CHEMISTRY

12

CH#13

Carboxilic Acids

These Notes Have been Prepared and Developed By

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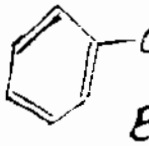
CHAPTER 13
CARBOXYLIC ACIDS

The organic Compounds which contain ($-\overset{\overset{O}{\|}}{C}-OH$) as a functional group are called **Carboxylic acids**. Their general formula is $R-\overset{\overset{O}{\|}}{C}-OH$

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

Formic acid — Acetic acid



Benzoic acid

Monocarboxylic acids Contain one Carboxyl group in their molecules. **Dicarboxylic acids** Contain two Carboxyl groups in their molecules **Polycarboxylic acids** contain many Carboxyl groups in their molecules

Common or Trivial names:-

The Common names of Carboxylic acids are derived from the names of their sources (ذرائع)

Formic acid ($HCOOH$) Present in red ants. Its name has been taken from Latin Word formica, ant.

Acetic acid Present in Vinegar (Latin Word acetum)

The butyric acid ($CH_3-CH_2-CH_2-COOH$) Present in butter (Latin Word butyrum)

The IUPAC names:-

(i) The longest chain of carbon atoms is selected. It is taken as parent chain.
(ii) Numbering begins from $-COOH$ end. The carbon atom of carboxyl group is taken as carbon "1".
(iii) The ending "e" of parent alkane is replaced by "oic acid".
(iv) The position of side groups is indicated.

Examples are given below.

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

methanoic acid — Ethanoic acid (acetic acid)

CH_3-CH_2-COOH , $CH_3-CH_2-CH_2-COOH$

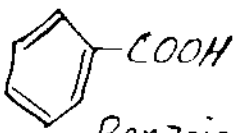
Propanoic acid — Butanoic acid

$CH_3-\underset{CH_3}{\underset{|}{CH}}-COOH$, $CH_3-CH_2-\underset{Cl}{\underset{|}{CH}}-COOH$

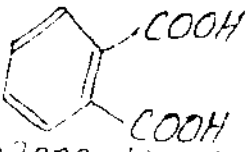
2-Methyl Propanoic acid — 2-Chloro butanoic acid

$\begin{matrix} COOH \\ | \\ COOH \end{matrix}$ Ethane-1,2-dioic acid (oxalic acid)

$HOOC-CH_2-COOH$ is Propane-1,3-dioic acid (Malonic acid)



Benzoic acid
(Benzene Carboxylic acid)



1,2 benzene dicarboxylic acid (Phthalic acid)

Preparation of Carboxylic acids

(1) From alcohols and aldehydes:-

$$R-CH_2-OH + [O] \xrightarrow{K_2Cr_2O_7 + H_2SO_4} R-CHO + H_2O$$

$$R-CHO + [O] \xrightarrow{K_2Cr_2O_7 + H_2SO_4} R-COOH$$

$$CH_3-CH_2-OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-CHO + H_2O$$

$$CH_3-CHO + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3-COOH$$

acetic acid

(2) From alkyl nitrile:-

Hydrolysis of alkyl nitrile gives Carboxylic acid.

$$R-C\equiv N + 2H_2O \xrightarrow{HCl} R-COOH + NH_3$$

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

(3) From Grignard Reagent:-

The reaction of Grignard reagent with Carbon dioxide in dry ether gives an addition Product. This addition Product on reaction with mineral acid gives Carboxylic acid.

$$R-\ddot{M}gX + O=C=O \xrightarrow[ether]{dry} R-\overset{\overset{O}{\|}}{C}-\ddot{O}\overset{+}{M}gX$$

Addition Product

$$R-\overset{\overset{O}{\|}}{C}-\ddot{O}\overset{+}{M}gX + H_2O \xrightarrow{HCl} R-\overset{\overset{O}{\|}}{C}-OH + Mg\begin{matrix}X\\OH\end{matrix}$$

$$CH_3-MgBr + O=C=O \xrightarrow[ether]{dry} CH_3-\overset{\overset{O}{\|}}{C}-OMgBr$$

$$CH_3-\overset{O}{\overset{\|}{C}}-O\overset{-}{\overset{+}{M}}gBr + H_2O \xrightarrow{HCl} CH_3-\overset{O}{\overset{\|}{C}}-OH + Mg\begin{matrix}Br\\OH\end{matrix}$$

(4) By Hydrolysis of Esters:- The reaction of an ester with NaOH gives Sodium salt of the acid. The Sodium salt reacts with dil HCl to give free Carboxylic acid.

$$R-COO\acute{R} + NaOH \longrightarrow R-COO\overset{-}{\overset{+}{N}}a + \acute{R}OH$$

$$R-COONa + HCl \longrightarrow R-COOH + NaCl$$

$$CH_3-COOC_2H_5 + NaOH \xrightarrow{*} CH_3COONa + C_2H_5OH$$

(ethyl acetate) — Sodium acetate

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

(acetic acid)

