# 3 Biochemistry of Cell

## 3.0 : Introduction :

**Q.1. Define:**

**i. Cell**

**ii. Cellular pool**

**Ans: i. Cell:** It is a fundamental, structural and functional unit of an organism.

**ii. Cellular pool:** The collection of various types of molecules in a cell is known as cellular pool.

**Q.2. Write a short note on cellular pool.**

**Ans: Cellular pool:**

i. There are different types of materials present in the cell which make it possible to carry on all metabolic activities. This collection of various types of molecules in a cell is known as cellular pool.

ii. It consists of inorganic material and organic compounds.

iii. Inorganic material includes water, salts and mineral ions; while organic compounds are carbohydrates, proteins, lipids, nucleic acids, etc.

iv. All the molecules in a cellular pool help in metabolic activities of the cell.

**Q.3. Define metabolism. Explain the parts of metabolism .**

**Ans:** i. Metabolism means various reactions that occur at cellular level in every living organism.

ii. Metabolism consists of two parts, i.e. catabolism and anabolism.

iii. In anabolism, new cellular materials are synthesized.

iv. In catabolism, complex storage products are hydrolyzed and simpler, smaller products are formed.

v. Both anabolic and catabolic reactions require enzymes.

**Q.4. What are macromolecules? Give examples.**

**Ans:** i. Macromolecules are large sized compounds with high molecular weight but poorly soluble in water.

ii. Examples: Proteins, polysaccharides, nucleic acids, etc.

**Q.5. Name two different kinds of metabolism.**

**Ans:** Anabolism and Catabolism are the two different kinds of metabolism.

## 3.1 : Basic chemical constitunets of cell :

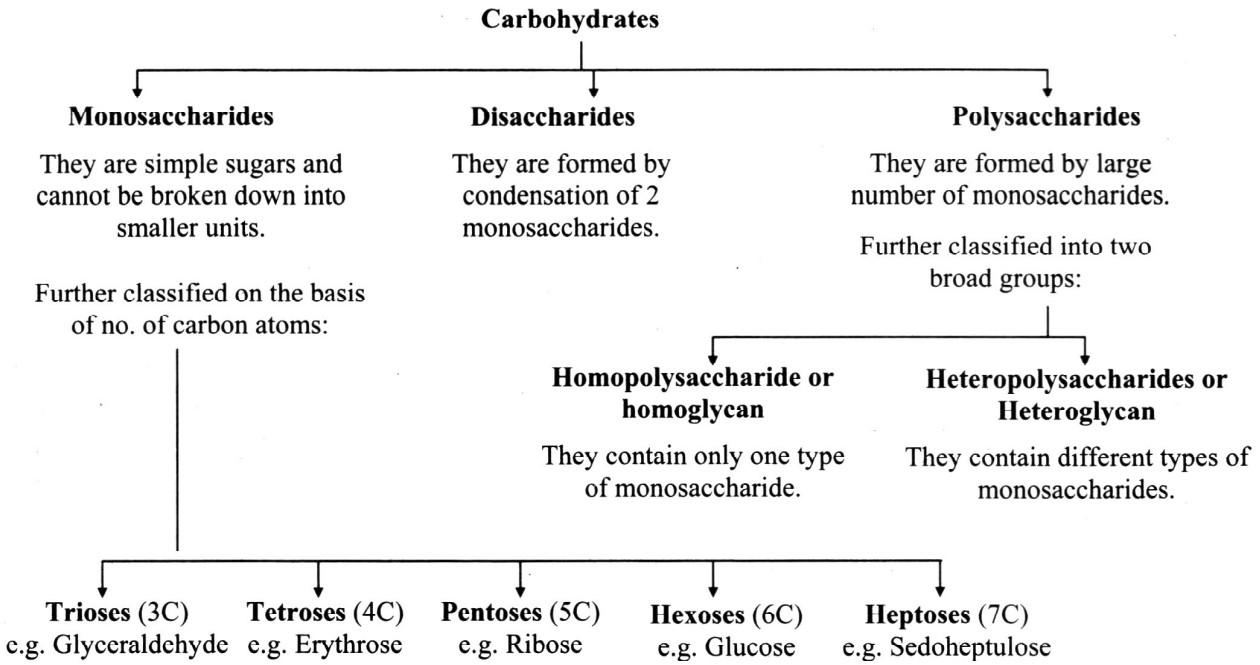
**Q.6. What are carbohydrates? Give the classification of carbohydrates.**

**Ans: Carbohydrates:**

Carbohydrates are organic compounds containing carbon, hydrogen and oxygen. Plants are the major source of carbohydrates as they produce carbohydrates during photosynthesis. The general formula of simple carbohydrates is $C_nH_{2n}O_n$ and complex carbohydrates is $(C_6H_{10}O_5)_n$ Some carbohydrates like rhamnose and digitoxose do not follow general formula of carbohydrates. Simple carbohydrates are commonly known as sugars which are involved in metabolic reactions, whereas complex carbohydrates form structural units.

