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Where Minds Pollinate

Class 12

Chemistry

Chapter 12

Nitrogen Compounds

Handwritten Notes

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CHAPTER # 12:

"NITROGEN COMPOUNDS"

There are three types of nitrogen compounds.

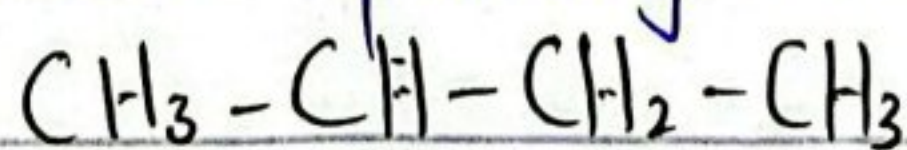
- ① Amine
- ② Amide
- ③ Nitrile

Amines: When hydrogen atom of ammonia is replaced by alkyl group, compound formed are called amines.

Types:

- 1) Primary amines $(R-NH_2)$
- 2) Secondary amines $(R-NH-R)$
- 3) Tertiary amines $(R-N(R)-R)$

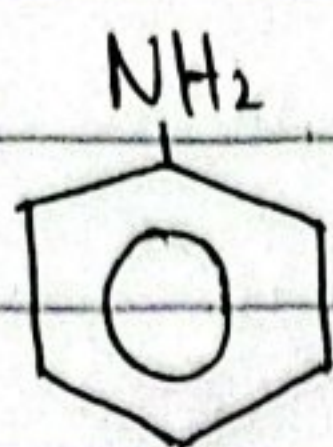
- 1) Primary amines: $(R-NH_2)$: When one hydrogen atom of ammonia is replaced by alkyl group, compound formed are called primary amines.



(Primary amine)

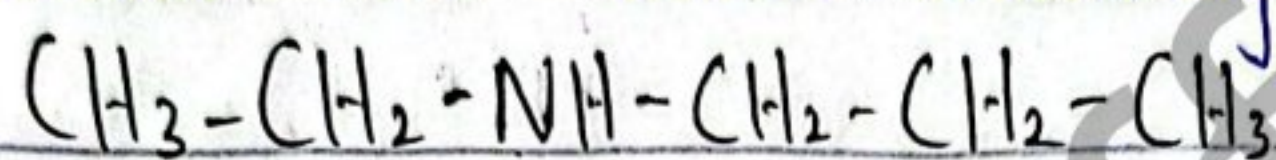
Secondary butyl amine (C.N)

2-Amino butane (IUPAC)



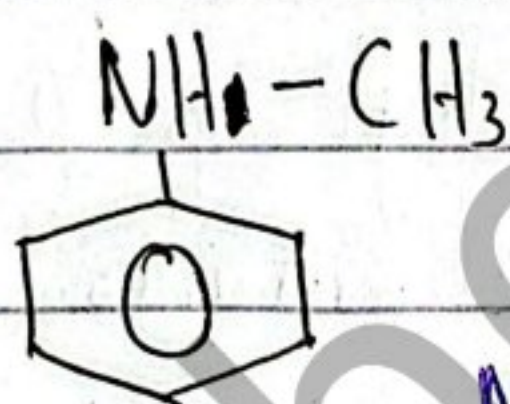
Aniline
or Aminobenzene (IUPAC)

2) Secondary amines: When two hydrogen atom of ammonia are replaced by alkyl group, compound formed are called secondary amines.



Ethyl propyl amine

N-Ethyl amino propane (IUPAC)



Methyl phenyl amine

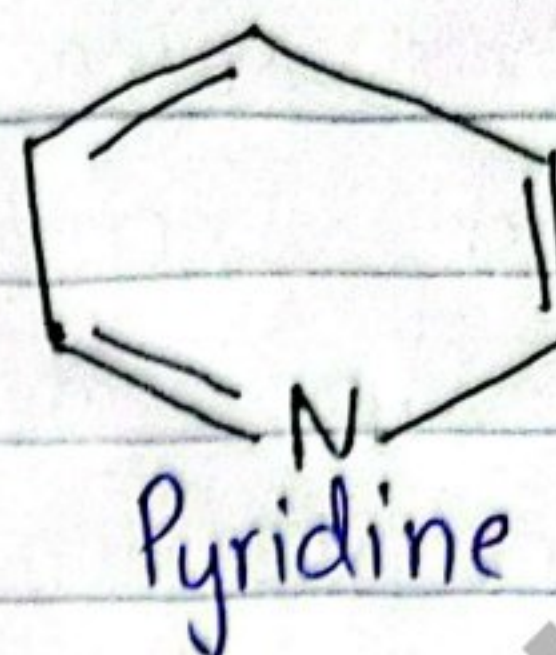
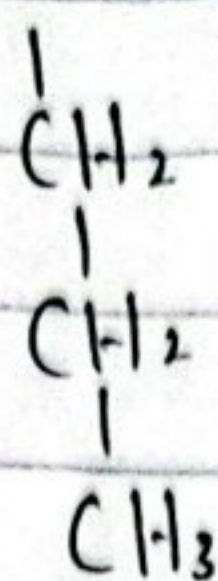
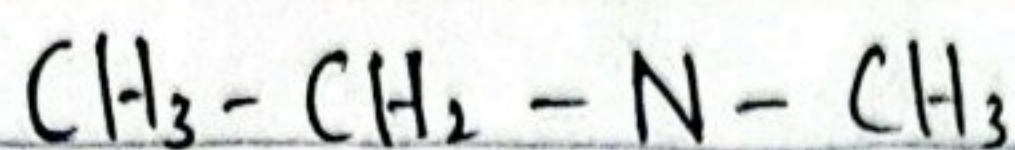
or

N-Methylaminobenzene



Pyrrole

3) Tertiary amines: When all hydrogen atom of ammonia are replaced by alkyl group, compound formed are called tertiary amines.

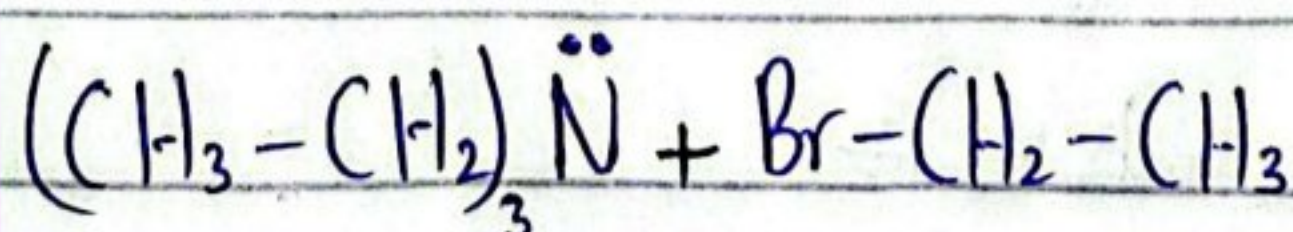
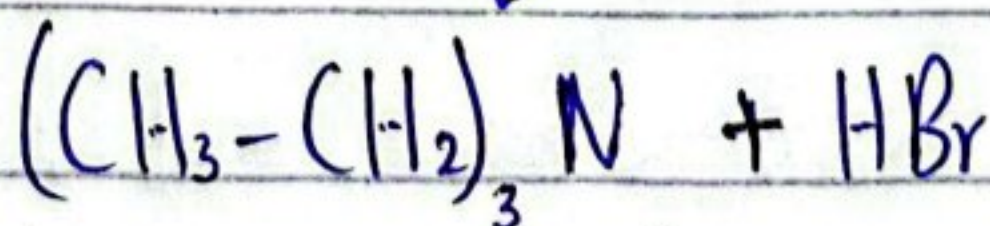
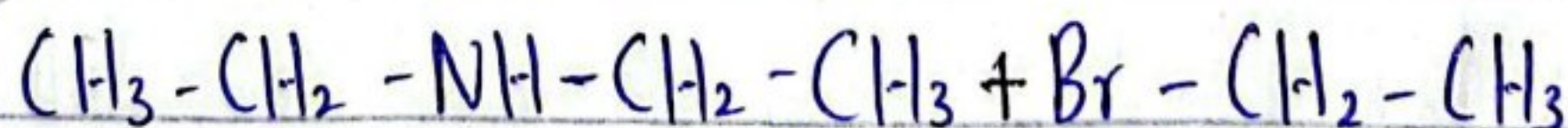
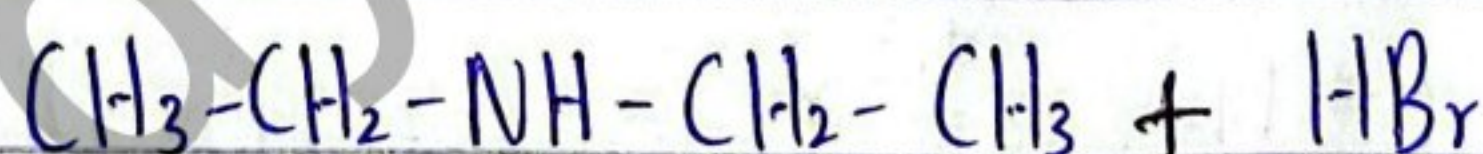
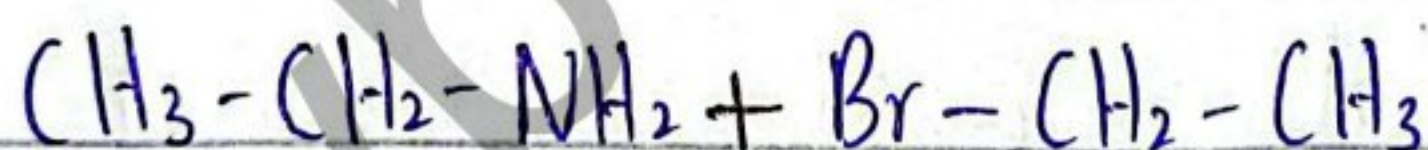


Ethyl methyl propyl amine

N-Ethyl - N-methyl amino propane (IUPAC)

Methods of Preparation:

1) Reaction of alkyl halide with Ammonia OR Aminolysis:



These amine are separated from each other by fractional distillation method and salt is removed by the reaction with strong base like KOH.