(5) By Oxidative Cleavage of alkenes:-

When an alkene is heated with alkaline $KMnO_4$, then it shows cleavage (breaking) at the double bond with the formation of Carboxylic acid

$$R-CH=CH-R + 4[O] \xrightarrow[Heat]{KMnO_4 + NaOH} 2\,R-COOH$$

(An alkene) — Carboxylic acid

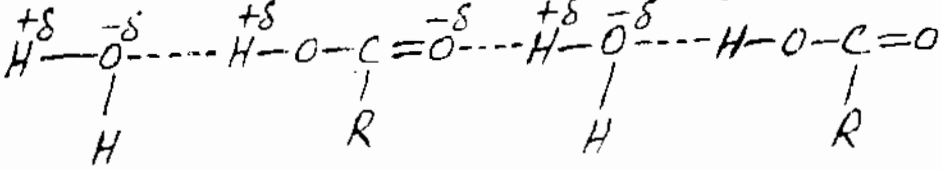
$$CH_3-CH=CH-CH_3 + 4[O] \xrightarrow[Heat]{KMnO_4 + NaOH} 2\,CH_3COOH$$

2-butene — acetic acid

Physical Properties :-

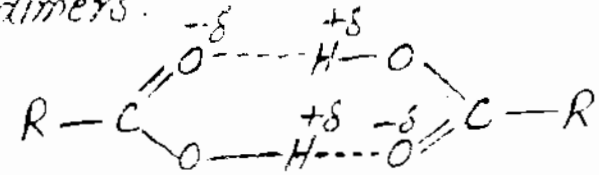
(i) Smell :- The first three acids have pungent smell and next three acids have unpleasant smell.

(ii) Solubility :- The first four acids are very soluble in water. It is due to hydrogen bonding



The solubility of acids decreases with the increase of molecular mass.

(iii) Boiling Points :- The boiling points of carboxylic acids are high. It is due to intermolecular hydrogen bonding. The carboxylic acids exist as cyclic dimers.



$HCOOH$	CH_3COOH	CH_3-CH_2-COOH
$B.P = 100^\circ C$	$118^\circ C$	$151^\circ C$

(iv) Melting Points :- The melting points of carboxylic acids increase irregularly with increase of the molecular mass. The melting point of an acid with even (جفت) number of carbon atoms is higher than its lower and higher member. e.g

The melting points of Propanoic acid, butanoic acid and pentanoic acid are -22°C, -6°C and -36°C respectively

Reactivity of Carboxylic acids

Carboxylic acids show following types of reactions
(i) Reactions which involve H-atom of Carboxyl group
(ii) Reactions which involve -OH group of acids
(iii) Reactions which involve Carboxyl group as a whole

⇒ Reactions involving H-atom of Carboxyl group (Salt formation)

Carboxylic acids react with bases, Carbonates, bicarbonates and active metals to form salts
Examples are given below.

$$CH_3COOH + NaOH \longrightarrow CH_3COO^-Na^+ + H_2O$$

$$2CH_3COOH + Na_2CO_3 \longrightarrow \underset{\text{Sod. Acetate}}{2CH_3COO^-Na^+} + CO_2 + H_2O$$

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 + H_2O$$

$$2CH_3COOH + 2Na \longrightarrow 2CH_3COO^-Na^+ + H_2$$

⇒ Reactions involving -OH group of Carboxylic acids

The -OH group of Carboxylic acids can be replaced by X^-, OR^- and NH_2^- to form acid halides, Esters and amides respectively.

(a) Formation of acid halides:-

$$CH_3COOH + PCl_5 \longrightarrow CH_3COCl + POCl_3 + HCl$$

(acetyl chloride)

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \xrightarrow{\text{Pyridine}} CH_3-\overset{O}{\overset{\|}{C}}-Cl + SO_2 + HCl$$

(Thionyl Chloride)

The mechanism of the reaction is given below.

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + Cl-\overset{O}{\overset{\|}{S}}-Cl \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl + H^+ + \bar{Cl}$$

$$\bar{Cl} + CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{S}}-Cl \longrightarrow CH_3-\underset{Cl}{\overset{O^-}{\overset{|}{C}}}-O-\overset{O}{\overset{\|}{S}}-Cl$$

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

(Acetyl Chloride)

$$H^+ + \bar{Cl} \longrightarrow HCl$$

(b) Formation of Ester (Esterification)

An organic acid reacts with an alcohol to form ester and water. It is called esterification. It takes place in Presence of Conc H_2SO_4

$$CH_3COOH + C_2H_5OH \underset{}{\overset{H_2SO_4}{\rightleftharpoons}} CH_3COOC_2H_5 + H_2O$$

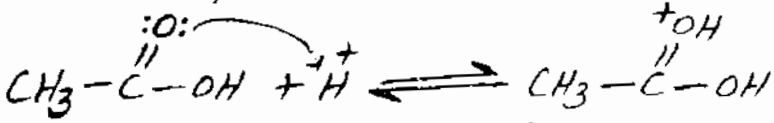
ethyl acetate (An ester)

Esters have fruity smell. They are used as artificial flavours. e.g Amyl acetate (Banana) Benzylacetate (Jasmine), Amyl butyrate (Apricot) خوبانی

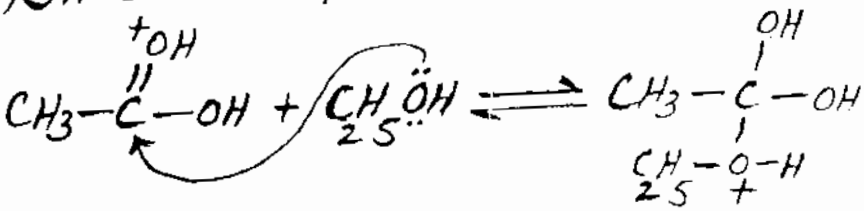
Ethyl butyrate (Pineapple), Octylacetate (orange)
Isobutyl formate (Raspberry کی خوشبو)

