CHEMISTRY

12

CH#14

Macromolecules

These Notes Have been Prepared and Developed By

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CHAPTER 14
MACROMOLECULES

The large molecules built up from small repeating units are called polymers or macromolecules e.g polythene, PVC etc.

The small and simple repeating units of polymers are called monomers. The polymer is Greek word, poly means many and mere means parts. The macromolecules have main two classes.

(i) **Inorganic Macromolecules** include giant molecules such as diamond, graphite and sand.

(ii) **Organic Macromolecules** include two types of polymers. They are biopolymers and synthetic polymers.

(a) The biopolymers consist of Proteins, lipids, Carbohydrates and nucleic acids

(b) The synthetic polymers consist of Plastics, Synthetic rubber and synthetic fibres.

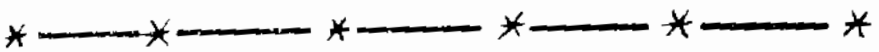
Structure of Polymers (Ways of Polymerization)

The structure of polymers may be of three types.

(i) Linear Polymer

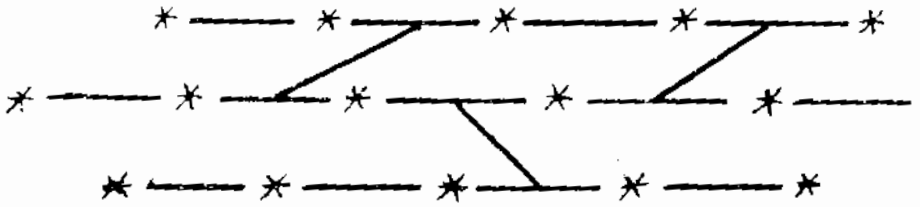
(ii) Branched Polymer

(iii) Interconnected Polymer



Linear Polymer

Branched Polymer



Cross linked or interconnected Polymer

Polymer

Degree of Polymerization (DP)

The number of "repeating units" in the chain of a polymer is called degree of Polymerization The molecular mass of a polymer is equal to the Product of molecular mass of repeating unit and its DP. For example, Polyvinyl chloride. Repeating unit = $CH_2-\underset{Cl}{CH}$

DP = 1000

Mol. mass of PVC = Mol. mass of repeat unit x DP

$+CH_2-\underset{Cl}{CH}+_n$ = 63 x 1000 = 63000

Types of Polymers

There are three types of Polymers on the basis of types of monomers.

(i) Homopolymer
(ii) Copolymer
(iii) Terpolymer

(i) Homopolymer:- A Polymer, formed by Polymerization of one type of monomers is called homopolymer. e.g Polythene, PVC

$$n\ CH_2=CH_2 \xrightarrow[0.01\%\ oxygen]{400^\circ C,\ 100\ atm} \{CH_2-CH_2\}_n$$

ethene — Polythene

$$n\ CH_2=CHCl \xrightarrow{Heat} \left\{CH_2-\underset{Cl}{CH}\right\}_n$$

vinyl chloride — (PVC)

$$n\ CH_2=\underset{OOCCH_3}{CH} \xrightarrow{Heat} \left\{CH_2-\underset{OOCCH_3}{CH}\right\}_n$$

vinyl acetate

A Polymer, formed by

(1) Addition Polymerization

The polymerization in which self addition of monomers takes place is called addition polymerization. e.g polymerization of styrene, polymerization of ethylene.

Here we explain free radical polymerization. It has three steps.

(a) Initiation:- Here free radicals are generated

$$\underset{\text{(Free radical)}}{\dot{R}} + CH_2=\underset{\underset{C_6H_5}{|}}{CH} \longrightarrow R-CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H}$$

(Styrene)

(b) Propagation:- New free radicals are produced.

$$R-CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H} + CH_2=\underset{\underset{C_6H_5}{|}}{CH} \longrightarrow R-CH_2-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H}$$

$$R-CH_2-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H} + CH_2=\underset{\underset{C_6H_5}{|}}{CH} \longrightarrow R-CH_2-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H}$$

(c) Termination:- Free radicals combine.

$$R+\left(CH_2-\underset{\underset{C_6H_5}{|}}{\dot{C}H}\right)_n + \dot{R} \longrightarrow R-\left(CH_2-\underset{\underset{C_6H_5}{|}}{CH}\right)_n-\underset{\underset{C_6H_5}{|}}{R}$$

(iii) Terpolymer:- A polymer, formed by polymerization, of three different types of monomers is called terpolymer. For example combination of methacrylate, butylacrylate and acrylic acid gives a terpolymer. It is highly tough polymer. It is used as a weather resistant paint.

There are two types of polymers on the basis of thermal properties.

(i) Thermoplastic Polymers

(ii) Thermosetting Polymers

(a) Thermoplastic Polymers:-

A polymer which becomes soft on heating and hard on cooling is called thermoplastic polymer. e.g PVC, Plastic toys, Polystyrene

(b) Thermosetting Polymer:-

A polymer which becomes hard on heating and can not be again softened is called thermosetting polymer. e.g

Synthetic varnish, epoxy resins

Polymerization Process

Polymerization has two classes. It was suggested by W.H. Carothers in 1929.

(1) Addition Polymerization

(2) Condensation Polymerization

(2) **Polyvinyl acetate (PVA)**

It is an addition polymer of vinyl acetate

$$n\ CH_2=\underset{\underset{OOCCH_3}{|}}{CH} \xrightarrow{Heat} \left(CH_2-\underset{\underset{OOCCH_3}{|}}{CH}\right)_n$$

vinyl acetate — Polyvinyl acetate

PVA is a colourless, non-toxic resin (غیر زہریلا)
It has characteristic odour.
Its polymers can have different DP values.
It is used as an adhesive material (لصوق)
It is used as a binder for paints.

(3) **Polystyrene** :- It is an addition polymer of styrene.

$$n\ CH_2=\underset{\underset{C_6H_5}{|}}{CH} \xrightarrow[Catalyst]{Heat} \left(CH_2-\underset{\underset{C_6H_5}{|}}{CH}\right)_n$$

Styrene — Polystyrene

It is used in making food containers
It is used in making toys and packing material
It is used in making cosmetic bottles.

