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**Q1.** How many members are presents in the ring of fructose present in sucrose?

**Q2.** Pyranose structure of glucose contains how many members in the ring?

**Q3.** Name any aldotetrose ; Aldopentose-Ribose.

**Q4.** Write the name of anomers of glucose.

**Q5.** Give one example each for disaccharide and polysaccharide.

**Q6.** The melting point and solubility in water of amino acids are generally higher than that of the corresponding halo acids. Explain.

**Q7.** What products are expected when lactose is hydrolysed?

**Q8.** Glucose or sucrose are soluble in water but cyclohexane or benzene (simple six membered ring compounds) are insoluble in water. Explain.

**Q9.** What are essential amino acids?

**Q10.** Write the equation which shows that glucose produces energy in living beings.

**Q11.** Which linkage is present between the two units of monosaccharides in disaccharide?

**Q12.** Name the monosaccharide units in maltose.

**Q13.** What is the monomer unit of cellulose and starch?

**Q14.** Classify the following into monosaccharides and disaccharides:
Ribose, 2-deoxyribose, maltose, galactose, fructose and lactose.

**Q15.** Write two main functions of carbohydrates in plants.

**Q16.** What are reducing sugars?

**Q17.** What products would be formed when a nucleotide from DNA containing thymine is hydrolysed?

**Q18.** Why vitamin C cannot be stored in our body?

**Q19.** Where does the water present in the egg go after boiling the egg?

**Q20.** What is isoelectric point of amino acid? How does it help in the separation of amino acids?

**Q21.** What are enzymes?

**Q22.** What is the basic structural difference between starch and celllulose?

**Q23.** On electrolysis in acidic solution amino acids migrate towards cathode while in alkaline solution these migrate towards anode. Why?

**Q24.** How do you explain the absence of aldehyde group in the penta acetate of D-glucose?

**Q25.** Why are vitamin A and vitamin C essential to us? Give their important sources.

**Q26.** How are vitamins classified? Name the vitamin responsible for the coagulation of blood?

**Q27.** How do you explain the amphoteric behaviour of amino acids?

**Q28.** What are essential and non-essential amino acids? Give examples of each type.

**Q29.** Enumerate the reactions of D-glucose which cannot be explained by its open chain structure.

**Q30.** What are the hydrolysis products of
(a) Sucrose and (b) lactose

**Q31.** What is glycogen? How is it different from starch?

**Q32.** Differentiate between saccharides.

**Q33.** Differentiate between primary and secondary structure of protein.

**Q34.** What are nucleic acids? Mention their two important functions.

**Q35.** Write important structural and functional differences between DNA and RNA.

**Q36.** What is the difference between a nucleoside and a nucleotide?

**Q37.** What do you understand by the term glycosidic linkage?

**Q38.** What are monosaccharides?

**Q39.** Write the major classes in which the carbohydrates are divided depending upon whether these undergo hydrolysis, and if so, on the number of products formed.

**Q40.** Differentiate between globular proteins and fibrous proteins.

**Q41.** Define the following as selected to proteins:
(a) Peptide linkage (b) Primary structure (c) Denaturation.

**Q42.** What happens when D-glucose is treated with the following reagents?
(a) HI (b) Bromine Water (c) $HNO_3$

**Q43.** Name the deficiency diseases caused due to lack of Vitamin A, C, E, $B_1$, $B_2$, $B_6$, $B_{12}$ and K.

**Q44.** Define and classify vitamins. Name the diseases caused due to lack of any three of them.

**Q45.** Answer the following queries about proteins:
(a) How are proteins related to amino acids?
(b) How are oligopeptides different from polypeptides?
(c) When is a protein said to be denatured.

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**S1.** Five members.