Mechanism :- It involves four steps

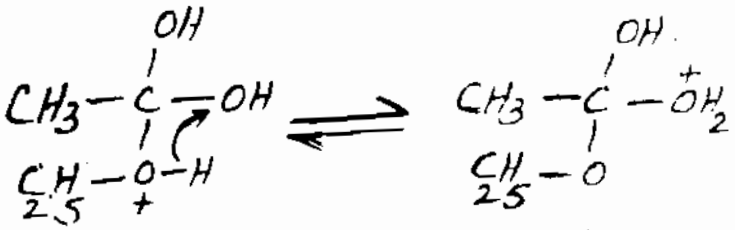
(i) In this step Protonation takes place



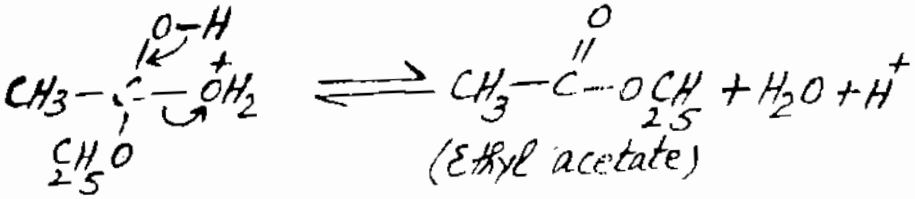
(ii) In second step alcohol attacks.



(iii) In third step transfer of hydrogen ion occurs

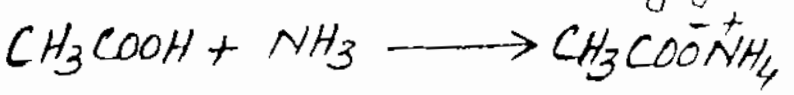


(iv) In fourth step H_2O and H^+ eliminate.



(Ethyl acetate)

(c) Formation of Amides :- Carboxylic acids react with NH_3 to form ammonium salts. This ammonium salt on heating gives amide



$CH_3COONH_4 \xrightarrow{Heat} CH_3-\overset{O}{\overset{\|}{C}}-NH_2 + H_2O$

Acetamide

Mechanism:- It involves three steps.

(i) $CH_3-\overset{O}{\overset{\|}{C}}-OH + \ddot{N}H_3 \rightleftharpoons CH_3-\overset{O^-}{\overset{|}{C}}-OH$ ($^+NH_3$)

(ii) $CH_3-\overset{\bar{O}}{\overset{|}{C}}-OH$ ($^+NH_3$) $\xrightleftharpoons{\text{Proton transfer}}$ $CH_3-\overset{O^-}{\overset{|}{C}}-\overset{+}{O}H_2$ (NH_2)

(iii) $CH_3-\overset{\bar{O}}{\overset{|}{C}}-\overset{+}{O}H_2$ (NH_2) $\rightleftharpoons CH_3-\overset{O}{\overset{\|}{C}}-NH_2 + H_2O$

(Acetamide)

(d) Formation of acid anhydride

Carboxylic acids on strong heating lose water molecules and form anhydride. e.g

$CH_3-\overset{O}{\overset{\|}{C}}-OH + HO-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[\Delta]{P_2O_5} CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + H_2O$

Acetic anhydride

⇒ **Reactions involving Carboxyl Group**

(a) Partial reduction:- The partial reduction of Carboxylic acid gives an alcohol.

$CH_3-\overset{O}{\overset{\|}{C}}-OH + 4[H] \xrightarrow{LiAlH_4} CH_3-CH_2-OH + H_2O$

(b) Complete reduction:- Complete reduction of Carboxylic acid gives an alkane.

$CH_3COOH + 6HI \xrightarrow{\text{red Phosphorous}} CH_3-CH_3 + 2H_2O + 3I_2$

Acetic Acid (CH_3COOH)

Laboratory Preparation:-

(i) Oxidation of ethyl alcohol with $K_2Cr_2O_7$ and H_2SO_4 gives acetic acid.

$$CH_3-CH_2OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3CHO + H_2O$$

$$CH_3-CHO + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} CH_3COOH$$

(ii) Hydrolysis of methyl nitrile with dil HCl gives acetic acid. 3-step

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

Commercial (Industry) Preparation:-

(1) **From Acetylene:-** Water adds to acetylene in presence of $HgSO_4$ and H_2SO_4 to give acetaldehyde. Then oxidation of acetaldehyde gives acetic acid.

$$CH\equiv CH + H_2O \xrightarrow[H_2SO_4]{HgSO_4} CH_2=CHOH \rightleftharpoons CH_3CHO$$

$$\underset{\text{Acetaldehyde}}{CH_3CHO} + [O] \xrightarrow[V_2O_5]{\text{Oxidation}} CH_3COOH$$

(2) Oxidation of ethyl alcohol with $K_2Cr_2O_7$ and conc H_2SO_4 gives acetaldehyde whose further oxidation gives acetic acid.

$$CH_3CH_2OH + [O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3CHO + H_2O$$

$$CH_3CHO + [O] \xrightarrow{K_2Cr_2O_7 + H_2SO_4} CH_3COOH$$

Physical Properties:-

(i) Acetic acid is a colourless liquid with vinegar odour (سرکہ جیسی بو)

(ii) Its boiling point is 118°C

(iii) Acetic acid freezes at 17°C and forms ice like crystals. Therefore it is called glacial (ice like) acetic acid.