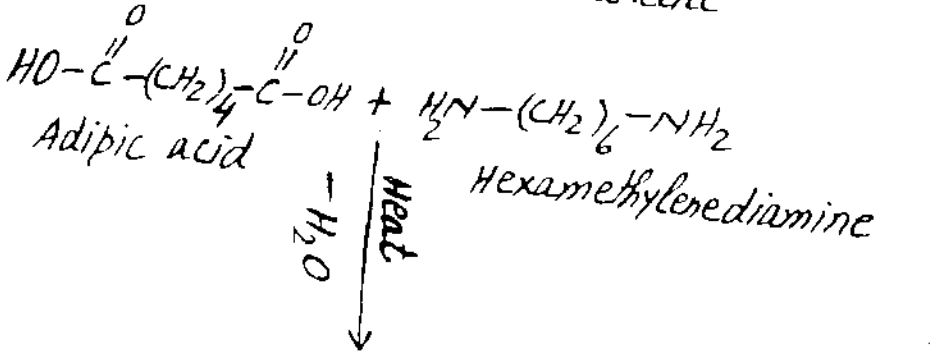
(4) **Acrylic Resins** :- These resins are produced by polymerization of acrylic acid, butyl acrylate and acrylonitrile.

$CH_2=CHCOOH$, $CH_2=CHCN$, $CH_2=CHCOOC_4H_9$
Acrylic acid — Acrylonitrile — Butyl acrylate

Acrylic resins are used for manufacture of

(2) Condensation Polymerization

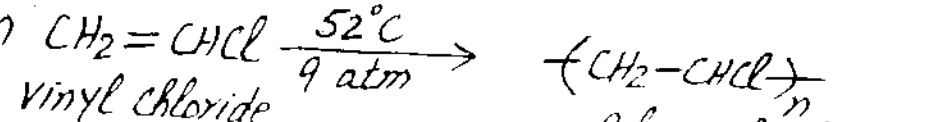
The Polymerization in which monomers with different functional groups Combine up with removal of water molecules is called Condensation Polymerization. e.g Formation of Nylon-6,6, Polyester and bakelite



Nylon-6,6

Synthetic Polymers

(1) Polyvinyl chloride (PVC):- It is an addition Polymer of Vinyl Chloride.

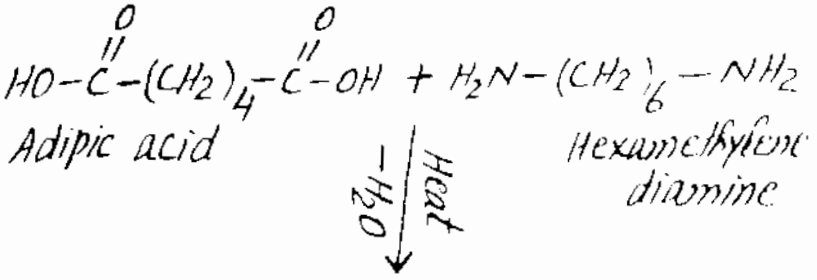


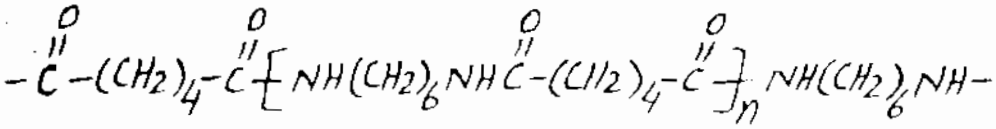
Vinyl Chloride — Polyvinyl Chloride

By adding plasticizer, the flexibility of PVC increases. PVC has following uses.

(i) It is used in gramophone recorders
(ii) Used in Pipes (iii) used in floor Covering.

and hexamethylene diamine) both have six Carbon atoms each.

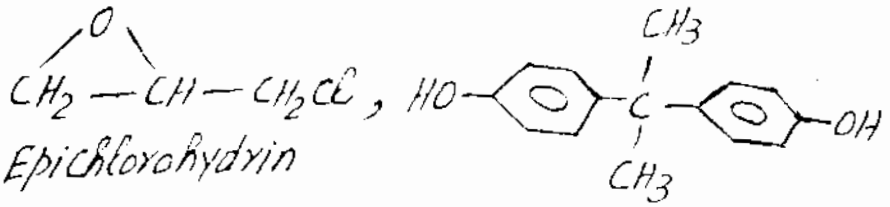




Nylon-6,6

Uses:- (i) Nylon-6,6 is used in textiles
(ii) Nylon-6,6 has high elasticity and toughness. So it is used in making hosiery (موزے)

(7) Epoxy Resins:- They are condensation polymers. Epoxy resins are in fact polyethers. Each epoxy resin is made by reaction of epichlorohydrin and diphenylolpropane.



Uses:- (i) Epoxy resins are used in coating materials due to their flexibility and toughness
(ii) Dams, bridges, floors are painted with

(i) Plastics (ii) Paints for Car industry
(iii) Weather resistant Paints.

(5) Polyester Resins :- They are condensation polymers. They are produced by reaction of an alcohol and aromatic bi-functional acids.
For example reaction of ethane 1,2 diol with benzene 1,4 dicarboxylic acid gives Polyester.

$$n\ HOOC-C_6H_4-COOH + n\ HO-CH_2-CH_2-OH$$

Benzene 1,4 dicarboxylic acid — Ethane 1,2 diol

$$\rightarrow \left[CO-C_6H_4-COO-CH_2-CH_2-O\right]_n + 2nH_2O$$

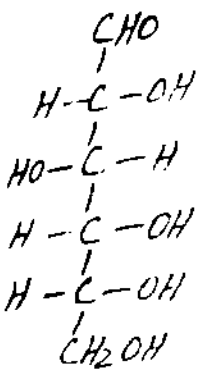
Polyester

Uses:- (i) Polyester is used in clothing
(ii) It is blended with Wool or Cotton for Winter or Summer Clothing
(iii) Polyester resin is used for making water tanks.

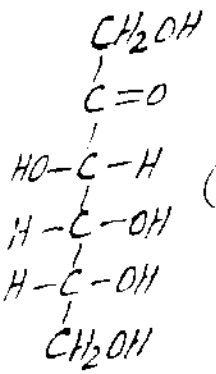
(6) Polyamide Resins:- They are condensation Polymer. They are Produced by Condensation of Polyamines with aliphatic dicarboxylic acids. For example Nylon-6,6. It is obtained by heating adipic acid with hexamethylene diamine. The name of Nylon-6,6 has been derived from its starting materials (Adipic acid

(i) Monosaccharides

The simple sugars which can not be hydrolyzed are called monosaccharides. e.g glucose, fructose etc. Their molecular formula is $(CH_2O)_n$ where $n \geq 3$. The monosaccharides are called aldoses if they contain aldehydic group and ketoses if they contain ketonic group. Monosaccharides are classified on the number of carbon atoms. For example sugars with five carbon atoms are called pentoses and sugars with six carbon atoms are called hexoses. Glucose and fructose are hexoses with formula $C_6H_{12}O_6$. Glucose is also called dextrose, grape sugar or blood sugar. It is found in sweet fruits and honey (شہد). It is the source of energy in our body. Fructose is found in combined and free states. It is used as sweetening agent. It is also used as a substitute (متبادل) of cane sugar. The open chain and cyclic forms of glucose and fructose are shown below.