**S2.** Six, five carbons and one oxygen.

**S3.** Aldotetrose-Erythrose; Aldopentose-Ribose.

**S4.** $\alpha$-D-glucose and $\beta$-D-glucose.

**S5.** Disaccharide-surcorse, Polysaccharide-starch.

**S6.** Amino acid molecules are dipolar (Zwitter ion) and so have strong intermolecular electrostatic forces between them. This makes their melting points and solubility in water higher than corresponding halo acids because in halo acids there is only hydrogen bonding between their molecules.

**S7.** On hydrolysis lactose yields equal amounts of D(+) glucose and D(+) galactose.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Hydrolysis}} \underset{\beta\text{–D–galactose}}{C_6H_{12}O_6} + \underset{\beta\text{–D–glucose}}{C_6H_{12}O_6}$$

**S8.** Glucose and sucrose have hydroxyl (–OH) groups which form strong hydrogen bonds with water molecules and hence these are soluble in water. Cyclohexane and benzene are non-polar compounds and do not have hydroxyl groups and hence they are not able to form hydrogen bonding with water molecules and therefore these are not soluble in water.

**S9.** The amino acids which are required proper growth and development and health and supplied through diet are known as essential amino acids. For example, valine, leucine, proline etc.

**S10.** $\underset{\text{Glucose}}{C_6H_{12}O_6} + 6CO_2 \longrightarrow 6CO_2 + 6H_2O + 2832\ kJ$

**S11.** Glycoside linkage

**S12.** Two units of $\alpha$-D-glucose.

**S13.** $\beta$-D-glucose in cellulose and $\alpha$-D-glucose in starch.

**S14.** (a) Monosaccharides — Ribose, 2-deoxyribose, galactose, fructose.

(b) Disaccharides — Maltose, lactose.

**S15.** (a) Carbohyrates are the structural components of cells. Cell wall of plants are made up of cellulose.

(b) In the form of starch, carbohydrates act as storage molecules in plants.

**S16.** All those carbohydrates which reduce Fehling solution and Tollen's reagent are referred to as reducing sugars. All monosaccharides whether aldose or ketose are reducing sugars. Disaccharides other than sucrose in which aldehydic or ketonic groups are free, are called reducing sugars. For example: maltose and lactose.

**S17.** Complete hydrolysis of a nucleotide from DNA containing thymine will yield.

(a) Phosphate group (b) β-D-2Deoxyribose sugar (c) Thymine

**S18.** Because vitamin C are water soluble vitamins and so these are readily excreted through urine and hence cannot be stored in our body.

**S19.** After boiling , the water soluble globular protein of egg white gets denatured and it coagulates into a hard and rubbery insoluble mass.

**S20.** The pH at which a particular amino acid does not migrate under the influence of an electric field is called isoelectric point of amino acid. At the isoelectric point, an amino acid does not dissolve in water. So isoelectric point of amino acids helps in the separation of different amino acids formed by the hydrolysis of proteins.

**S21. Enzymes:** Biological catalyst to catalyse to different specific biological reaction are called enzymes *Characteristics of enzymes*. Almost all enzymes are globular proteins. Some enzymes are non-proteins also. Enzymes are very specific for a particular reaction and for a particular substrate. Chemically enzymes are naturally occurring simple or conjugate proteins.

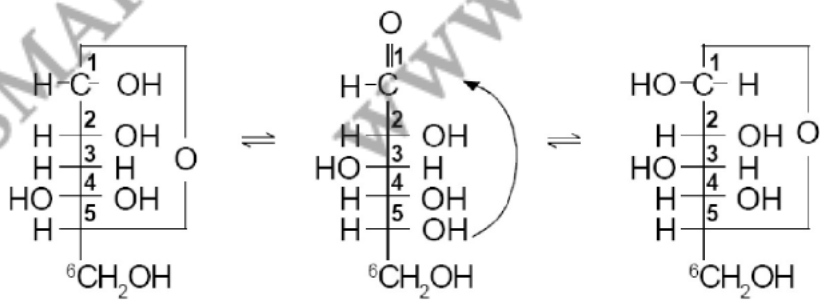
For example, maltase amylase. inertase etc.