(iv) Acetic acid is miscible with water, ether, alcohol in all proportions

Chemical Properties:-

(i) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(ii) $CH_3COOH + SOCl_2 \xrightarrow{Pyridine} CH_3COCl + SO_2 + HCl$
(Acetyl Chloride)

(iii) $CH_3COOH + C_2H_5OH \underset{}{\overset{Conc\ H_2SO_4}{\rightleftharpoons}} CH_3COOC_2H_5 + H_2O$
ethyl acetate

(iv) $CH_3COOH + NH_3 \longrightarrow CH_3COONH_4$

$CH_3COONH_4 \xrightarrow{Heat} CH_3CONH_2 + H_2O$
(Amm. acetate) (Acetamide)

(v) $2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$

Uses of Acetic Acid:-

(i) Acetic acid is used as solvent (حل)

(ii) It is used in preparation of Pickles (اچار)

(iii) It is used as a coagulant (لخثہ) for rubber latex

(iv) Acetic acid is used in manufacture of plastic, silk and rayon (Cellulose acetate)
(v) It is used in medicine as a local irritant.
(vi) It is used for Preparation of other Chemicals e.g acetone, ethyl acetate, acetamide etc

Amino Acids

The organic compounds which Contain both amino and Carboxyl groups are called amino acids

e.g $CH_2(NH_2)-COOH$ (glycine) $CH_3-CH(NH_2)-COOH$ (Alanine)

The general formula of amino acids is

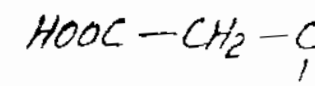
$$R-CH(NH_2)-COOH$$

Amino acids are the building blocks of Proteins. About 20 amino acids have been found in Proteins All naturally occuring amino acids are called α-amino acids because amino group is bonded to α-Carbon. There are three types of amino acids.

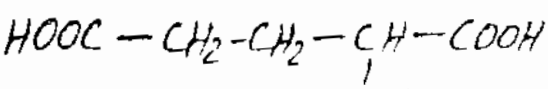
(i) Neutral amino acids:- The amino acids which Contain one Carboxyl group and one amino group are called neutral amino acids.

e.g glycine , alanine.

(ii) **Acidic amino acids:-** The amino acids which contain two carboxyl groups and one amino group are called acidic amino acids.

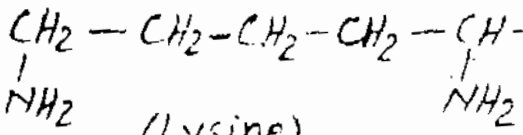
e.g 

(Aspartic acid)

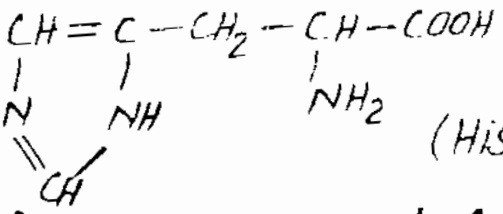


(Glutamic acid)

(iii) **Basic amino acids:-** The amino acids which contain two amino groups and one carboxyl group are called basic amino acids.

e.g 

(Lysine)



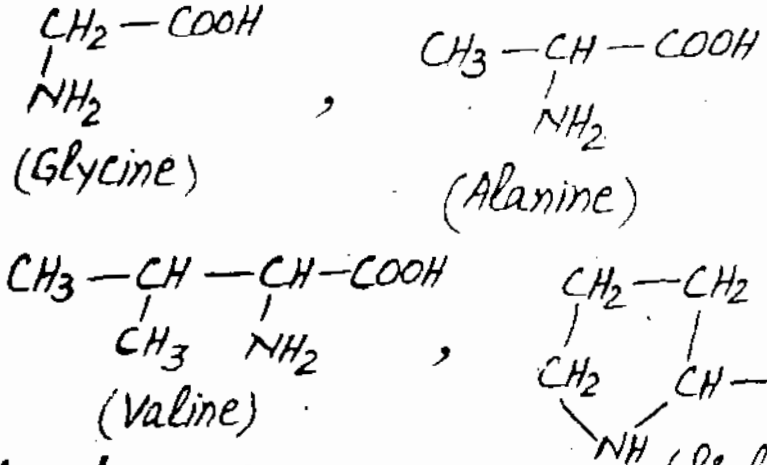
(Histidine)

Essential and non-essential amino-Acids.