(glucose) open chain form ,



(Fructose) open chain form

epoxy resins.

(iii) Industrial materials, thermal power houses and patching materials are coated with epoxy paints.

Biopolymers

The life molecules are biologically important substances. They are found as very large molecules or in the form of polymers. We explain here main four classes.

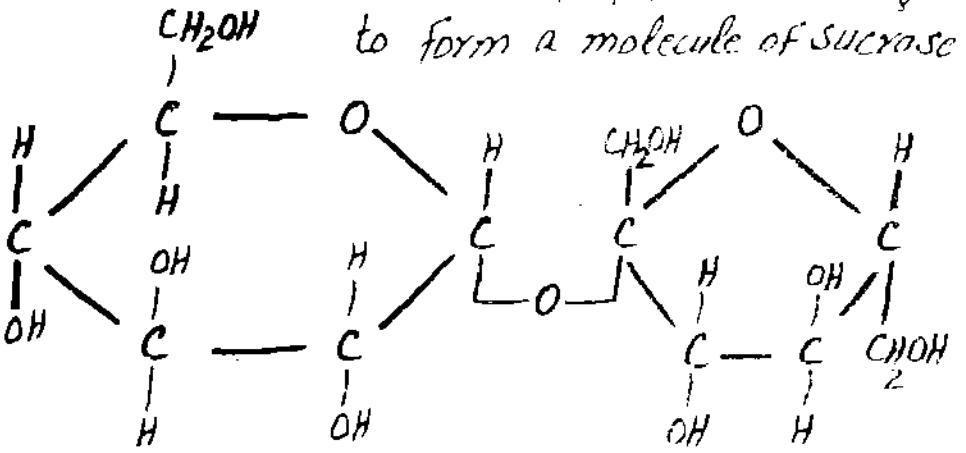
(i) Carbohydrates (ii) Lipids
(ii) Proteins (iv) Nucleic acids

Carbohydrates

Carbohydrate is an old word which means hydrate of carbon. The compounds of Carbon, hydrogen and oxygen with empirical formula $C_x(H_2O)_y$ are called Carbohydrates. The polyhydroxy aldehydes or ketones or those substances which give such compounds on hydrolysis are called Carbohydrates. e.g Glucose, Fructose, Starch etc. The Carbohydrates are commonly called sugars (Saccharides) There are three classes of Carbohydrates.

(i) Monosaccharides
(ii) Disaccharides or oligosaccharides
(iii) Polysaccharides.

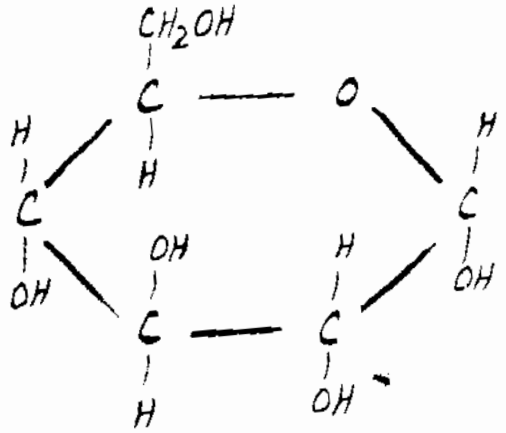
mango, almond (Badam), coffee and honey etc. Lactose is a disaccharide found in the milk. It is not found in plants. The structure of sucrose is shown below. Glucose and Fructose condense by glycoside linkage to form a molecule of sucrose



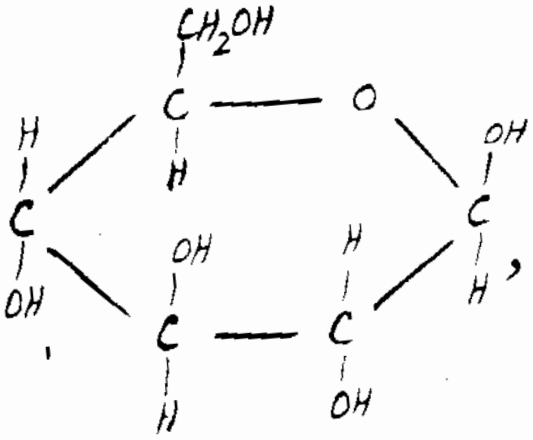
(Sucrose)

Polysaccharides

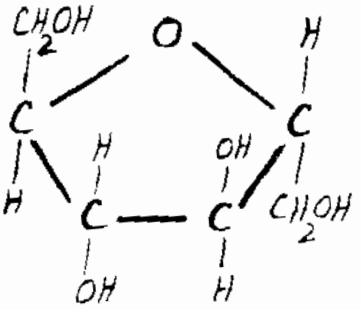
The saccharides of high molecular mass which produce many monosaccharide units on hydrolysis are called polysaccharides. For example starch, cellulose and glycogen. The molecular formula of starch and cellulose is $(C_6H_{10}O_5)_n$. The polysaccharides are amorphous solids, water insoluble, and tasteless. They are also called "Non-Sugars." The plants store glucose in the form of starch and animals store glucose in the form of glycogen.



