Biomolecules

10 Chapter

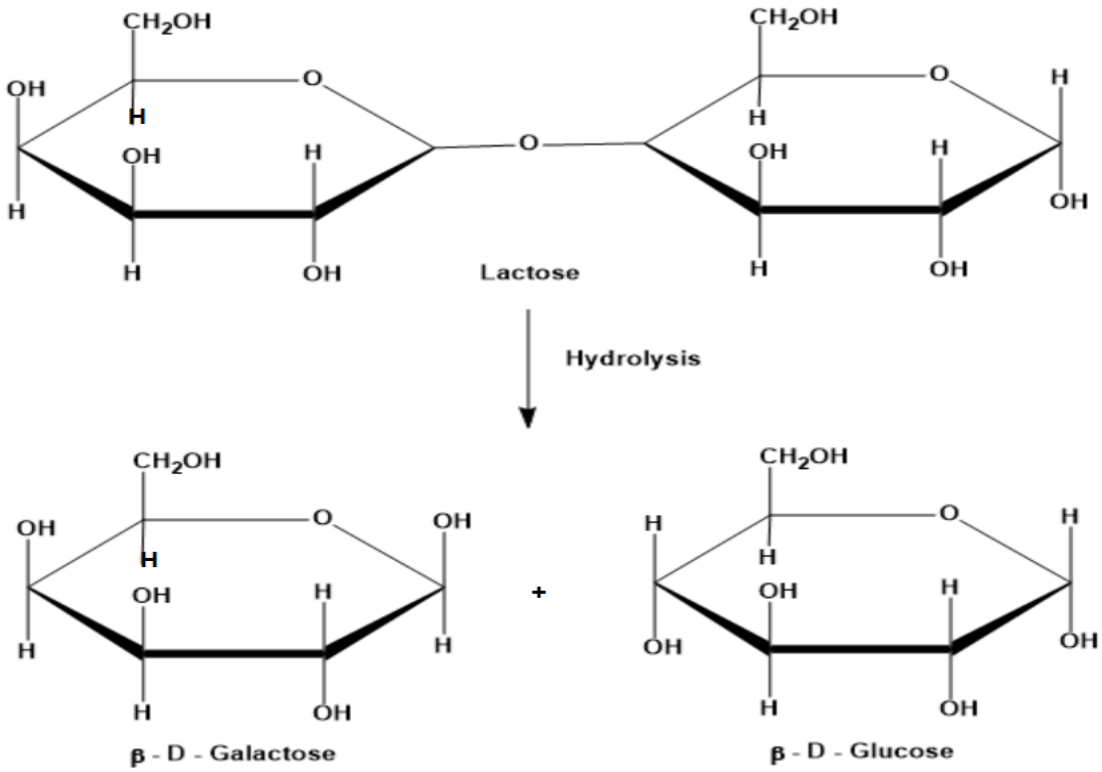
Intext Questions

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

Ans: The presence of H – bonding shows the dissolving property (solubility) of any compound. The glucose (5 -OH groups) and sucrose (8 -OH groups) can easily form H – bonding with water and thus, are soluble. Whereas, cyclohexane and benzene are not soluble in water due to absence of -OH groups within them.