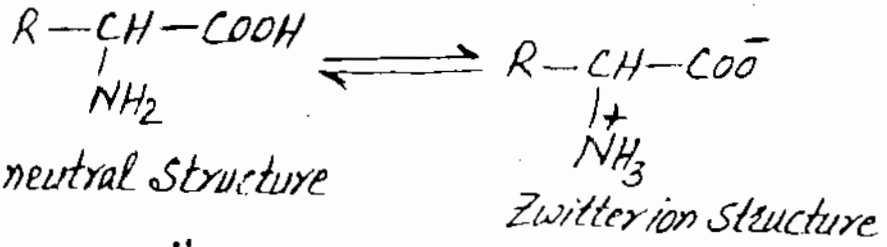
The amino acids which can be synthesized within the body are called non-essential amino acids. The amino acids which can not be synthesized within the body are called essential amino acids. These must be present in our diet (غذا). Their deficiency (کمی) may cause diseases

Nomenclature of Amino acids

Amino acids can be named by IUPAC system but their trivial (common) names are generally used. The common names are derived from their origin or from their particular properties. For example, Glycine (Greek glyky = sweet)
Tryosine (Greek tryos = cheese)
Each amino acid is given an abbreviation
e.g Glycine = Gly, Alanine = Ala
Valine = Val, Proline = Pro
The names and structural formulae of some amino acids are given below.



Structure of amino acids:-
The amino acids form dipolar ion or "**Zwitterion**" It has both positive and negative ends. In the formation of Zwitterion, a proton from the Carboxyl group goes to amino group.



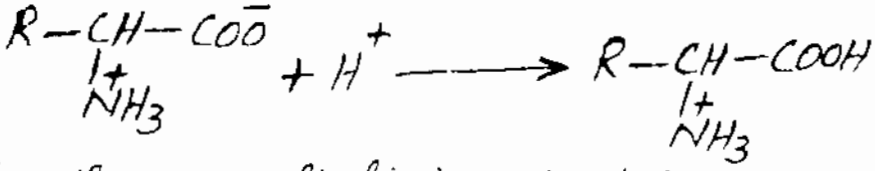
neutral structure

Zwitterion structure

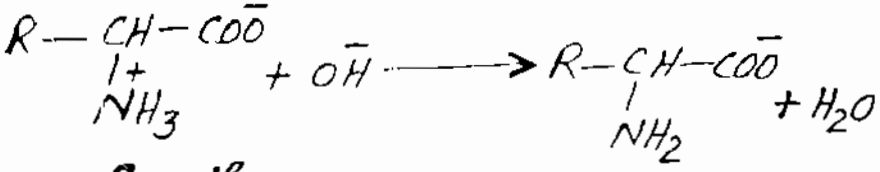
The "Zwitterion" structure of an amino acid is also called internal salt.

Acidic and basic Character of amino acids

(i) When an acid is added to an amino acid, then its Carboxylate ion accepts a Proton. Therefore amino acid shows basic Character



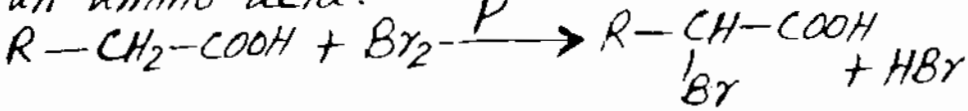
(ii) When an alkali is added to an amino acid, then its $-\overset{+}{N}H_3$ group donates a Proton. Therefore amino acid shows acidic Character.



Synthesis of amino Acids

Amino acids are Prepared by two methods.

(i) The reaction of α-bromo acid with NH_3 gives an amino acid.



$$R-\underset{Br}{\underset{|}{CH}}-COOH + NH_3 \longrightarrow R-\underset{NH_2}{\underset{|}{CH}}-COOH + HBr$$

(An amino acid)

(ii) Strecker Synthesis :-

An aldehyde reacts with HCN to give cyanohydrin The cyanohydrin reacts with NH_3 to give an α-amino nitrile. The hydrolysis of α-amino nitrile gives amino acid.

$$R-\overset{O}{\overset{\|}{C}}-H + HCN \longrightarrow R-\underset{CN}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-H$$

$$R-\underset{CN}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-H + NH_3 \longrightarrow R-\underset{CN}{\underset{|}{\overset{NH_2}{\overset{|}{C}}}}-H + H_2O$$

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

(α-amino nitrile) (An amino acid)

Reactions of amino Acids

(i) Esterification :- An amino acid reacts with an alcohol to form an amino ester.

$$R-\underset{NH_2}{\underset{|}{CH}}-COOH + \acute{R}-OH \rightleftharpoons R-\underset{NH_2}{\underset{|}{CH}}-COO\acute{R} + H_2O$$

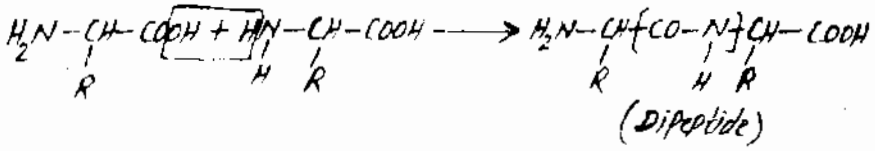
(ii) Reaction with nitrous acid :-

An amino acid reacts with nitrous acid (HNO_2) to Produce α-hydroxy carboxylic acid and Nitrogen gas.

