . Thus H^+ ion cannot be accepted ~~at all~~ The lone pair of e^- NOT available to accept H^+ ions.

↳ Gives green colour in universal indicator

Formation of Amines

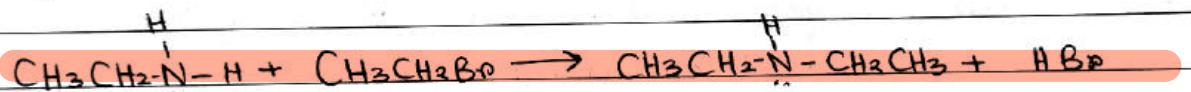
1) Halogenoalkane reacts with hot excess concentrated ethanolic NH₃ ^{in a sealed vessel} to form alkyl amine and hydrogen halide.

Type of reaction: Nucleophilic Substitution



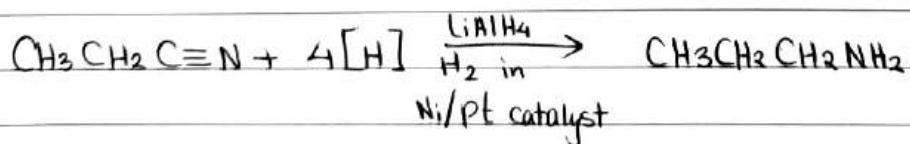
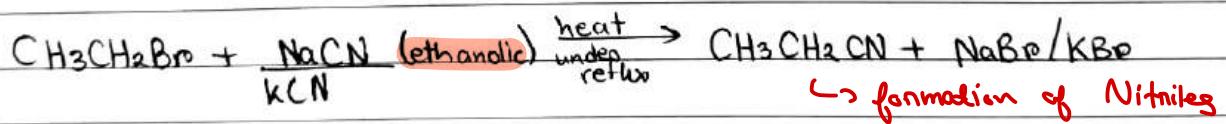
→ Excess concentrated NH₃ is used to prevent hydrogen halide from reacting with alkyl amine e.g. NH₃ + HBr → NH₄Br

→ NH₃ is used in excess to prevent formation of secondary or tertiary amine As amine itself is a strong nucleophile, thus can react remaining halogenoalkane:

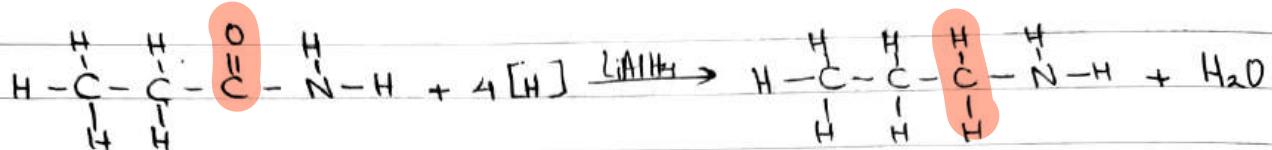


2) Nitrile compounds are reduced in presence of LiAlH₄ (Lithium Aluminium hydride) in dry ether or hydrogen in presence of Ni/Pt catalyst to form alkyl amine.

Type of reaction: Reduction

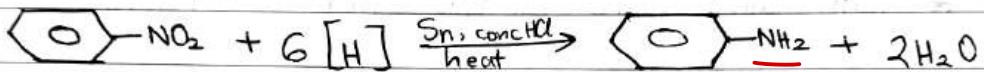


- 3) Amide compounds are reduced by using LiAlH_4 in dry ether to form amines and water.



- * 4) Nitrobenzene are reduced in presence of (Sn) tin and conc HCl on heating to form phenyl amine and water.

Type of reaction: Reduction.

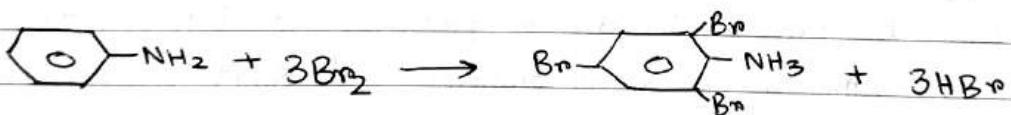


NOT NH_3^+ because phenyl amine very weak base

Reactions of phenyl amine

- 1) Just like phenol, phenylamines also react with aq-aq Bromine readily to form 2,4,6-tribromophenyl amine and HBr .

Observation: decolourises Bromine and forms white ppt.