2. What are the expected products of hydrolysis of lactose?

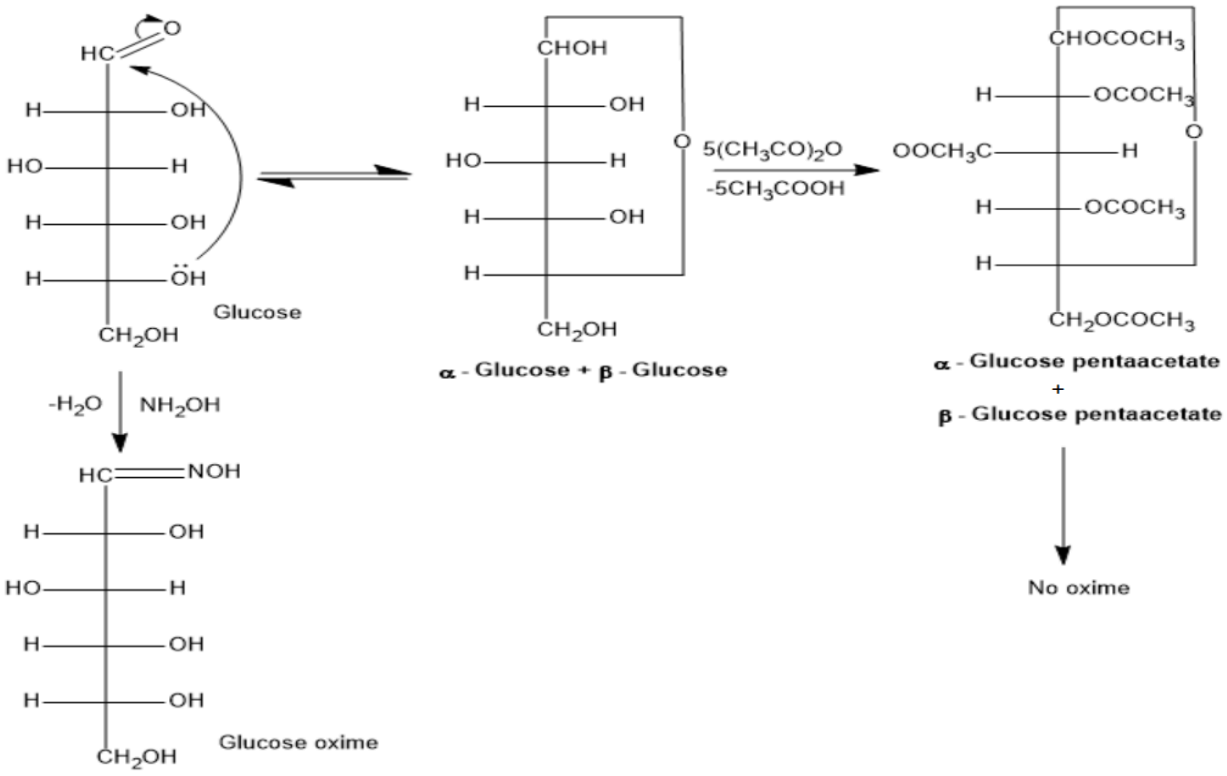
Ans: Lactose is made up of β-D-galactose and β-D-glucose which on hydrolysis gives the same compounds. This can be illustrated by;



3. How do you explain the absence of aldehyde group in the pentaacetate of D-glucose?

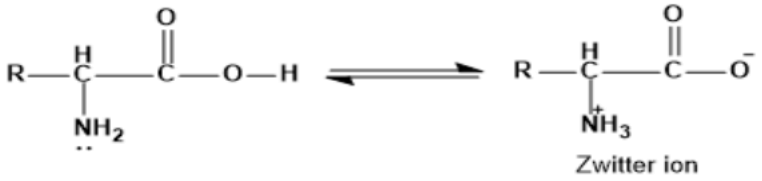
Ans: The open structure of D-glucose reacts with hydroxylamine $\left(NH_2OH\right)$ to form an oxime because of the presence of aldehydic group in the structure. Whereas, the pentaacetate of D-glucose is not an open structure and thus, it does not react with hydroxylamine. This shows the absence of aldehydic group on pentaacetate of D-glucose.

This can be illustrated as follows;



4. The melting points and solubility in water of amino acids are generally higher than that of the corresponding halo acids. Explain.

Ans: The molecules of amino acid contains both acidic (carboxyl) and basic (amino) groups within them. Thus, they show dipolar behavior when dissolved in water giving rise to zwitter ion. Whereas, halo acids do not show up the same behavior.The zwitter ion is formed when the carboxyl group loses a proton and the amino group accepts the same. This can be illustrated by;



Hence, the melting points and the solubility of amino acids in water are higher than those of the corresponding halo-acids.

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

Ans: When we boil the egg, the proteins present within them gets denatured and thus, goes under coagulation. The excess water present is then absorbed by the coagulated protein through H – bonding.

6. Why cannot vitamin C be stored in our body?

Ans: The water-soluble compounds cannot retain in human body due to constant excretion through urine. The vitamin C is water soluble component in our body and thus, cannot be stored.

7. What products would be formed when a nucleotide from DNA containing thymine is hydrolyzed?

Ans: The hydrolysis of a nucleotide of DNA having thymine as its base give thymine β -D-2 deoxyribose and phosphoric acid as products.

8. When RNA is hydrolyzed, there is no relationship among the quantities of different bases obtained. What does this fact suggest about the structure of RNA?

