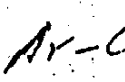
"CARBOXYLIC ACIDS"

CHAPTER NO. 13 (BOOK-II)

INTRODUCTION:- Organic compounds having -COOH functional group are called "CARBOXYLIC ACIDS". CARBOXAL is combination of carbonyl -C- and hydroxal "-OH" groups. Carboxylic acids are divided in two types:-

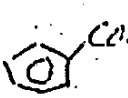
(i) **ALIPHATIC CARBOXYLIC ACIDS:-** (FATTY ACIDS) (OPEN CHAIN ACIDS)

$R-\overset{O}{\overset{\|}{C}}-OH$ e.g. CH_3COOH, CH_3CH_2COOH, $CH_3CH_2CH_2COOH$.

(ii) **AROMATIC CARBOXYLIC ACIDS:-** $Ar-COOH$. 

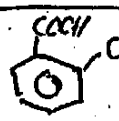
CARBOXYLIC ACIDS MAY ALSO BE DIVIDED INTO FOLLOWING TYPES:

MONOCARBOXYLIC ACIDS:- They have one carboxyl groups.

$H-\overset{O}{\overset{\|}{C}}-OH$, $CH_3-\overset{O}{\overset{\|}{C}}-OH$, 

FORMIC ACID ACETIC ACID BENZOIC ACID

DICARBOXYLIC ACIDS:- They have two Carboxal groups.

 , $\begin{matrix}COOH\\COOH\end{matrix}$, $CH_2\begin{matrix}COOH\\COOH\end{matrix}$

PHATHALIC ACID OXALIC ACID (ETHANDIOIC ACID) MALONIC ACID (PROPANDIOIC ACID)

NOMENCLATURE OF CARBOXYLIC ACIDS:

The aliphatic carboxylic acids are called FATTY ACIDS because higher members are obtained from hydrolysis of fats such as:- Palmitic acid and stearic acids obtained from Fats.

PALMITIC ACID = $C_{15}H_{31}COOH$, STEARIC ACID $C_{17}H_{35}COOH$.

TRIVIAL NAMES are derived from sources from which they are obtained for example.

FORMIC ACID } $HCOOH$ OBTAINED FROM RED ANTS.

ACETIC ACID } CH_3COOH OBTAINED FROM ACETUM (VINEGAR)

BUTYRIC ACID } $CH_3CH_2CH_2COOH$ " " BUTYRUM (BUTTER)

The position of substituent is mentioned by using Latin alphabets α, β, γ, etc.

$CH_3CH_2-\overset{\alpha}{C}H-COOH$ α-Bromo butyric acid.

β Br

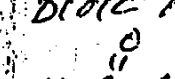
$CH_3-CH-COOH$ isoBUTYRIC ACID

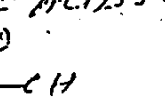
CH_3

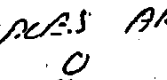
I.U.P.A.C. NOMENCLATURE :-

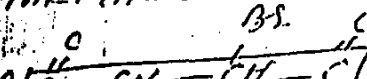
THE I.U.P.A.C NAME IS ALKANOIC ACID. RULES OF NOMENCLATURE:

1) SELECT LONGEST CARBON CHAIN AND WRITE NAME OF PARENT HYDROCARBON
2) REPLACE "e" OF ALKANE NAME BY "-OIC ACID".
3) NUMBER CARBON CHAIN FROM CARBOXYLIC GROUP.
4) WRITE NAME OF SUB. IN ALPHABETICAL ORDER. WRITE POSITION OF EACH SUBSTITUENT.
5) IF TWO CARBOXYL GROUPS ARE PRESENT WRITE SUFFIX DIOIC ACIDS :- EXAMPLES ARE GIVEN BELOW.

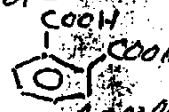

METHANOIC ACID


ETHANOIC ACID

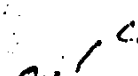

PROPANOIC ACID.