**Classification:**

Based on their structure, carbohydrates are classified as follows:




**Q.7. Write short notes on:**

**i. Monosaccharides ii. Disaccharides iii. Polysaccharides**

**Ans: i. Monosaccharides:**

Monosaccharides are the basic units of complex carbohydrates.
Monosaccharides cannot be further hydrolyzed into smaller units.
They are simple sugars with potentially free aldehyde or ketone groups.
They are crystalline, soluble in water and sweet to taste.
Monosaccharides are further classified as aldoses and ketoses, depending on the presence of aldehyde or ketone as functional group.
Monosaccharides with ketone group are called ketose sugars. e.g. ribulose, fructose; while those with aldehyde group are called aldose sugars. e.g. glucose, xylose, etc.
According to the number of C-atoms they possess, they are further classified as
Example: Triose (3C) – Glyceraldehyde – $C_3 H_6 O_3$
Tetrose (4C) – Erythrose – $C_4H_8 O_4$
Pentose (5C) - Deoxyribose - $C_5 H_{10}O_4$ and ribose sugars – $C_5 H_{10} O_5$
Hexose (6C) - Glucose, fructose - $C_6H_{12}O_6$
Heptose (7C) - Sedoheptulose - $C_7 H_{14}O_7$

**ii. Disaccharides:**

They are composed of 2 monosaccharides.
They can be further hydrolyzed into monosaccharides.
They are soluble in water, sweet in taste and crystalline.
The linkage between two monosaccharide sugar molecules to form a disaccharide IS called a glycosidic linkage or glycoside bond.
When two sugar molecules get linked, one water molecule is formed.
Example: Lactose, sucrose, maltose, etc.

**iii. Polysaccharides:**

Complex carbohydrates are formed by the condensation of large number of monosaccharides.
They can be easily hydrolyzed.
They are amorphous, tasteless and insoluble in water.
General formula of polysaccharide is (C6HIO05)n. Here, 'n' represents number of monosaccharide

links.

They are classified into two types :

i. **Homopolysaccharides or homoglycans:**
It contains same type of monosaccharides.
Example: Starch, cellulose, glycogen, pectin, agar.

ii. **Heteropolysaccharides or heteroglycans:**
They consist of different types of sugar or sometimes non-sugar components also.
Example: Hemicellulose, mucilage, heparin.

## Additional information :

**Some important disaccharides are :**

Disaccharides: e.g., Maltose, Sucrose, Lactose, etc.

Maltose is formed by condensation of two glucose monomers. It is commonly known as malt sugar.

Sucrose is formed by condensation of one glucose monomer and one fructose monomer. It is commonly known as cane sugar.

Lactose is formed by condensation of one glucose and 'one galactose monomer. It is commonly known as milk sugar.

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**Q.8. What is the general formula of carbohydrates?**

**Ans:** $C_nH_{2n}O_n$ is the general formula of carbohydrates.

**Q.9. What is the main role of carbohydrates?**

**Ans:** Main role of carbohydrates 'is to provide energy to the body for metabolism.

**Q.10. Give the role of carbohydrates.**

**OR**

**What role does carbohydrates play in living body?**

**Ans: Role of carbohydrates:**

i. The most important function of carbohydrates is to provide energy to the body for metabolism. Glucose supplies the immediate energy to the body. One, gram of carbohydrate on oxidation yields on an average four calories. In plants, starch is the reserved food, while in man glycogen is the reserved food.
ii. Monosaccharides like glucose is the main substrate for synthesis of ATP.
iii. Carbohydrates are the structural components of cell membrane and cell wall.
iv. Cell wall of plants consists of cellulose and pectin.

**Q.11. Distinguish between monosaccharides and disaccharides.**

**Ans:**

| No. | Monosaccharides | Disaccharides |
|---|---|---|
| i. | They are composed of 3-6 carbon atoms. | They are composed of two monosaccharide units covalently linked to each other. |
| ii. | They cannot be hydrolyzed into smaller units. | They can be hydrolysed into monosaccharides. |
| iii. | Example: Glucose, Fructose | Example: Sucrose and Lactose |

**Q.12. Differentiate between Disaccharides and Polysaccharides.**

**Ans:**

| No. | Disaccharides | Polysaccharides |
|---|---|---|
| i. | Made up of 2 monosaccharide units. | Made up of many monosaccharide units. |
| ii. | Soluble in water | Not soluble in water. |
| iii. | Sweet in taste. | Tasteless. |
| iv. | e.g. Sucrose, maltose, lactose. | e.g. Glycogen, starch and cellulose. |
| v. | They are crystalline. | They are amorphous. |

**Q.13. What are the three groups of carbohydrates?**

**Ans: The three groups of carbohydrates are:**

i. Monosaccharides ii. Disaccharides iii. Polysaccharides

**Q.14. Who coined the term 'protein'?**

**Ans:** Berzelius (1830) coined the term 'protein'.

**Q.15. Write a note on the. properties of proteins.**

**Ans: Properties of proteins:**

i. Proteins are long chain polymers of amino acids and contain carbon, hydrogen, oxygen and nitrogen.
ii. Proteins are large macromolecules with high molecular weight and most abundant organic components of the cell.
iii. Proteins are important structural constituents of the cell.
iv. Many proteins are host specific and show slight variation in each species.
v. The differences among the species are due to differences in the protein components.
vi. The number of proteins in a cell varies.
vii. Some protein molecules contain sulphur and other elements in addition to C, H, O and N.