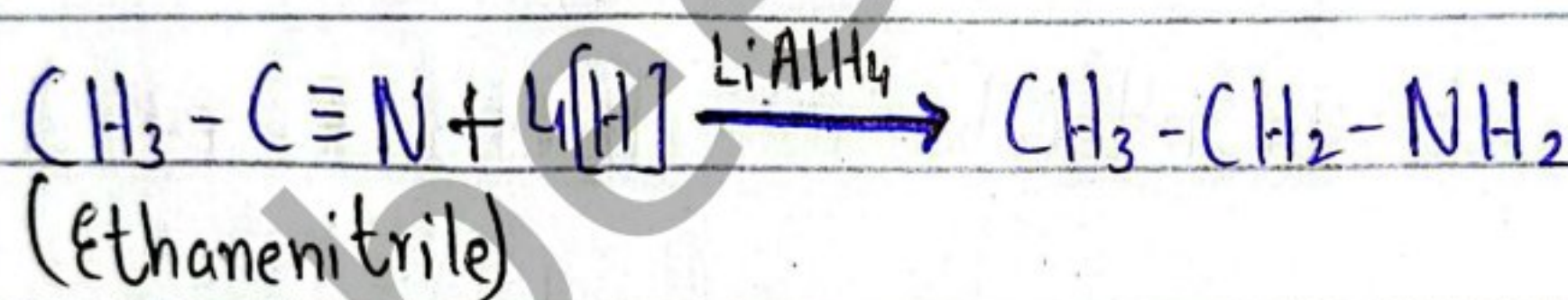
2) By the reduction of nitrogen containing functional groups:

① Reduction of nitrile:

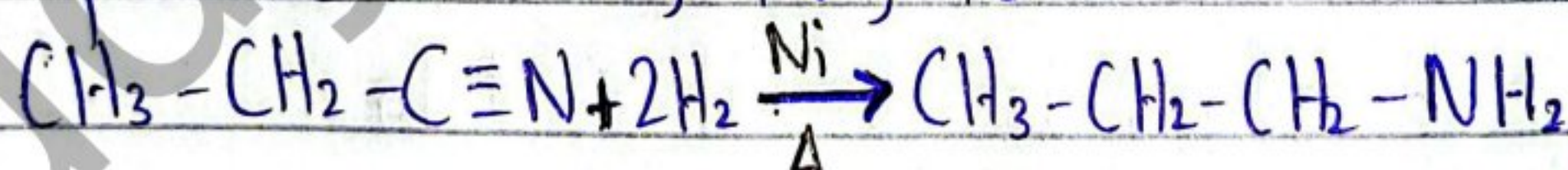
① by using reducing agent:

i) LiAlH_4

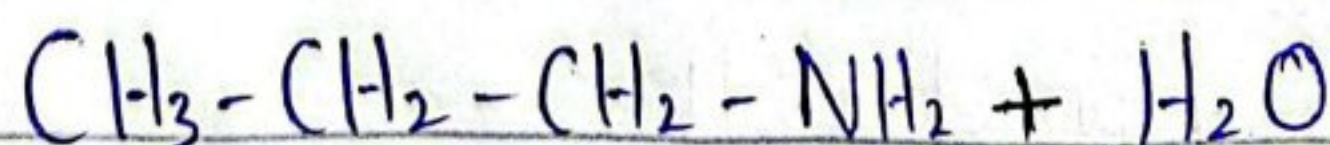
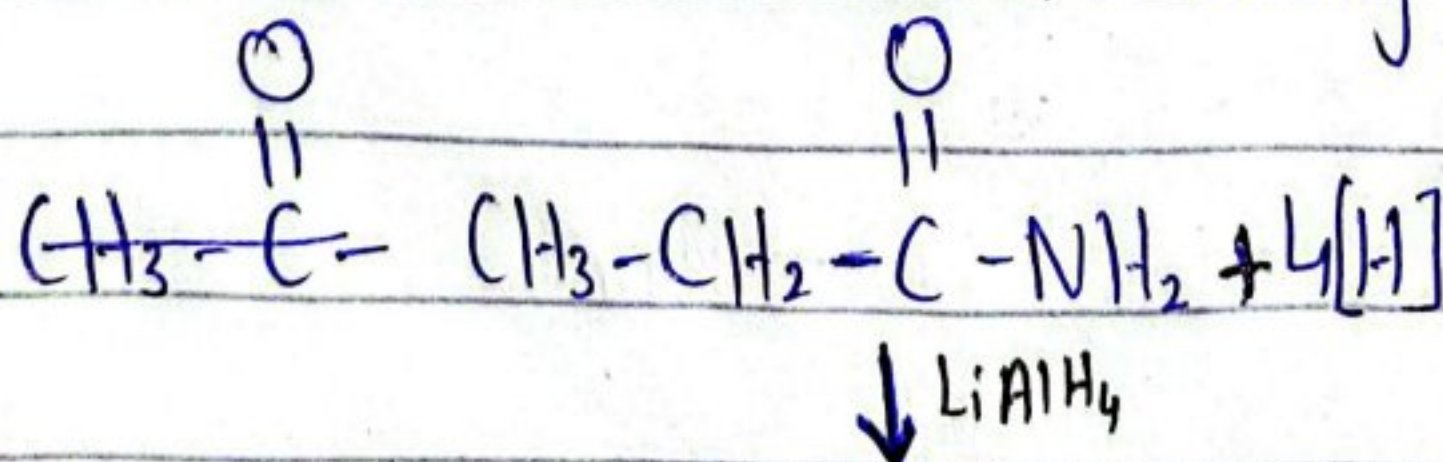
ii) Sodium in ethanol



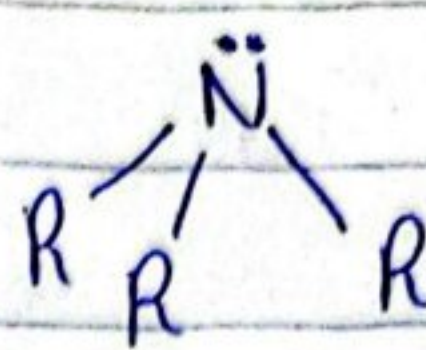
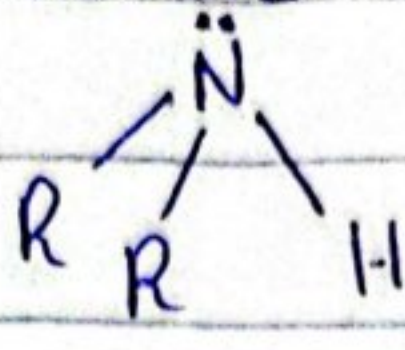
② by catalytic reduction: H_2 in the presence of Ni, Pt, Pd



② Reduction of amide: Reducing agent = LiAlH_4



Basicity of amines: All amines are basic in nature



2°-amine

1°-amine

⇒ In all amines 'N' is sp^3 hybridized.

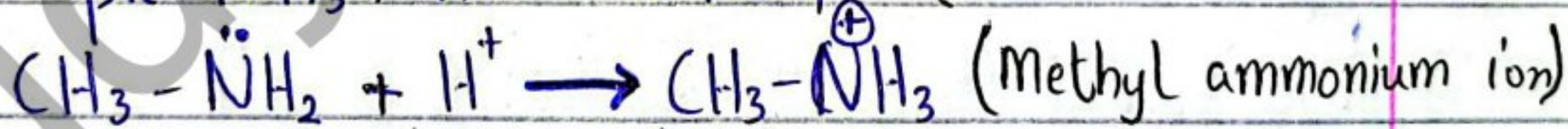
⇒ Tertiary amine is optical active if three alkyl groups are different.

⇒ Methyl amine / All amines are more basic than ammonia.