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} \xrightarrow{\text{Maltase}} \underset{\text{Glucose}}{2C_6H_{12}O_6}$$

**S22.** Starch is a mixture of amylose (linear polymer of α-glucose) and amylopectin (branched chain polymer of α-glucose) whereas cellulose is a linear polymer of β-glucose.

**S23.** Because in acidic solution the amino acid has a positive charge on $NH_3$ and hence migrate towards cathode, whereas in basic solution there is no positive charge on $NH_3$ but have a negative charge on $COO^-$ and hence migrate towards anode in alkaline medium.

**S24.** If we add $NH_4OH$ or Fehling's solution or tollen's reagent to D-glucose pentacetate, no chemical reaction take place which shows that it does not have free aldehyde group and has cyclic structure. This explains the absence of —CHO group glucose or penta acetate of glucose and also existence of glucose in two forms as shown below. These two cyclic forms exist in equilibrium with open chain structure.



**S25.** (a) Vitamin A is essential for us because its deficiency causes — Xerophthalmia (hardening of cornea of eye) and night blindness.

(b) Vitamin C is essential as its deficiency will cause scurvy (bleeding gums)

**Vitamin A:** Fish liver oil, carrots, butter and milk.

**Vitamin B:** Citrus fruits, amla and green leafy vegetables.

**S26. Classification of vitamins:** Vitamins are classified into two groups depending upon their solubility in water or fat.

(a) **Fat soluble vitamins:** Vitamins which are soluble in fat and oils but insoluble in water are kept in this group. These are vitamins A, D, E and K. They are stored in liver and adipose (fat strong) tissues.

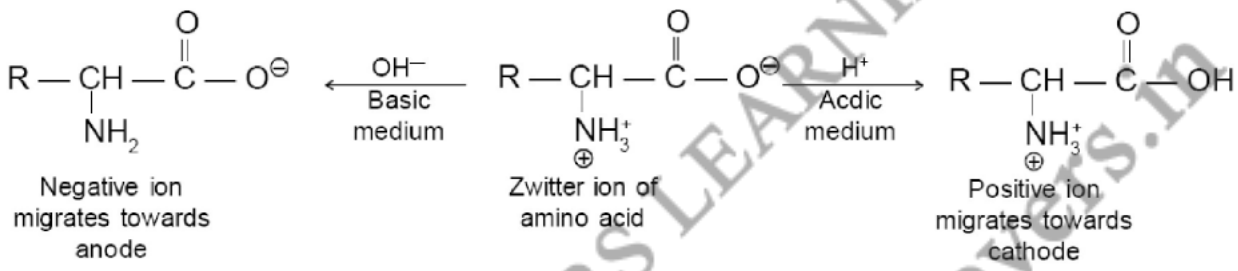
(b) **Water soluble vitamins:** B group vitamins and vitamin C are soluble in water so they are grouped together. Water soluble vitamins must be supplied regularly in diet because they are readily excreted in urine and cannot be stored (except vitamin $B_{12}$) in our body.

**Vitamin K** is responsible for the coagulation of blood.

**S27. Amphoteric nature of amino acids:** The zwitteric ionic form of amino acids react both with the acids and bases.

(a) In acidic solution, the carboxylate group zwitter ion accepts a proton and gets converted into carboxylic acid.

(b) In basic solution, the ammonium substituent ($NH_3$) of zwitter ion lose a proton and gets converted into amino group.




**S28.** (a) **Essential amino acids:** Amino acids which cannot be synthesized in our body and must be obtained through diet are known as essential amino acids.

**For example:** Valine, Leucine.

(b) **Non-Essential amino acids:** The amino acids which can be synthesized in our body are known as non-essential amino acids.

**For example:** Glycine, Alanine.

**S29.** Glucose does not give 2,4-DNP test, Schiff's test and does not react with sodium hydrogen sulphite and ammonia. These reactions indicate that glucose does not contain CHO group.