**Q.16. Explain about the formation of a protein molecule.**

**OR**

**How does the formation of a protein molecule take place?**

**Ans:** i. The basic building blocks of proteins are amino acids.
ii. In a long chain' of amino acids forming a protein, the amino group ($–NH_2$) of one amino acid is linked to the carboxyl (–COOH) group of the other amino acid.
iii. Two amino acids are condensed by removal of a water molecule (OH from COOH and H from $NH_2$) to form a peptide linkage.
iv. The remainder of each amino acid after removal of water molecule (Wand OH-) is called residue.
v. A molecule of a protein made up of two amino acid residues is called a dipeptide, of three residues are tripeptide and of many residues as polypeptide.
vi. Each polypeptide, i.e. a long chain of amino acids contain free amino group (-NH2) at one end and carboxyl (-COOH) group at the other end called N-terminal and C-terminal respectively.
vii. During elongation of polypeptide chain, a new amino acid can be added at either end due to free amino or carboxyl group.

**Q.17. Name the different amino acids that occur in the cell.**

**Ans:** The different amino acids occuring in the cell are as follows:

| | | | |
|---|---|---|---|
| i. Glycine | ii. Alanine | iii. Serine | iv. Cysteine |
| v. Aspartic acid | vi. Glutamic acid | vii. Asparagine | viii. Glutamine |
| ix. Methionine | x. Threonine | xi. Valine | xii. Leucine |
| xiii. Isoleucine | xiv. Lysine | xv. Histidine | xvi. Arginine |
| xvii. Phenylalanine | xviii. Tyrosine | xix. Tryptophan | xx. Proline |

**Q.18. How amino acids are linked to form a long chain?**

**Ans:** In a long chain of amino acids, the amino group ($–NH_2$) of one amino acid is linked by peptide linkage to the carboxyl group (-COOH) of the other amino acid.

**Q.19. Give the classification of proteins.**

**Ans:** Proteins are classified into two main types depending upon the chemical composition:

i. Simple proteins ii. Conjugated proteins

**i. Simple proteins:** They are made up of amino acids or their derivatives. There are different groups included in simple proteins.
e.g. Albumin, globulin, histones, zein from maize.

**ii Conjugated proteins:** They consist of simple proteins (amino acids) in combination with some nonprotein component. The non-protein part is called prosthetic group.

e.g.

a. Lipoproteins (Proteins + Lipids), e.g. egg yolk, serum
b. Nucleoproteins (Protein + Nucleic acid).
c. Glycoproteins (Proteins + Carbohydrates), e.g. mucin of the saliva.
d. Chromoproteins (Proteins + Pigment) e.g. Cytochrome, haemoglobin

**Q.20. What are proteins? Describe different biological functions of proteins.**

**Ans: Proteins:**

Proteins are the long chain polymers of amino acids and possess high molecular weight. They contain C, H, O and N. The presence of N distinguishes them from carbohydrates and lipids. Some proteins contain sulphur, while few proteins contain phosphorus also. Cells contain a large number of proteins.

**Biological functions of proteins:**

The biological importance of proteins is as follows:

**i.** **Membrane proteins:** Cell membrane consists of proteins and lipids. All membrane bound cell organelles have lipids and proteins in their membranes.

**ii.** **Enzymes:** All enzymes are proteins. Enzymes may contain some other non-protein part also along with protein. e.g. Amylase.

**iii.** **Hormones:** Hormones are proteins. They play an important role in the regulation of metabolic reactions in the body. e.g. Insulin, thyroxine.

**iv.** **Transport protein:** Haemoglobin which is present in R.B.C. of man is a type of protein. It is useful for transportation of oxygen.

**v.** **Contractile protein:** Muscle fibres consist of proteins, which help in contraction. e.g. Myosin.

**vi.** **Structural protein:** These proteins form parts of cells or tissues. e.g. Keratin is present in hair and skin, while elastin is present in connective tissue.

**vii.** **Defensive proteins:** Useful for the protection of body. e.g. Immunoglobin, thrombin for clotting of blood. .

**Q.21. What are lipids? Explain their generai properties and composition.**

**Ans: Lipids:**

i. They are macro-biomolecules.
ii. Lipids are a group of heterogeneous compounds like fats, oils, steroids, waxes, etc.

**Properties:**

i. Animal fat is often solid while in plants, liquid oils are present.
ii. Lipids are insoluble in water.
iii. They are soluble in organic or non-polar solvents like benzene, chloroform, etc.

**Composition:**

i. Lipids are composed of C, H, O atoms.
ii. The proportion of H : O is greater than 2 : 1.
iii. Compound lipids contain N, S and P in addition to C, H and O.
iv. Lipids possess two types of monomers such as fatty acids and long chain alcohols, commonly glycerol.

**Q.22.Why plant fats are liquid at room temperature while animal fats are solid?**

**Ans:** i. Plant fats are unsaturated fatty acids, whereas animal fats are saturated fatty acids ..
ii. Fats having unsaturated fatty acids are liquid at room temperature.
iii. Saturated fatty acids are solid at room temperature.
iv. Hence, plant fats are liquid at room temperature, while animal fats are solid.

**Q.23. Describe different types of lipids. Add a note on their role or functions.**

**Ans: Lipids are classified into three main types:**

i. Simple lipids ii. Compound lipids iii. Derived lipids

**i. Simple lipids:**

These are esters of fatty acids with alcohol. Fatty acid is a long straight chain of carbon atoms with a carboxyl group (–COOH) at one end. Monoglycerides have one molecule of fatty acid, diglycerides

have two apd triglycerides have three molecules of fatty acids.

The fatty acids are of two types:

**a. Saturated fatty acid:**

These fatty acids do not have double bond between carbon atoms of its chain and consists of maximum possible hydrogen atoms. e.g. Stearic acid, palmitic acid, etc.