α - D - Glucose
(Cyclic form)



β - D - Glucose
(Cyclic form)



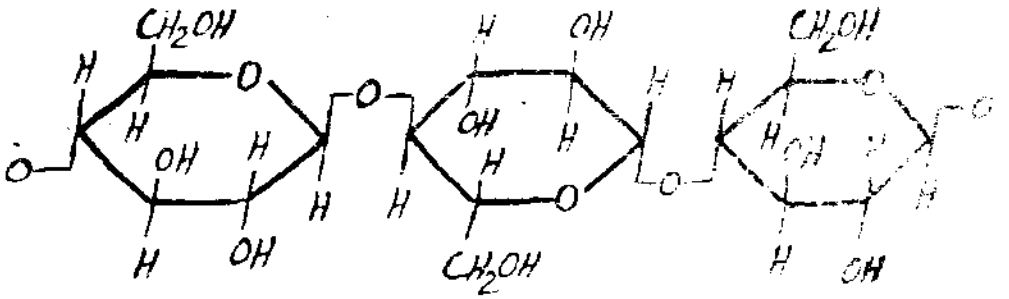
Fructose
(Cyclic form)

(2) Disaccharides (oligosaccharides)

The saccharides which on hydrolysis produce two to nine monosaccharides units are called disaccharides or oligosaccharides. e.g Sucrose The oligosaccharides are formed when two to nine monosaccharides combine by loss of water molecules For example Sucrose is a disaccharide of glucose and fructose. It is found in cane sugar, beet sugar

(ii) Cellulose:-

Cellulose is the most abundant polysaccharide Plants produce about 100 billion tons of the cellulose per year. For example cotton is 99% cellulose. It is a polymer of β-D-glucose It is the main component of plants but also occurs in some marine animals (ascidians) Upto 2500 glucose units join by 1→4 linkages during the formation of cellulose. It provides fibre and bulk to the food. It serves as filler to satisfy the appetite. It stimulates intestinal (peristaltic) movement. Human body can not digest it due to lack (کمی) of enzyme cellulase.



Cellulose (Polymer of β-D-glucose)

(iii) Glycogen:-

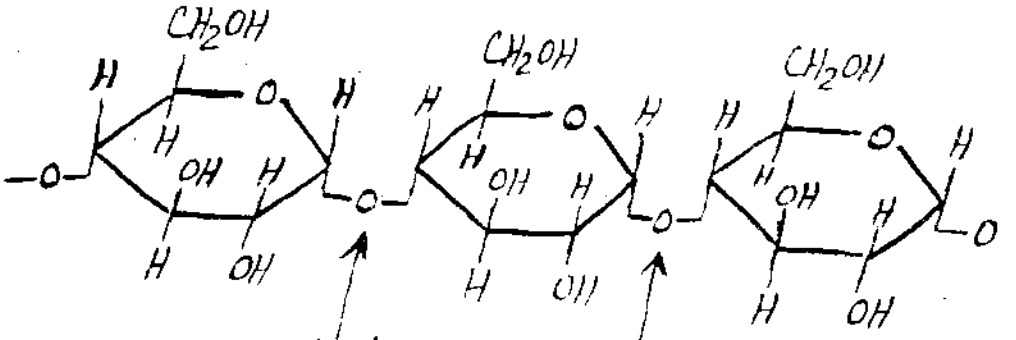
Glycogen is a polysaccharide found in the liver and muscles of animals Therefore it is called "animal starch". Its structure is similar to that of amylopectin. Its hydrolysis yields glucose units.

Now we explain three main Polysaccharides.
(i) Starch (ii) Cellulase (iii) Glycogen.

(i) Starch :-

Starch is a Polysaccharide of molecular formula $(C_6H_{10}O_5)_n$. It is found in Plants. Its main sources are Wheat, rice, maize (مکئی), Potato and barley (جو). It is a Polymer of α-D-glucose. It is not a pure compound. It is a mixture of two Polysaccharides (Amylose and Amylopectin) Natural starch consists of 10–20% amylose and 80–90% amylopectin. Starch gives blue colour with Iodine due to amylose.

Uses:- (i) Starch is used in coating and sizing of Paper.
(ii) Starch is used in laundering
(iii) It is used for Preparation of glucose and ethyl alcohol



(Structure of Amylose)

Conjugated Proteins. For example Phospho-Proteins are conjugated with Phosphoric acid, Lipoproteins are conjugated with Lipids (Cholesterol, lecithin)

(iii) Derived Proteins:-

The proteins which are derived from simple and conjugated proteins are called derived Proteins. e.g peptones, Polypeptides, oligopeptides etc

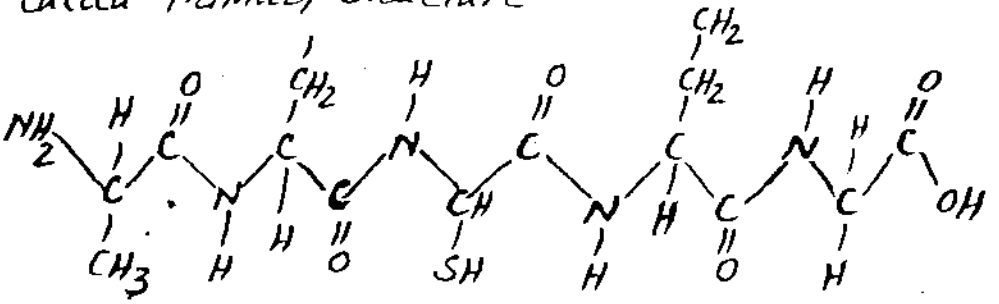
The proteins may be classified on the basis of their functions. They are called Specific function Proteins. e.g regulatory or hormonal Proteins, Structural Proteins, transport Proteins and genetic Proteins.

Structure of Proteins

The structure of Proteins may be of four types

(i) Primary Structure.
(ii) secondary structure
(iii) Tertiary structure.
(iv) Quatenary Structure.

(i) Primary structure:- The sequence of the amino acids combined in a peptide chain is called Primary structure.



Proteins

The Organic Compounds of high molecular weight which yield amino acids upon complete hydrolysis are called Proteins. e.g albumin, insulin, thyroxine The human body contains at least 10000 different kinds of Proteins. The name Protein is derived from Greek word "Proteios" which means 'Prime importance' Life is not possible without Proteins. All Proteins contain elements, C, H, O, N and S. They may also contain P and traces of Fe, Cu, Zn, Mn and Iodine. Proteins are present in skin, hair, muscles and non-bony tissues of the body.

Classification of Proteins:- Proteins have three classes on the basis of physico-chemical properties.

(i) Simple Proteins (ii) Compound Proteins (iii) Derived Proteins

(i) Simple Proteins:- The Proteins which yield only amino acids or their derivatives on hydrolysis are called Simple Proteins. e.g albumins, legumin, globulins, Collagen etc. Globulins are insoluble in water but soluble in dilute Salt solutions. They are found in animals. e.g lactoglobulin is found in body muscles. The legumin and Collagen are present in connective tissues of the body. They are the most abundant Proteins and form 25 to 35% of body Protein.

(ii) Compound or Conjugated Proteins:- The Proteins in which molecules are attached (conjugated) to some non-Protein group or Prosthetic group are called Compound Proteins or

(iv) Nucleoproteins act as carriers of heredity from one generation to the other

(v) Enzymes (biological catalysts) are protein in nature.