**S30.** (a) Hydrolysis products of sucrose:

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

(b) Hydrolysis of lactose:

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Lactose}} \underset{\text{D–Glucose}}{C_6H_{12}O_6} + \underset{\text{D–Galactose}}{C_6H_{12}O_6}$$

**S31.** Glycogen is a branched chain polymer of $\alpha$-glucose and is similar to amylopectin. It is also called animal starch as carbohydrates are stored in animal body as glycogen. It is present in liver, muscles and brain. When the body needs glucose, enzymes break the glycogen to glucose.

### Difference between Glycogen and starch:

Glycogen is a chain polymer of $\alpha$-glucose similar to amylopectin whereas starch is a mixture of amylopectin and amylose (linear polymer of $\alpha$-glucose).

**S32.** Difference between mono-, di- and polysaccharides:

| S. No. | Monosaccharides | Disaccharides | Polysaccharides |
|---|---|---|---|
| 1. | Their general formula is $C_nH_{2n}O_n$, where $n$ lies between 3 and 7. | General formula is $C_{12}H_{22}O_{11}$. | General formula is $(C_5H_8O_4)_n$ or $(C_6H_{10}O_5)_n$. |
| 2. | Soluble in water and sweet in taste. For example: Fructose. | Less soluble in water and sweet in taste. For example: Sucrose. | Insoluble in water and no sweet taste. For example: Starch. |

**S33.** Difference between primary and secondary structure:

| S. No. | Primary structure | Secondary structure |
|---|---|---|
| 1. | It determines the sequence in which amino acids are emerged. | The secondary structure of a protein refers to shape in which long amino acids chain exists. |
| 2. | It determines the function of a protein and is critical to its biological activity. | It does not determine the function of protein. |

**S34.** Nucleic acids are complex acids occurring in all living cells and composed of a phosphoric acid, sugar molecules, two types of purines and three types of pyrimidines. These are of two types:

(a) DNA – Deoxyribonucleic acid.

(b) RNA – Ribonucleic acid.

### Functions of nucleic acids:

(a) Store and pass on the hereditary message.

(b) Involved in protein synthesis.

**S35.** Differences between DNA and RNA:

| DNA | RNA |
|---|---|
| 1. Deoxyribose sugar. | 1. Ribose sugar. |
| 2. Pyrimidine base is thymine. | 2. Pyrimidine base is uracil. |
| 3. Double helix structure. | 3. Single helix structure. |
| 4. Found in the nucleus of the cell. | 4. Found in the fluid outside the cell (cytoplasm). |
| 5. Very big polymers. | 5. Comparatively smaller molecules. |
| 6. Responsible for transmission of hereditary characters. | 6. Responsible for synthesis of proteins in the cells. |

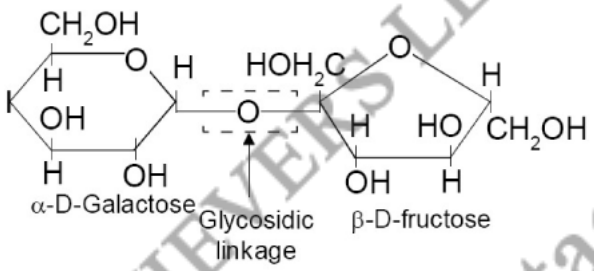
**S36.** (a) **Nucleoside:** It is a glucoside like complex of a carbohydrate and nitrogen containing bases like purines and pyrimidines.

**Nucleoside** = Base + Sugar

(b) **Nucleotide:** It is the phosphate ester of nucleoside. It is made up of three parts: Phosphoric acid, Pentose sugar, Nitrogen containing bases (Purines and Pyrimidines).

