CHAPTER 21

BIOCHEMISTRY

After completing this lesson, you will be able to:

- Explain the role of various carbohydrates in health and diseases.
- Identify the nutritional importance and their role as energy storage.
- Explain the basis of classification and structural—function relationship proteins
- Describe the role of various proteins in maintaining body function and their nutrition importance.
- Describe the role of enzyme as biocatalyst and relate this role to various functions such as digestion food.
- Identify factors that affect enzyme Activity such as effect
- Explain the role of inhibitors of enzyme catalyzed reaction.
- Describe the basis of classification and structure-function relationship of Identify the nutritional and Biological importance of lipids.
- Identify the structural components of DNA and RNA.
- Recognize the differences between DNA polymer (double stand) and RNA (single strand)
- Relate DNA sequence to its function as storage of genetic information,
- Relate RNA sequence (transcript) to its role in transfer of information to protein (Translation).

Q1. What is Biochemistry? Give its importance.

Answer

As the name indicates, biochemistry is a hybrid science: Biology is the science of living organisms and chemistry is the science of atoms and molecules, so biochemistry is the science of the atoms and molecules in living organisms.

Biochemistry is the branch of science concerned with studying the various molecules

that occur in living cells and organisms, with their chemical reactions. Biochemistry is concerned with the complete spectrum of all forms of life, from relatively simple viruses and bacteria to complex human beings. It attempts to describe in molecular terms the structures, mechanisms, and chemical processes shared by all organisms.

Living organisms should be able to transform matter and energy into different forms, show response to changes in their environment and show growth and reproduction. All living organisms undergo changes due to large organic compounds called macromolecules. Four main types of macromolecules control all activities. They are carbohydrates, proteins, lipids and nucleic acids. Now, we discuss these one by one.

Q2. What are carbohydrates? Give their types and functions.

Answer

Carbohydrates are called carbohydrates because they contain carbon, oxygen and hydrogen and these are generally in proportion to form water with the general formula

$C_n(H_2O)_n$

Modern Definition

Carbohydrates are polyhydroxy compounds of aldehydes or ketones.

Carbohydrates or saccharides are the most abundant of the four types of macromolecules. These are sugars or starches. They have several roles in living organisms, including energy transportation, as well as being structural components of plants and arthropods. Carbohydrate derivates are actively involved in fertilization, immune systems, development of disease, blood clotting and growth. Most organic matter on earth is made up of carbohydrates because they are involved in so many aspects of life, including:

- Energy stores, fuels, and metabolic intermediaries.
- Ribose and deoxyribose sugars are part of the structural framework of RNA and DNA.
- The cell walls of are mainly made up of polysaccharides (types of carbohydrate).
- Cellulose (a type of carbohydrate) makes up most of plant cell walls.

- Carbohydrates are linked to many proteins and lipids (fats), where they are vitally involved in cell interactions.

Classification of Carbohydrates

Carbohydrates are classified into three types.

a) Monosaccharides

Definition: The carbohydrates which do not hydrolyze to simpler units are called monosaccharides.

This is the smallest possible sugar unit. Examples are glucose, galactose or fructose. When we talk about blood sugar, we refer to glucose in the blood; glucose is a major source of energy for a cell. Glucose is naturally in honey and corns. In human nutrition, galactose can be found most readily in milk and dairy products, while fructose is found mostly in vegetables and fruits (grapes).

When monosaccharides merge together in linked groups, they are called polysaccharides.

- Monosaccharides can be further classified by the number of carbons present. Hexoses (6-carbons) are by far the most prevalent.

Number of Carbons		
Six = Hexose	Five = Pentose	Three = Triose
Glucose	Ribose	Glyceraldehyde
Galactose		
Fructose		

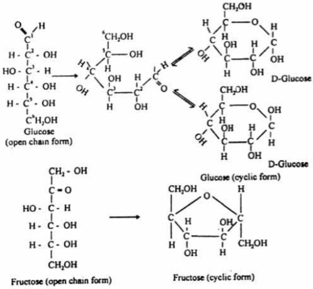


Fig. 21.1

b) Disaccharides

Two monosaccharide molecules are bonded together to form disaccharide. Disaccharides are polysaccharides; "poly" specifies any number higher than one, while "di" specifies exactly two. Examples of disaccharides include lactose, maltose, and sucrose.

- Lactose is formed in the milk
- Sucrose occurs in sugarcane, sugar beet, mango, pineapple, almond and apricot.

How the monosaccharides combine with each other:

The OH group of one monosaccharide molecule acts as alcohol. It forms a glyosidic linkage with the hemiacetal group of second monosaccharide molecule. In this way, glucoside produced which is called disaccharide.

So disaccharides are the acetals which are formed from two monosaccharides by the elimination of one molecule of HO. the following reaction makes the idea clear.

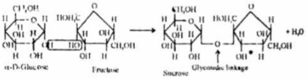


Fig. 21.2

If we bond one glucose molecule with a galactose molecule, we get lactose, which is commonly found in milk

a) Polysaccharides

Definition: The carbohydrates producing large number of mono-saccharides on hydrolysis are called polysaccharides.

Starch and cellulose are the example of polysaccharides.

It is a chain of two or more monosaccharides. The chain may be branched (molecule is like a tree with branches and twigs) or unbranched (molecule is a straight line with no twigs). Polysaccharide molecule chains may be made up of hundreds or thousands of monosaccharides.

Polysaccharides are polymers. A simple compound is a monomer, while a complex compound is a polymer which is made of two or more monomers. A brief summary is presented below;

Carbohydrates

Interesting Information

A new system for classifying carbohydrates is the glycemic index. The glycemic index blood ranks foods on how they affect blood sugar level by measuring how much the sugar increases after one eats.

Monosaccharides	Disaccharides	Polysaccharides
Glucose	Sucrose	Starch
Galactose	Maltose	Glycogen
Fructose	Lactose	Cellulose
Ribose		
Glyceraldehyde		

Functions of Carbohydrates

The main functions of carbohydrates are given below:

1) They spare protein so that protein can concentrate on building, repairing, and maintaining body tissues instead of being used up as an energy source.

2) For fat to be metabolized properly, carbohydrates must be present. If there are not enough carbohydrates, then large amounts of fat are used for energy. The body is not able to handle this large amount so quickly, so it accumulates ketone bodies, which make the body acidic. This causes a condition called ketosis.

3) Carbohydrate is necessary for the regulation of nerve tissue and is the only source of energy for the brain.

4) Certain types of carbohydrates support the growth of healthy bacteria in the, intestines for digestion.

5) Some carbohydrates are high in fibre, which helps prevent constipation and lowers the risk for certain diseases such as cancer, heart disease and diabetes.

Polysaccharides act as food stores in plants in the form of starch, or in humans and other animals in the form of glycogen. Polysaccharides also have structural roles in the plant cell wall in the form of cellulose or pectin, and the tough outer skeleton of insects in the form of chitin. Three major functions of polysaccharides are discussed below.

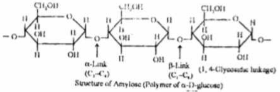
a) Storage Polysaccharides

- **Glycogen** - a polysaccharide that humans and animals store in the liver and muscles.
- **Starch** - these are glucose polymers made up of Amylose (10-20%) and Amylopectin (80-90%). Starches are water insoluble. Humans and animals digest them by hydrolysis; our bodies have amylases which break them down. Rich sources of starches for humans are potatoes, rice and wheat.

Structures of Amylase and Amylopectin are given below in Fig 21.3

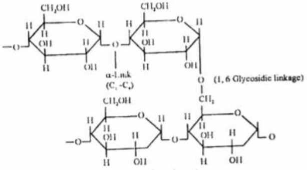
b) Structural Polysaccharides

- **Cellulose** - the structural constituents of plants are made mainly from cellulose - a type of polysaccharide. Wood is mostly made of cellulose, while paper and cotton are almost pure cellulose.



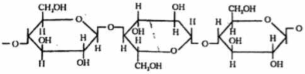
Structure of Amylose (Polymer of α-D-glucose)

Fig.21.3 (a)



Structure of Amylopectin

Fig. 21.3 (b)



Cellulose (Polymer of β-D-glucose)

Fig.21.4

- Chitin - chitin, a polysaccharide, is one of the most abundant natural materials in the world. Microorganisms such as bacteria and fungi secrete chitinases, which over time can break down chitin.

Chitin is the main component of fungi cell walls, the exoskeletons (hard outer shell/skin) of arthropods, such as crabs, lobsters, ants, beetles, and butterflies.

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a) Bacterial Polysaccharides

They are found in bacteria, especially in bacterial capsules. Pathogenic bacteria often produce a thick layer of mucous-like polysaccharide which protects the bacteria from the host's immune system. In other words, if the bacteria were in a human, that human's immune system would less likely attack the bacteria because the polysaccharide layer covers its pathogenic properties.

Nutritional Importance of Carbohydrates

- Scientific research has shown the diverse functions of carbohydrates in the body and their importance for good health. Bread, pasta, beans, potatoes, bran, rice and cereals are carbohydrate-rich foods.

Their main functions are given by:

a) Body Weight Regulation

People eating a diet high in carbohydrates are less likely to accumulate body fat compared with those who follow a low carbohydrate high-fat diet. The reasons for this observation are threefold:

It could be due to the lower energy density of high carbohydrate diets, as carbohydrates have fewer calories than fats. Fiber-rich foods also tend to be bulky and physically filling, so fewer calories may be consumed. Studies show that carbohydrates, both in the form of starch and sugars, work quickly to aid satiety and that those consuming high carbohydrate diets are therefore less likely to overeat. It is evident that diets high in carbohydrate, as compared with those high in fat, reduce the likelihood of developing obesity.

b) Diabetes

There is no evidence that sugar consumption is linked to the development of any type of diabetes. However, there is now good evidence that obesity and physical

inactivity increase the likelihood of developing non-insulin dependent diabetes, which usually occurs in middle age.