(vi) Haemoglobin (a protein) acts as a carrier of oxygen. The insulin, thyroxine act as harmonal proteins.

(vii) The leather is made by tanning of hides. It is precipitation of proteins with tannic acid.

(viii) Gelatin is used in bakery good. It is obtained by heating bones, skin and tendons.

(ix) Caesein is used in manufacture of buttons and buckles.

Lipids

The naturally occuring organic compounds of animals and plants which are soluble in organic solvents are called Lipids. e.g oils, fats, waxes and steroids all are lipids.

Classification of lipids:-

There are three classes of lipids

(i) Simple lipids

(ii) Compound lipids

(iii) Derived lipids.

(i) **Simple lipids:-** The lipids which contain fatty acids and glycerol are called simple lipids.

e.g Common fats and oils.

(ii) **Secondary Structure:-** The structure in which polypeptide chains show regular coiling i.e. by hydrogen bonding between >NH and >C=O groups of amino acids is called secondary structure of proteins.

(iii) **Tertiary Structure:-** The structure in which three dimensional twisting and folding of polypeptide chains take place is called tertiary structure. It is also due to hydrogen bonding

(iv) **Quaternary structure:-**

A more complex three dimensional coiling of polypeptide chains is called quaternary structure

Denaturation of Proteins

The process in which structure of proteins is disrupted (broken) by heat, change of pH or by steong conditions is called denaturation of proteins. For example white component of egg albumin shows denaturation (coagulation i.e.) on cooking It is an irreversible change.

Importance (uses) of Proteins

(i) Proteins are main component of muscles, skin, hair and other non-bony bulk of body

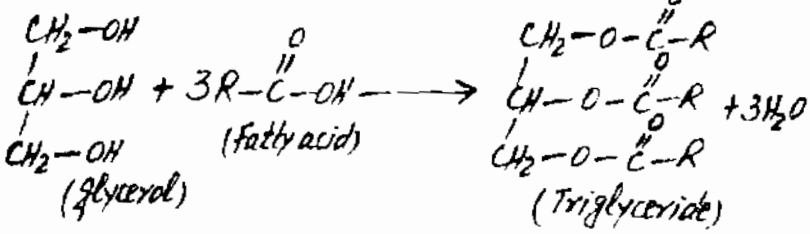
(ii) Life is impossible without proteins

(iii) Proteins take an essential part in formation of protoplasm.

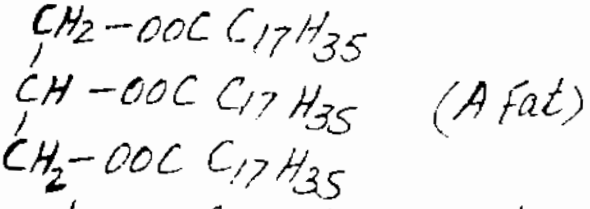
The vegetable oils are present in seeds and nuts. The marine oils are obtained from sea animals like Wales and Salmons etc.

"Structure and Composition of fats and oils"

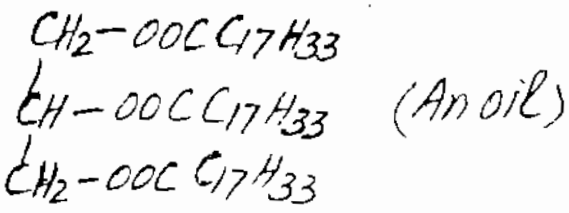
All fats and oils are triesters of fatty acids with glycerol. They have similar chemical structures They are also called triglycerides or glycerides.



The triglycerides of long chain saturated fatty acids are called fats. They are solids or semi-solids. for example,



The triglycerides of long chain unsaturated fatty acids are called oils. They are liquid at room temperature. e.g



The common oils and fats are mixture of

(ii) **Compound lipids:-** The lipids which contain fatty acid, glycerol, Phosphorous and Nitrogen compounds are called Compound lipids. For example Phospho lipids, sphingolipids, lipoproteins etc.

(iii) **Derived lipids:-** The lipids which are obtained by hydrolysis of simple or Compound lipids are called derived lipids. e.g Vitamin D, terpenes, sterols.

Characterishes:-

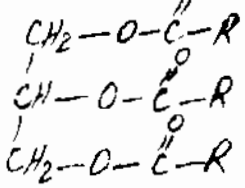
(i) Lipids are <u>insoluble in water</u> but <u>soluble in organic solvents</u>. e.g Ether, benzene, Chloroform

(ii) They are produced and utilized by <u>living organisms</u>

(iii) The fatty acids, glycerol and sterols are the building blocks of lipids.

Fats and oils

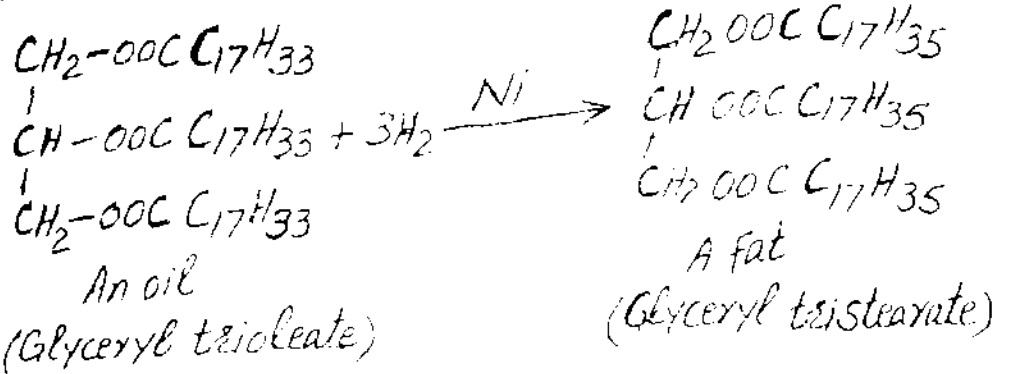
Triesters formed from glycerol and long chain fatty acids are called fats and oils. They are the most important lipids found in nature. Their general formula is given below.



(an oil or fat)

Sources of oils and Fats:- Fats and oils are obtained from animals, plants and marine organisms. The butter and ghee are animal fats made from milk.

(3) Hardening of oils:- The process in which an unsaturated glyceride reacts with hydrogen to give a saturated glyceride is called hardening of oil. In this reaction an oil is converted into fat.