**Nucleotide** = Base + Sugar + Phosphate Group

**S37.** The two monosaccharides are joined together (in disaccharides or polysaccharides) by an oxide linkage formed by the loss of water molecule. Such a linkage between two monosaccharides units through oxygen atom is called glycosidic linkage for example, in sucrose two monosaccharides are help together by a glycosidic linkage between $C_1$ of $\alpha$-D-glucose and $C_2$ of $\beta$-D-fructose.




**S38.** A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called a monosaccharide.

Classification of monosaccharide on the basis of number of carbon atoms present in their molecules:

The monosaccharide with aldehyde group (— CHO) are called aldoses while those have ketonic group (>C ═ O) are called ketoses. They have the general formula $(CH_2O)_n$ where *n* is 3 to 7.

| No of carbon atoms | Type of sugar | Formula | Aldose | Ketose |
|---|---|---|---|---|
| 3 | Trioses | $C_3H_6O_3$ | Glyceraldehyde (an aldotriose) | Dihydroxy acetone (a keto-triose) |
| 4 | Tetroses | $C_4H_8O_4$ | Erythrose (an aldotetrose) | Eruthrulose (a keto-tetrose) |
| 5 | Pentoses | $C_5H_{10}O_5$ | Xylose (an aldopentose) | Xylulose (a keto-pentose) |
| 6 | Hexoses | $C_6H_{12}O_6$ | Glucose (an aldohexose) | Fructose (a keto-hexose) |

**S39.** The carbohydrates can be divided into three major classes, depending upon their hydrolysis.

(a) **Monosaccharides:** These cannot be broken into small units on hydrolysis.

(b) **Oligosaccharides:** These produce 2-10 monosaccharides on hydrolysis.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

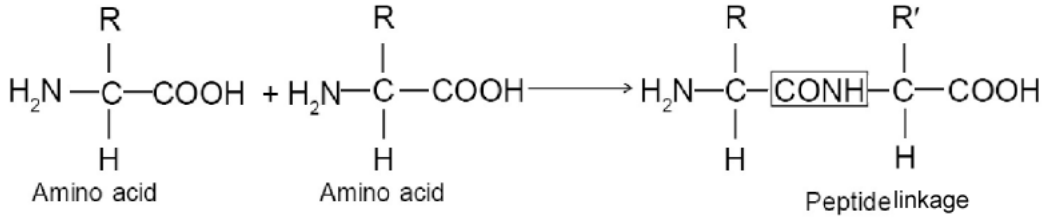
(c) **Polysaccharides:** These are high molecular mass carbohydrates which yield many molecules of monosaccharides on hydrolysis.

$$\underset{\text{Cellulose}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{H^+} \underset{\text{Glucose}}{nC_6H_{12}O_6}$$

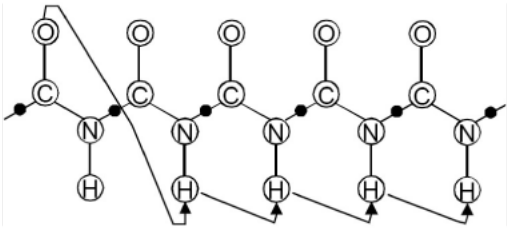
**S40.** Differences between globular proteins and fibrous proteins.

| Globular Proteins | Fibrous proteins |
|---|---|
| 1. $\alpha$-helix are tightly held up by weak attractive forces of various types – Hydrogen bonding, disulphide bridges, ionic or salt bridges. | 1. Fibrous proteins are held together by strong hydrogen bonds and disulphide bonds. |
| 2. Globular proteins have less spherical shape (compact structure). | 2. They can be stretched and contracted like a thread. |
| 3. Globular proteins usually less soluble in water. | 3. Firbrous proteins are usually insolublein water |
| 4. In globular proteins, polypeptide chains are arrange as coils. | 4. Fibrous proteins polpeptide chains run parallel to each other. |
| 5. **Example:** Insulin, thyroglobin, albumins, haemoglobin. | 5. **Example:** Keratins (hair, wool, silk, nails), myosins, elastins. |