**b. Unsaturated fatty acid:**

These fatty acids contain one or more double bonds in between carbon atoms of its chain. e.g. Oleic acid. These acids are not fully saturated with hydrogen atoms. Fats containing unsaturated fatty acids are liquids at room temperature and are called oils.

**ii. Compound lipids:**

These lipids contain some additional element or groups in addition to fatty acids and alcohol such as nitrogen, phosphorus, sulphur, protein, etc. e.g. Phospholipids, glycolipids.

**iii. Derived lipids:**

These are the hydrolytic products of lipids. Lipids include steroids, waxes, carotenoids, essential oils, etc.

**a, Steroids:**

Each molecule of steroid has carbon atom arranged in four interlocking rings. Cholesterol, bile salts, male and female sex hormones are some of the biologically important steroids.

**b. Waxes:**

Plant waxes are esters of saturated fatty acids with long chain alcohols (other than glycerol) and ketone. These are secreted by epidermis and present on stem, fruit and leaves. In animals, feathers and fur are coated with wax.

**c. Carotenoids:**

These are pigments, which are present in the thylakoids of chloroplasts and chromoplasts of almost all higher plants. e.g. Alpha and beta carotene, xanthophylls, etc.

**Biological function of lipids:**

i. Lipids are reserved food material providing energy to the body. Lipids give more amount of energy to the body after oxidation. One gm lipid produces 9.0 kcal of heat.
ii. The cell membrane consists of lipids along with proteins.
iii. Some lipids act as components of some enzyme systems.
iv. Fats are present in subcutaneous tissue which acts as insulator for heat.
v. Some lipids are important as vitamins.
vi. Waxes found in animal tissues are esters of fatty acids and provides water proofing and check the rate of transpiration in plants.
vii. Cholesteroi takes part in the synthesis of vitamin D and is precursor of many sex hormones.

**Q.24. What are saturated fatty acids?**

**Ans:** Fatty acids not having double bond between carbon atom of its chain and consist of maximum possible hydrogen atoms are called as saturated fatty acids.

**Q.25. How many types of nucleic acids are present in the nucleus?**

**Ans: There are two types of nucleic acids present in the nucleus:**

**i. DNA:** Deoxyribose nucleic acid
**ii. RNA:** Ribose nucleic acid

**Q.26.What are nucleic acids? Give a brief account of DNA.**

**Ans: Nucleic acids:**

Nucleic acids are macromolecules composed of many small units or monomers called nucleotides. There are two types of nucleic acids, i.e. DNA and RNA.

**Brief account of DNA:**

i. DNA is a genetic material of a cell. It is double stranded helix. Each strand of helix is made up of deoxyribose nucleotides.

ii. These nucleotides are linked with each other by phosphodiester bonds.
iii. Two strands of DNA molecule are parallel, complementary and joined by weak hydrogen bonds.
iv. Nitrogen bases are complementary, i.e. A = T, G == C.
v. Each nucleotide is made up of deoxyribose sugar which is a pentose sugar, phosphoric acid and nitrogenous base.
vi. Two strands of DNA are antiparallel and complementary to each other. Adenine and thymine are paired with each other and cytosine is paired with guanine ..
vii. Double hydrogen bond is present between adenine and thymine and triple hydrogen bond is present between cytosine and guanine.
viii. Purine: Pyrimidine ratio is 1 : 1

**Q.27. State the difference between nucleoside and nucleotide.**
**Ans:** Nucleotide is made up of base, sugar and phosphoric acid, whereas nucleoside is made up of base and sugar.

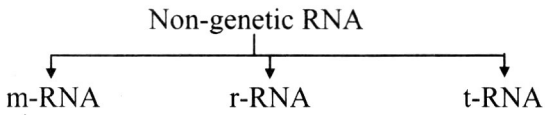
**Q.28. Who proposed the double helix structure of DNA ?**
**Ans:** Watson and Crick proposed the double helix structure of DNA.

**Q.29. Where is DNA located in the eukaryotic cell? What are its functions?**
**Ans: Location:** DNA is situated mainly in the nucleus, but also occurs in mitochondria and chloroplasts.
**Function:** It is the genetic material and contains all the information needed for development and existence of an organism.

**Q.30. Describe the structure of RNA. Also, mention its types.**
**Ans: Structure:**
RNA (Ribose Nucleic Acid) is a single stranded structure having fewer nucleotides as compared to DNA.
The strands may be straight or variously folded upon itself.
It is made up of nucleotides.
Each nucleotide consists of ribose sugar (5C), nitrogen base and phosphate.
Nitrogen bases are of two types: purine and pyrimidine. Adenine and guanine are two types of purines.
Cytosine and uracil are two types of pyrimidines.
**Types of RNA:**
There are two main types of RNA:
**i. Genetic RNA:** Present in most plant viruses and some animal viruses.
**ii. Non-genetic RNA:** It is of three types: mRNA, rRNA and tRNA.
Non-genetic RNA is responsible for protein synthesis in the cell.

**Q.31.What is genetic RNA?**
**Ans:** When RNA acts as genetic material as in plant viruses and some animal viruses, it is known as genetic RNA.

**Q.32. Describe non genetic RNA types.**
**Ans:** The non genetic RNA is present in organisms where DNA is the genetic material. The non genetic RNA is of the following types:




**a. m-RNA (Messenger RNA):**
i. Messenger RNA forms 5% ofthe total RNA.
ii. It is always single stranded, linear molecule.
iii. It is produced from DNA. The process of formation of m-RNA from DNA is called transcription.
iv. **Function:** It carries the genetic message from DNA to ribosomes, which are the sites of protein synthesis.