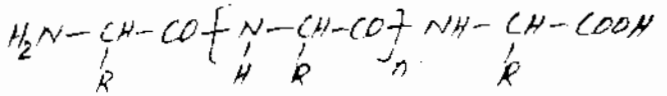
$$R-\underset{NH_2}{\underset{|}{CH}}-COOH + HNO_2 \xrightarrow[\cdot HCl]{NaNO_2} R-\underset{OH}{\underset{|}{CH}}-COOH + N_2 + H_2O$$

Peptides and Proteins

The Compounds formed by condensation of two or more Same or different amino acids are called Peptides. They contain $-CO-NH-$ bond in their structure. It is called Peptide bond or Peptide linkage. The bond formed between Carboxyl group of one amino acid and amino group of other amino acid with elimination of water molecule is called peptide bond. It is $-CO-NH-$ bond



Two molecules of amino acids join and form dipeptide. Three molecules of amino acids join and form tripeptide A large number of amino acids join by Peptide bonds and form a Polypeptide. A Peptide having molecular mass upto 10,000 is called Polypeptide. A Peptide having molecular mass more than 10,000 is called Protein The human body contains at least 10,000 different kinds of proteins. They are present in skin, hair, muscles and non-bony tissues of our body. The structure of of Polypeptide or Protein is given below.



Test of Amino Acids (Ninhydrin Test)

Ninhydrin ($C_9H_6O_3 \cdot H_2O$) reacts with amino acid and forms a deep bluish violet colour Product. The ninhydrin test is used to "visualize" amino acids separated by Paper Chromatography

EXERCISE

Q1. *Fill in the Blanks.*

(i) Formula of malonic acid is _____.
(ii) Methyl nitrile upon acidic hydrolysis produces _____.
(iii) Melting point of carboxylic acids containing even number of carbon atoms are _____ than the next lower and higher members containing odd number of carbon atoms.
(iv) Acetic acid on heating with _____ produces acetic anhydride.
(v) Acid chloride and acid anhydride are called _____ of acid.
(vi) Pure acetic acid is called _____.
(vii) Formula of alanine is _____.
(viii) Proline is a _____ amino acid.
(ix) A peptide having a molecular mass more than 10000 is called ____.

Answer:- (i) CH_2(COOH)(COOH) (ii) acetic acid (iii) higher
(iv) P_2O_5 (v) derivative (vi) glacial acetic acid (vii) CH_3--CH(NH_2)— COOH
(viii) neutral (ix) protein

Q2. *Indicate True and False.*

(i) Acetic acid exists as dimer in benzene.
(ii) First three aliphatic acids have fruity smells.
(iii) Carboxylic acids on reduction with $LiAlH_4$ produce alkenes.
(iv) Acetic acid on dehydration produces CO and H_2.
(v) Sodium formate on heating with soda lime produces $NaHCO_3$ and hydrogen.
(vi) Amino acids exist as Zwitterion.
(vii) Histidine is an acidic amino acid.
(viii) A peptide having molecular mass upto 10000 is called protein.
(ix) Phthalic acid is a monocarboxylic acid.
(x) Formula of Glycine is CH_2COOH.

Answer:- (i) true(ii) false(iii) false (iv) false (v) false
(vi) true (vii) false(viii) false (ix) false (x) false

Q3. Multiple Choice Questions. Encircle the correct answer.

(i) Acetic acid is manufactured by.
(a) Distillation (b) Fermentation (c) Ozonolysis (d) Esterification
(ii) A carboxylic acid contains
(a) A hydroxyl group (b) A carboxyl group
(c) A hydroxyl and carboxyl group(d)A carboxyl and an aldehydic group
(iii) Which acid is used in the manufacture of synthetic fiber.
(a) Formic acid (b) Oxalic acid (c) Carbonic acid (d) Acetic acid

(iv) Which following derivative can not be prepared directly from acetic acid.
(a) Acetamide (b) Acetyl chloride
(c) Acetic anhydride (d) Ethyl acetate

(v) Which regent is used to reduce a carboxylic group an alcohol.
(a) H_2/Ni (b) H_2/Pt (c) $NaBH_4$ (d) $LiAlH_4$

(vi) The solution of which acid is used for seasoning of food.
(a) Formic acid (b) Acetic acid
(c) Benzoic acid (d) Butanoic acid

(vii) Organic compounds X and Y react together to form organic compound Z. What types of compounds can X, Y and Z be?

	X	Y	Z		X	Y	Z
(a)	alcohol	ester	acid	(b)	acid	ester	alcohol
(c)	ester	alcohol	acid	(d)	alcohol	acid	ester

(viii) An aqueous solution of an organic compound reacts with sodium carbonate to produce carbon dioxide gas. Which one of the following could be the organic compound.
(a) $CH_2 = CH — CH_3$ (b) $CH_3 — CHO$
(c) $CH_3COOH_2H_5$ (d) $CH_3 — CH_3 — COOH$

(ix) Which of the following is not a fatty acid?
(a) Propanoic acid (b) Acetic acid
(c) Pthalic acid (d) Butanoic acid

(x) Acetamide is prepared by
(a) Heating ammonium acetate.
(b) Heating methyl cyanide
(c) Heating ethyl acetate.
(d) The hydrolysis of methyl cyanide

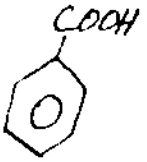
Answer:- (i) b (ii) b (iii) d (iv) a (v) d
(vi) b (vii) d (viii) d (ix) c (x) a

Q4. Write down the structural formula of the followings.
(i) Valeric acid (ii) Propionic acid
(iii) Oxalic acid (iv) Benzoic acid
(v) Acetic anhydride (vi) Acetyl chloride