⇒ Basicity of amines depend upon two factors

1) Availability of lone pair $\propto$ basicity

2) Stability of ammonium ion $\propto$ basicity
(+ charge on Nitrogen)



→ reduce positive charge

$$pK_b \propto \frac{1}{\dots}$$

Basicity

pK_b of $\ddot{N}H_3 = 4.78$

pK_b of $\underline{\text{CH}_3-\text{NH}_2} = 3.38$

→ electron donor

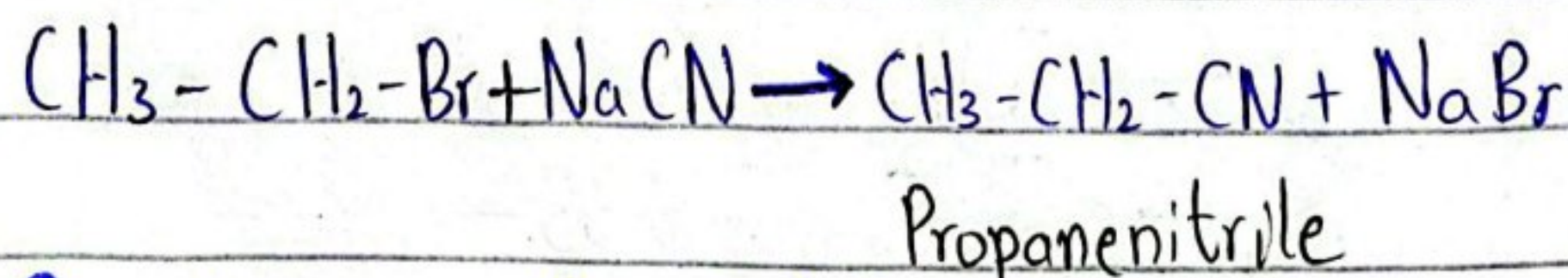
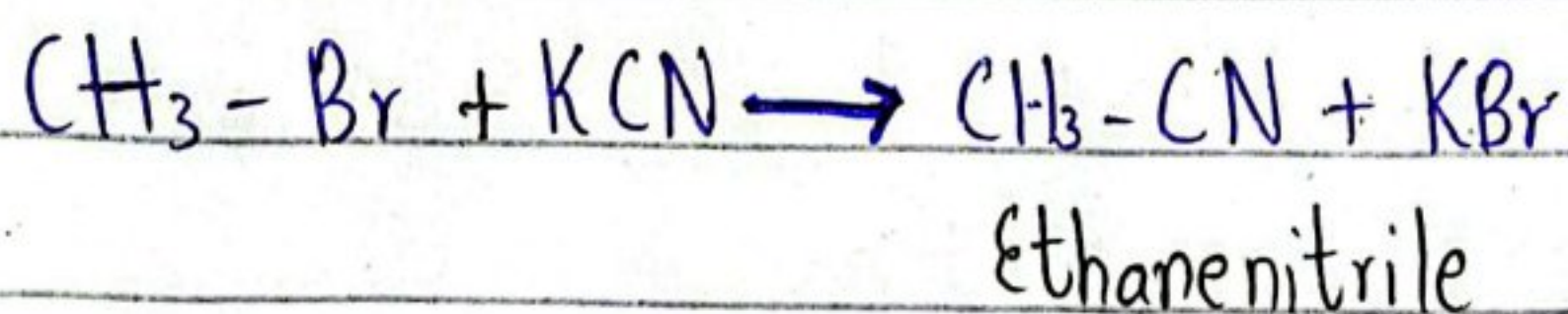
⇒ Basicity order of amines are

$2^\circ\text{-amine} > 1^\circ\text{-amine} > 3^\circ\text{-amine}$

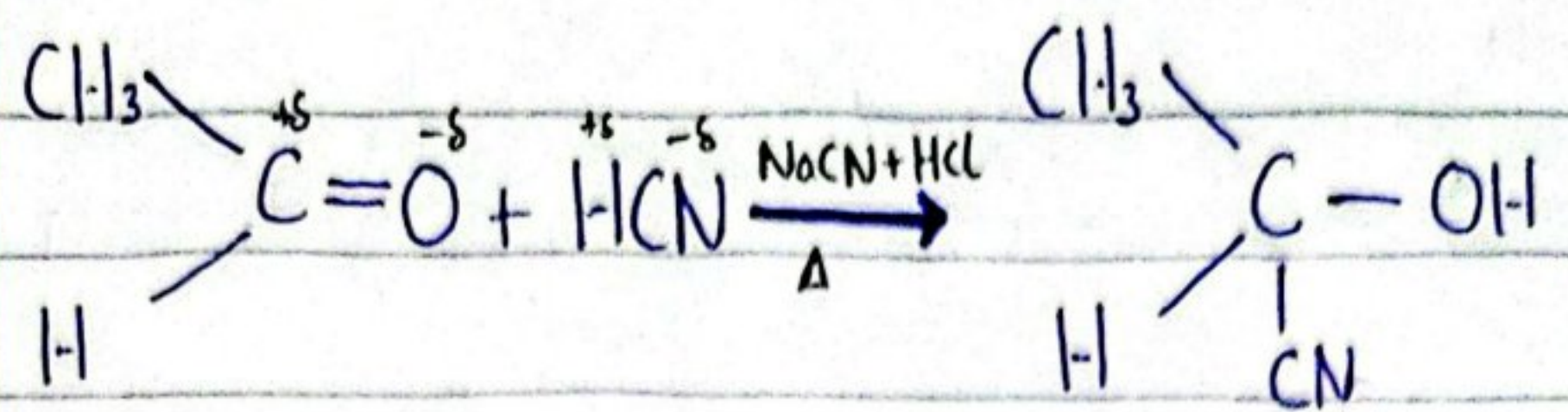
Secondary amine is more basic than primary amine because in secondary amines, there are two electron donor alkyl groups which reduce positive charge on ammonium ion more than in primary amine due to presence of only one electron donor alkyl group in primary amine.

Primary amine is more basic than tertiary amine because in tertiary amine, three bulky groups are attached with nitrogen atom which cause steric hindrance. There is no availability of lone pair thus its ammonium ion will not be formed.

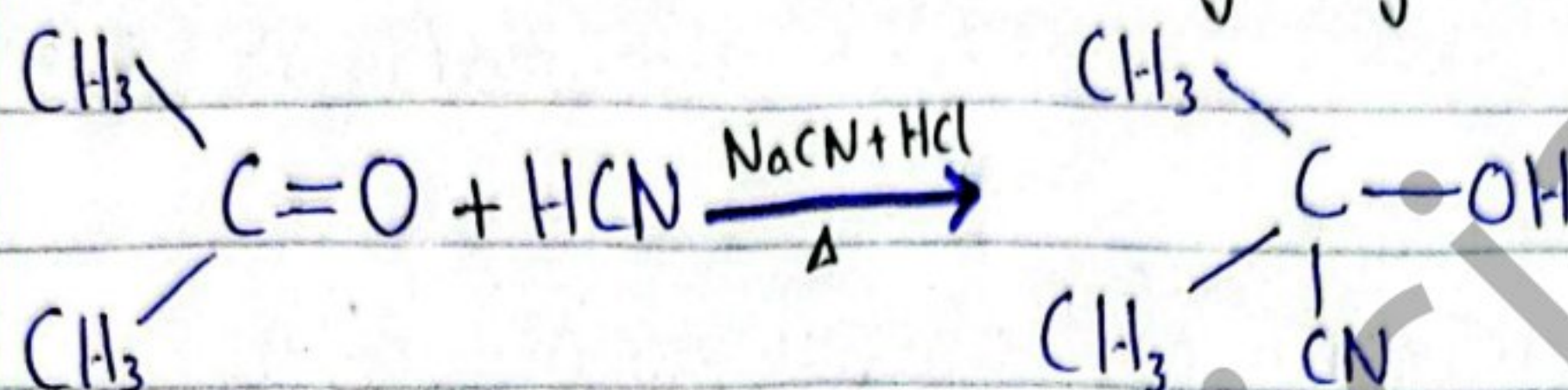
Formation of Nitrile:



Reactions of aldehydes and ketones with HCN:



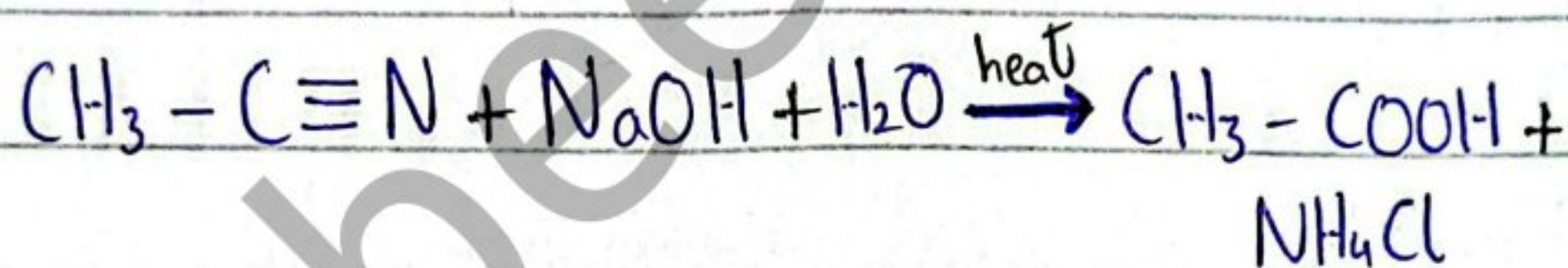
Ethanal cyanohydrin



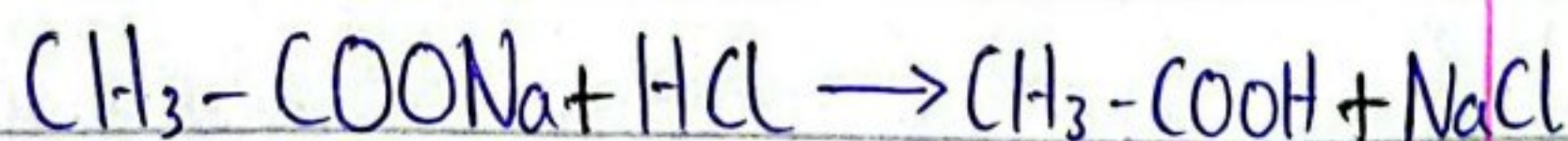
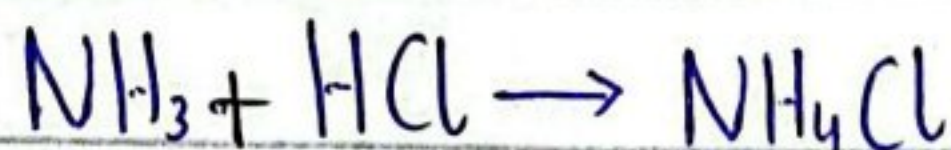
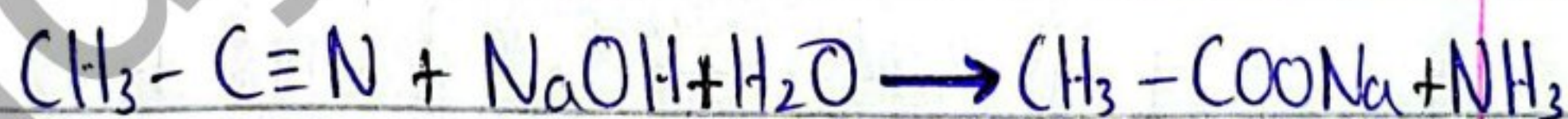
Propanone cyanohydrin

Hydrolysis of nitrile:

① Acid hydrolysis of nitrile:

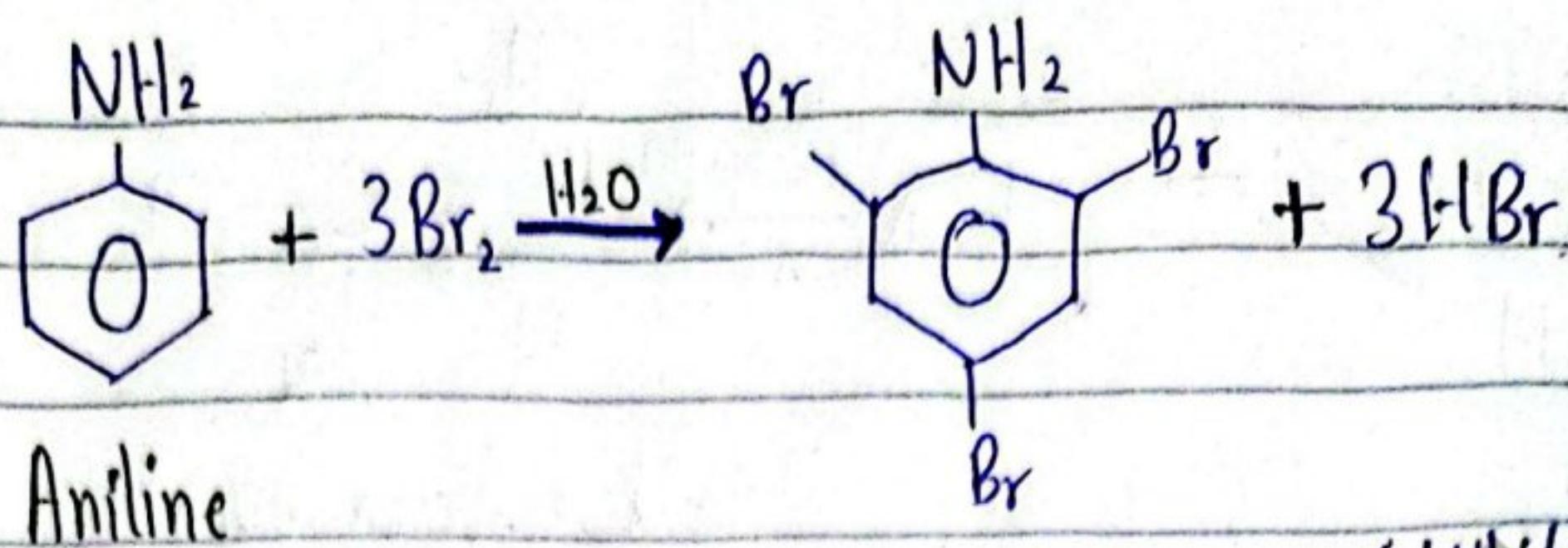


② Alkaline hydrolysis of nitrile:



Phenyl amine and Azo compounds:

1) Reaction of phenyl amine with Bromine water:

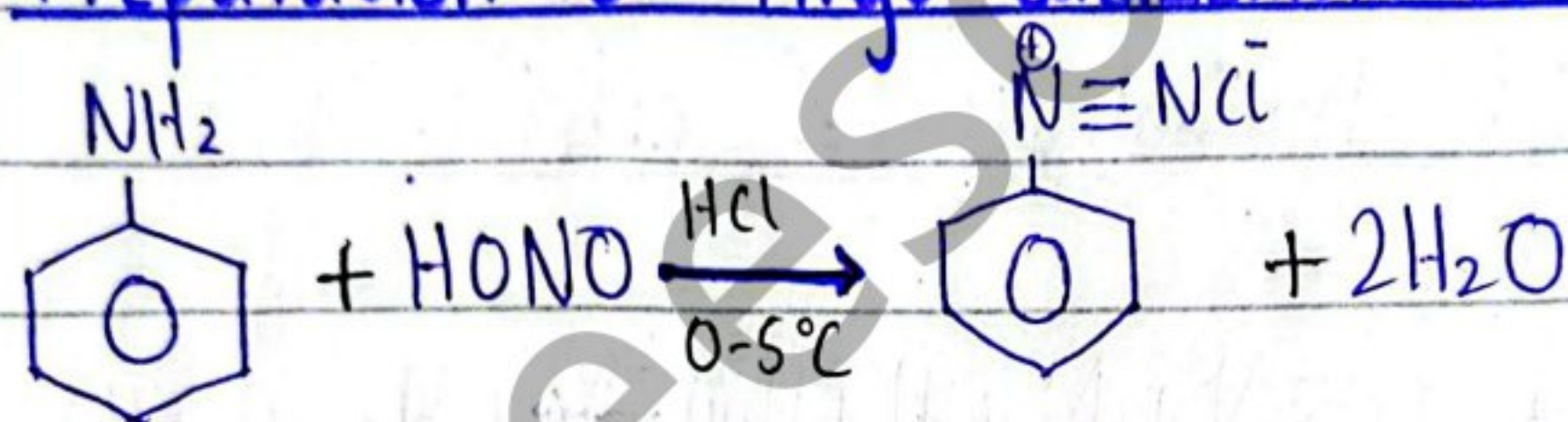


2,4,6-Tribromo Aniline (white ppt)

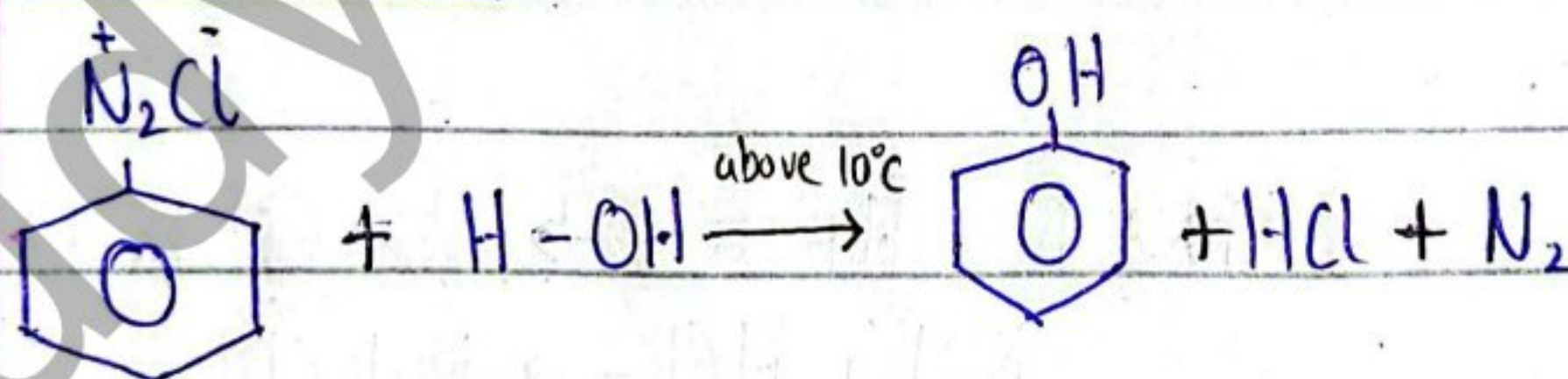
2) Reaction of phenyl amine with nitrous acid:

OR

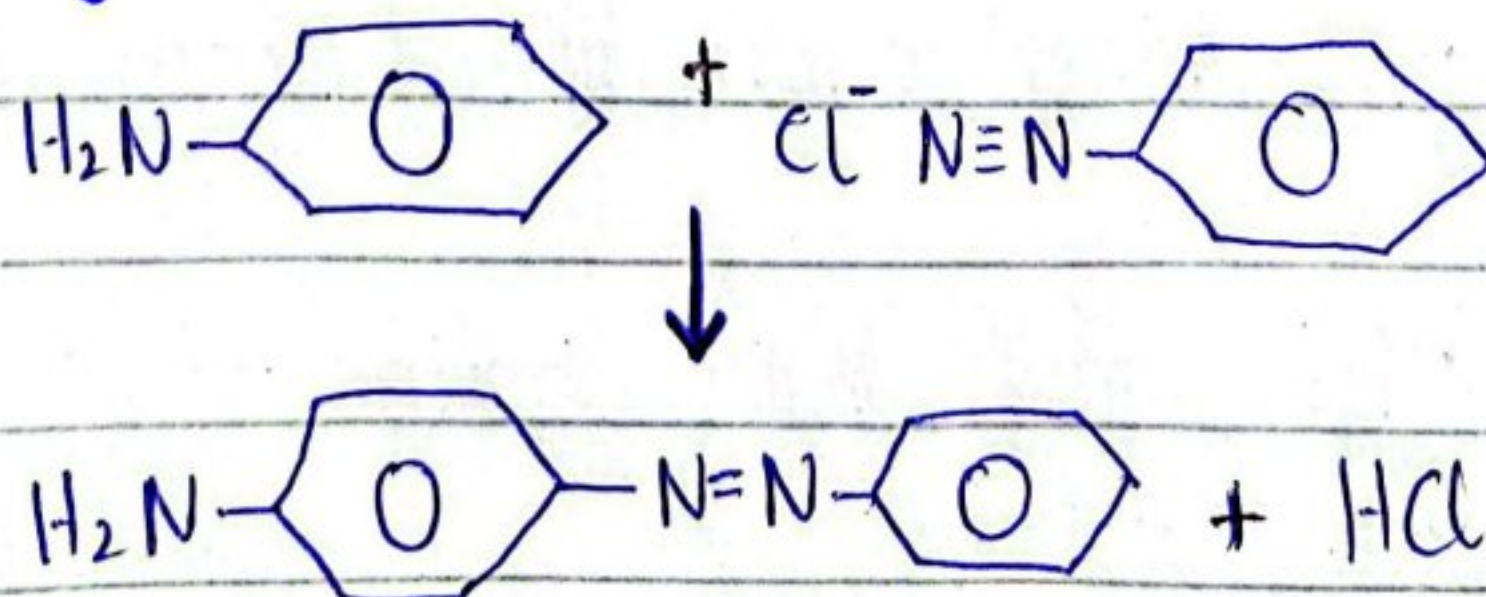
Preparation of Aryl diazonium salt:



3) Reaction of aryl diazonium salt with H_2O :

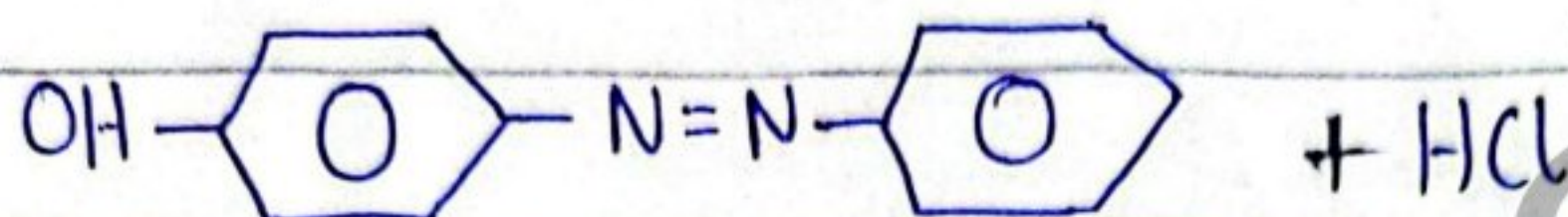
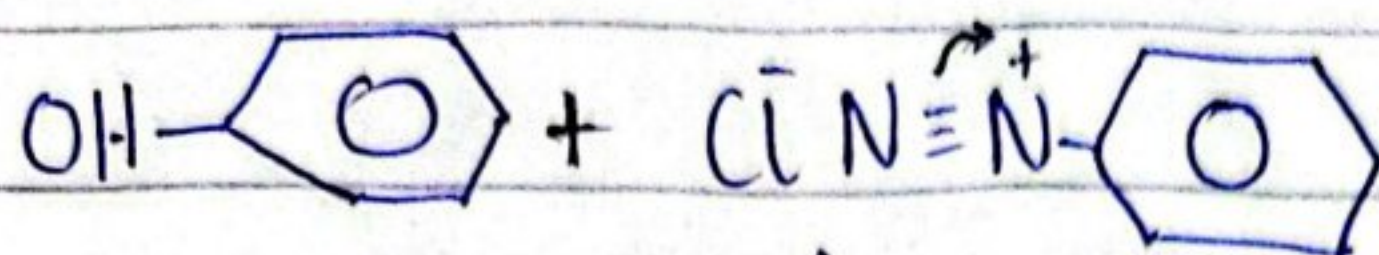


4) Reaction of phenyl amine with aryl diazonium salt:



Phenylamine azobenzene (Yellow or red ppt)

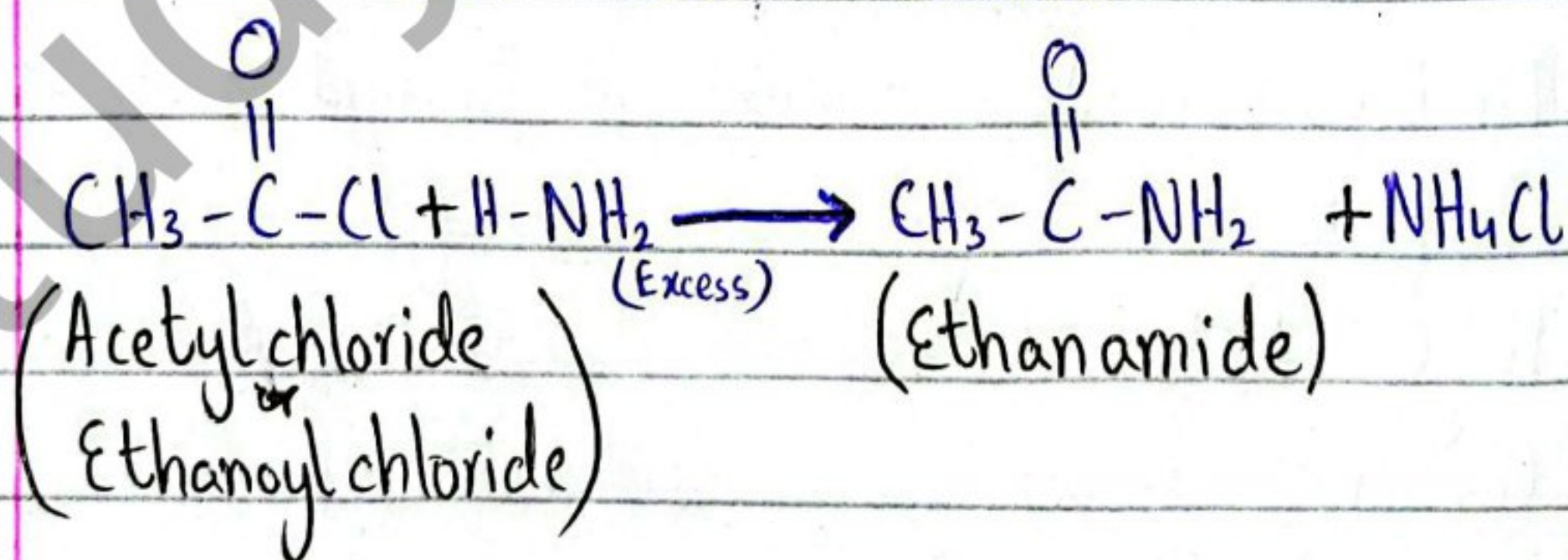
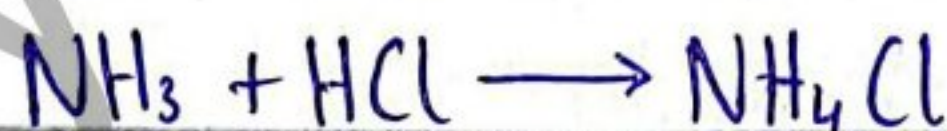
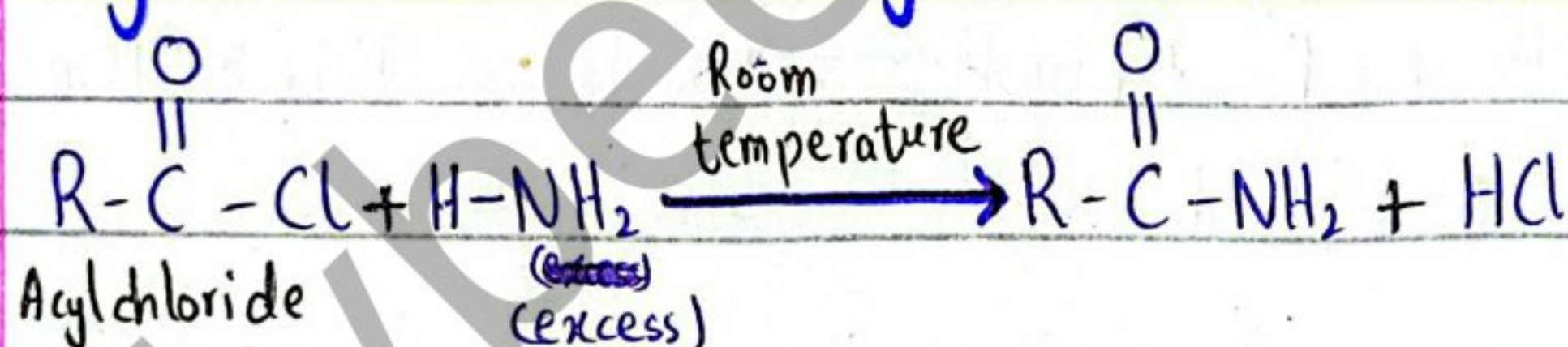
5) Reaction of phenol with aryl diazonium salt or benzene diazonium chloride:



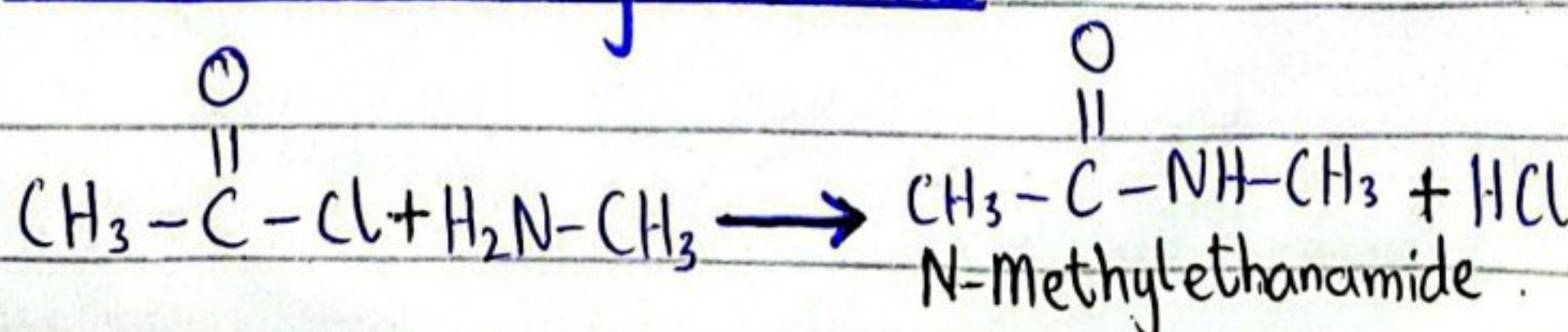
Phenolazo benzene (Yellow or red ppt)

Preparation of Amide: (R-C(=O)-NH₂)

1) By reaction of Acyl chloride with NH₃:

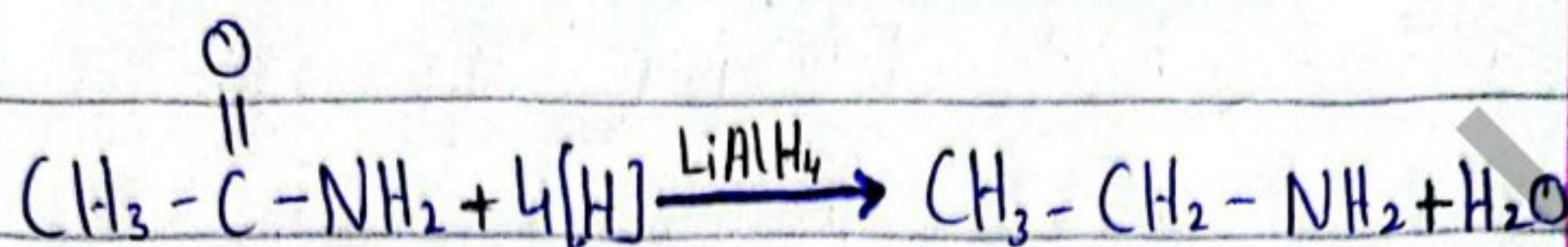


2) By the reaction of Acyl chloride with Primary amine:



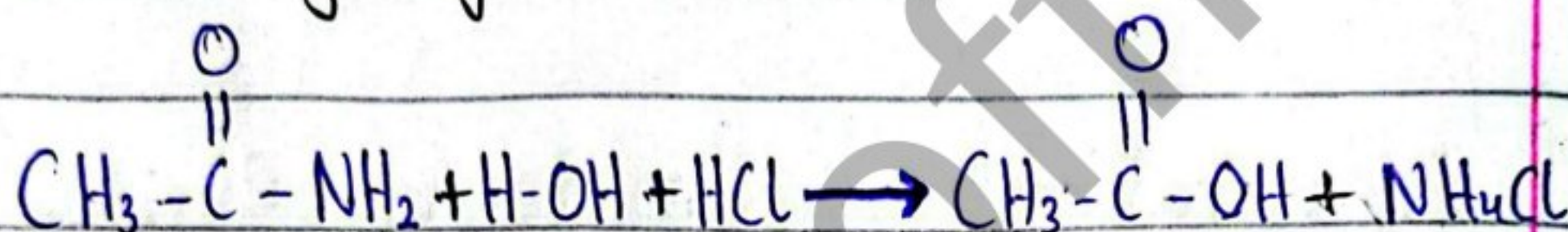
Reactions of amides:

1) Reduction Reductions of amide:

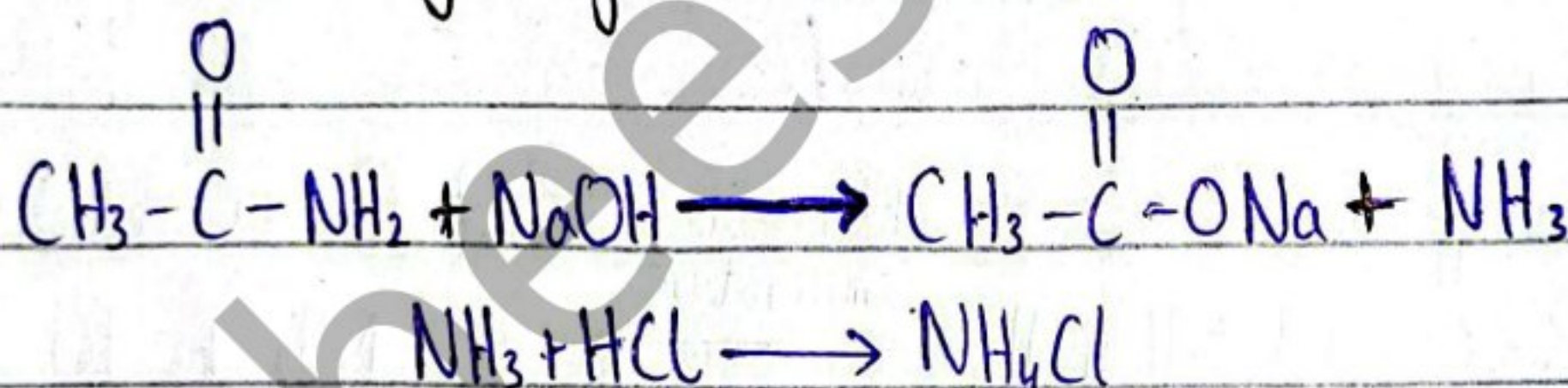


2) Hydrolysis of amides:

① Acid hydrolysis of amide:

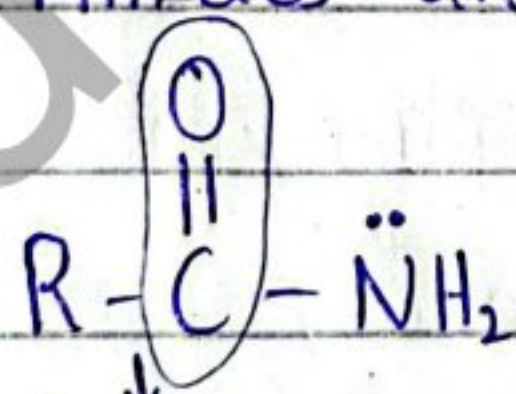


② Alkaline hydrolysis of amide:



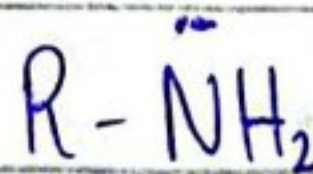
Basicity of amide:

Amides are less basic than amines.

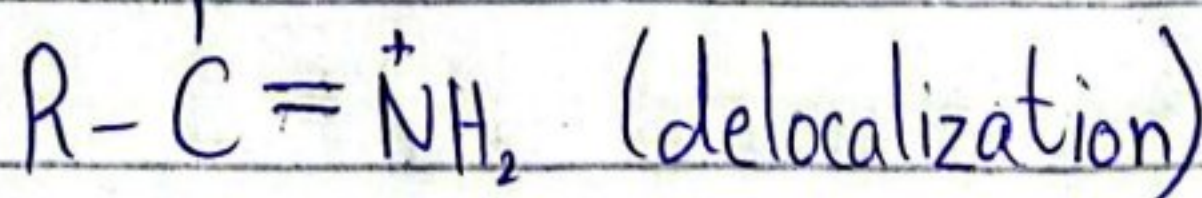
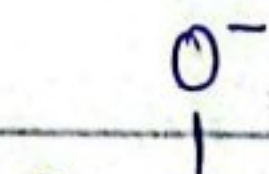


↓
Carbonyl group

is electron withdrawing group.