Weight reduction is usually necessary and is the primary dietary aim for people with non-insulin dependent (Type II) diabetes. Consuming a wide range of carbohydrate foods is an acceptable part of the diet of all diabetics, and the inclusion of low glycemic index foods is beneficial as they help to regulate blood glucose control. Most recommendations for the dietary management of diabetes allow a modest amount of ordinary sugar as the inclusion of sugar with a meal has little impact on either blood glucose or insulin concentrations in people with diabetes

c) Dental Health

The incidence of tooth decay is influenced by a number of factors. These include:

- degree of oral hygiene and plaque removal carried out,
- availability of fluoride,
- of food eaten,
- frequency of consumption of any fermentable carbohydrate
- genetic factors

Foods containing sugars or starch can be broken down by the enzymes and in the mouth to produce acid which attacks the enamel of the teeth. However, it is not the amount of sugar or other carbohydrate that is important but how often they are consumed. After an acid challenge, saliva provides a natural repair process which rebuilds the enamel. When carbohydrate-containing foods are consumed too frequently, or nibbled over time, this natural repair process is overwhelmed and the risk of tooth decay is increased.

d) Getting Active

There is now substantial evidence that carbohydrates can improve the performance of athletes. During high intensity exercise, carbohydrates are the main fuel for the muscles. By consuming high levels of carbohydrate before,

during and after training or an event, glycogen stores are kept well stocked. These stocks help the athlete to perform for longer and help their bodies sustain the effort.

The vital role of physical activity in maintaining health and fitness in the general population is now recognized. There is no doubt that many people would benefit from increasing their Activity level as it helps in the regulation of body weight. It also reduces the risk of developing diseases such as heart disease and diabetes. For those who want to keep fit and active, a well-balanced high-carbohydrate diet is recommended.

Q3. What is protein? Give their types, structure, properties and importance.

Answer

The molecules which yield amino acids on complete hydrolysis are called Proteins.

Proteins are probably the most important class of biochemical molecules, although of course lipids and carbohydrates are also essential for life. Proteins are the basis for the major structural components of animal and human tissue. Proteins are natural polymer molecules consisting of amino acid units. The number of amino acids in proteins may range from two to several thousand.

These molecules contain nitrogen, carbon, hydrogen and oxygen. They act as biological catalysts (enzymes), form structural parts of organisms, participate in cell signal and recognition factors, and act as molecules of immunity. Proteins can also be a source of fuel.

Classification of Proteins

Three classes of proteins are usually defined.

A. Simple Proteins: (Those which give one amino acid only, upon hydrolysis)

Numerous examples of simple proteins are given below.

- Albumins: blood (serumbumin); milk (lactalbumin); egg white (ovolbumin); lentils (legumelin); kidney beans (phaseolin); wheat (leucosin). Globular protein is soluble in water and dilute salt solution; it is precipitated by saturation with ammonium sulfate solution; coagulated by heat; usually found in plant and animal tissues.
- Globulins: blood (serum globulins); muscle (myosin); potato (tuberin); Brazil nuts (excelsin); hemp (edestin); lentils (legumin). Globular protein is sparingly soluble in water and soluble in neutral solutions; precipitated by dilute ammonium sulfate and coagulated by heat; distributed in both plant and animal tissues.
- Glutelins: wheat (glutenin); rice (oryzenin). It is insoluble in water and dilute salt solutions; soluble in dilute acids; found in grains and cereals.
- Histones: thymus gland, pancreas and nucleoproteins (nucleohistone). It is soluble in water, salt solutions and dilute acids; insoluble in ammonium hydroxide; yields large amounts of lysine and arginine; combined with nucleic acids within cells.
- Scleroproteins: connective tissues and hard tissues. Fibrous protein is insoluble in all solvents and resistant to digestion.

B) Conjugated Proteins

(Those which give an amino acid and non-protein group upon hydrolysis) Some examples are given below.

- Nucleoproteins: cytoplasm of cells (ribonucleoprotein), nucleus of chromosomes (deoxyribonucleoprotein), viruses and bacteriophages. It contains nucleic acids, nitrogen and phosphorus. It is present in chromosomes and in all living forms as a combination of protein with either DNA or RNA.
- Mucoprotein: saliva (mucin) and egg white (ovomucoid). Proteins combined with amino sugars, sugar acids and sulfates.

- Glycoprotein: bone (osseomucoid), tendons (tendomucoid) and cartilage (chondromucoid). Containing more than 4% hexosamine, mucoproteins; if less than 4%, then glycoproteins.
- Phospboprotein: milk (casein) and egg yolk (ovovitellin). Phosphoric acid joined in ester linkage to protein.

C) Derived Protien

(Those which are derived from simple and conjugated proteins) Its typical examples are given below.

- Proteans: edestan (from elastin) and myosin (myosin). It results from short action of acids or enzymes; insolvent in water.
- Proteases; intermediate products of protein digestion. It is soluble in water; not coagulated by heat; and precipitated by saturated ammonium sulfate; result from partial digestion of protein by pepsin or trypsin.
- Peptones; intermediate products of protein digestion. It has the same properties as proteases except that they cannot be salted out; of smaller molecular weight than proteases.
- Peptides; intermediate products of protein digestion. Two or more amino acids joined by a peptide linkage; hydrolyzed to individual amino acids.

Structure of Protiens

The structure of a protein depends upon the spatial arrangement of polypeptide chains present in proteins. Since three spatial arrangements are possible, proteins have the following three structures.

i) Primary structure

ii) Secondary structure

iii) Tertiary structure

iv) Quaternary structure

a) The Primary Structure of Proteins

The sequence of amino acids in a peptide chain is called primary structure.

Amino acids are linked with one another through peptide bond. The arrangement of these acids is called primary structure.

b) The Secondary Structure of Proteins

Peptide chains may acquire spiral shape or may be present in a zig-zag manner. This coiling or zigzagging of polypeptide is called secondary structure of protein. It is due to H-Bond

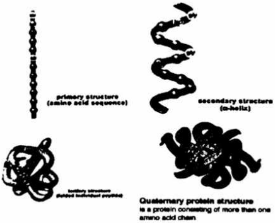
c) The Tertiary Structure of Proteins

- Twisting or folding of polypeptide chains represents tertiary structure of proteins.

D) Quaternary Proteins

Quaternary means four. This is the fourth phase in the creation of a protein.

Quaternary protein is the arrangement of multiple folded protein or coiling protein molecules in a multi-subunit complex. A variety of bonding interactions including hydrogen bonding, salt bridges, and disulfide bonds hold the various chains into a particular geometry.



Properties of Proteins

Proteins are one of the four major groups of macromolecules that are found in all living organisms. These giant molecules carry out many of the vital functions needed by cells. Proteins are involved in such processes as food digestion, cell structure, catalysis, movement, energy manipulation and much more. They are complex, huge associations of molecular subunits that appear impossibly difficult to understand. Fortunately, they are all built using the same construction principle. As with all macromolecules, proteins are polymers, composed of smaller subunits - the amino acids - joined together in long chains.

There are about 20-22 common amino acids found in most proteins. All but one of these small molecules has the same common structure, but varies in the nature of one chemical group - termed the "R-group". It is the varying structure and properties of these R-groups that make amino acids different from one another.

Amino acids are joined together in long chains called "polypeptides", a name which comes from the type of bond holding the chains of amino acids together. The group of atoms that hold the amino acids together is called a peptide bond.

The order, or sequence of amino acids along a polypeptide chain establishes the first critical property of proteins, its primary structure.

Importance of Proteins

Following are the features of the protein in they are thought to be very important:

l) Proteins play an important role in the formation of protoplasm. Protoplasm is the essence of all form of life.

2) Nucleoproteins are complex proteins and act as the carrier of heredity from one generation to the other.

3) Enzymes are the biological catalyst and they are also proteins. Without enzymes life is not possible.

4) Hemoglobin is a protein. It acts as carrier of oxygen.

5) Some of the proteins act as hormones. They carry out the regulatory function of the body.

6) Proteins have great importance in industry. The tanning of hides is an industrial process. This process is the precipitation of protein by tannic acid.

7) Gelatin is obtained by heating bones, skins and tendons in water. It is used in bakery goods.

8) Casein is another protein used in the manufacture of buttons and buckles.

9) Proteins obtained from the soya bean are used for the manufacture of plastics.

Q4. What are enzymes? Give their role as biocatalyst

Answer

(Greek word En means in and Zyme means yeast)

Enzymes are biocatalysts which alter the speed of metabolic activities in the living bodies.

Enzymes are complex protein molecules which are quite specific in action and sensitive to temperature and pH.

Role of Enzymes as a Biocatalyst:

The life of living organisms is a reflection of what is going on in their bodies.

Metabolism is the set of biochemical reactions that occur in living organ isms in order to maintain life. These processes allow organism to grow and reproduce, maintain their structures, and respond to their environments. Anabolism includes the biochemical reactions in which larger molecules are synthesized while catabolism includes the biochemical reactions in which larger molecules are broken down. Usually, energy is released in catabolism and it is utilized in anabolism. In this way the biochemical reactions are actually energy transfers.

During metabolism, chemicals are transformed from one form to the other by enzymes. Enzymes are crucial to metabolism because they act as biocatalysts and speed up and regulate metabolic pathways.

Enzymes are proteins that catalyze (i.e. speed up) biochemical reactions and are not changed during the reaction. The molecules at which enzymes act are called substrates, and enzyme converts them into different molecules, called products.

Q5. How enzymes work?

Answer

When enzyme attaches with substrate, a temporary enzyme-substrate (ES) complex is formed. Enzyme catalyzes the reactions and substrate is transformed into product. After it, the ES complex breaks enzyme product.

$$E + S \rightarrow ES\ \text{Complex} \rightarrow E + P$$

A) In order to explain the mechanism of enzyme action a German chemist Emil Fischer in 1894, proposed lock and key model. According to this model, both

enzyme and substrate possess specific shapes that fit exactly into one another. This model explains enzyme specificity.