**b. r-RNA (Ribosomal RNA):**

i. Ribosomal RNA, as the name suggests, is found associated with the ribosome.
ii. It comprises about 80% of total cell RNA.
iii. It is single stranded but folded upon itself in some regions. In some regions, nitrogen base pairing may be observed.
iv. Function: It provides proper binding site for m-RNA during protein synthesis.

**c. t-RNA (Transfer RNA):**

i. t-RNA is also called soluble RNA (s-RNA).
ii. It is about 10 - 15% of the total cell RNA.
iii. It is the smallest RNA.
iv. It is either hair-pin like or clover leaf like structure.
v. A particular t-RNA carries a specific activated amino acid from cytoplasm to ribosome which is the site for protein synthesis.
**vi. Function:** It helps intelongation of polypeptide chain during the process called translation.

**Q.33. Why is purine: pyrimidine ratio 1 : 1 in DNA while it is not so in RNA?**

**Ans:** DNA is a double stranded molecule which is stabilized by the constant purine-pyrimidine ratio, whereas RNA is a single stranded molecule. Hence, the purine: pyrimidine ratio in DNA is 1: 1 and not in RNA.

**Q.34. Distinguish between m - RNA and r - RNA.**

**Ans:**

| No. | m – RNA | r – RNA |
|---|---|---|
| i. | m – RNA is a linear molecule. | r – RNA is linear molecule but folded upon itself. |
| ii. | m – RNA forms about 5 % of total cellular RNA. | r – RNA is 80 % of total cellular RNA. |
| iii. | It is formed in nucleus and moves to cytoplasm. | It is present on ribosomes in cytoplasm. |

**Q.35. Distinguish between DNA and RNA.**

**Ans:**

| No. | DNA | RNA |
|---|---|---|
| i. | It is a genetic material of majority of the organisms. | It is a genetic material of some viruses. |
| ii. | It is double stranded. | It is single stranded. |
| iii. | Deoxyribose sugar is present. | Ribose sugar is present. |
| iv. | Thymine is present as one of the pyrimidine base. | Uracil is present as one of the pyrimidine base. |
| v. | Specific base pairing is observed. | Nitrogen bases do not form pair. |
| vi. | Total number of purine is equal to total number of pyrimidine. Thus, purine to pyrimidine ratio is 1:1. | Amount of purine and pyrimidine may or may not be equal. |
| vii. | It is present in nucleus. | It is present in nucleus and cytoplasm. |
| viii. | It is responsible for determining hereditary characters and for formation of RNA. | It takes part in protein synthesis. |

## 3.2 : Enzymes :

**Q.36. Who coined the term enzyme?**

**Ans:** The term 'enzyme' was coined by William Kuhne (1878) while working on fermentation. [Greek: En - in; zyma - yeast]

**Q.37. What are endoenzymes?**

**Ans: Endoenzymes:** The enzymes that are produced within a cell for metabolic activities are known as endoenzymes

**Q.38. What are exoenzymes?**

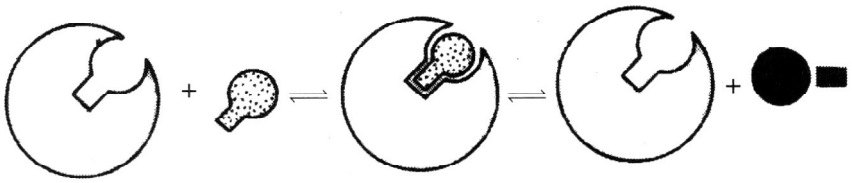
**Ans: Exoenzymes:** The enzymes which act away from the site of synthesis are called exo-enzymes. These are also known as extracellular enzymes.

**Q.39. Discuss the mechanism of enzyme-action.**

**Ans:** i. It is explained by lock and key theory.

ii. According to this postulate, lock is the enzyme and key is the substrate. Only key with correctly positioned structure fits into key hole (i.e. active site) of enzyme.

iii. As specific key fits into specific lock, in the similar way specific enzyme reacts with specific substrate molecule.




iv. The substrate (S) binds to the active site of the enzyme (E) and ES complex is formed.

v. This induces the enzyme to alter its shape, fitting more tightly around S.

vi. Active site breaks the chemical bonds of S and new EP (product) complex is formed.

| E | + | S | ⇒ | ES | ⇒ | Enzyme | + | Products |
|---|---|---|---|---|---|---|---|---|
| Enzyme | | Substrate | | Enzyme Substrate Complex | | | | |

vii. Enzyme releases the P and free E is ready to bind another molecule of S to repeat the cycle. ( It is assumed that the substrate plays a role in determining the final shape of the enzyme. It induces E to alter its shape.