↓
(Electron donor)

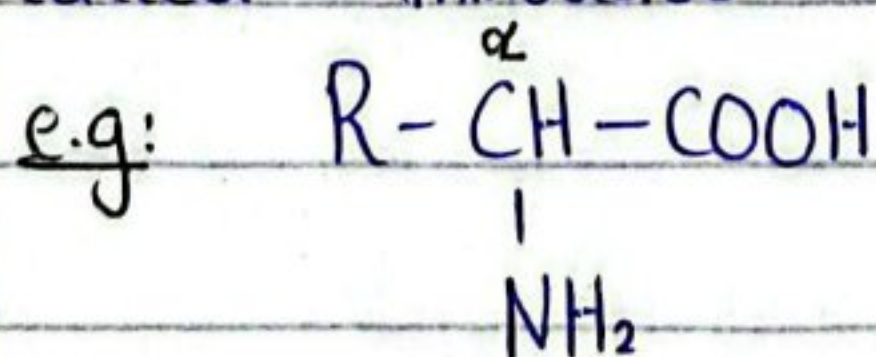


Amides have carbonyl group which is extremely electronegative. It pulls electron electrons toward itself by inductive effect. Moreover, in amides, double bond of $(-\overset{\overset{O}{\parallel}}{C}-)$ delocalize so it has ~~little~~^{less} basicity due to decreased availability of lone pair.

In amines, lone pair of nitrogen atom is not delocalized. Moreover, alkyl group tends to increase electron density around nitrogen atoms. So amines have strong ability to attract proton ~~[H⁺]~~ (H^+), because availability of lone pair is easy.

So Amides are less basic than amines.

Aminoacid: Organic compound containing amino group and carboxylic group within the same molecule are called aminoacids.



All naturally occurring aminoacid are alpha aminoacids. For protein synthesis

20 aminoacid are required. 10 aminoacid which can be synthesized in ~~our~~ human body are called non-essential aminoacids.

10 aminoacid which cannot be synthesized in human body are called essential aminoacid.

There are 3 types of aminoacids.

- 1) Acidic Aminoacid
- 2) Basic Aminoacid
- 3) Neutral aminoacid

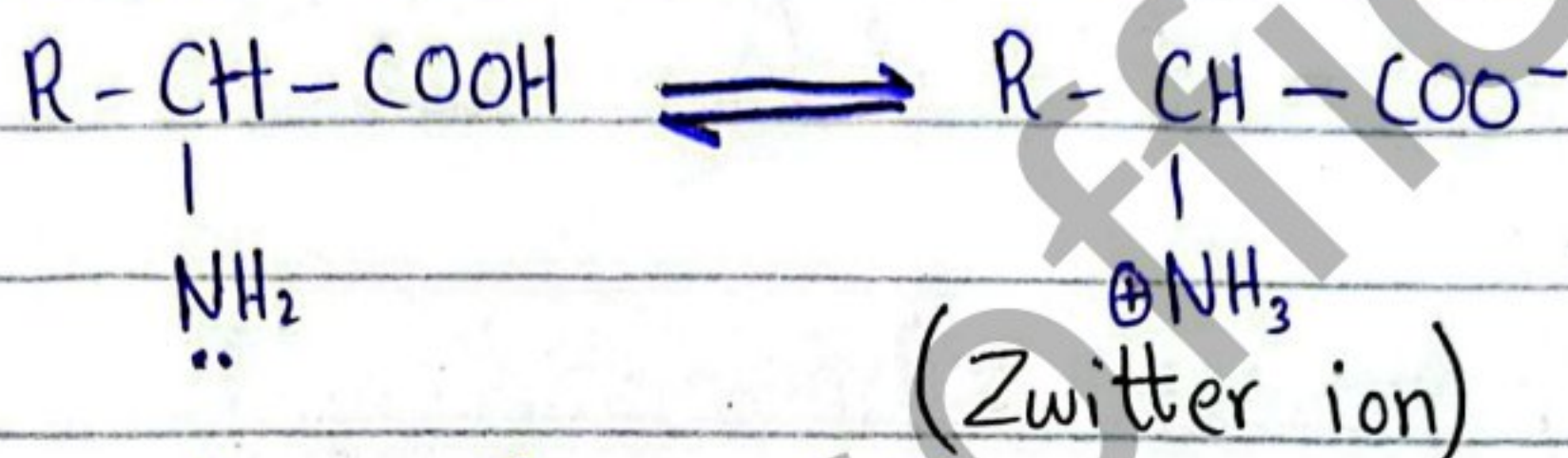
1) Acidic aminoacid: Aminoacid containing two carboxylic group and one amino group are acidic aminoacid.
e.g: Aspartic acid

2) Basic aminoacid: Aminoacid containing ^{two} ~~one~~ amino group and one carboxylic group are called basic aminoacid.
e.g: Histidine

3) Neutral aminoacid: Aminoacid containing one aminogroup and one carboxylic group are called neutral amines.

Physical Properties of Amines:

- They show hydrogen bonding with each other.
- They have high melting and boiling point.
- All alpha amino acids exist in Zwitter ion form.

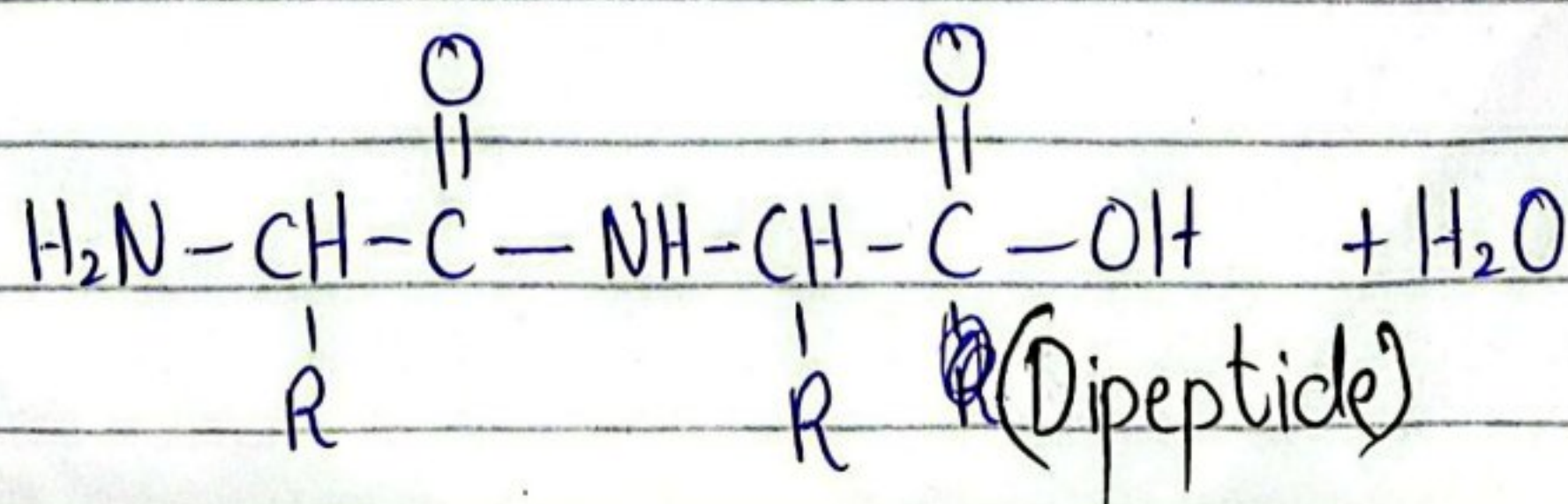
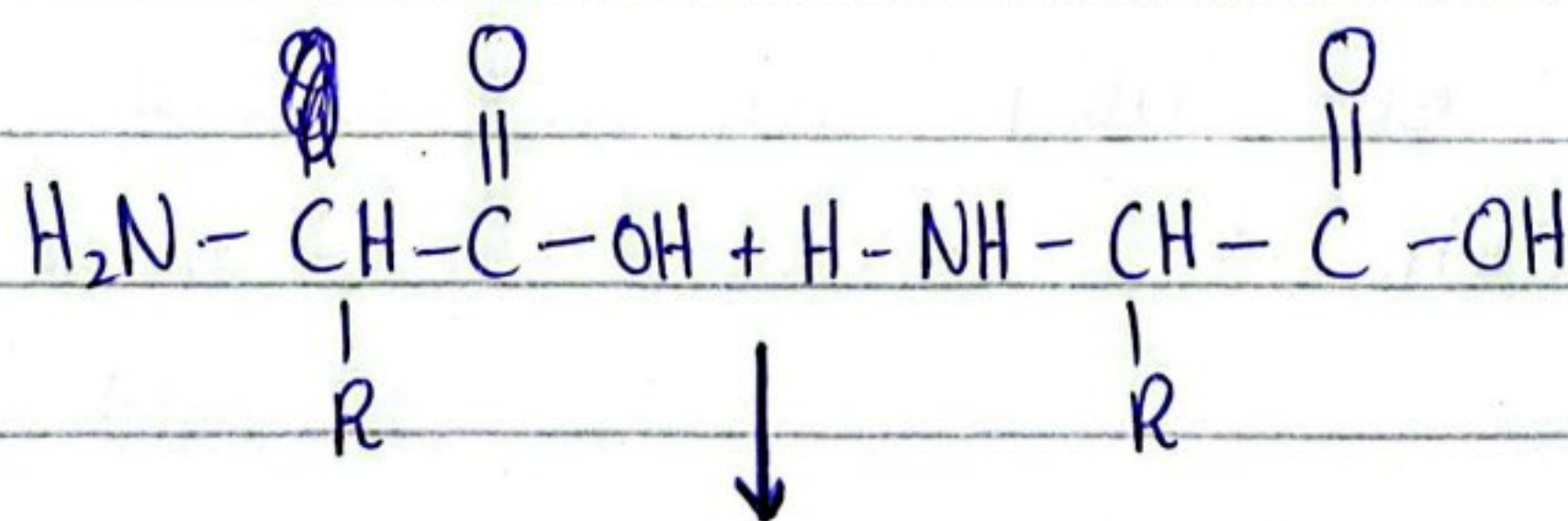