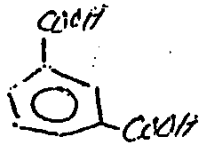

2-BROMOBUTANDIOIC ACID

ETHANDIOIC ACID

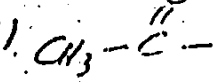

1,2-Benzen-dicarboxylic acid.

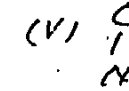
EXERCISE Q.NO. 5 :-

(i) 
PROPANDIOIC ACID

(ii) 
1,3-BENZEN DICARBOXYLIC ACIDS

(iii) 
METHANOIC ACID

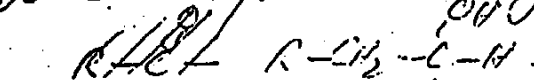
(iv) 
ETHYL ETHANOATE.

(v) 
2-AMINO ETHANOIC ACID.

(vi) 
ETHYL METHANOATE OR ETHYL FORMATE.

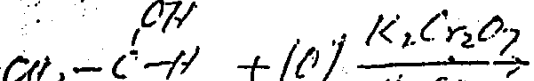
"GENERAL METHODS OF PREPARATION"

1 OXIDATION OF 1°-ALCOHOLS: Alcohols are oxidized to carboxylic acids by using $K_2Cr_2O_7$ and H_2SO_4



$$R-CH_2-\overset{OH}{\overset{|}{C}}-H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} R-CH_2-\overset{O}{\overset{\|}{C}}-H$$

$$R-CH_2-\overset{O}{\overset{\|}{C}}-H + [O] \longrightarrow R-CH_2-\overset{O}{\overset{\|}{C}}-OH$$



$$CH_3-\overset{OH}{\overset{|}{C}}-H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow{[O]} CH_3-\overset{O}{\overset{\|}{C}}-OH$$

ETHANOL ETHANAL ETHANOIC ACID

The length of carbon chain is maintained in carboxylic acid.

2. OXIDATION OF ALDEHYDES Aldehydes are oxidized to carboxylic acids by using $K_2Cr_2O_7$ and conc. H_2SO_4.

$$CH_3-\overset{O}{\overset{\|}{C}}-H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-OH$$

3. HYDROLYSIS OF NITRILS Nitriles or cyanides on hydrolysis produce carboxylic acids. The reaction is carried out in presence of an acid or base.

$$R-C\equiv N + 2H_2O \xrightarrow[OH^-]{H^+ \text{ or}} R-COOH + NH_3$$

$$CH_3-C\equiv N + 2H_2O + HCl \longrightarrow CH_3COOH + NH_4Cl$$

The length of carbon chain is increased in this method

$$CH_3CH_2OH \xrightarrow[-SO_2, HCl]{SOCl_2} CH_3CH_2Cl \xrightarrow{KCN} CH_3CH_2CN + KCl$$

ETHANOL

$$CH_3CH_2CN + 2H_2O \xrightarrow{H^+} CH_3CH_2COOH + 2NH_3$$

PROPANOIC ACID

4) FROM GRIGNARD REAGENT Grignard reagent on reaction with CO_2 followed by hydrolysis produces carboxylic acids. CO_2 is passed through ethereal soln. of G.R. or G.E. is added to crushed DRY ICE suspended in ether

$$R-\overset{\delta-}{Mg}-\overset{\delta-}{X} + \overset{\delta+}{C}(=O)_2 \longrightarrow R-\overset{O}{\overset{\|}{C}}-OMgX \xrightarrow[H^+]{H\overset{\delta+}{-}OH} R-\overset{O}{\overset{\|}{C}}-OH + Mg(OH)X$$

$$CH_3\overset{\delta-}{Mg}-Br + O=\overset{\delta+}{C}=O \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-OMgBr \xrightarrow[H_2O]{H^+} CH_3-\overset{O}{\overset{\|}{C}}-OH + \text{ACETIC ACID}$$