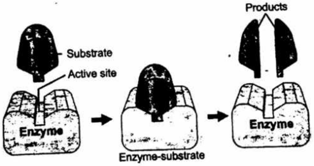
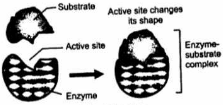


Fig. Lock and Key Model

B) In 1958, an American biologist Daniel Koshland suggested a modification to lock and key model and proposed induced-fit model. According to this model, active site is not a rigid structure rather is molded into the required shape to perform its function. "Induced fit model" is more acceptable than "lock and key" model of enzyme action.



Induced Fit Model

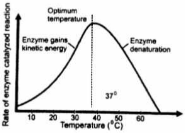
Q6. What are factors affecting enzyme activity?

Enzymes are very sensitive to the environment in which they work. Any factor that can change the chemistry or shape of enzyme molecule, can affect its activity. Some of the factors that can affect the rate of enzyme action are being discussed here.

i) Temperature

Increase in temperature speeds up the rate of enzyme catalyzed reactions, but only to a point. Every enzyme works at its maximum rate at a specific temperature called as the optimum temperature for that enzyme.

When temperature rises to a certain limit, heat adds in the activation energy and also provides kinetic energy for the reaction. So, reactions are accelerated. But when temperature is raised well above the optimum temperature, heat energy increases the vibrations of atoms of enzyme and the globular structure of enzyme is lost. This is known as the denaturation of enzyme, it results in a rapid decrease in rate of enzyme action and it may be blocked completely.

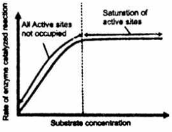


Effect of Temperature on Enzyme Activity

ii) Substrate Concentration

If enzyme molecules are available in a reaction, increase in substrate concentratio increases the rate of reaction. If enzyme concentration is kept constant and amount of substrate in increased, a point is reached where any

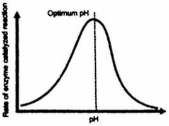
further increase in substrate docs not increase the rate of reaction any more. When the active sites of all enzymes are occupied (at high substrate concentration), any more substrate molecules do not find free active site. This state is called saturation of active site and reaction rate does not increase.



Effect of Substrate Concentrationn EnzymeActivity

iii) pH

All enzymes work at their maximum rate at a narrow range of pH, called as the optimum pH. A slight change in this pH causes retardation in enzyme Activity or blocks it completely. Every enzyme has its specific optimum pH value. For example, pepsin (working in stomach) is active in acidic medium (low pH) while trypsin (working in small intestine) shows its Activity in alkaline medium (high pH). Change in pH cui affect the ionization of the amino acids at the active site.



Effect of pH on Enzyme Activity

Q7. Give role of inhibitors in enzyme catalyzed reactions.

Answer

Inhibitors

Substances that tend to decrease the activity of enzymes are called inhibitors.

OR

an inhibitor is a chemical substance which can react (in place of substance) with the enzyme but is never transfered into products by blocking the active site of enzyme temporarily or permanently.

Examples of Inhibitors:

Poisons like cyanide, antibodies, anti-metabolic and some drugs.

Types of Inhibitors

Inhibitors can be divided into two types

(a) Irreversible inhibitors **(b)** Reversible inhibitors

Irreversible Inhibitors

They occupy the active sites by forming covalent bond or they may physically block the active sites. They decrease the reaction rate by occupying the active sites or destroying the globular structure of enzymes.

Reversible Inhibitors

They form weak linkages with the enzyme. Their effect can be neutralized completely or partly by an increase in the concentration of the substrate.

Role

In an enzyme catalyzed reaction, the inhibitors may decrease the activity of enzymes and thus the rate of the reaction either by combining directly with the enzyme or by reacting with the activator, so that the activator does not remain available to enzyme for activation.

A number of inhibitors have structures similar to substrate molecules. So, due to the structural similarity with the substrate, they may be selected by the binding sites, but are not able to activate the catalytic site. They complete with the original for the same binding site. Often their affinity to the enzyme is much higher than that of the substrate, so the substrate is displaced effectively. The enzyme molecules are thus to a large degree inactivated by the binding of the inhibitors. No products are formed in this way this type of inhibition is known as "competitive inhibition".

Example

Succinic acid (substrate) is converted into Fumaric acid (product) by the enzyme succinic dehydrogenase.

Succinic dehydrogenase + succinic acid → Funaric acid + succinic dehydrogenase

(Enzyme) (Substate) (Product) (Enzyme)

But in the presence of malonic acid (competitive inhibitor) having structural similarity with succinic acid (substrate), the binding sites are occupied by the malonic acid but no catalysis takes place at the active or catalytic site, hence no product is formed

Succinic dehydrogenase + Malonic acid → No reaction possible

(Enzyme) (Competitive inhibitor) (Enzyme blocked)

Another type of inhibitors, called non-competitive inhibitors cause ¾lon competitive inhibition". Here, the inhibitor is not bound to the catalytic or active site but to some other site of enzyme. This binding distorts the enzyme's structure also affecting the catalytic site of the enzyme in such a way that even if genuine substrate binds the active sites, catalysis fails to take place.

In the reactions catalyzed by enzymes irreversible inhibitors cause irreversible inhibition either by physically blocking the active sites of enzymes or by occupying

the active sites and forming covalent bonds. So, the rate of reaction is retarded due to the occupation of active sites of enzymes by irreversible inhibitors or due to the destruction of the globular structure of enzymes.

Note:

Competitive and non-competitive inhibitors are the two major types of reversible inhibitors.

Q8. Give industrial applications of enzymes.

Enzymes are extensively used in different industries for fast chemical reactions. For example;

1) **Food industry:** Enzymes that break starch into simple sugars are used in the production of white bread, buns etc.
2) **Brewing industry:** Enzymes break starch and proteins. The products are used by yeast for fermentation (to produce alcohol).
3) **Paper industry:** Enzymes break starch to lower its viscosity that aids in making paper.
4) **Biological detergent:** Protease enzymes are used for the removal of protein stains from clothes. Amylase enzymes are used in dish washing to remove resistant starch residues.

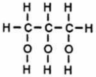
Q9. What are lipids? Give their classification cation and structure?

Answer

(Greek, lipos means fat)

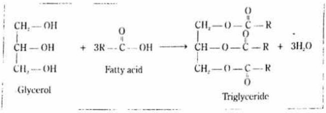
Naturally occurring organic compounds of animals and plants origin, which are soluble in organic solvents are Called lipids.

These molecules consist of carbon, hydrogen, and oxygen atoms. The main constituents of all membranes in all cells (cell walls), food storage molecules, intermediaries in signaling pathways, Vitamins A, D, E and K, cholesterol.



All lipids are hydrophobic: that's the one property they have in common. This group of molecules includes fats and oils, waxes, phospholipids, steroids (like cholesterol), and some other related compounds.

Fats and oils are made from two kinds of molecules: glycerol (a type of alcohol with a hydroxyl group on each of its three carbons) and three fatty acids joined by dehydration synthesis. Since there are three fatty acids attached, these are known as triglycerides.



Classification of Lipids

There are three broad classes of lipids, discussed below.

a) Simple Lipids

These are the ester of fatty acids with glycerol e.g.

- Triglycerides, neutral fats: Found in adipose tissue, butterfish, fish oils, olive oil, and corn oil. Waxes: beeswax, head oil of sperm whale, carnauba oil, and lanolin of industrial and medicinal importance.

b) Compound Lipids

These contain radicals in addition to fatty acids and alcohols. e.g.

- Phospholipids (phosphatides): Found chiefly in animal tissues.
- Plasmalogen: Found in brain, heart, and muscle.
- Lipositol: Found in brain, heart, kidneys, and plant tissues together with phytic acid. Phosphatidyl inositol; phosphatide linked to inositol; rapid synthesis and degradation in brain; evidence for role in cell transport processes.
- Sphingomyelin: Found in nervous tissue, brain, and red blood cells. Source of phosphoric acid in body tissue.

c) Derived Lipids (These are hydrolytic product of compound lipids)

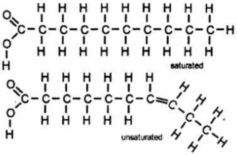
- Fatty acids: occur in plant and animal foods; also exhibit in complex forms with other substances. Obtained from hydrolysis of fats; usually contains an even number of carbon atoms and are straight chain derivatives.

Structure of Lipids

Lipids are generally defined in terms of solubility, and not in terms of particular structures, as in the cases of proteins and nucleic acids. Lipids associate with one **another**via van der Waals forces and the hydrophobic effect. In particular, we discuss the structure of 'Fatty Acids'.

The "tail" of a fatty acid is a long hydrocarbon chain, making it hydrophobic. The "head" of the molecule is a carboxyl group which is hydrophilic. Fatty acids are the main component of soap, where their tails are soluble in oily dirt and their heads are soluble in water to emulsifier and wash away the oily dirt. However,

when the head end is attached to glycerol to form a fat, that whole molecule is hydrophobic.



The terms saturated, mono-unsaturated, and poly-unsaturated refer to the number of hydrogens attached to the hydrocarbon tails of the fatty acids as compared to the number of double bonds between carbon atoms in the tail. Fats, which are mostly from animal sources, have all single bonds between the carbons in their fatty acid tails, thus all the carbons are also bonded to the maximum number of hydrogens possible. Since the fatty acids in these triglycerides contain the maximum possible amount of hydrogens, these would be called saturated fats. The hydrocarbon chains in these fatty acids are, thus, fairly straight and can pack closely together, making these fats solid at room temperature. Oils, mostly from plant sources, have some double bonds between some of the carbons in the hydrocarbon tail, causing bends or "kinks" in the shape of the molecules. Because some of the carbons share double bonds, they're not bonded to as many hydrogens as they could if they weren't double bonded to each other. Therefore, these oils are called unsaturated fats. Because of the kinks in the hydrocarbon tails, unsaturated fats can't pack as closely together, making them liquid at room temperature.