An oil (Glyceryl trioleate)

A fat (Glyceryl tristearate)

This reaction is used to produce vegetable ghee or margarine. The hardened oils are also used for making soap and candles

Rancidity of fats and oils:-

The fats and oils when kept for a long time, are spoiled and give off unpleasant odour and taste. It is called rancidity. It is due to formation of some foul smelling aldehydes and fatty acids in fats and oils during their oxidation and hydrolysis. The oils from sea animals show rapid rancidity (deterioration خراب) due to their high unsaturation nature.

saturated and unsaturated triglycerides.

Physical Properties of fats and oils:-

(i) Pure oils and fats are colourless, odourless and tasteless.

(ii) They may be liquids or non-crystalline solids

(iii) They are soluble in organic solvents.

(iv) They are poor conductors of heat and electricity

(v) They form emulsions when shaked with H_2O

Chemical Properties of oils and fats

(1) Hydrolysis:- The oils and fats show hydrolysis to give glycerol and fatty acids

$$\begin{array}{l} CH_2-OOCR \\ | \\ CH-OOCR \\ | \\ CH_2-OOCR \end{array} + 3H_2O \xrightarrow[\text{Enzyme}]{\text{Lipase}} \begin{array}{l} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{array} + 3R-COOH$$

(glycerol)

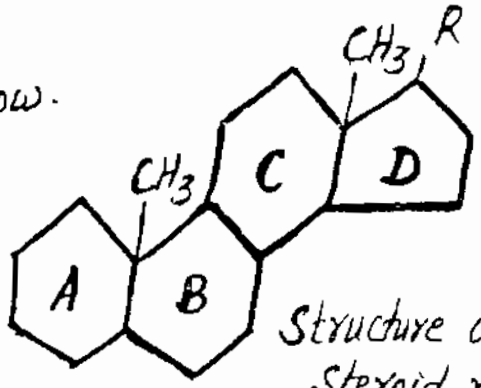
(2) Saponification:-

The reaction in which an oil or fat reacts with an alkali to form soap and glycerol is called Saponification. The soaps are salts of fatty acids

$$\begin{array}{l} CH_2-OOCR \\ | \\ CH-OOCR \\ | \\ CH_2-OOCR \end{array} + 3NaOH \longrightarrow \begin{array}{l} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{array} + 3RCOO^-Na^+$$

(Soap)

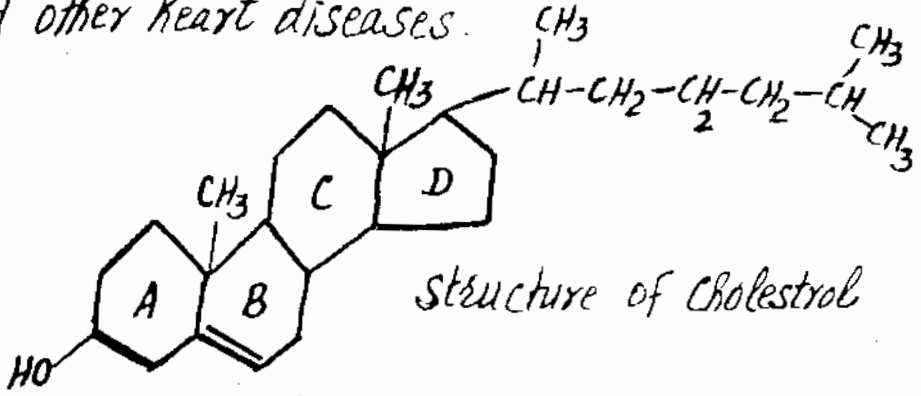
It is shown below.



Structure of Steroid nucleus

Examples of steroids are Cholestrol, ergosterol, Sex harmones etc.

Cholestrol:- It is the most abundant animal sterol. It is present both in free and combined state. It is found in blood, egg-yolk, animal tissues, various oils and fats. It may deposit in the arteries. So it causes blood Pressure and other heart diseases.



Structure of Cholestrol

Ergosterol:- It is the sterol of fungi and yeasts. When ultra violet rays fall on, it changes to Vitamin D_2 (ergocalciferol)

Saponification number:-
The number of milligrams of KOH required to saponify completely one gram of an oil or fat is called Saponification number.
e.g Saponification number of glyceryl tripalmitate is 208.

Iodine Number:- The number of grams of Iodine which will add to 100 grams of an oil or fat is called Iodine number. The iodine number depends on the number of double bonds in the fat or oil. The glycerides with no double bond have zero iodine number.

Acid number:- The number of milligrams of KOH required to neutralize one gram of an oil or fat is called acid number. The acid number of an oil or fat indicates the amount of free fatty acids in oil or fat. It also indicates extent of rancidity in oil or fat

Steroids

The natural lipids in which Parent nucleus Consists of three Six-membered rings (A, B, C) and one five-membered ring (D) are called Steroids. The Parent nucleus of Steroids has a Component Perhydrocyclopentanophenanthrene with 17-C atoms

The non-Protein Component of enzyme is called co-enzyme or co-factor. The co-factor may be a vitamin or an inorganic ion bonded with organic or metallo-organic molecule. For example Fe^{+2} (Chrome oxidase), Zn^{+2} (Carbonic anhydrase), Mg^{+2} (glucose 6-Phosphatase) The enzyme thiamine Phosphatase contains vitamin B_1

Naming the Enzymes:- In naming the enzyme, the Suffix "ase" is added to the name of substrate or to the name of chemical reaction. For example Sucrase, Urease, cellulase, Oxidase, dehydrogenase.

Classification of Enzymes:- International Union of Biochemistry (IUB) classified enzymes into six types.

There are six main types of enzymes

(1):- **Hydrolases:-** These enzymes catalyze hydrolysis. e.g Proteolytic enzymes (lypase, amylase)

(2) **Lyases:-** These enzymes catalyze addition or removal of H_2O, NH_3 or CO_2 molecules.

e.g Fumaric acid $\xrightarrow{\text{Fumarase}}$ Maleic acid

(3) **Oxireductases:-** These enzymes catalyze oxidation-reduction reactions. e.g oxidase, dehydrogenase etc

(4) **Transferases:-** These enzymes catalyze the exchange of functional groups. e.g Kinases, transaminases, Phospho-transferases.

Phospholipids:- Phospholipids have great biological importance. In these compounds two -OH groups of glycerol are esterified with fatty acids and third is linked with H_3PO_4 or its derivative.

Importance of Lipids:-

(i) Lipids are good source of energy.
(ii) They make the food more palatable.
(iii) They show insulating effect on nervous tissues.
(iv) They are important part of cell protoplasm.
(v) Some lipids are important for production of steroid harmones.