**Q.40. What are different classes of enzymes?**

**OR**

**Give a classification of enzymes with examples.**

**Ans: Enzymes are classified into six classes:**

| | |
|---|---|
| Oxidoreductase | Oxidase and dehydrogenase are the enzymes that bring about oxidation. reduction reaction. e.g, NAD oxidoreductase. |
| Transferases | They transfer functional group such as amino, methyl, phosphate from one substance to the other.e.g. Hexokinase,transaminase. |
| Hydrolases | They bring about hydrolysis of ester, ether, peptide bond, glycosidic bonds, C-C bonds e.g. alkaline phosphatase |
| Lyases | They catalyze removal of a group from their substrate without hydrolysis. e.g. Fumarase and aldolase |
| Isomerases | Causes catalytic interconversions of geometric,optical and positional isomers. e.g. Phospho hexose isomerase,triose-phospho-isomerase. |
| Ligases | Helps in joining the two molecules. e.g. acetyl CoA carboxylase, succinic thiokinase are examples of ligases. |

**Q.41. What are enzymes? State the general properties of enzymes.**

**Ans: Enzymes:** An enzyme is a specialized proteinaceous substance produced within an organism which 'is capable of catalyzing a specific chemical reaction within the cell.

It alters the chemical reaction without undergoing any change itself.

It is also called as biocatalyst.

Properties of enzymes:

**i. Role in biochemical reaction:**

Enzymes accelerate the reaction, but do not initiate it.

ii. **Participation in the reaction:**
Enzymes do not participate in the reaction but they remain unchanged at the end of the reaction. Enzymes are therefore required in small amounts. They speed up the reaction.

iii. **Active site of enzyme:**
The molecule of an enzyme is larger than that of substrate molecule and hence during a reaction a specific part of enzyme molecule comes in contact with the substrate molecule. That part is called active site of an enzyme.

iv. **Amphoteric nature:**
Chemically, most of the enzymes are proteins and therefore show amphoteric nature.
Enzymes can react with acidic substances as well as alkaline substances.

v. **Specificity:**
Most of the enzymes are specific in their action. A single enzyme acts upon a single substrate or a group of closely related substrates.
**Example:**
a. Enzyme urease can act only upon urea and no other molecule.
b. Enzyme invertase can act upon sucrose only.
A slight change in the configuration of the substrate molecule requires action by a different enzyme.

vi. **Colloidal nature:**
All enzymes are colloidal in nature and thus provide large surface area for reaction to take place.
Colloids (colloids-gel like) are mixtures of two components, i.e. dispersed particles and dispersion medium.
The size of the dispersed particles is larger than the dispersion medium.

vii. **Enzyme optima:**
Enzyme works best under certain defined conditions referred as optima. It includes temperature and pH.

**Q.42. Describe the factors affecting enzyme activity.**

**OR**

**Write a note on factors affecting enzyme activity.**

**Ans: Factors affecting the activity of enzymes:**

i. **Temperature:**
Enzyme action is greatly affected by temperature.
Enzyme activity increases with increase in temperature upto 40°C. Above 60°C, there is loss of enzyme activity because proteins get denatured.
When the temperature is reduced to .freezing point or below freezing point, the enzymes become inactivated but not destroyed. At optimum temperature, rate of reaction is more.

ii. **pH :** For most enzymes, the effective pH is 4 to 9. Strong acid or strong base destroys the enzyme.

iii. **Concentration of enzyme and substrate:** Rate of reaction is directly proportional to concentration of reacting molecules. With the increased concentration of substrate molecules, rate of enzyme reaction also increases upto a certain limit. Beyond a certain point, however, the enzyme becomes saturated with substrate molecules.

iv. **Inhibitors:** Certain compounds combine with an enzyme but do not serve as substrate. They block the action of enzymes and function as inhibitors. The inhibitors usually closely resemble the substrate in structure. They are called competitive inhibitors. Poison like cyanide does not bind the enzyme at substrate binding site but binds at some other site and inhibits the activity of enzyme. Such substances are called non-competitive inhibitors.

## Additional Information :

**Isoenzymes or isozymes:**
Multiple forms of enzymes with different molecular weight but with same catalytic activity, for example, lactate dehydrogenase has five different forms but all the five forms have same function, i.e. it catalyzes the interconversion of pyruvate and lactate.

**Q.43. What is the active site of an enzyme?**
**Ans:** Active site of an enzyme is a specific part of an enzyme which comes in contact with the substrate during reaction.

**Q.44. Write a note on enzyme inhibitors.**
**Ans:** Enzyme inhibitors are certain chemicals which inhibit enzyme activity.
During the reaction, the active site of enzyme is occupied by these substances instead of substrate molecules and the activity of the enzyme is lost.
There are two basic types of enzyme inhibitors:

i. **Competitive inhibitors:** Competitive inhibitors are substances which are similar to substrate molecules in their structure.
ii. **Non-competitive inhibitors:** Non-competitive inhibitors do not bind with enzyme at substrate binding site, but bind at some other site (prosthetic group) and inhibit the activity of the enzyme. e.g. Cyanide.

**Q.45. What is apoenzyme?**
**Ans:** Proteinaceous part of enzyme is called apoenzyme.

**Q.46. Define co-factors. Explain it with examples.**
**Ans:** i. Non-protein constituents which make an enzyme catalytically active are called as co-factors.
ii. Prosthetic groups are the cofactors tightly bound to an apoenzyme.
iii. Vitamins are essential chemical components of many coenzymes.
iv. Metal ions are required for activation of certain enzymes.