Q10. Give physical and chemical.

Answer

Properties of Lipids

1) Physical Properties

1) Oils and fats may be either liquids or non-crystalline solids at room temperature

2) Fats and oils in the pure states are colorless, odorless and tasteless.

3) The color fats arise due foreign substances, for example yellow color of the butter is due to the presence of keratin.

4) They are lighter than water.

5) They are insoluble in water.

6) They are readily soluble in organic solvents like diethyl ether, carbon disulphide, acetone, benzene, chloroform and carbon tetrachloride.

7) They form emulsions when they are agitated with water in the presence of soap or another emulsifier.

8) Fats and oils are poor conductor of heat and electricity and serve as excellent insulator for the animal body.

2) Chemical Properties

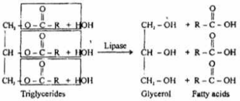
I) Fats and oils undergo various types of reaction but the most important are:

i) Hydrolysis **ii)** Hydrogenation

1) Hydrolysis of fats and oils:

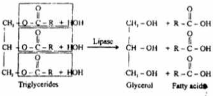
Fats and oils are triglycerides. They are Triesters. They are hydrolyzed by enzymes which act as catalysts. These enzymes are called lipases.

Actually, this hydrolysis takes place in the digestive tract of human beings and animals. Fatty acids are produced in animal body which play an important role in the metabolic pathways.



2) Saponification

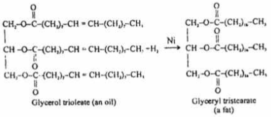
Saponification is the hydrolysis of triglycerides by alkalis. Glycerol is produced along with sodium or potassium salt of fatty acids. These Na and K salt are called soaps.



3) Hardening of Oils:

We know that unsaturated triglycerides are liquids at room temperature. They are called oils. They can be saturated by passing hydrogen in them in the presence of metal catalysts. In this way, liquid triglycerides are converted into a semisolid triglyceride. This reaction is used commercially to harden the vegetable oil, for the production of vegetable ghee or margarine.

These hardened oils are also used extensively for making soaps and candles.



Q11.Give nutritional importance of lipids.

Answer

Lipids play three major biochemical roles:

I) As a storage form for metabolic energy (triglycerides)

2) As components of membranes

3) As messengers (prostaglandins, steroid hormones)

A major role of lipids in nutrition is to provide energy, since unsaturated, saturated and trans fats all provide about 9 calories per g compared to carbohydrates or protein with 4 calories per g. Even though it is high in calories, fat does not necessarily cause weight gain if you monitor your total intake. Our body also needs fat from your diet to be able to absorb and use fat-soluble essential nutrients such as vitamin A, vitamin D and vitamin E.

Essential Lipids

Some nutrients are essential in your diet because you need them for good health but your body cannot produce them. The essential lipids are polyunsaturated fats called omega-6 and omega-3 fats. You need these fats for hormone synthesis, cell membrane structure and healthy brain and vision, and they may help lower your blood cholesterol levels. You can get omega-6 fatty acids from vegetable oils and nuts. Omega-3 fatty acids are also in flaxseed, walnuts and fatty fish.

Non-Essential Lipids

Monounsaulrated fatty acids are not essential in the diet because your body can synthesize them, but they may help reduce your risk for heart disease. They are in olive oil, peanuts and avocadoes. You do not need to get saturated fat, trans fat or cholesterol in your diet, and these lipids raise bad cholesterol levels in your blood. Saturated fat is in fatty meats and cheese, palm and coconut oil, and butter. Trans fat is in partially hydrogenated oils in processed and fried foods, while cholesterol is fatty animal foods. Some other functions are:

1) tissues reconstruction;

2) nervous system organization;

3)increases and assures a normal function of the skin;

4) antibodies formation;

5) good function of endocrine glands(thyroid);

6) water metabolism;

Q12. What are nucleic Acids? Discuss DNA and RNA.

Answer

Discovery

1) Nucleic acids were first of all demonstrated in the nuclei of puss cells in 1868. 2) They were found in sperm heads by Frederik Miescher in 1872.

Nucleic acids are present in:

1) In every living cell as well as in viruses.

2) They have been found to be essential substance of genes.

Properties:

1) Nucleic acids contain in their structures the blue-prints for the normal growth and development in each and every living organism.

2) They have two fundamental properties which are common to all living organism.

a) The ability to reproduce, store and transmit genetic information

b) To undergo mutation.

Types of Nucleic Acids:

There are two types of nucleic acids which have been discovered:

1) Deoxyribonucleic acids (DNA)

2) Ribonucleic acid (RNA)

Nucleic acids and proteins:

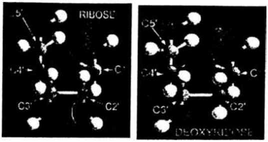
In the human body the nucleic acids occur as part of the conjugated proteins which are called nucleoproteins. The nucleic acids direct the synthesis of proteins.

Structural Components of DNA and RNA

DNA stands for deoxyribonucleic acid. It is a polymer of deoxyribonucleotides. The nucleotide consists of: one sugar, one nitrogenous base, and at least one phosphate. The structures of all components are introduced below and shown together as a strand of DNA.

i) Sugar

The sugar in DNA is deoxyribose. The sugar in RNA is ribose. The deoxy- prefix indicates that this form of the sugar contains one less oxygen atom. The 2-carbon of the pentose sugar has two hydrogens attached to it instead of a hydrogen and hydroxyl (OH).



The positions of the carbon atoms are indicated by the numbers. The apostrophe after the number means 'prime' and denotes the atoms on the sugar, as opposed to an atom in the base. The atoms therefore, read from one-prime through to five-prime. When the sugars are displayed on their own the prime is omitted. All of the bases are linked to the carbon I atom of the sugar.

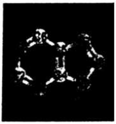
ii) Nitrogenous Bases

a) Pyrimidines

Pyrimidines

There are three pyrimidine bases, and each consists of a 6-membered ring containing both nitrogen and carbon atoms. Two pyrimidines, Thymine and Cytosine, are found in DNA. RNA also contains two pyrimidines, but they are Cytosine and Uracil.

b) Purines



Again, the purines are made from two heterocyclic rings of carbon and nitrogen. This time, a 6-member and a 5-member ring have fused. There are two purines, Adenine and Guanine and both are found in DNA and RNA.

III) Phosphates

The addition of one or more phosphate groups to a nucleoside, transforms it into a nucleotide. This is the base-sugar-phosphate unit which, when polymerized, forms DNA.

DNA — Storage of Information RNA — Transfer of Information They differ in three ways.

I. The sugar in RNA is ribose while the sugar in DNA is 2-deoxyribose.

2. Four different bases are found in DNA cytosine (c) thiamine (T) adenine (A) and guanine (G). In RNA thiamine does not occur and its place is taken by uracil (U).

3. DNA is nearly always double stranded, while RNA is usually single strand.

Q13. What are different minerals of biological significance?

Answer

Minerals are the nutrients that exist in the body, and are as essential as our need for oxygen to sustain life. Minerals are also found in organic and inorganic combinations in food. In the body only 5% of the human body weight is mineral matter, vital to all mental & physical processes & for total well-being. They are most important factors in maintaining all physiological processes, are constituents of the teeth, bones, tissues, blood, muscle, and nerve cells.

Acting as catalysts for many biological reactions within the human body, they are necessary for transmission of messages through the nervous system, digestion, & metabolism or utilization of all nutrients in foods. Vitamins cannot be properly assimilated without the correct balance of minerals. For example; calcium is needed for vitamin "C" utilization, zinc for vitamin "A", magnesium for "B" complex vitamins, selenium for vitamin "E" absorption, etc.

The roles of major and minor minerals in human body are given in Table.

Important minerals in human diet and their roles		
Minerals	**Role in body**	
Major minerals		
Sodium	Fluid balance in the body Helps in absorption of other nutrients	Important for muscle contraction, nerve impulse transmission, heart function, and blood pressure
Potassium	Fluid balance in the body Acts as cofactor for enzymes	
Chloride	Fluid balance in the body Component of hydrochloric acid	
Calcium	Development and maintenance of bones and teeth and Blood clotting	
Magnesium & Phosphorus	Development and maintenance of bones and teeth	
Trace Minerals		
Iron	Oxygen transport and storage	Act as enzyme cofactors Support immune function
Zinc	Aids insulin action Helps in growth and reproduction	
Copper	Acts as enzyme cofactor	
Chromium	Helps in insulin action	
Fluoride	Stabilizes bone mineral and hardens tooth enamel	
Iodine	Essential for normal thyroid function	

Out of all above mentioned mineral only Calcium, phosphorus, Iron and Zinc are included in our syllabus.

Q14. Give sources of important minerals.