Answer:-

(i) $CH_3-CH_2-CH_2-CH_2-COOH$ (Valeric acid)

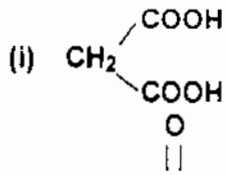
(ii) Propionic acid CH_3-CH_2-COOH

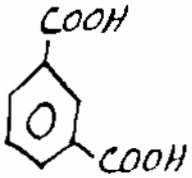
(iii) Oxalic acid $\begin{matrix} COOH \\ | \\ COOH \end{matrix}$ (iv) Benzoic acid 

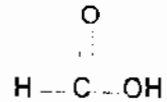
(v) Acetic anhydride $CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

(vi) Acetyl chloride $CH_3-\overset{O}{\overset{\|}{C}}-Cl$

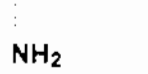
Q5. Write down the names of the following compounds by IUPAC system.

(i) 

(ii) 

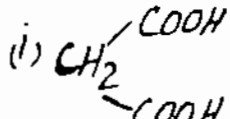
(iii) 

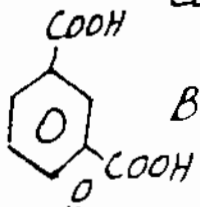
(iv)

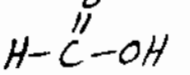
(v) 

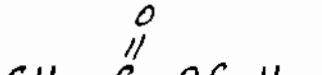
(vi) $HCOOC_3H_7$

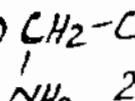
Answer:-

(i)  Propane 1,3 dioic acid

(ii)  Benzene, 1,3 dicarboxylic acid

(iii)  Methanoic acid.

(iv)  Ethyl ethanoate

(v)  2-amino ethanoic acid

(vi) $HCOOC_3H_7$ n-Propyl methanoate

Q6. (a) How is acetic acid manufactured? What is glacial acetic acid?
(b) How would your convert acetic acid into
(i) Methane (ii) Acetyl chloride (CH_3COCl)
(iii) Acetamide (iv) Acetic anhydride

Answer:- See on Page No 203, 204

Glacial Acetic acid:- Pure acetic acid freezes at 17°C and forms ice like crystals. It is called glacial acetic acid.

(b) (i) $CH_3COOH + NaOH \xrightarrow{CaO} CH_3COONa + H_2O$

$CH_3COONa + NaOH \longrightarrow CH_4 + Na_2CO_3$

(ii) $CH_3COOH + SOCl_2 \longrightarrow CH_3COCl + SO_2 + HCl$

(iii) $CH_3COOH + NH_3 \longrightarrow CH_3COO^-NH_4^+$

$CH_3COONH_4 \xrightarrow{Heat} CH_3CONH_2 + H_2O$

Ammonium acetate (acetamide)

(iv) $CH_3-\overset{O}{\overset{\|}{C}}-OH + HO-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[-H_2O]{Heat} CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

acetic acid — Acetic anhydride

Q7. (a) What are fatty acids?
(b) What is vinegar? Describe how is vinegar prepared from ethanol?

Answer:- The highey members of Carboxylic acids are obtained by hydrolysis of fats or oils. They are called fatty acids. e.g Palmitic acid ($C_{15}H_{31}COOH$) and Stearic acid ($C_{17}H_{35}COOH$) etc.

Vinegar:- 10% aqueous solution of acetic acid is called vinegar. It is used for Preparation of pickles اچار and for preservation of food. It is prepared by oxidation of ethyl alcohol.

$CH_3-CH_2OH + [O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3CHO + H_2O$

$CH_3CHO + [O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3COOH$

Q8. How would you convert the following.
(i) Acetic acid into acetamide
(ii) Acetic acid into acetone

Answer:- (i) $CH_3COOH + NH_3 \longrightarrow CH_3COO^-NH_4^+$

$CH_3COONH_4 \xrightarrow{Heat} CH_3CONH_2 + H_2O$

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

$(CH_3COO)_2Ca \xrightarrow{Dry\ distillation} CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CaCO_3$

acetone

Q9. Write down the mechanism of the following reactions.

(i) Between acetic acid and ethanol
(ii) Between acetic acid and ammonia
(iii) Between acetic acid and thionyl chloride

Answer:- see page No. 208, 209

Q10. What happens when following compounds are heated.

(i) Calcium acetate
(ii) Sodium formate and soda lime
(iii) Ammonium acetate

Answer:-

(i) $(CH_3COO)_2Ca \xrightarrow{Distil} CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + CaCO_3$

Calcium acetate — acetone

(ii) $HCOONa + NaOH \xrightarrow{Heat} Na_2CO_3 + H_2$

Sodium formate

(iii) $CH_3COONH_4 \xrightarrow{Heat} CH_3CONH_2 + H_2O$

Ammonium acetate — Acetamide

Q11. What are amino acids? Explain their different types with one example in each case.

Anwer:- see page No. 213

Q12. Write a short note on acidic and basic character of an amino acid.

Answer:- see page No. 214

Q13. What is a peptide bond? Write down the formula of a dipeptide.

Answer:- When $-NH_2$ group of one amino acid and $-COOH$ group of other amino acid condense, a bond of type $-NH-CO-$ is formed. It is called peptide bond. The formula of a dipeptide is given below.

$$H_2N-\underset{R}{\underset{|}{CH}}-CO-NH-\underset{R}{\underset{|}{CH}}-COOH$$

Q14. What are zwitterions? see page No. 215

Q15. What are α- amino acids, proteins and peptides?