Ans: Considering a DNA molecule; it has double stranded structure in which adenine always pairs up with thymine and cytosine always pairs up with guanine through H – bonding. Thus, when hydrolyzed the quantity of adenine produced is equal to that of thymine and similarly, the quantity of cytosine is equal to that of guanine. But when RNA is hydrolyzed, there is no such relationship between the products obtained. Thus, this proves the single stranded structure of RNA.

Text solution

1. What are monosaccharides?

Ans: Monosaccharides are the most basic units of the biomolecules. They cannot be hydrolyzed further to give simpler units. They are then classified on the basis of;

- Number of C atoms: trioses, tetroses, pentoses, hexoses, and heptoses.
- Functional groups: aldoses (aldehyde) and ketoses (ketone).

Now, if a monosaccharide having 5 C atoms and ketone as a functional group then it is named as – ketopentose.

2. What are reducing sugars?

Ans: The carbohydrates that reduce Fehling's solution and Tollen's reagent are known as reducing sugars. All the monosaccharide and disaccharides are reducing sugars, except for sucrose.

3. Write two main functions of carbohydrates in plants.

Ans: The two main functions of carbohydrates (polysaccharides) in plants are:

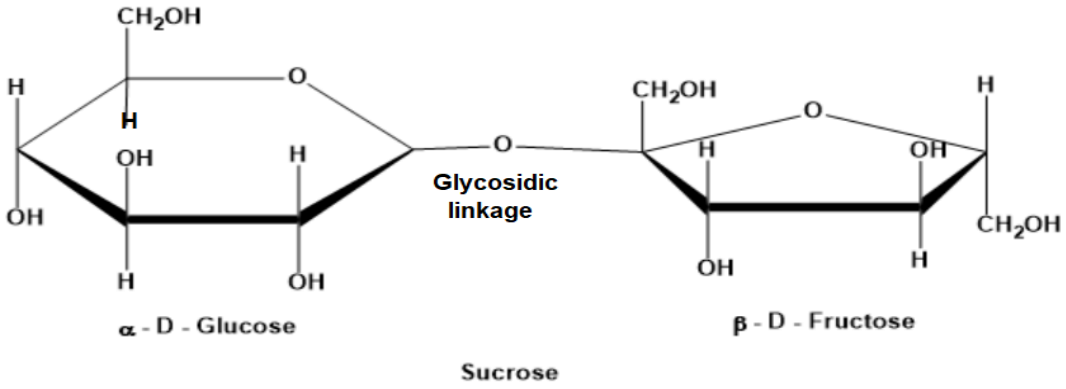
- Starch serves as storage molecules.
- Cellulose is used to build the cell wall.

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

Ans: The classification is given as;
Monosaccharides: Ribose, 2-deoxyribose, galactose and fructose.
Disaccharides: Maltose and lactose.

5. What do you understand by the term glycosidic linkage?

Ans: The linkage formed between two monosaccharide units through an oxygen atom by the loss of a water molecule is known as glycosidic linkage. For example:
Sucrose molecule has a glycosidic linkage which links α-D-glucose and β-D-fructose. This can be illustrated as;



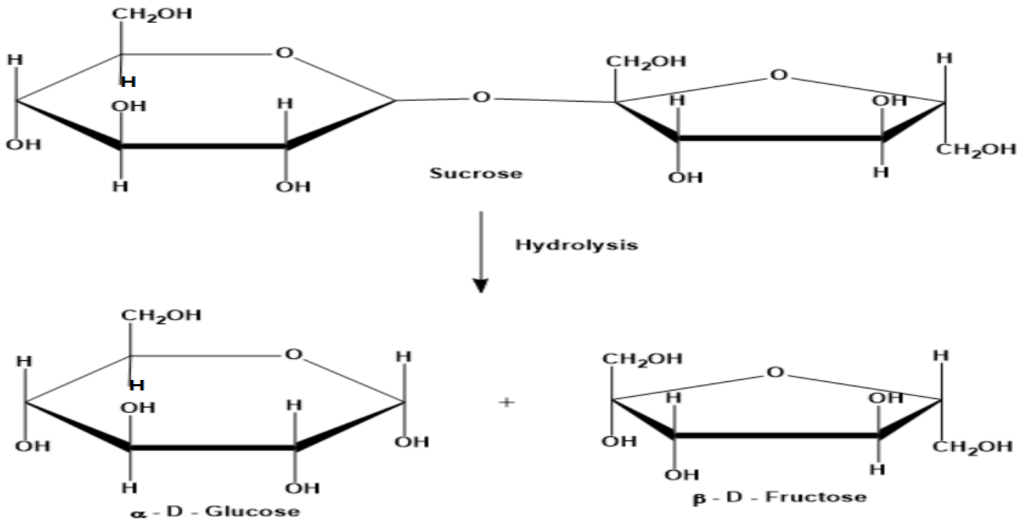
6. What is glycogen? How is it different from starch?