Answer

Here is a list of good food sources for a number of important minerals that are an essential part of good nutrition.

i) Calcium

Calcium is important to bone growth and formation, blood clotting and nerve and muscle functioning.

a) **Sources:** We get calcium from milk, cheese, egg yolk, beans, nuts, cabbage etc.

b) **Deficiency:** A deficiency may result in arm and leg muscles spasms, softening of bones, back and leg cramps, brittle bones, rickets, poor growth, osteoporosis, tooth decay and mental depression.

ii) Iron

Iron is an essential mineral. Its major function is to combine with protein and copper in making hemoglobin, the component of the blood that carries oxygen from the lungs to the tissues throughout the body.

a) **Sources:** We get Iron from red meat, egg yolk, whole wheat, fish, spinach and mustard etc..

b) **Deficiency:** A deficiency may result in weakness, fatigue, paleness of the skin, constipation and anemia.

iii) Phosphorus

Phosphorus is after calcium the second most abundant mineral in the body. It is a principal mineral of bones and teeth. Phosphorus is involved in most metabolic

actions in the body, including kidney functioning, cell growth and the contraction of the heart muscle.

a) **Sources:** We get phosphorus from egg yolk, cheese, milk, cabbage etc.

b) **Deficiency:** A deficiency is unusual, but may have symptoms varying from painful bones, irregular breathing, fatigue, anxiety, numbness, skin sensitivity and changes in body weight.

iv) Zinc

Zinc is vital to immune resistance, wound healing, digestion, reproduction, physical growth, diabetes control, taste and smell and maintaining normal Vitamin A levels and usage. Zinc can be found in almost every cell of the body and serves as part of more than 70 enzymes that control body processes.

a) **Sources:** We get zinc from Oyster, red meat, chicken, beans, nuts, dairy products and some sea foods.

b) **Deficiency:** A deficiency may result in poor growth, acne-like rash, hair loss, diarrhea, delayed sexual maturation, impotence, sterility, eye lesions, loss of appetite, reduced sense of taste and smell, skin lesions and inflammation, poor wound healing, reduced resistance to infections, mental confusion, poor learning ability, changes in hair and nails and anemia.

Q15. What is biological significance of minerals?

Answer

a) Importance/ Significance of Iron:

The primary role of iron relates to the ability of red blood cells to adequately carry oxygen for use throughout the entire body. Some functions of iron are mentioned below.

Fatigue

To prevent fatigue, iron is needed by the body to make hemoglobin rich blood, which transports oxygen to the cells. It is also needed for adenosine triphosphate production (ATP), which is essential for cellular energy and proper cell function.

Exercise

Iron is lost through sweat and through bleeding of the digestive from the harsh motion of exercise. Studies indicate that 34% of female runners and 8% male runners are iron deficient.

Pregnancy

Iron is needed for proper placenta development and also for the prevention of pre-term and low birth weight babies. Studies estimate that up to 58% of pregnant women are iron deficient.

Pediatric

Iron is essential during the first eight months for brain growth and the effects of anemia may be associated with developmental delays in both motor and cognitive abilities.

Treatment Duration

Up to six months to restore low iron stores, its sufficient quantity must be used. When iron deficiency is left untreated, it can lead to conditions that are more serious.

Metabolic Processes

Iron plays an important pan in the metabolic processes of the animals. The function of iron in the body is limited almost exclusively to the oxygen transport in the blood, through hemoglobin. It is present in some enzymes that catalyze

reactions of cellular oxidation. In human body, the richest organs in iron are liver and spleen. In smaller amount, it is also present in bones, medulla, kidneys and intestines.

b) Importance/Significance of Calcium:

Calcium is the most common mineral in the human body, where it is present in almost the same relative abundance as in the earth's crust. There are six stable isotopes of calcium: calcium40 is the most common (97 %), and calcium46 the least abundant (0.003 %).

- The integrity of the system depends critically on vitamin D status; if there is a deficiency of vitamin D, the loss of its calcaemic action leads to a decrease in the ionized calcium and secondary hyperparathyroidism and hypophosphataemia. This is why experimental vitamin D deficiency results in rickets and osteomalacia whereas calcium deficiency gives rise to osteoporosis.
- Approximately 99% of total body calcium is in the skeleton and teeth and 1% in

blood and soft tissues. Calcium has four major biological functions:

- **a.** Structural as stores in the skeleton
- **b.** Electrophysiological - carries charge during an action potential across membranes
- **c.** Intracellular regulator, and
- **d.** As a cofactor for extracellular enzymes and regulatory proteins.

c) Importance/Significance of Phosphorus

Phosphorus is present in plants and animals. There is over 1 1b (454 grams) of phosphorus in the human body. It is a component of adenosine triphosphate (ATP), a fundamental energy source in living things. It is found in complex organic compounds in the blood, muscles, and nerves, and in calcium

phosphate, the principal material in bones and teeth. Phosphorus compounds are essential in the diet. Organic phosphates, ferric phosphate, and tricalcium phosphate are added to foods. Dicalcium phosphate is added to animal feeds.

I) The main function of phosphorus is in the formation of bones and teeth.

2) It plays an important role in the body's utilization of carbohydrates and fats and in the synthesis of protein for the growth, maintenance, and repair of cells and tissues.

3) It is also crucial for the production of ATP, a molecule the body uses to store energy.

4) Phosphorus works with the B vitamins.

5) It also assists in the contraction of muscles, in the functioning of kidneys,

6) In maintaining the regularity of the heartbeat, and

7) In nerve conduction.

d) Importance/Significance of Zinc

Zinc is the most omnipresent of all trace elements involved in human metabolism. More than a hundred specific enzymes require zinc for their catalytic function. If zinc is removed from the catalytic site, Activity is lost; replacement of zinc restores Activity. Studies in individuals with acrodermatitis enteropathica, a genetic disorder with zinc malabsorption resulting in severe deficiency, have provided much insight into the functional outcomes of zinc deficiency. These include impairments of dermal, gastrointestinal, neurologic and immunologic systems.

Loss of zinc through gastroifltestinal tract accounts for approximately half of all zinc eliminated from the body. Considerable amount of zinc is secreted through the biliary and intestinal secretions, but most of it is reabsorbed and this process

is an important point of regulation of zinc balance. Other routes of zinc excretion include the urine and surface losses (desquamated skin, hair, sweat).

Q16.Write a detailed note on:

a) Hibernating animals and their reserve food
b) Complex carbohydrates.
c) Glucosaminoglyhcans (CAGs)
d) Fibrous Proteins from hair and silk
e) Insulin

Answer

Glycogen — A store house

Glycogen is reserved food material that store in muscles and liver in animals and human. When body requires energy due to lack of glucose, the glycogen reconverted into glucose and provide energy to the body in the form of ATP.

a) Hibernating Animals and Reserve Food

Large amount of fat is store in the boy of some animals that hibernate during winter. In winter the metabolic activities slow down. They use this fat as reserved food material that produce ATP during oxidation.

b) Complex carbohydrates which Provide Lubrication to the Elbow and Knee:

Glucosamine, glucosaminoglycons or proteoglycan are the complex carbohydrates which provide lubrication to elbow and knee.

Glucosamine ($C_6HI_3NO_5$) is an amino sugar. It is produced naturally in the body and plays a key role in building cartilage and lubricating joints. It is found in the fluid that is around joints. It is a prominent procurer for glycosaminoglycans and for glyeosaylated proteins and lipids.

Gluasamine has been shown to help keep our joints resilient and healthy by lubricating and resting the connective tissue. It is a naturally occurring nutrient and is a glutamine derivative that retains an amine group and a sugar molecule (glucose).

Over time, every day wear and tear, less than perfect nutrition, injuries and aging can result in dry, brittle cartilage which is vulnerable to damage and stiffening. Research has shown that glucosamine may repair damaged or strained connective tissue.

Our joints are made up of two third of water yet are into able to attract and retain it.

Glucosamine has shown to help keep cartilage resilient and healthy by attracting and holding water and nutrients within this matrix. Studies have even shown glucosamine may even help to regenerate new cartilage once it becomes damaged, thereby restoring joint function and mobility. Because of its ability to help to lubricate and restore elbow and knee joints, it is quite popular with weight trainers, sports enthusiasts etc.

c) Glucosaminoglycans (CAGs) are the most abundant hetropolysaccharides in the body. They are long unbranched molecules containing a repeating disaccharide unit. Usually one sugar is uronic acid and the other is either GlcNAc or CalNAc. GAGs have negative charge on them. GAGs are a major component of joint cartilage.

Chondroitin sulphate (D. glucuronate + CalNSc sulphate) is the most abundant GAG found in cartilage. Keratan sulphate (Gal + GlcNAc sulphate) is often aggregated with chondroitin sulphate.

GAGs have unique properties i.e. the ability to fill space, bind and retain water and repel negatively charged molecules. Because of high viscosity and low compressibility, they are ideal for a lubricating fluid in the joints especially in

knee and elbow. On the other hand, their rigidity provides structural integrity to the cells.

Proteoglycans (mucoproteins) are formed of glycosamineglycaosn (GAGs) and core proteins, covalently bonded to each other. These are found in all connective tissues.

Proteoglycans can also be called joint grease. Proteoglycan appears to be a necessary compound in synovial fluid for normal joint lubrication and function. (Synovial fluid is a clear pale-yellow fluid, the main function of which is to serve as a lubricant in joints or tendon sheath.)

Aggrecan is one of the most important extra cellular proteoglycans. To each aggrecan core protein, multiple chains of chondroitin sulphate and keratin sulphate are covalently attached through the trisaccharide linker. They play an important role in hydration of cartilage of joints. They give cartilage its gel like properties i.e. lubricate it and provide resistance to deformation.

d) Fibrous Proteins from hair and Silk

Fibrous proteins consist of elongated molecules having one or more polypeptide chains in the form of fibrils. Secondary structure is most important in them. They are insoluble in aqueous media, a property conferred by a high concentration of hydrophobic amino acid residues both in interior of the proteins and or its surface. They are non-crystalline and are elastic in nature. Their characteristic feature is regular repeating pattern. They play structural or supporting role in the body. Examples are silk fiber, keratin (of nails, and hair), myosin (in muscle cells), fibrin of blood clot.

Fibrous protein from hair i.e. alpha keratin is a helix of helices (2 pairs of alpha helices wound around one another) and has a seven amino acid repeating structure. Alpha keratin helix in hair has somewhat thicker elements near the amino and carboxyl terminal. Pairs of those helices are inter-wound in a left-

handed sense to form two chain coiled coils. Those then combine in higher order structure called proto filaments and protofibrils. About 4 protofibrils (32 strands of alpha keratin altogether) combine to form an intermediate filament:

- Alpha keratin helix
- Two chain coiled coil
- Proto-filament (20-30A)
- Protofibril
- Intermediate filament
- Hair

Fibrous protein from silk i.e. silk fibroin is produced by insects and spiders. It si composed up of only ant parallel beta sheets. It two has a repeating pattern i.e. layers of glycine alternate with the layers of alanine in beta sheets. This pattern permits a close packing of beta sheets and inter locking arrangement of R groups. The overall structure is stabilized by extensive hydrogen bonding between all peptide linkages fail in polypeptides of each beta sheet and by optimization of van der Walls interaction between sheets. Silk does no stretch, because the beta conformation is already highly extended. However, the structure is flexible because the sheets are held together by numerous weal interaction rather than by covalent bonds such as the disulphide bonds in alpha keratins.

e) Insulin — A protein hormone whose deficiency leads to diabetes mellitus.