5) BY HYDROLYSIS OF ESTERS The esters on boiling with conc. alkalies produce sodium salts. These salts on treatment with acids produce carboxylic acids

$$R-\overset{O}{\overset{\|}{C}}-OR' + NaOH \longrightarrow R-\overset{O}{\overset{\|}{C}}-ONa + R'OH$$

$$R-\overset{O}{\overset{\|}{C}}-ONa + HCl \longrightarrow R-\overset{O}{\overset{\|}{C}}-OH + NaCl$$

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + HOC_2H_5$$

$$CH_3COONa + HCl \longrightarrow CH_3COOH + NaCl$$

6. OXIDATIVE CLEAVAGE OF DOUBLE BONDS Alkenes with alkaline $KMnO_4$ are oxidized to acids

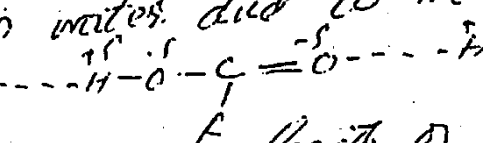
$$CH_3-\underset{H}{C}=\underset{H}{C}-CH_3 + 4[O] \xrightarrow[\text{ALKALINE}]{KMnO_4} CH_3-\overset{O}{\overset{\|}{C}}-OH + CH_3COOH$$

$$R-CH=CH-R + 4[O] \xrightarrow[\text{ALKALINE}]{\Delta} 2RCOOH$$

WRITE PHYSICAL PROPERTIES OF CARBOXYLIC ACIDS

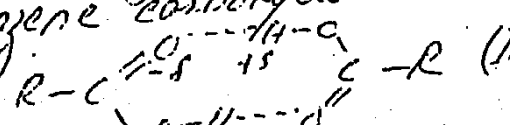
COLOUR AND SMELL:-
First three carboxylic acids are colourless liquids with pungent smell. The next three are colourless liquids with somewhat unpleasant smell.

2. SOLUBILITY: The first four aliphatic acids are very soluble in water due to intermolecular hydrogen bonding



with increase in length of carbon chain solubility in water decreases.

3- BOILING POINTS: The boiling points of carboxylic acids are relatively high due to intermolecular hydrogen bonding. In benzene carboxylic acids exist in dimeric form.



(DIMER OF CARBOXYLIC ACID)

Boiling point increase with length of carbon chain

HCOOH	CH_3COOH	CH_3CH_2COOH
100°C	118°C	157°C (BP)

4- MELTING POINTS: The melting points of carboxylic acids increase IRREGULARLY with increase in length of carbon chain. The M.P of carboxylic acids ~~increase~~ with even number of carbon atoms are greater than next lower and higher member with odd number of carbon atoms consider following straight chain acids.

C_2H_5COOH	C_3H_7COOH	CH_3COOH
M.P = 251 K	267 K	237 K

REACTIVITY OF CARBOXYLIC ACIDS: The carboxylic acids show reactions of both carbonyl (-C=O) and hydroxal groups. Carboxylic acids undergo following types of reactions

(1) ACIDIC REACTIONS:- Hydrogen atom of hydroxal group is involved

(2) Reactions in which -OH is replaced by other group.

(3) Reactions of carboxal group as a whole.

ACIDIC REACTIONS OF CARBOXYLIC ACIDS.

Carboxylic acids are weaker acids than mineral acids (HCl, HNO_3, H_2SO_4 etc) An acid possess following characteristics of acids

① PRODUCE H_3O^+ IONS IN WATER:-

$$R-\overset{O}{\overset{\|}{C}}-OH + H_2O \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-O^{\ominus} + H_3O^+$$

carboxylate ion.

② PRODUCE CO_2 WITH CARBONATE AND BICARBONATES.

$$CH_3-COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2\uparrow + H_2O.$$

$$2CH_3-COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2\uparrow + H_2O$$

③ REACTION WITH BASES TO FORM SALT AND WATER

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

$$2CH_3COOH + Ca(OH)_2 \longrightarrow (CH_3COO)_2Ca + 2H_2O$$

④ PRODUCE H_2 GAS WITH ACTIVE METALS:-

$$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$$

These reactions prove acidic nature of carboxylic acids.