Ans: In animals, carbohydrates are stored in the form of glycogen which itself is a complex carbohydrate.Starch is a carbohydrate consisting of two components i.e., amylose (nearly 15 – 20%) and amylopectin (nearly 80 – 85%) in nature. Whereas, glycogen consists of just one component which is similar to the structure of amylopectin but more branched than actual amylopectin.

7. What are the hydrolysis products of

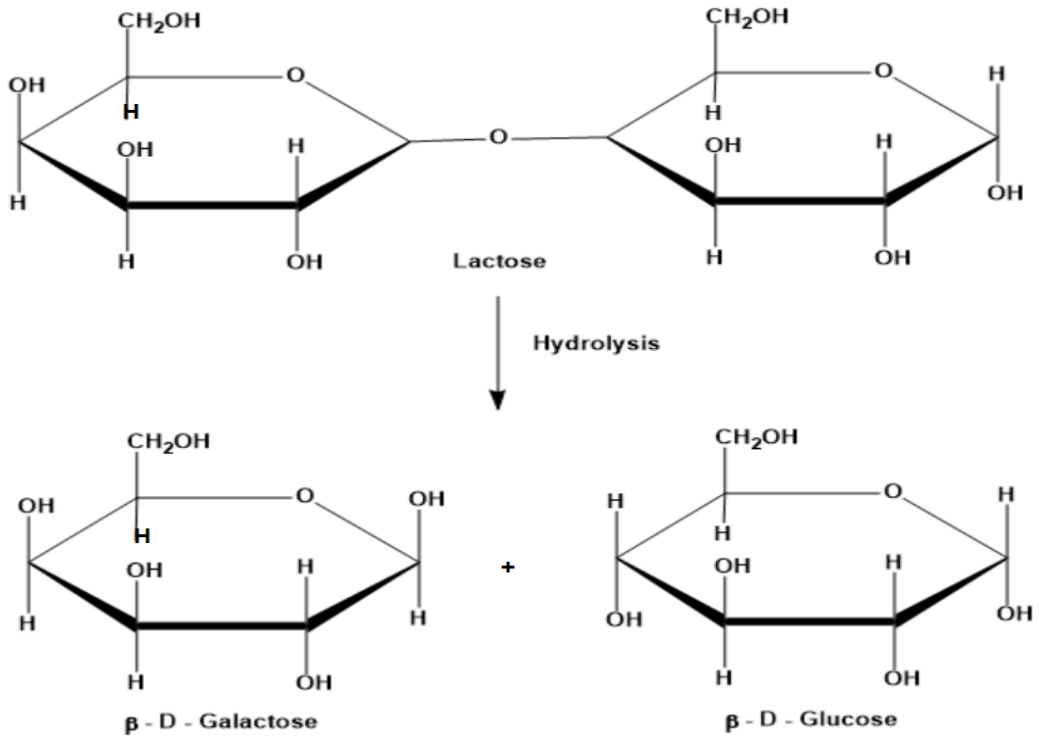
(i) sucrose and

Ans: When hydrolyzed, sucrose gives molecules of α -D-glucose and β-D-fructose, each. This can be illustrated as;



(ii) lactose?

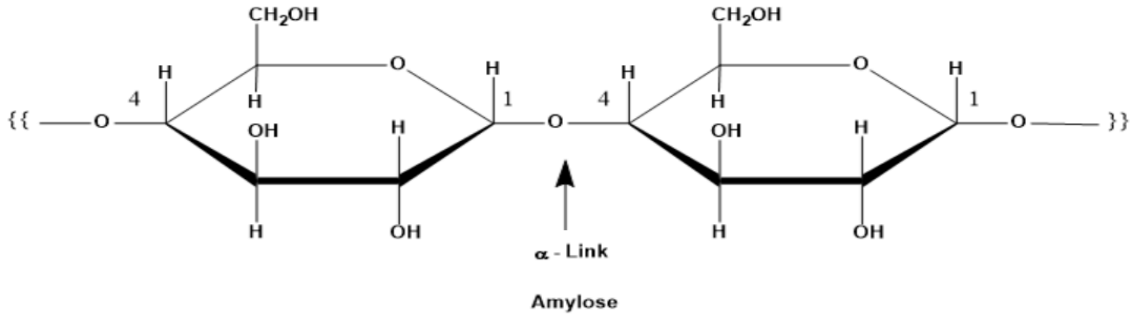
Ans: When hydrolyzed, lactose gives molecules of β-D-galactose and β-D-glucose each. This can be illustrated as;