Insulin is a 51 amino acid peptide hormone that is produced exclusively by pancreatic beta cells. F. Sanger was the first scientist who determined the sequence of amino acids in insulin. After 10 years of careful work, he concluded that insulin is composed up of 51 amino acids in two chains, one alpha chain and one beta chain. The alpha chain contains 21 amino acids and the beta chain contains 30 amino acids. Both chains are held together by disulphide bridges. The molecule weight of insulin is 5808.

Insulin hormone is central in regulating carbohydrate and fat metabolism in the body. It causes the cells in liver, muscles and fat tissue to take up glucose from the blood. In the liver and skeletal muscles, glucose is stored as glycogen, while in adepocytes, it is stored as triglycerides.

Insulin stops the use of fat as energy source. When blood glucose level falls below a certain limit, the body begins to use stored sugar as an energy source through glycogenolysis. As a central metabolic control mechanism its status is also used as a control signal to other body systems (such as amino acids uptake by body cells.). in addition, it has several other anabolic effects throughout the body.

When control of insulin level fails, diabetes mellitus can result. Diabetes mellitus is state of hyperglycemia. Diabetes mellitus is of two types. Type I diabetes mellitus is caused due to autoimmune-mediated destruction of insulin producing beta cello in the pancreas, resulting in absolute in the pancreas, resulting in absolute insulin deficiency. Type B diabetes mellitus is a malefactor syndrome with combined influence of genetic susceptibility and influence of environmental factors, the best-known being obesity, and physical inactivity, resulting in insulin resistance in cells requiring insulin for glucose absorption. This form of diabetes is strongly inherited.

So, insulin is used medically to treat some forms of diabetes patients with type I diabetes depend upon external insulin for their survival. Patients with type 2 diabetes are insulin resistant and may suffer from a relative insulin deficiency. Some patients with type 2 diabetes may eventually require insulin if other medications fail to control blood glucose level adequately. Over 40% of type 2 diabetes patient's require insulin as part of their diabetes management plan.

Q17.Give role of minerals in the body. Also give macro and micro minerals.

Answer

I) Minerals act as cofactors for the enzyme reactions. Enzymes don't work without minerals. All cells require enzymes to work and function. They give us our vitality.

2) They maintain the pH balance with in the body.

3) Minerals actually facilitate the transfer of nutrients across cell membranes.

4) They maintain proper nerve conduction.

5) Mineral help to and relax muscles.

6) They help to regulate our bodies' tissue growth.

7) Minerals provide structural support for the body.

These are two categories of mineral essential with in body, macro-minerals and microminerals. There is no one mineral deficiency; they all must be maintained in balance within body.

Macro-minerals

- Calcium
- Chloride
- Phosphorous
- Sodium
- Potassium
- Sulfur
- Magnesium

Micro-minerals (or Trace Minerals)

- Iron
- Boron
- Chromium
- Iodine
- Manganese

- Molybdenum
- Selenium
- Silicon
- Copper
- Cobalt
- Rubidium
- Germanium
- Lithium
- Zinc
- Vanadium

Structure and Function of Minerals

The term mineral is applied to chemical elements present in the ash of calcined tissue. Dietary minerals Amy are present in inorganic salts, or as part of carbon containing organic compounds. For example, magnesium is present in chlorophyll, the pigment that makes plants green. Six minerals are required by people in gram amount: sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), Phosphorous (P), and chlorine (CD. Daily requirements range from 0.3 to 2.0 grams per day. Nine trace minerals are required by people in minute amounts: chromium (Cr), copper (Cu), iodine (I), iron (Fe), fluorine (F), manganese (Mn), molybdenum (MO), selenium (Se), and zinc (Zn). There are additional requirements for cobalt (Co) but these are generally expressed in terms of the cobalt containing vitamin B 12. All trace minerals are toxic at high levels.

Calcium

Calcium is the most abundant mineral in the human body. More than 99% of total body calcium is sorted in the bones and teeth. Calcium is also found in body fluid where its function is to regulate contractions of blood vessels and muscles. The requirement for calcium is greatest form puberty to maturity, when

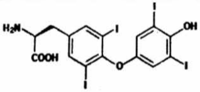
the body grows very quickly. Milk and dairy products are god sources of galcium.

Fluorine

Most of the body's fluorine (F) is contained in bones and teeth. The main source of fluoride is drinking water. Fluorine hardens tooth enamel and effectively prevents dental caries. Excessive fluorine in drinking water can accumulate in teeth and bones, causing fluorosis. Permanent teeth that develop during high fluorine intake have irregularly distributed chalky patches on the surface of the enamel which become stained yellow or brown, producing a characteristics mottled appearance.

Iodine

Iodine (I) is primarily involved in the synthesis of two thyroid hormones, thyroxine and triiodothyronine. In adults about 80% of the iodide absorbed is by the thyroid gland.



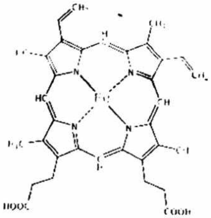
Thyroxine

Most environmental iodine occurs in seawater. People living far from the sea are at particular risk of deficiency. Salt fortified with iodide (typically 70ug/g) helps ensure adequate intake (IOOug/day). Deficiency is rare in areas where iodized salt is used but common worldwide. Iodine deficiency develops when iodide intake is less than 20ug/day. In mild or moderate deficiency, the thyroid gland hypertrophies to concentrate iodine in itself, resulting goiter which is an

enlargement of the thyroid gland visible as a swelling of front the of neck. Excessive iodine consumption can lead to thyrotoxicosis, a condition resulting from high concentrations of thyroid hormones in the body which can result from eating foods that have high amounts of iodine, such as kombu-type kelp or seaweed.

Iron

Iron (Fe) is a component of hemoglobin, myoglobin, and many enzymes in the body. Heme iron, contained mainly in animal products is absorbed much better than nonheme iron, which accounts for over 85% of iron in the average diet. However, absorption of nonheme iron is increased when it is consumed with animal protein and vitamin C. the Recommended Daily Allowance (RDA) of iron is 8 milligrams for men and postmenopausal women. Iron deficiency, which may be caused by improper vegan or ovo-lacto vegetarian diets. Chronic bleeding may also cause iron deficiency, iron may accumulate in the body when a person is given repeated blood transfusions or takes an overdose of iron supplements. Excess iron is toxic any damage the intestines and other organs, as well as cause vomiting and diarrhea.



Heme, a constituent of hemoglobin

Magnesium

Magnesium (Mg) has several important metabolic functions in the production and transport of energy. It is also important for the contraction and relaxation of muscles. Magnesium is involved in the synthesis of protein, and it assists in the functioning of some enzymes. Most dietary magnesium comes from nuts, cereals, and dark green, leafy vegetable which are rich in chlorophyll.

Manganese

Manganese (Mn) is necessary for healthy bone structure and is a component of several enzyme systems including manganese-specific glycosyltransferases and phosphoenolpyruvate carboxykinase. Manganese is found in cereal and nuts. The adequate intake of manganese is 2 to 5 mg/day.

Molybdenum

Molybdenum (MO) is a component of coenzymes necessary for the activity of xanthine oxidase, sulfite oxidase, and aldehyde oxidase. Sulfite oxidase catalyses the transformation of sulfite to sulfate which is necessary for the metabolism of sulfur containing amino acids, such as cysteine. Legumes such lentils, beans, and peas are good sources of molybdenum.

Potassium

Potassium (K) maintains fluid volume inside and outside of cells, and acts to blunt the rise of blood pressure in response to excess sodium intake. The adequate intake of potassium is 4.5 grams per day for children 9 to 13 years old and 4.7 grams per day for older person. Potassium is generally found in fruits and vegetables, dried peas, dairy products, meats and nuts. Potassium from supplements or slat subtitles can result in hyperkalemia and possibly sudden death if excess is consumed by individuals with chronic renal insufficiency (kidney disease) or diabetes.

Selenium

Selenium (Se) is a part of the enzyme glutathione peroxides, which metabolizes hydroperoxides formed from polyunsaturated fatty acids. Selenium is also a part of the enzyme that deiodinate thyroid hormones. Generally, selenium acts as an antioxidant that works with vitamin E. deficiency of selenium causes Keshan disease which is a form of congestive chardiomyopathy. The RDA for selenium is 70 micrograms (mcg). The tolerable upper level of selenium is 400 mcg/day for adults based on the prevention of hair and nail brittleness and early signs of chronic selenium toxicity.

Sodium

Sodium (Na) is usually consumed as table salt (Sodium Chloride, NaCl). The adequate intake of 1.5 grams per day with an upper limit of 2.3 grams per day is calculated to meet the needs for sweet losses for individuals 8 years or older engaged in recommended levels of physical activity. Active people in humid climates who sweat excessively may need more than the adequate intake.

Zinc

Zinc (Zn) is contained mainly in bones, teeth, hair, skin, hair, liver, muscle, leukocytes, and testes. Zinc is a component of several hundred enzymes, including many nicotinamide adenine dinucleotide (NADH) dehydrogenases, RNA and DNA polymerases, and DNA transcription, factors as well as alkaline phosphatase, super oxide dismutase, and carbonic anhydrase. Good dietary sources of zinc include mollusks, such as oysters, and cereals.

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EXERCISE

Q1. Select the right answer from the choices given with each question.