REACTIONS IN WHICH $-OH$ IS REPLACED:-

Carbonyl group of carboxylic acids can be easily attacked by nucleophile. The addition is followed by removal of hydroxal group. The examples of such reactions are ESTERIFICATION, AMIDE AND ACID HALIDE FORMATION.

Q WRITE NOTE ON CONVERTION OF CARBOXYLIC ACIDS INTO ACID HALIDES. ALSO WRITE ITS MECHANISM.

Carboxylic acids can be converted into acid halides by following methods

$$CH_3COOH + PCl_5 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-Cl + POCl_3 + HCl.$$

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-Cl + SOCl_2 + HCl.$$

MECHANISM:-

(1) $CH_3-\overset{O}{\overset{\|}{C}}-O-H + Cl-S(=O)-Cl \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl + H^+$

2) $CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl + Cl^- \longrightarrow CH_3-\overset{O^-}{\overset{|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl + Cl^-$

3) $CH_3-\overset{Cl}{\overset{|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl \longrightarrow CH_3-\overset{Cl}{\overset{|}{C}} + SO_2 + Cl^-$

4) $H^{\oplus} + Cl^- \longrightarrow HCl.$

ESTERIFICATION The reaction of carboxylic acids with alcohols in presence of conc. H_2SO_4 produces esters. The reaction is called ESTERIFICATION.

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + HOC_2H_5 \rightleftharpoons[H_2SO_4] CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5 + H_2O$$

MECHANISM:- It involves following steps:

(i) **PROTONATION**

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + H^{\oplus} \rightleftharpoons CH_3-\overset{\overset{\oplus}{O}-H}{\overset{|}{C}}-OH$$

(ii) **ATTACK OF ALCOHOL**

$$CH_3-\overset{\overset{\oplus}{O}-H}{\overset{|}{C}}-OH + CH_3CH_2\ddot{O}-H \rightleftharpoons CH_3-\overset{O-H}{\overset{|}{C}}-OH$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad H_5C_2-\overset{\oplus}{O}-H$$

(iii) **H-TRANSFER**

$$CH_3-\overset{O-H}{\overset{|}{C}}-OH \longrightarrow CH_3-\overset{O-H}{\overset{|}{C}}-\overset{\oplus}{O}-H$$
$$H_5C_2-\overset{\oplus}{O}H \qquad\qquad\qquad\qquad H_5C_2O \quad H$$

(iv) **ELIMINATION OF WATER AND $H^{\oplus}$**

$$CH_3-\overset{OH}{\overset{|}{C}}-\overset{\oplus}{C}-H \rightleftharpoons CH_3-\overset{O}{\overset{\|}{C}}-OC_2H_5 + H_2O + H^+$$
$$\qquad H_5C_2O \quad H \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{CATALYST}$$

USE OF ESTERS:- Esters have pleasant smell. They are used as artificial flavours. (Please see Table from Text Book).

FORMATION OF AMIDE (REACTION WITH NH_3):-

Reaction of carboxylic acids with NH_3 produces ammonium salt of carboxylic acid, which on heating produces amide.

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + NH_3 \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-\bar{O}\overset{+}{N}H_4$$
Ammonium acetate

$$CH_3-\overset{O}{\overset{\|}{C}}-ONH_4 \xrightarrow[\text{heat}]{\Delta} CH_3-\overset{O}{\overset{\|}{C}}-NH_2 + H_2O$$
ACETAMIDE

MECHANISM:-

(i) $CH_3-\overset{O}{\overset{\|}{C}}-OH + H-\ddot{N}-H \rightleftharpoons CH_3-\overset{O^-}{\overset{|}{C}}-OH$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad R-\overset{\oplus}{N}-H$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad H$

(ii) $CH_3-\overset{O^-}{\overset{|}{C}}-OH \longrightarrow CH_3-\overset{\overset{\oplus}{O}}{\overset{|}{C}}-\overset{\oplus}{O}-H$
$\qquad\qquad H-\overset{\oplus}{N}-H \qquad\qquad\qquad\qquad\qquad\qquad\quad NH_2$
$\qquad\qquad\quad H$

$CH_3-C(=O^{\oplus}H)-O-H \rightleftharpoons CH_3-C(=O)-NH_2 + H_2O$ (NH2, H)

ACETAMIDE

FORMATION OF ACID ANHYDRIDE.