**Q.47. Write the full form of NADP.**
**Ans: NADP:** Nicotinamide adenine dinucleotide phosphate.

## 3.3 : Concept of Metabolism :

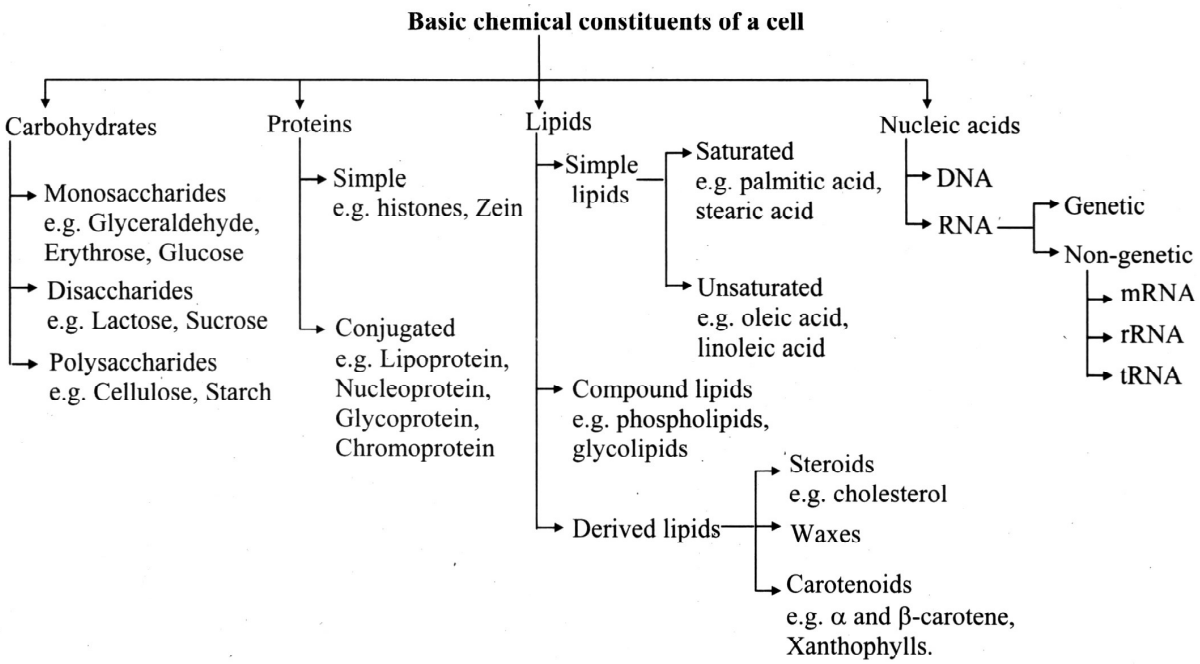
**Q.48. Explain the term metabolism.**
**Ans:** i. It is the sum of all processes that take place in each living cell to meet day to day needs.
ii. It consists of two kinds of reactions-catabolic process and anabolic process.
iii. Among these processes, synthetic processes are called anabolic reactions. e.g. production of enzymes.
iv. Degrading processes of cell are called catabolic reactions. e.g. glycolysis.
v. Anabolic processes consume the energy, while catabolic processes release energy.

**Q.49. Name the two different kinds of metabolism.**
**Ans:** Anabolism and catabolism are two different kinds of metabolism.

## Additional Theory Questions :

Q.1. Write a note on simple lipids and derived lipids. Refer Q.23. (i) and (iii)
Q.2. What are the biological functions of lipids? Refer Q.23.
Q.3. Write a short note on m-RNA. Refer Q.32. (a)
Q.4. Describe the important properties of enzymes. Refer Q.41.
Q.5. What are non-competitive inhibitors? Refer Q.44. (U)

## Quick Review :




- **Scientists and their contribution :**

| No. | Scientists | Contribution | Year |
|---|---|---|---|
| i. | Bloor | Coined the term 'lipid' | 1943 |
| ii. | Emil Fischer | Called amino acids as building blocks of the proteins. | – |
| iii. | Berzelius | Introduced the term protein. | 1830 |
| iv. | F. Sanger | Established the sequence of amino acids of insulin which contains 51 amino acids | 1955 |
| v. | Fredrick Miescher | Gave the name nuclein to nucleic acid isolated from pus cells. | 1869 |
| vi. | Richard Altmann | First to usc thc term 'nuclcic acid.' | 1899 |
| vii. | Ascoli, Levine and Jones | Disclosed two kind of nucleic acids DNA and RNA | 1900 |
| viii. | Watson and Crick | Put forward the double stranded helical model of DNA molecule | 1953 |
| ix. | Kuhne | Coined the term 'enzyme'. | 1878 |
| x. | Edward Buchner | Discovered enzyme. | 1897 |