**S41.** (a) **Peptide linkage:** The amide bond formed when the carboxylic group of one amino acid molecule reacts with amino group of another amino acid molecule with the elimination of water molecule called a *peptide bond* or *peptide linkage*. Linking together of many amino acids by peptide bonds result in the formation of peptide chain. Peptide bond is represented as —CONH—



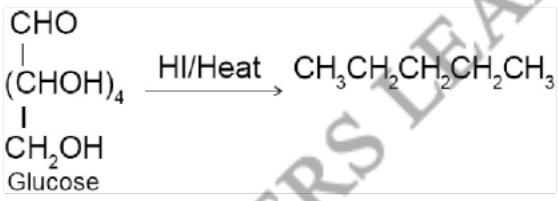

(b) **Primary structure of proteins:** Proteins may have one or more polypeptide chains. Each polypeptide in a protein has amino acids linked with each other in a structure of that protein. Any change in this primary structure *i.e.*, the sequence of amino acids creates a different protein.



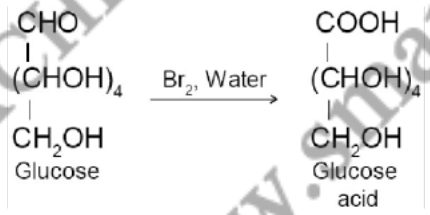
Primary structure of proteins. Linear polypetide chain.

(c) **Denaturation of proteins:** Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, protein loses its biological activity. This is called denaturation of protein.

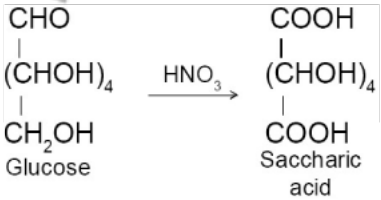
**S42.** (a) **HI:** On prolonged heating with HI, glucose forms *n*-hexane.




(b) **$Br_2$ Water:** Glucose gets oxidised (gluconic acid) on reaction with a mild oxidising agent like bromine water.




(c) **$HNO_3$:** On oxidation with nitric acid, glucose yields a dicarboxylic acid, that is saccharic acid.



**S43.** Deficiency diseases due to:

Vitamin A = Night blindness (Xerophthalmia)
Vitamin C = Scurvy

Vitamin E = Increase fragility of RBC's and muscular weekness
Vitamin $B_1$ = Beri-beri
Vitamin $B_2$ = Cheilosis, digestive disorder

Vitamin $B_6$ = Convulsions severe dermatitis
Vitamin $B_{12}$ = Pernicious anemia
Vitamin K = Increase blood clotting time.

**S44.** Vitamins can be defined as essential dietary factors required by an organism in minute quantities.

Vitamins are generally classified into two broad types based on their solubility *i.e.*, fat-soluble and water-soluble.

(a) **Fat-soluble vitamins:** These are oily substances not readily soluble in water. The group includes vitamins A, D, E and K.

(b) **Water-soluble vitamins:** This group includes the remaining vitamins *i.e.*, vitamins of B group (B-complex) and vitamin C.

Deficiency diseases caused due to lack of vitamins:

| Vitamins | Diseases |
|---|---|
| A | Xerophthalmia *i.e.*, hardening of cornea of eye. |
| C | Scurvy. |
| $B_1$ | Beri-beri (a disease of nervous system) |
| $B_6$ | Severe dematitis, convulsions. |
| $B_{12}$ | Pernicious anemia. |
| K | Increase blood clotting time. |

**S45.** (a) Proteins are high molecular mass complex biopolymers of amino acids present in all living cells.

(b) Relatively shorter peptides are known as *oligopeptides*, whereas longer peptides are called *polypeptides*.

(c) In denaturation of protein, globules unfold and helix get uncoiled and protein loses its biological activity. During denaturation, 2° and 3° structures are destroyed while 1° structure does not change.