Enzymes:- The biological catalysts which are produced by living cells and catalyze the chemical reactions are called enzymes. For example lypase, Urease, Zymase, Sucrase, invertase etc.
The enzymes are macromolecules with molecular masses upto millions. Two remarkable properties of enzymes are given below.

(i) **Specificity:-** Each enzyme catalyzes only one reaction
(ii) **Amazing Efficiency:-** Enzymes may speed up the reactions upto 10^{20} times. Each enzyme molecule has a region (active site) where substrate binds itself.

Components of enzymes:- Enzymes have two components The Protein component of enzyme is called apoenzyme.

Factors affecting Enzyme activity

(1) **Concentration:-** The rate of enzymatic reaction is directly proportional to concentration of substrate. It is also directly proportional to the square root of enzyme concentration. It means that rate of reaction increases with increasing concentration of substrate and enzyme.

(2) **Temperature:-** The rate of enzymatic reaction is maximum at 37°C. At high temperature enzymes destroy and at low temperature activity of enzymes decreases. The temperature at which an enzyme reaction is the fastest is called its optimum temperature.

(3) **Effect of PH:-** The PH at which an enzyme reaction has maximum rate is called optimum PH. For example, the optimum PH of salivary amylase is 6.4—6.9

(4) **Radiation:-** When U.V light, β-rays, X—rays and gamma-rays fall on enzymes, then enzymes become inactive

(5) **Other substances:-** Some substances increase or decrease rate of enzyme reaction. These substances are Co-enzymes, activators and inhibitors.

(a) **Co-enzyme:-** The non-proteinous part of

(5) :- **Isomerases** :- These enzymes catalyze isomeric reactions. e.g mutases, epimerases

(6) **Ligases** :- These enzymes catalyze the linkage of two molecules after breaking the high energy bonds. e.g Carboxylase, thiokinases.

Properties of Enzymes

(1) **Specificity** :- Enzymes are specific in action. It means that an enzyme will act on only one substrate. e.g Glucokinase is specific for glucose only.

(2) **Protein nature** :- Enzymes are protein in nature. They are produced by living cells only.

(3) **Action in Vivo and Vitro**:- The enzymes are produced by living cells but they catalyze both vivo and vitro (living and nonliving) reactions.

(4) **Direction of reactions** :- The enzymatic reactions are reversible. The same enzyme catalyzes reaction in both directions

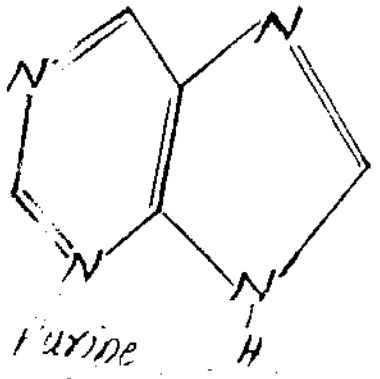
(5) **Isoenzymes**:- Different enzymes which catalyze the same chemical reaction are called isoenzymes. They are physically and chemically distinct (different)

Nucleic Acids

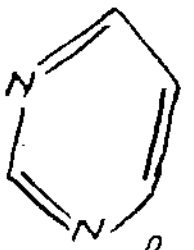
The nucleic acids are biopolymers made up of large number of nucleotide units. They are present in every living cell as well as in viruses. They are the chemical carriers of cell genetic informations. There are two types of nucleic acids. They are RNA (ribonucleic acid) and DNA (Deoxyribonucleic acid). In the body they are attached with nucleoproteins.

Components of Nucleic acids :-

The basic unit of nucleic acid is nucleotide. Each nucleotide consists of a nitrogeneous base and sugar phosphoric acid complex. The nitrogeneous bases are of two types
(i) Purine type (ii) Pyrimidine type



Purine



Pyrimidine

The Purine type bases are adenine and guanine. The Pyrimidine bases are Cytosine

an enzyme is called co-enzyme. The Proteinous part of an enzyme is called apo-enzyme. Some enzymes are simple proteins e.g insulin Most of the enzymes are combination of co-enzyme and apo-enzyme. Without co-enzyme part the enzymes become inactive.

(b) Activators:- Inorganic substances which increase the activity of enzymes are called activators. e.g Mg^{+2} ions are activators for phosphatase enzymes.

(C) Inhibitors:- The substances which reduce activity of enzyme are called inhibitors e.g An electrolyte, acid or base.

Importance of enzymes:-

(i) Enzymes are very helpful in diagnosis (تشخیص) of some diseases. e.g Lactic dehydrogenase or LDH-1 is used in heart diseases.

(ii) Many enzymes can be used as drugs. e.g Thrombin is used to stop bleeding.

(iii) Many enzymes can be used for treatment of cancer. for example L-asparaginase is used in the treatment of blood cancer in children.

(iv) Enzymes are used in many biological processes. e.g digestion of food, fermentation of starch etc.

EXERCISE

Q1. *Fill in the Blanks.*

(i) Macromolecules are built up from small units called_____.
(ii) Nylon is a polyamide and terylene is a _____.
(iii) Nylon is prepared by the reaction of _____and hexamethylendiamine.
(iv) Based on their thermal properties, plastics are divided into _____main classes.
(v) Polyvinyl chloride is a _____plastic.
(vi) Glucose is stored as_____in the liver.
(vii) Glucose and fructose are water _____carbohydrates .
(viii) Protein after digestion changes to_____.
(ix) Purine and pyrimidines are_____of nucleic acids.
(x) Addition of a plasticizer_____the flexibility of the polymer.

Answer:- (i) monomers (ii) polyester (iii) adipic acid
(iv) two (v) thermo (vi) glycogen (vii) soluble
(viii) amino acids (ix)bases (x)increases

Q2. *Indicate True or False.*

(i) Nylon 6,6 and terylene are condensation polymers.
(ii) The disposal of plastics does not cause any pollution problem.
(iii) Fructose is a polysaccharide carbohydrate.
(iv) Human beings get no food nutrient from cellulose.
(v) The most abundant and the most important steroid in the human body is vitamin D.
(vi) Enzymes are the compounds containing C, H and O only.
(vii) The degree of unsaturation of fats is measured by their iodine number.
(viii) Activity of an enzyme varies with temperature and pH.
(ix) Nucleic acids are biological catalysts.
(x) The nucleic acids are responsible for protein synthesis in the human body.

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

Q3. Multiple Choice Questions. Encircle the Correct Answer.