Carboxylic acids are dehydrated to Acid anhydride. The best dehydrating agent is P_2O_5 (Phosphorus pentoxide)

$CH_3-C(=O)-OH + HO-C(=O)-CH_3 \xrightarrow{P_2O_5} CH_3-C(=O)-O-C(=O)-CH_3 + H_2O$

ACETIC ANHYDRIDE

REACTIONS OF CARBOXYL GROUP AS A WHOLE.

Q: WRITE NOTE ON REDUCTION OF CARBOXYLIC ACIDS.

Carboxylic acids are reduced to Alcohols on Reaction with $LiAlH_4$ $CH_3-C(=O)-OH + [H] \xrightarrow{LiAlH_4} CH_3CH_2OH + H_2O$

(b) REDUCTION TO ALKANES / Carboxylic acids are reduced to alkanes with HI and Red Phosphorus.

$CH_3COOH + 6HI \xrightarrow{P} CH_3-CH_3 + 2H_2O + 3I_2$

The carboxyl group is reduced to $-CH_3$ group in this reaction.

Q NO1- WRITE LABORATORY AND COMMERCIAL METHODS OF PREPARATION OF ACETIC ACIDS (VINEGAR).

1) BY OXIDATION OF ETHYL ALCOHOL

$CH_3-CH(OH)-H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-C(=O)-H + H_2O$

$CH_3-C(=O)-H + [O] \longrightarrow CH_3-C(=O)-OH$

2) HYDROLYSIS OF METHYL NITRILS / Methyl nitrils on hydrolysis produces Acetic acid

$CH_3CN + H_2O \xrightarrow{H^+} CH_3-C(=O)-NH_2 \xrightarrow{H_2O} CH_3-C(=O)-OH + NH_3$

COMMERCIAL METHODS OF PREPARATION:

(A) FROM ACETYLENE / Acetylene when treated with 20% H_2SO_4 and 10% $HgSO_4$ at 80°C, Acetaldehyde is produced. It is oxidized to Acetic acid with V_2O_5

$HC\equiv CH + H(OH) \xrightarrow[10\% HgSO_4]{20\% H_2SO_4} H-C(OH)=C-H$ (ENOL) $\xrightarrow{\quad} H-C(=O)-CH_3$

$CH_3-C(=O)-H + [O] \xrightarrow{V_2O_5} CH_3-C(=O)-OH$

ACETIC ACID

FROM FERMENTATION (OXIDATION OF ETHANOL)

ETHANOL is prepared by fermentation of molasses. It is oxidized to acetaldehyde and then Acetic acid with $K_2Cr_2O_7$ and H_2SO_4.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{INVERTASE}]{\text{Yeast}} C_6H_{12}O_6 + C_6H_{12}O_6$$

MOLASSES

$$C_6H_{12}O_6 \xrightarrow[\text{YEAST}]{\text{ZYMASE}} 2C_2H_5OH + 2CO_2$$

$$CH_3CH_2OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-H$$ Acetaldehyde

$$CH_3-\overset{O}{\overset{\|}{C}}-H + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-\overset{O}{\overset{\|}{C}}-OH$$ Acetic acid

PHYSICAL PROPERTIES OF ACETIC ACID:

1. It's a colourless liquid with B.P 118°C.
2. Pure acid freezes to ice like solid at 17°C, thus it is called glacial acetic acid
3. It has strong vinegar like smell and sour taste.
4. It is miscible in water, alcohol and ether in all proportions.