1) Biochemistry covers the practical application of:

a) Medicine b) Agriculture

c) Nutrition d) All of these

2) Macromolecules are of how many types?

a) Three b) Four

c) Five d) Six

3) The general formula for carbohydrates is:

a) $N_n(H_2O)_n$ b) $P_n(H_2O)_n$

c) $C_n(H_2O)_n$ d) $H_n(CO_2)_n$

4) Most organic matter on earth is made up of:

a) Carbohydrates b) Lipids

c) Olive Oils d) Proteins

5) The no. of carbon atoms in hexose is:

a) One b) Four

c) Olive Oils d) Proteins

6) The long chains of Amino Acids are called:

a) Oils b) Polypeptide

c) Proteins d) Monopeptides

7) Proteins are used in both forms of:

a) Catabolism b) Anabolism

c) Enzymes d) Metabolism

8) What is TRUE about enzymes?

a) They make biochemical reaction to proceed spontaneously.

b) They lower the activation energy of a reaction.

c) They are not very specific in their choice of substrates.

d) They are needed in large quantities.

9) To what category of molecules do enzymes belong?

a) Carbohydrates b) Lipids

c) Nucleic acids d) Proteins

10) What is TRUE about cofactors?

a) Break hydrogen bonds in proteins.
b) Help facilitate enzyme activity.
c) Increase activation energy
d) Are composed of proteins.

11)Prosthetic groups are:

a) Required by all enzyme.
b) Loosely attached with enzymes
c) Proteinous nature
d) Tightly bound to enzyme.

12)Lipids are generally defined in terms of:

a) Solubility
b) Structure
c) Molarity
d) All of these

13) DNA and RNA are made up of:

a) Peptides
b) Nucleotides
c)Neurons
d) None of these

14) ____________ of the human body weight is mineral matter?

a) 5%
b) 10%
c) 50%
d) 100%

15) ______________ is needed for vitamin C utilization:

a) Acid
b) Iron
c) Phosphorus
d) Calcium

16) The component of blood that carries oxygen in the body is:

a) Fats
b) Myoglobin
c) Hemoglobin
d) Amino Acid

17) Most RNA molecules are:

a) Independent
b) Double Stranded
c) Single Stranded
d) Multiple Stranded

18) ___________ are the major component of soap:

a) Fatty Acids
b) Palm Oils
c) Proteins
d) Saccharides

19) The mineral, related with the formation of bones and teeth is:

a) RNA
b) Phosphorus
c) Iron
d) Sulphur Answers

Answers

1)	d)	2)	b)	3)	c)	4)	d)	5)	c)
6)	c)	7)	d)	8)	b)	9)	d)	10)	b)
11)	d)	12)	b)	13)	b)	14)	a)	15)	
16)	c)	17)	c)	18)	b)	19)	b)		

Q2. Give brief answers for the following questions.

Q1. What do you understand by the word Biochemistry?

Answer

Biochemistry

Please see answer of QI of chapter notes.

Q2. Briefly state the functions of carbohydrates.

Answer

Functions of Carbohydrates

Major functions of carbohydrates are as follows:

i) Energy stores, fuels and metabolic intermediaries.

ii) Ribose and deoxyribose sugars are part of the structural framework of RNA and DNA.

iii) The cell walls of bacteria are mainly made up of polysaccharides (Type of carbohydrates).

iv) Cellulose (a type of carbohydrate) makes up most of the plant cell walls.

v) Carbohydrates are linked to many proteins and lipids (fats), where they are vitally involved in cell interactions.

Q3. Name the classes and Sub—classes of Proteins.

Answer

There are three major classes and thirteen sub—classes which are as follows:

A) Simple Proteins:

a) Albumins b) Globulins c) Glutelins

d) Histones e) Scleroproteins

B) Conjugated Proteins:

a) Nucleoproteins b) Mucoproteins

c) Glycoproteins d)Phosphoprotein

C) Derived Proteins:

a) Proteins b) Proteases

c) Peptones d) Peptides

Q4. In a range of 0—35^{0}C, the rate of reaction of an enzyme is proportional to temperature. Justify it.

Answer

Most of the enzymes which are performing function in human body the range of their optimum temperature ranges 35 — 38^{0}C.

The activity of enzymes decreases when we move from 35 to O^{o}C and it becomes zero at O^{o}C.

Q5. How does PH affect enzyme activity?

Answer

PH affect enzyme activity:

Please see answer of Q31 of chapter notes.

Q6. Describe lock and key mechanism of enzyme action.

Answer

Please see answer of Q30 of chapter notes.

Q7. What is the main use of enzymes in paper industry?

Answer

The main use of enzymes in paper industry is to break starch to lower its viscosity that aids in making paper.

Q8. Define cofactor and co-enzymes.

Answer

Cofactors or co — enzymes are the non — protein components of the en4tme. These are actually inorganicinos and complex organic or metallo — organic molecules which includes Fe^{2+} (chrome oxidase) Zn^{2+} (carbonic anhydrase) and Mg^{2+} (glucose 6 — phosphate) and many enzymes contain vitamins as their cofactors or co — like nicotinamide adenine dinucleotide contains nicotinamide vitamin and thiamine pyrophosphate contains vitamin B.

Q9. Shortly explain the only property that all the lipids have in common.

Answer

They insoluble in water but dissolve in organic solvent.

Q10. Explain the structural components of DNA and RNA.

Answer

Please see answer of Q57 of chapter notes.

Q11. Define Lipids and state the difference between fat and oil.

Answer

Lipids

Lipids are the organic compounds of animals and plants origin and are triglycerides of fatty acids and glycerol.

Difference between fat and oil

Fat	Oil
i) Fats are mostly obtained from animal sources.	i) Oils are mostly obtained from plant sources.
ii) Fats have single bond between C — C thus maximum number of hydrogen atoms are attached hence called as saturated fats.	ii) Oils have some double bonds between C = C, thus less number of hydrogens are attached compared to fats that's why they are called unsaturated fats.

Q12. Briefly state how vitamin D is formed in human body?

Answer

Vitamin D is produced through the action of ultraviolet irradiation (UV) on its precursor 7 — dehydrocholesterol, this molecule occurs naturally in the skin of animals and milk. Vitamin D can be made by exposure of the skin to UVB or by exposing milk directly to UV.

Q13. State the difference between the chemical structures of DNA and RNA.

Answer

Please see answer of Q58 of chapter notes.

Q14. Briefly state why minerals are important for human life.

Answer

Please see answer of Q62 of chapter notes.

Q15. Name different routes for the loss of Zinc from human body.

Answer

About half of the Zinc from the human body is eliminated through gastrointestinal tract. Considerable amount of Zinc excretion occurs through urine and surface losses (desquamated skin, hair, sweat etc)

Q3. Give detailed answers for the following questions.

Q1. Describe different classes of carbohydrates.

Answer

Please see answer of Q3 of Chapter notes.

Q2. Explain the structures of proteins.

Please see answer of Q 19 of Chapter notes.

Q3. Briefly describe the factors that affect the activity of the enzymes.

Answer

Please see answer of Q31 of Chapter notes.

Q4. What is the nutritional importance of lipids?

Answer

Please see answer of Q48 of Chapter notes.

Q5. Explain the structure of Nucleic acids.

Answer

Please see answer ofQ57 of Chapter notes.

Q6. Describe four important minerals and their sources.

Answer

Please see answer of Q77, Q80, Q66 and Q67 of chapter notes.

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MULTIPLE CHOICE QUESTIONS

1) Branch of chemistry deals at molecular level, in living cells

a) biotechnology b) biochemistry

c) bioenergetics d) both a and b

2) The general formula of carbohydrate is

a) $Cn(H_2O)n$ b) $C(H_2O)n$

c) $Cn\ (H_2O)$ d) $C\ (H_2O)$

3) What are monosaccharides

a) proteins b) carbohydrates

c)lipids d) oils

4) Which are monosaccharides

a) ribose b) glucose

c)lactose d) both a and b

5) Which are disaccharides

a) fructose b) starch

c) glyceraldehyde d) sucrose

6) Which is polysaccharide

a) glycogen b) sucrose

c)maltose d) lactose

7)Which is plant carbohydrate

a) lactose b) starch

c)glycogen d) chitin

8)Which is bacterial carbohydrate

a) chitin b) cellulose

c)starch d) glycogen

9)1 gm of carbohydrate contains

a) 5 KCal b) 4 Kcal

c) 8 KCal d) 2 Kcal

10)1 gm of proteins contain

a) 4 KCal b) 6 Kcal

c)8 KCal d) 9Kcal

11) 1 gm of fats contain

a) 4 KCal b) 6KCal

c) 8 KCal d) 9 Kcal

12)Due to hyperglycemia, which disease occurs

a) diarrhea b) small pox

c) diabetes d) anthrax

13)Molecules which yield amino acids on complete hydrolysis are called

a) proteins b) peptides

c) polysaccharides d) lipids

14)Those proteins which give one amino acid only upon hydrolysis are called

a) simple proteins b) derived proteins

c) compound proteins d) conjugated proteins

15) Which is the simple protein

a) peptones b) peptides

c) glycoproteins d) albumins

16) Proteins which give an amino acid and non-protein group upon hydrolysis is

a) simple proteins b) derived proteins

c) compound proteins d) conjugated proteins

17) Which is conjugated protein

a) albumin b)histones

c) phosphoprotein d) proteases

18) Proteins derived from simple proteins are

a) simple proteins b)derived proteins

c) conjugated proteins d) none of these

19) Which is derived protein

a) peptones b)histones

c) glutelins d)globulins

20)In sequence of amino acids in a peptide chain is straight than the protein structure is

a) secondary b) primary

c) tertiary d) quaternary

21)If peptide chains are in the spiral or zig-zag manner, the protein structure is