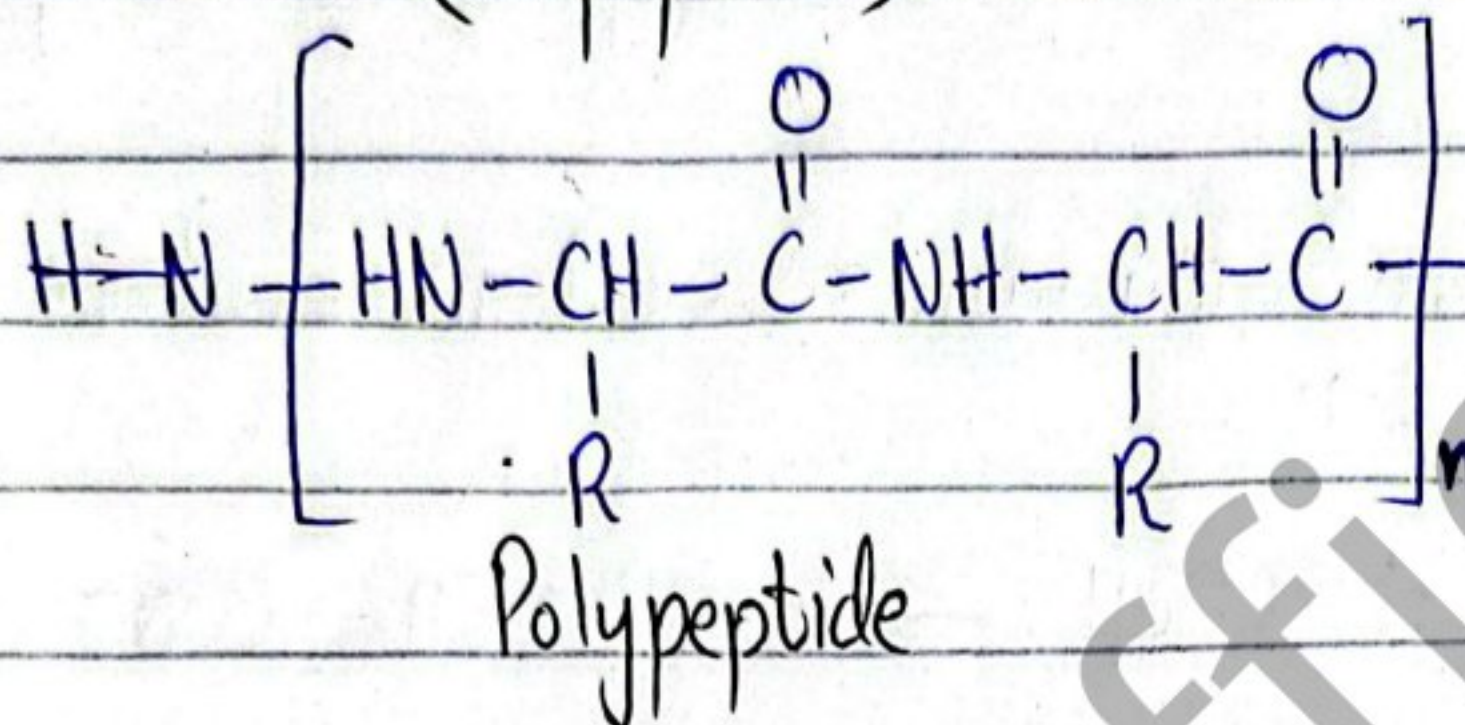
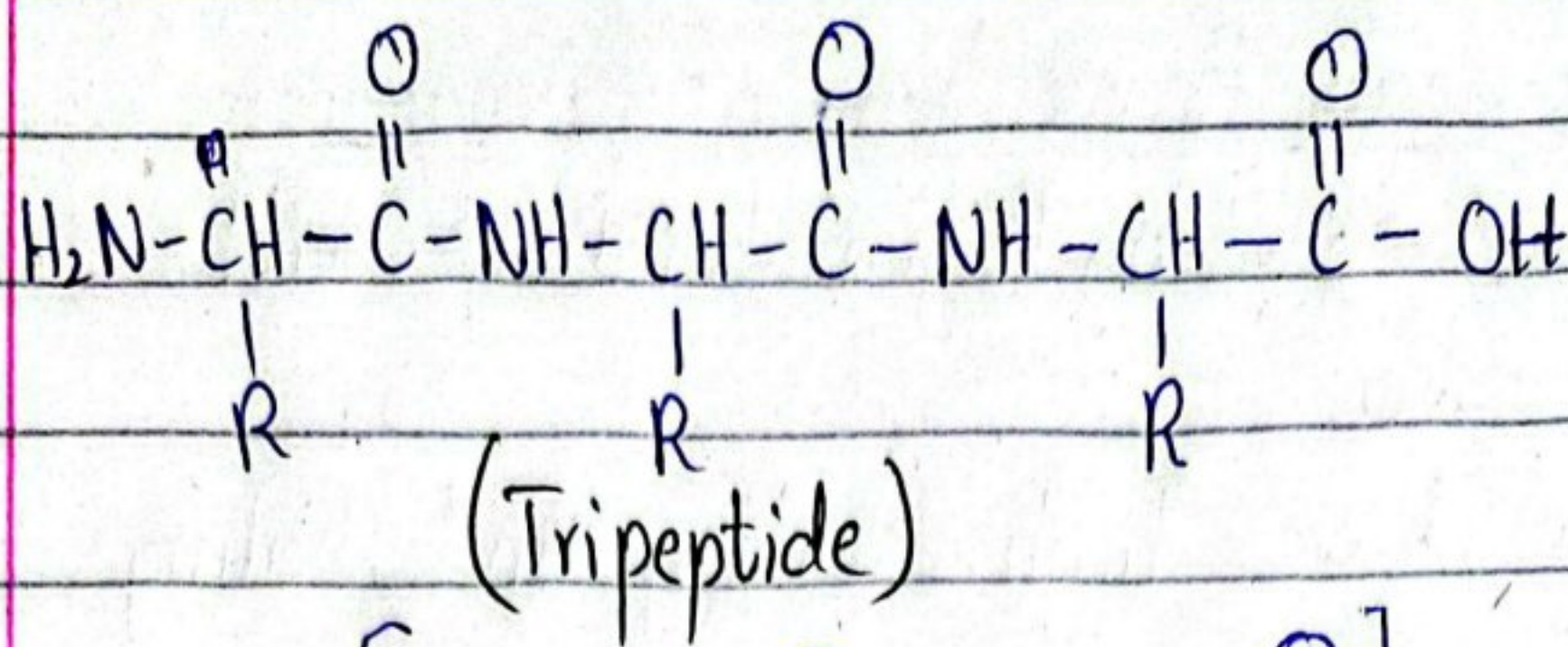
Formation of peptide:

Peptide having molecular mass upto 10,000 are called polypeptide.

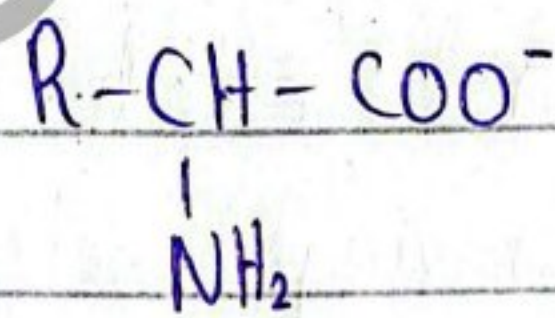
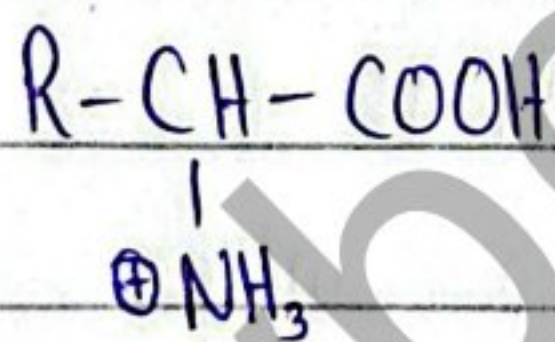
Peptide having molecular mass more than 10,000 are called protein.

Linkage between CO and NH is called peptide bond.





Behaviour of Aminoacid and peptide in electric field:



In acidic solution, aminoacid exist in +ve form, it is attracted toward cathode.
(-ve pole)

In basic solution, aminoacid exist in -ve form, it is attracted toward anode.
(+ve pole)

EXERCISE :-

MCQs:

①	A	⑦	C
②	B	⑧	A
③	B	⑨	B
④	C	⑩	C
⑤	C	⑪	B
⑥	A	⑫	A