WRITE IMPORTANT USES OF ACETIC ACID

1) It is used as a coagulant for latex in Rubber industry.
2) Used for manufacture of P.V.C, P.V.A and Rayon (Cellulose acetate) and silk
3) In medicine it is used as local irritant.
4) It is used as a solvent for carrying out reactions.
5) It is used in manufacture of pickels
6) In organic chemistry it is used for manufacture of Acetone, acetate and esters

AMINO ACIDS:-

The organic compounds having amino group and carboxyl group attached to the same α-carbon are called AMINO ACIDS. Alkyl group "R" is different for different amino acids. Amino acids may also be α, β, γ-amino acids but all naturally occurring amino acids are α-Amino acids.

Amino acids are basic building block of proteins.

ACIDIC AMINO ACIDS/ Amino acids which have an carboxylic acid group in side chain are called Acidic amino acids.

Example Glutamic acid ⇒ $COOH-CH_2CH_2-\underset{NH_2}{\overset{H}{C}}-COOH$

ASPARTIC ACID ⇒ $HOOC-CH_2-\underset{NH_2}{CH}-COOH$

BASIC AMINO ACID/ An amino acid having amino group in side chain are called basic amino acids. For example LYSINE. $\underset{NH_2}{CH_2(CH_2)_3-CH}-COOH$ $\quad NH_2$

NON-POLAR AMINO ACID/ Side chain is non polar for example Alanine $CH_3-\underset{NH_2}{CH}-COOH$

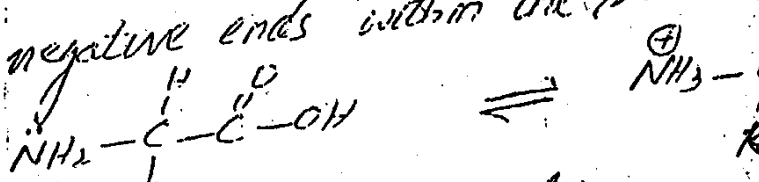
Animal and plants contain at the maximum 20 different types of Aminoacids.

ESSENTIAL AMINO ACIDS:- The α-AMINO ACIDS which our body cannot synthesize are called essential amino acids. These amino acids must be present in our daily diet. The deficiency of these amino acids can cause diseases.

NON-ESSENTIAL AMINOACIDS:- These amino acids can be synthesized in our body. These are α-Non essential amino acids.

NOMENCLATURE / Amino acids are generally named by their source or some property.
GLYCINE from glyky means sweet. It has sweet taste
TYROSINE from tyros means cheese. It was obtained from cheese. Hence named tyros.
ABBREVIATIONS / Each amino acid has been given a three lettered abbreviation. For example "Gly" is an abbreviation of Glycine aminoacid. Similarly "Ala" is an abbreviation of Alanine.

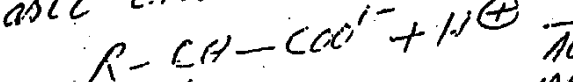
Q WHAT IS ZWITTER ION OR INTERNAL SALT?
The amino acids exist in the form of a dipolar ion called Zwitterion or internal salt. It has a positive and negative ends within the same molecule



ZWITTER ION

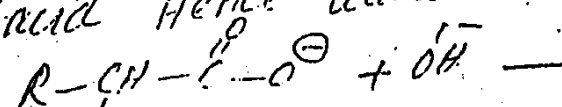
The proton goes from carboxal group to amino group. ALL α-AMINO ACIDS exist in the form of Zwitterion

Q:- WRITE ACIDIC AND BASIC CHARACTER OF AMINE ACIDS?
Due to dipolar nature amino acids can act as acids or bases.
BASIC CHARACTER:- The carboxylate ion can accept proton when it is added to acidic medium. Hence Basic character is due to Carboxylate ion.