## Multipal Choice Question's

1. Most common constituents of organic compounds found in organisms are
   a) C, H, O, P  b) C, H, O
   c) C, H, N, P  d) C, H, O, N, P
2. Carbohydrates are composed of
   a) carbon  b) hydrogen
   c) oxygen  d) all of these
3. In which of the following, the ratio of hydrogen and oxygen atoms is 2 : I?
   a) proteins  b) fats
   c) oil  d) carbohydrates
4. Which of the following do not give smaller sugar units on hydrolysis?
   a) Monosaccharides
   b) Disaccharides
   c) Polysaccharides
   d) Glycogen
5. The simplest monosaccharide made up of three carbons amongst the following is
   a) erythrose  b) glucose
   c) glyceraldehyde  d) ribose
6. Deoxyribose sugar is an example of
   a) monosaccharide  b) disaccharide
   c) polysaccharide  d) simple protein
7. Common example/s of hexose sugar is/are
   a) glucose  b) fructose
   c) erythrose  d) both a) and b)
8. If a compound contains 2 monosaccharides, then it is described as
   a) derived monosaccharide
   b) disaccharide
   c) polysaccharide
   d) pentose sugar
9. In a disaccharide, monomers are linked with each other through
   a) peptide bonds  b) hydrogen bonds
   c) glycosidic bonds  d) ester bonds
10. A disaccharide that gives two molecules of glucose on hydrolysis is
    a) sucrose  b) maltose
    c) lactose  d) none of these
11. Sugar present in milk is
    a) fructose  b) lactose
    c) galactose  d) sucrose
12. Polysaccharides consist of
    a) two monosaccharide units
    b) eight monosaccharide units
    c) many monosaccharide units
    d) amino acids
13. The most abundant carbohydrate in nature is
    a) Chitin  b) Glucose
    c) Peptidoglycan  d) Cellulose
14. Proteins are linear polymers of
    a) amino acids
    b) fatty acids
    c) monosaccharides
    d) nucleic acids
15. Proteins are formed by the condensation of
    a) nucleic acids  b) amino acids
    c) fatty acids  d) carbohydrates
16. Protein is
    a) micromolecule
    b) macromolecule
    c) soluble
    d) specific
17. Which of the following is the milk protein?
    a) Lactose  b) Casein
    c) Insulin  d) Glucagan
18. Which of the following releases lot of energy on its breakdown?
    a) Carbohydrate  b) Fat
    c) Starch  d) Protein
19. Simple lipids are esters of
    a) amino acids
    b) proteins
    c) phosphorus
    d) fatty acids with glycerol
20. Keratin is a _____ protein.
    a) transport  b) protective
    c) structural  d) storage
21. Fatty acids which do not contain double bond between carbon atoms are
    a) saturated fatty acids
    b) unsaturated fatty acids
    c) oleic and linoleic acids
    d) linoleic and linolenic acids
22. Cell membranes are made up of
    a) proteins
    b) lipids
    c) lipids and proteins
    d) carbohydrates
23. A nucleotide contains
    a) sugar + phosphate
    b) N-base + phosphate

c) sugar + nitrogenous base
d) sugar + N-base + phosphate

**24.** Nucleotides, the polymers of nucleic acid ,are joined together by
a) Peptide bond
b) Ester bond
c) Phosphodiester bond
d) Glycosidic bond

**25.** Find the odd one.
a) Adenine b) Cytosine
c) Thymine d) Uracil

**26.** ATP, the energy currency of cell is a
a) Protein b) Nucleotide
c) Nucleoside d) Coenzyme

**27.** The two strands of DNA are
a) similar in nature and complementary
b) anti-parallel and complementary
c) parallel and complementary
d) basically different in nature

**28.** RNA is genetic material in
a) bacteria b) cyanobacteria
c) bacteriophages d) plant viruses

**29.** Which RNA is present in more amount in the cell?
a) m-RNA b) t-RNA
c) r-RNA d) not certain

**30.** Smallest RNA is
a) t-RNA b) m-RNA
c) r-RNA d) not specific

**31.** Hair pin like structure is observed in
a) m-RNA b) t-RNA
c) r-RNA d) DNA

**32.** All enzymes are
a) proteins b) lipids
c) carbohydrates d) vitamins

***33.*** Find out the incorrect one.
a) All enzymes are specific
b) All enzymes are biocatalysts
c) All enzymes are proteins
d) All proteins are enzymes

**34.** _____ catalyze hydrolysis of ester, ether etc.
a) Lyases b) Ligases
c) Hydrolases d) Transferases

***35.*** _____ catalyze interconversions of geometric, optical and positional isomers.
a) Transferases b) Ligases
c) Oxidoreductase d) Isomerases

**36.** _____ are also known as dehydrogenases.
a) Oxidoreductases b) Ligases
c) Lyases d) Transferases

**37.** The enzyme functions best at temperature
a) 30° to 50° C b) 15° to 25° C
c) 20° to 30° C d) 40° to 50° C

**38.** As temperature changes from 30° to 45° C, the rate of enzyme activity will
a) decrease
b) increase
c) first increase and then decrease
d) first decrease and then increase

**39.** Out of the following, which is not a property of enzymes?
a) Specific in nature
b) Proteinaceous
c) Used up in reaction
d) Increased rate of biochemical reaction

**40.** At high temperature, enzyme gets
a) denatured b) killed
c) slightly activated d) inactivated

**41.** Majority of cellular enzymes function best at _____ pH.
a) acidic b) basic
c) neutral d) strang base

**42.** The action of enzyme with a substrate is explained by lock and key theory.
a) relative b) specific
c) random d) abstract

**43.** _____ was the first to isolate urease in pure crystalline form from the Jack bean extract.
a) W. Kuhne b) G. Mendel
c) J. B. Sumner d) both a) and c)



## Answer Keys

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. b) | 2. d) | 3. d) | 4. a) | 5. c) | 6. a) | 7. d) | 8. b) | 9. c) | 10. a) |
| 11. b) | 12. c) | 13. d) | 14. a) | 15. b) | 16. b) | 17. b) | 18. b) | 19. d) | 20. c) |
| 21. a) | 22. c) | 23. d) | 24. c) | 25. a) | 26. b) | 27. b) | 28. d) | 29. c) | 30. a) |
| 31. b) | 32. a) | 33. d) | 34. c) | 35. d) | 36. a) | 37. a) | 38. c) | 39. c) | 40. a) |
| 41. c) | 42. b) | 43. c) | | | | | | | |