(i) In which of these processes are small organic molecules made into macromolecules.
(a) The cracking of petroleum fractions
(b) The fractional distillation of crude oil
(c) The polymerization of ethene
(d) They hydrolysis of proteins

(ii) Which of these polymers is an addition polymer?
(a) Nylon 6,6 (b) Polystyrene (c) Terylene (d) Epoxy resin

(iii) Which of these polymers is a synthetic polymer?
(a) Animal fat (b) Starch (c) Cellulose (d) Polyester

Uracil and thyamine

Properties of nucleic acid:-

(i) Nucleic acids Provide the blue prints for the normal growth and development of every living organism

(ii) They Control reproduction and genetic informations of living organism

(iii) They indicate how living organism undergo mutation

Difference between RNA and DNA

(i) **RNA** Contains sugar ribose but **DNA** Contains the sugar 2-deoxyribose

(ii) **RNA** Contains the bases adenine, Cytosine, guanine and Uracil but **DNA** Contains the bases adenine, Cytosine, guanine and thyamine

(iii) **RNA** is single stranded but **DNA** is always double stranded

DNA and Molecular biology

We know that DNA is responsible to transfer genetic informations from generation to generation. It is due to double stranded structure of DNA This fact was deduced by **J. Waslon and F. Crick** in 1953. It was inital discovery of **molecular biology**. The mechanism by which the genetic information can be duplicated (نقل کرنا) is called **replication**.

(b) In Nylon 6,6 the repeating units are adipic acid and hexamethylenediamine.

(C) In teflon the repeating unit is tetrafluoro ethene ($CF_2=CF_2$)

(d) In Orlon the repeating unit is vinyl Cyanide ($CH_2=CH-CN$)

Q7. What are carbohydrates and how are they classified?

Answer:- see page No. 234, 235, 236

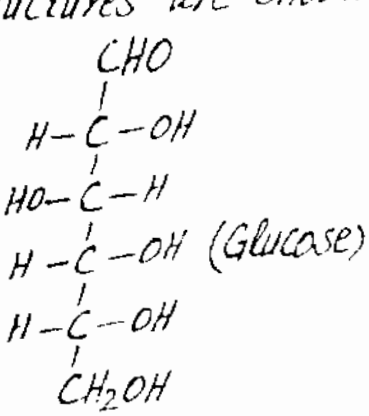
Q8. Point out one difference between the compounds in each of the following pairs.

(a) Glucose and fructose (b) Sucrose and maltose

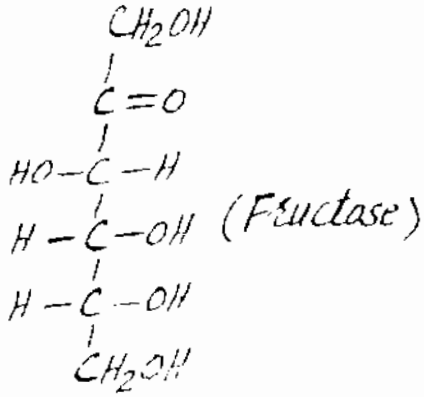
(c) Cellulose and starch

Answer:- **(a) Glucose and Fructose :-**

Glucose is polyhydroxy aldehyde and Fructose is polyhydroxy ketone. Their open chain structures are shown below.



(Glucose)



(Fructose)

(b) Sucrose and maltose :- The hydrolysis of sucrose gives one molecule of glucose and one molecule of Fructose. The hydrolysis of maltose gives two molecules of glucose.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{invertase}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + \underset{\text{(Fructose)}}{C_6H_{12}O_6}$$

(Sucrose)

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{maltase}} \underset{\text{(glucose)}}{C_6H_{12}O_6} + \underset{\text{(glucose)}}{C_6H_{12}O_6}$$

(Maltose)

(iv) Plastics are a pollution problem because many plastics.
(a) are made from petroleum (b)are very inflammable
(c) burn to produce toxic fumes (d)decompose to produce toxic products

(v) The fiber which is made from acrylonitrile as monomer.
(a) PVC (b) Rayon fibre (c) Acrylic fibre (d) Polyester fibre

(vi) A polymeric substance that is formed in the liquied state and then hardened to a rigid soiid is called a.
(a) Fibre (b) Plastic (c) Varnish (d) Polyamide resin

(vii) Vegetable oils are
(a) Unsaturated fatty acids
(b) Glycerides of unsaturated fatty acids.
(c) Glycerides of saturated fatty acds.
(d) Essential oils obtianed from plants.

(viii) Which one of the following elements is not present in all proteins?
(a) Carbon (b) Hydrogen (c) Nitrogen (d) Sulphur

(ix) Which one of the following is a water soluble vitamin?
(a) Niacin (b) Riboflavin (c) Trypsin (d) Ascorbic acid

(x) Which one of the following enzymes brings about the hydrolysis of fats?
(a) Urease (b) Maltase (c) Zymase (d) Lypase

(xi) The reaction between fat and NaOH is called
(a) Esterification (b) Hydrogenolysis
(c) Fermentation (d) Saponification

(xi) Which one of the following statements about glucose and Sucrose is incorrect?.
(a) Both are soluble in water.
(b) Both are naturally occurring.
(c) Both are carbohydrates
(d) Both are disaccharides.

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

Q4. Explain the following terms.
(a) Addition polymer (b) Condensation polymer
(c) Thermoplastic (d) Thermosetting plastic

Answer:- see page No. 228

Q5 Write notes on
(a) Polyester resins (b) Polyamide resins (c) Epoxy resins

Answer:- see page No. 232, 235

Q6. What is the repeating unit in each of the following polymers?
(a) Polystryene (b) Nylon 6,6
(c) Teflon (d) Orlon

Answer:- (a) In polystyrene the repeating unit is styrene.

(styrene)

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۔

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

اَللّٰهُمَّ صَلِّ عَلٰى مُحَمَّدٍ

وَّعَلٰى اٰلِ مُحَمَّدٍ كَمَا صَلَّيْتَ

عَلٰى اِبْرَاهِيْمَ وَعَلٰى اٰلِ اِبْرَاهِيْمَ

اِنَّكَ حَمِيْدٌ مَّجِيْدٌ ۝

اَللّٰهُمَّ بَارِكْ عَلٰى مُحَمَّدٍ وَّعَلٰى

اٰلِ مُحَمَّدٍ كَمَا بَارَكْتَ عَلٰى

اِبْرَاهِيْمَ وَعَلٰى اٰلِ اِبْرَاهِيْمَ

اِنَّكَ حَمِيْدٌ مَّجِيْدٌ ۝