ACIDIC MEDIUM

RADIC CHARACTER / when an alkali is added to amino acid. $-\overset{\oplus}{N}H_3$ group releases proton and act as acid Hence acidic character is due to $-\overset{+}{N}H_3$ group



SYNTHESIS OF AMINO ACIDS:- Amino acids can be synthesized by following reactions

HELLVOLHARD ZELINSKY REACTION

A carboxylic acid is treated with halogen in presence of phosphorus an α-halo acid is produced.

$$R-\underset{H}{CH}-\overset{O}{\overset{\|}{C}}-OH + Br_2 \xrightarrow{P} R-\underset{Br}{CH}-\overset{O}{\overset{\|}{C}}-OH + HBr$$

α-Bromoacid is reacted with ammonia to form an amino acid

$$R-\underset{Br}{CH}-COOH + 2NH_3 \longrightarrow R-\underset{NH_2}{CH}-COOH + NH_4Br$$

STRECKER SYNTHESIS/ When an aldehyde is treated with HCN in presence of ammonia, an α-Amino Nitril is produced

$$R-CHO + HCN + NH_3 \longrightarrow R-\underset{NH_2}{CH}-CN$$

α-Aminonitril upon acid hydrolysis yields α-Amino acid

$$R-\underset{NH_2}{CH}-CN + 2H_2O \xrightarrow{H^+} R-\underset{NH_2}{CH}-COOH + 2NH_3$$

WRITE NOTE ON FOLLOWING REACTIONS OF AMINO ACIDS

1 ESTERIFICATION/ Amino acids form AMINO ESTER when treated with Alcohol in presence of strong acid

$$R-\underset{NH_2}{CH}-COOH + HOR \underset{}{\overset{H^+}{\rightleftharpoons}} R-\underset{NH_2}{CH}-COOC_2H_5 + H_2O$$

2) DEAMINATION REACTION/ REACTION WITH NITROUS ACID

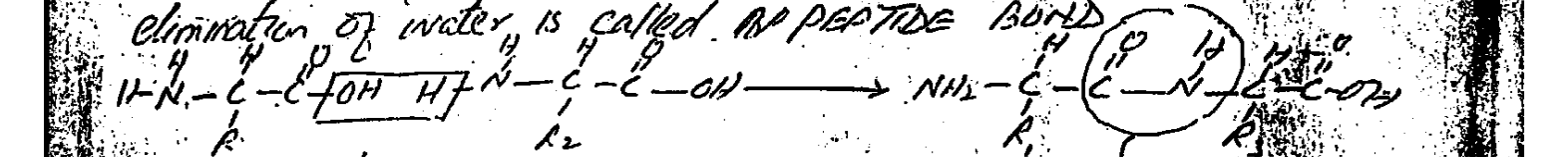
Amino acids react with nitrous acid to produce α-hydroxy carboxylic acid and nitrogen gas.

$$R-\underset{NH_2}{CH}-COOH \xrightarrow[NaNO_2+HCl]{} R-\underset{OH}{CH}-COOH + N_2$$

3. **NINHYDRIN TEST** / Ninhydrin reacts with amino acids to produce an intensly blue ~~coloured~~ violet product. This reaction is used to visualize amino acids separated by paper chromatography.

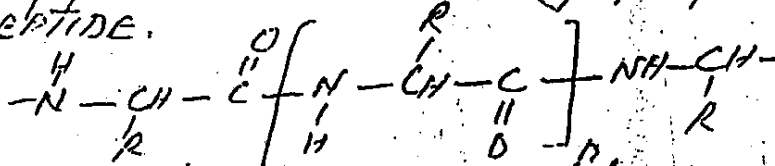
DEFINE THE FOLLOWING TERMS:

PEPTIDE BOND: The condensation between two amino acids with elimination of water is called as PEPTIDE BOND



The carboxyl group of one amino acid gets condensed with amino group of other amino acid with elimination of water. (PEPTIDE LINKAGE)

PEPTIDES: The compounds having peptide bonds are called PEPTIDES. If a large number of amino acids are joined by peptide bond the resulting polymide is called POLYPEPTIDE.



Depending upon number of amino acids in a peptide, they may be dipeptide, tripeptide, polypeptide.

A PEPTIDE having upto 10,000 is called POLYPEPTIDE.

PROTEIN: - A polypeptide having Molecular mass more than 10000 it is called PROTEIN.