Answer:- see page No. 213 : 218

Q16. Study the facts give in (a), (b) and (c) below and then answer questions which follow.

(a) A is an organic compound made up of C, H, and O. It has a vapour density 15. [Hint Molecular mass = 2 x vapour density]

(b) On reduction A gives a compound 'X' which has the following properties.

(i) X is a colourless liquid miscible with water.

(ii) X is neutral to litmus.

(iii) When X is warmed with a few drops of conc. H_2SO_4 followed by a little salicylic acid a characteristic smell is produced.

(c) When X is subjected to strong oxidation, it gives compound B, which has the following properties.

(i) B is a pungent smelling mobile liquid.

(ii) It is miscible with water, alcohol or ether.

(iii) It is corrosive and produces blisters on contact with skin.

(iv) B can be obtained by passing the vapours of A with air over platinum black catalyst.

(v) B liberates H_2 with sodium.

(vi) It give CO_2 with $NaHCO_3$.

1. What is the molecular weight of A?
2. Identify A, X and B.
3. Give five appropriate reactions to confirm the identities of A,X and B.
4. State one large scale use of either A, X or B.

Answer:

(1)

Molecular mass of A = 2 × Vapour density

= 2 × 15 = 30 a.m.u

(2) A is Formaldehyde

X is methyl alcohol

B is Formic acid

(3) $HCHO + 2[H] \xrightarrow[H_2O]{Na/Hg} CH_3OH$

$CH_3OH + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} HCHO + H_2O$

$\underset{\text{Formaldehyde}}{HCHO} + [O] \xrightarrow[H_2SO_4]{K_2Cr_2O_7} \underset{\text{Formic acid}}{HCOOH}$

گلدستہ ڈاٹ پی کے کی جانب سے خوش آمدید

السلام علیکم ورحمتہ اللہ وبرکاتہ

مختصر تعارف

کافی عرصہ سے خواہش تھی کہ ایک ایسی ویب سائٹ بناؤں جس پر طالب العلموں کیلئے کچھ تعلیمی مواد جمع کر سکوں۔ اللہ تعالیٰ نے توفیق دی اور میں نے ایک سال کی محنت کے بعد ایک سائٹ "گلدستہ ڈاٹ پی کے" کے نام سے بنائی جو کہ قرآن و حدیث، اصلاحی، دلچسپ، تاریخی قصے واقعات، اُردو انگلش تحریریں، شاعری و اقوال زریں، F.Sc اور B.Sc کے مضامین کے آن لائن نوٹس، اسلامک، تفریحی، معلوماتی وال پیپرز، حمد و نعت، فرقہ واریت سے پاک اسلامی بیانات، پنجابی نظمیں و ترانے اور کمپیوٹر و انٹرنیٹ کی دنیا کے بارے میں ٹپس، آن لائن کمائی کرنے کے مستند طریقہ کار۔ کے ساتھ ساتھ اور بھی بہت سی چیزوں پر مشتمل ہے۔ اور انشاء اللہ میں مزید وقت کے ساتھ ساتھ اضافہ کرتا جاؤں گا۔ آپ کی قیمتی رائے کی ضرورت ہے۔ عرنان شفیق

اہم نوٹ

ذیل میں جو نوٹس مہیا کیے گئے ہیں وہ کئی گھنٹوں کی لگاتار محنت کے مرتب ہوئے ہیں۔ اور آپ کو بالکل مفت مہیا کر رہے کیے جارہے ہیں۔ آپ سے ان کی قیمت صرف اتنی سی متوقع ہے کہ ایک بار **درودّ ابراھیمی** اپنی زبان سے ادا کر دیں۔

درود شریف

بسم اللہ الرحمٰن الرحیم

اَللّٰھُمَّ صَلِّ عَلٰی مُحَمَّدٍ وَّ عَلٰٓی اٰلِ مُحَمَّدٍ کَمَا

اے اللہ! رحمت بھیج حضرت محمد پر اور حضرت محمدؐ کی آل پر

صَلَّیْتَ عَلٰٓی اِبْرَاھِیْمَ وَ عَلٰٓی اٰلِ اِبْرَاھِیْمَ

جس طرح تو نے رحمت بھیجی حضرت ابراھیم پر اور حضرت ابراہیمؑ کی آل پر

اِنَّکَ حَمِیْدٌ مَّجِیْدٌ

بے شک تو تعریف کیا گیا بزرگ ہے۔

اَللّٰھُمَّ بَارِکْ عَلٰی مُحَمَّدٍ وَّ عَلٰٓی اٰلِ مُحَمَّدٍ کَمَا

اے اللہ! برکت دے حضرت محمد کو اور حضرت محمدؐ کی آل کو جس

بَارَکْتَ عَلٰٓی اِبْرَاھِیْمَ وَ عَلٰٓی اٰلِ اِبْرَاھِیْمَ

طرح برکت دی تو نے حضرت ابراھیم کو اور حضرت ابراہیمؑ کی آل کو

اِنَّکَ حَمِیْدٌ مَّجِیْدٌ

بے شک تو تعریف کیا گیا بزرگ ہے۔