a) secondary b) primary

c) tertiary d) quaternary

22)If peptide chains are twisted or folded than the protein structure is

a) secondary b) primary

c) tertiary d) quaternary

23)If peptide chains are folded or coiled the protein structure is

a) primary b) secondary

c) tertiary d) quaternary

24)Those inhibitions which bind with the active site by forming covalent bond are

a) reversible inhibitors b) irreversible inhibitors

c) inhibitors d) both a and b

25)Which are biological catalysis and alter the speed of metabolic activities

a) proteins b) lipids

c) enzymes d) carbohydrates

26)The set of biochemical reactions that occur in living organisms is called

a) metabolism b) anabolism

c) catabolism d) both a and b

27)Biochemical reaction in which larger molecules are synthesised are called

a) metabolism b) catabolism

c) anabolism d) none of these

28)Biochemical reactions in which larger molecules are broken into simpler one are called

a) metabolism b) catabolism

c) anabolism d) none of these

29)The molecule at which enzymes act is called

a) substrate b) product

c) paritone d) intermediate complex

30)Who presents key and lock model of enzyme action

a) daniel koshland b) emil fischer

c) friedrick miescher d) none of these

31)Which enzyme breaks peptide bonds

a) protease b) lactase

c) glutamase d) aminase

32)Which enzyme acts on lipids and digests them into fatty acid glycerol

a) protease b) lipase

c) cellulase d) histamase

33)When temperature, substrate concentration and pH increases from optimal level, the rate of enzyme action

a) increases b) decreases

c) same d) becomes double

34)Substances which tend to decrease the activity of enzymes are called

a) cofactors b) inhibitors

c) prosthetic group d) both a and b

35)Which are extensively used in different industries for fast chemical reactions

a) enzymes b) proteins

c) lipids d) carbohydrates

36)Vegetable ghee is converted into vegetable oil by passing glycerol trioleate (an oil) through a catalyst.

a) platinum b) nickle

c) dehydrogenase d) lipase

37)Nucleic acids was discovered by

a) friedreik miescher b) emil fischer

c) doniel koshland d) none of these

38)Purines are made from how many heterocyclic rings

a) four b) two

c) one d) three

39)Pyridine contains

a) thymine b) cytosine

c) uracil d) both a and b

40)A protein hormone which leads to diabetes mellitus is

a) Insulin b) glucagon

c) estrogen d) progesterone

41)Which maintain pH, nerve conduction, tissue growth, support to the body and aids in transfer of nutrients across cell membranes are

a) enzymes b) proteins

c) minerals d) carbohydrates

Answer

1)	b.	2)	a.	3)	b.	4)	d.
5)	d.	6)	a.	7)	b.	8)	b.
9)	b.	10)	a.	11)	d.	12)	c.
13)	a.	14)	a.	15)	d.	16)	d.
17)	c.	18)	b.	19)	a.	20)	b.
21)	a.	22)	c.	23)	d.	24)	b.
25)	c.	26)	a.	27)	c.	28)	b.
29)	a.	30)	b.	31)	a.	32)	b.
33)	a.	34)	b.	35)	a.	36)	b.
37)	a.	38)	b.	39)	d.	40)	a.
41)	c.						

Short Questions and Answers

QI. Define biochemistry.

Answer

Bio chemistry is the branch of science concerned with studying the various molecules that occur in living cells and organisms with their chemical reactions.

Q2. What are carbohydrates? Give examples.

Answer

Carbohydrates the substances which contains carbon, oxygen and hydrogen and have general formula Cn $(H_2O)_n$.

Q3. What are monosaccharides? Give examples.

Answer

Those carbohydrates which do not hydrolyze to simpler units are called monosaccharides.

Examples: Glucose, Ribose etc..

Q4. What are disaccharides? Give example.

Answer

Disaccharides are the carbohydrates which contain two monosaccharides. Examples: Lactose, Sucrose.

Q5. What are polysaccharides? Give examples.

Answer

The carbohydrates producing large number of monosaccharides on hydrolysis are called poly saccharides.

Examples: Starch, Glycogen etc..

Q6. What is glycemic index?

Answer

The glycemic index ranks foods on how they affect blood sugar level by measuring how much the blood sugar increases after one eats.

Q7. What are storage polysaccharides?

Answer

Glycogen and starch are called storage polysaccharides. Glycogen store in human and animals' liver and muscles while starch stores in potatoes, rice and wheat and it is plant polysaccharide.

Q8. What is chitin?

Answer

Chitin is a polysaccharide and is main component of fungi; cell walls the exoskeleton of arthropods such as crabs, lobsters, and set.

Q9. 1— gram of carbohydrates, proteins and fats contains how much calories?

Answer

I — gram of carbohydrates = 4 Kcal

I — gram of Proteins = 4 Kcal

I — gram of fats = 4 Kcal

Q 10. How obesity is caused? And how it could be reduced?

Answer

Obesity is caused due to consuming high-fat diet and overeating and low carbohydrate diet.

Obesity can be reduced to take diet high in carbohydrates.

Q11. How diabetes is caused?

Answer

There are two types of diabetes:

Type I: Occur when this disease is present in the gene while the type II occurs due to obesity and physical inactivity.

Q12. What are proteins? Give examples.

Answer

The molecules which yield amino acids on complete hydrogesis are called proteins. Examples: Albumin, Peptones etc..

Q13. What are Albumins?

Answer

Albumins are simple proteins which are present in blood, milk, egg white, lentils, wheat etc..

Q14. What are simple proteins? Give examples.

Answer

Those proteins which give one amino acid only upon hydrolysis are called simple proteins.

Examples: Albumins, Globulins, etc..

Q15. What are conjugated proteins? Give examples.

Answer

Those proteins which give an amino acid and non-protein group upon hydrolysis are called conjugated proteins.

Examples: Nucleoproteins, Mucoprotein etc.

Q16. What are derived proteins? Give examples.

Answer

Those proteins which are derived from simple and conjugated proteins are called

derived proteins.

Examples: Proteins, Proteses.

Q17. What are enzymes? Give examples.

Answer

Enzymes are biocatalysts which alter the speed of metabolic activities in the living bodies.

Examples: Hydrolysis, Amylase etc..

Q18. What is metabolism?

Answer

Metabolism is a set of biochemical reactions that occur in living organisms in order to maintain life.

Q19. What is catabolism?

Answer

Those biochemical reactions in which larger molecules are broken down into smaller ones are called catabolism.

Q20. What is anabolism?

Answer

Those biochemical reactions in which larger molecules are synthesized are called anabolism.

Q21. Who present lock and key model of an enzyme action and induced fit model?

Answer

In American biologist Daniel koshland proposed induced fit model of enzyme action while Emil Fischer proposed lock and key model.

Q22. Name the factors affecting enzyme activity.

Answer

I) Temperature **2)** Substrate concentration

3) PH

Q23. What are inhibitors? Give example.

Answer

Substances that tend to decrease the activity of enzymes are called inhibitors. Example: Cyanide, antibodies etc..

Q24. What are irreversible inhibitors? Give example.

Answer

These are the inhibitors which occupy the active sites by forming covalent bond or they physically block the active site.

Example: Succinic dehydrogenase + Malonic acid No reaction.

Q25. What are reversible inhibitors? Give example.

Answer

These are the inhibitors which form weak linkages with enzymes.

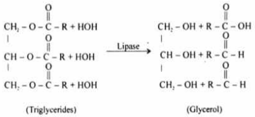
Example: Succinic dehydraenase + Succinic dehydrogenose.

Q26. What are fats and oils? Give examples.

Answer

Fats and oils are the esters of glycerol with fatty acids.

Example: Triglycerides.



Q27. What is saponification?

Answer

Saponification is the hydrolysis of trigly cerides by alkalis. Glycerol is produced along with sodium salt of fatty acids. These Na are called soap.

Q28. What are saturated fats? Give example.

Answer

Saturated fats are the fats which have all signal bonds between the carbons in their fatty acid tail and have maximum number of hydrogens.

Examples: obtained from animal sources such as glycogen etc..

Q29. What are unsaturated fats? Give example.

Answer

Unsaturated fats are fats which have double bonds between the carbon and have minimum hydrogen atoms attached to it.

Example: These are obtained from plant sources such as oils obtained from coconut, pea etc..

Q30. What are lipids? Give example.

Answer

Naturally occurring organic compounds of animals and plants origin, which are soluble in organic solvents are called lipids.

Example: fats, oils, waxes, steroids etc..

Q31. What are compound lipids? Give example.

Answer

Triglycerides with radicals in addition to fatty acids and alcohol. Example: Phospholipids.

Q32. What are derived lipids? Give example.

Answer

These are hydrolytic product of compound lipids. Example: Fatty acids.

Q33. What are essential lipids? Give example.

Answer

Those lipids which the human body cannot synthesize are called essential lipids. Example: Omega — 3 and Omega — 6 fats.

Q34. What are non-essential lipids? Give example.

Answer

Those lipids which the human body can synthesize are called non-essential lipids. Example: oil, saturated fats etc..

Q35. What are nucleic acids? Who discover them?

Answer

DNA and RNA are commonly called nucleic acids. Frederik Miescher discover them in the nuclei of puss cells in 1866.

Q36. Name the structural component of DNA and RNA.

Answer

i) Sugar

ii) Nitrogenous bases

iii) Phosphate

Q37. What are major minerals? Give example.

Answer

Those minerals which are required in large quantities are called major minerals. Example: sodium, calcium, chloride, phosphorus etc..

Q38. What are minor or Trace minerals? Give example.

Answer

Those minerals which are required in small quantities are called minor minerals. Examples: Iron, zinc, copper, fluorine etc..

Q39. What is insulin?

Answer

Insulin is a protein hormone whose deficiency leads to diabetes mellitus. It is a 51 amino acid peptide hormone.

Q40. What is diabetes mellitus?

Answer

Diabetes mellitus is a state of hyper glycaemia. It has two types. Type is caused due to autoimmune-medicated destruction of insulin while type 2 is a malefactor syndrome with influence of genetic susceptibility.