2,4,6-Tribromophenyl amine
white ppt

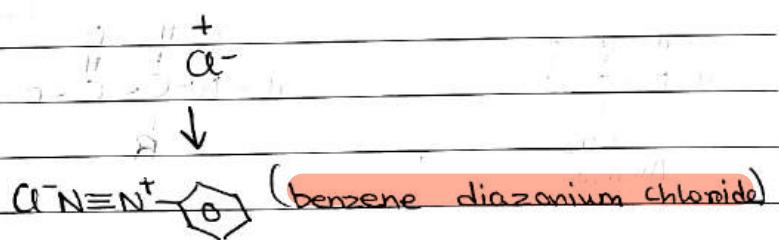
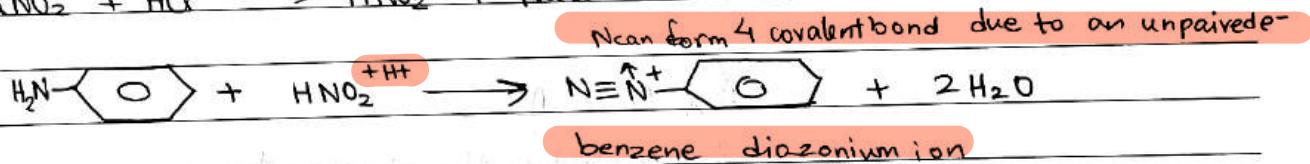
2) **Diazotisation reaction** ($\text{NaNO}_2 + \text{HCl}$)

Phenyl amine reacts with nitrous acid at a temp between $0-10^\circ\text{C}$ to form diazonium ion ($\text{C}_6\text{H}_5\text{N}_2^+$)

Nitrous acid is an unstable compound, thus has to be prepared immediately before the reaction by reacting NaNO_2 and HCl .

Diazonium ion formed it is very unstable at higher temp. Thus temp of the reaction mixture is always maintained from $0-10^\circ\text{C}$

Diazonium ions are used to form azo dye

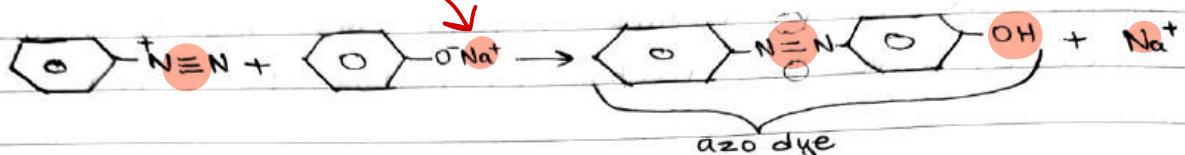


If the temp is raised above 10°C by warming:



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Dizonium ion can react with other benzene derivatives to form colourful stable compounds, these are known as azo dye. Eg: dizonium ion reacts with phenol dissolved in alkali to form an azo dye with orange colour.



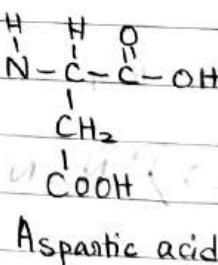
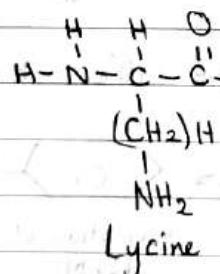
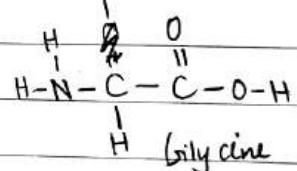
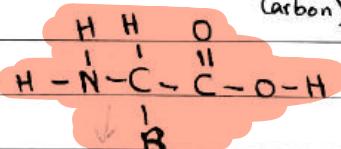
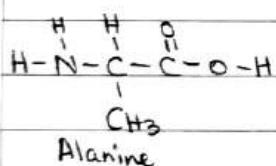
Q Why azo-dye is very stable?

The π -bonding system of $\text{N}=\text{N}$ overlaps with the π -bonding system of both the benzene ring. Thus creating bridge of electron charge cloud over the entire molecule causing it to be very stable.

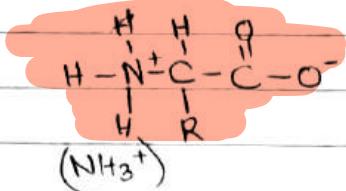


Amino Acids

2 amino acid (as NH_2 is on the 2nd carbon)



The amines and -COOH groups can interact with each other to form NH_3^+ ion and COO^- ion.



zwitter ion

Amino acid	At pH 7	At pH 2 (Acidic)	At pH 12 (Alkaline)
$\begin{array}{c} \text{H} & \text{H} & \text{O} \\ & & \\ \text{H}-\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_3 \quad (+1) \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_3 \quad (-1) \end{array}$
$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ (\text{CH}_2)_4 \\ \\ \text{NH}_2 \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ (\text{CH}_2)_4 \\ \\ +\text{NH}_3 \quad (+1) \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ (\text{CH}_2)_4 \\ \\ +\text{NH}_3 \quad (+2) \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ (\text{CH}_2)_4 \\ \\ \text{NH}_2 \quad (-1) \end{array}$
$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_2 \\ \\ \text{O} \\ \text{Tyr} \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_2 \\ \\ \text{O} \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_2 \\ \\ \text{O} \quad (+1) \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_2 \\ \\ \text{O}^- \quad (-2) \end{array}$
$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_2 \\ \\ \text{OH} \\ \text{Ser} \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_2 \\ \\ \text{OH} \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_3\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{CH}_2 \\ \\ \text{OH} \quad (+1) \end{array}$	$\begin{array}{c} \text{H} & \text{O} \\ & \\ \text{H}_2\text{N}-\text{C}-\text{C}-\text{O}^- \\ \\ \text{CH}_2 \\ \\ \text{OH}^- \quad (-2) \end{array}$

pH 9 reacts with strong alkali

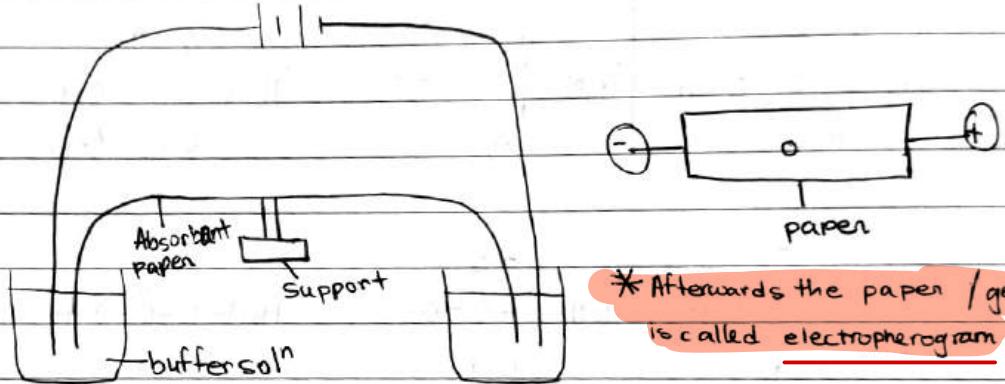
(Phenol reacts with strong Alkali)

OH does not react with alkali

Electrophoresis.

When a protein molecule is hydrolysed different amino acids are formed in order to examine the protein molecule amino acids have to be separated from each other. Electrophoresis is used to separate mixture of amino acids.

In this process the sample that is to be analysed is placed at the center of an absorbent paper or gel supported on a glass plate. Both the ends of the absorbent paper or gel is immersed into a buffer soln both the ends are connected to opposite terminals of a d.c power supply

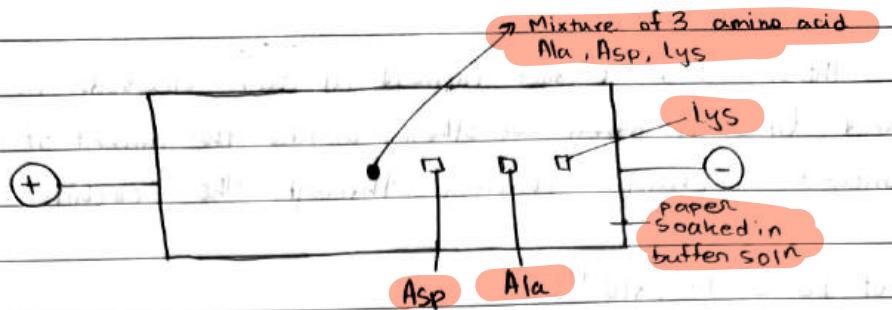


* Afterwards the paper / gel is called electropherogram

When an electric field is applied the amino acids will start to move due to its charge at a particular pH. The amino acids that are +ve charged will move towards the negative electric field and vice versa. The speed of movement or distance travelled by the amino acids will depend on their charge/mass ratio.

↑ charge / mass ↑ distance travelled





Alanine $\rightarrow +1$

Lysine $\rightarrow +2$

Asp $\rightarrow +1$

\rightarrow Paper chromatography

$+1 = \text{Asp}$

$+2 = \text{Lys}$

$0 + \text{Tris} + 0.1\% \text{ Coomassie Blue}$

PAKED

Dissolve

Faint blue spot

PAKED

Red spot

PAKED

Blue spot

PAKED

Misc. Notes

- # Since phenol more reactive than benzene, it can react with "impure" versions of X_2 like bromine water whereas benzene could only react with pure $BBr_2(g)$
- # π -bond in Benzene is more stable than those in alkenes - mg