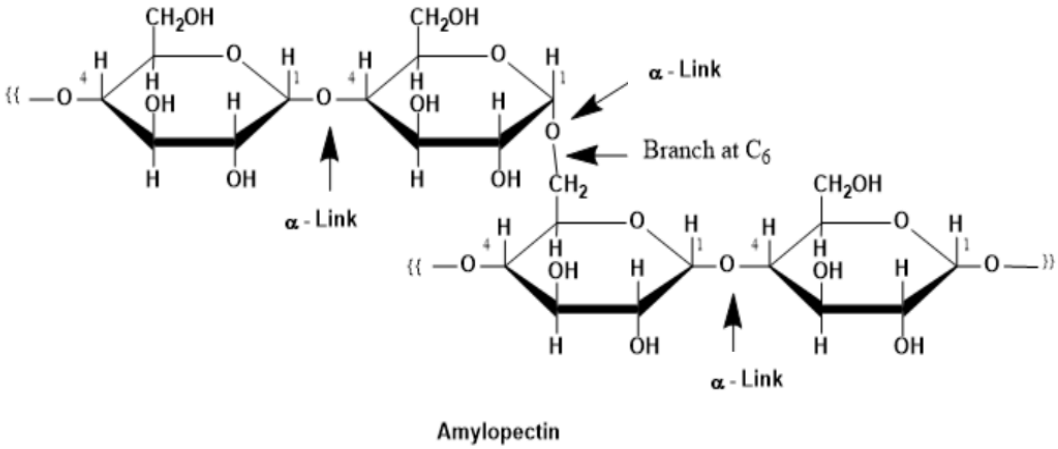
8. What is the basic structural difference between starch and cellulose?

Ans: Starch:

- It consists of two components i.e. amylose and amylopectin.
- Amylose is a long linear chain of α-D-glucose units linked by a glycosidic linkage at position 1 and 4 i.e., C1 – C4 linkage.



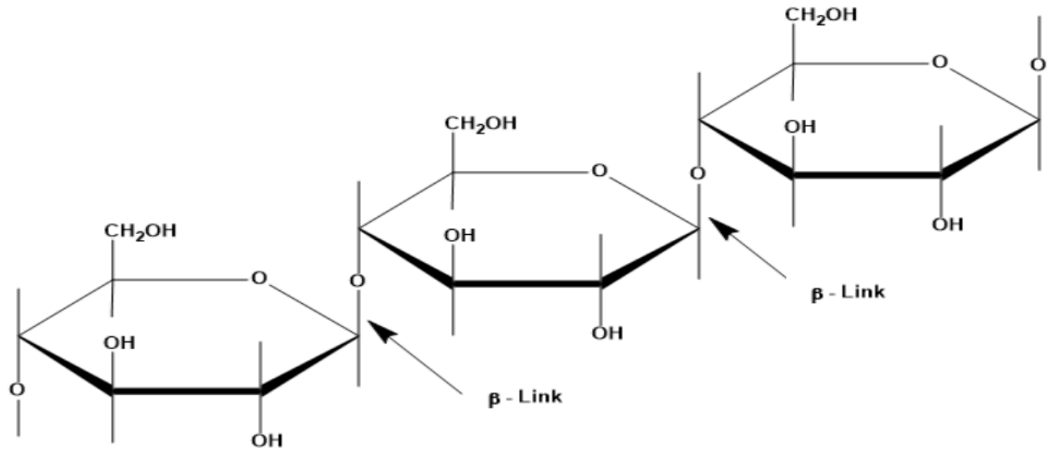
- Amylopectin is a branched chain polymer of α-D-glucose units. The chain is formed by C1 – C4 glycosidic linkage and branching occurs at C1 – C4 position.



Amylopectin

Cellulose:

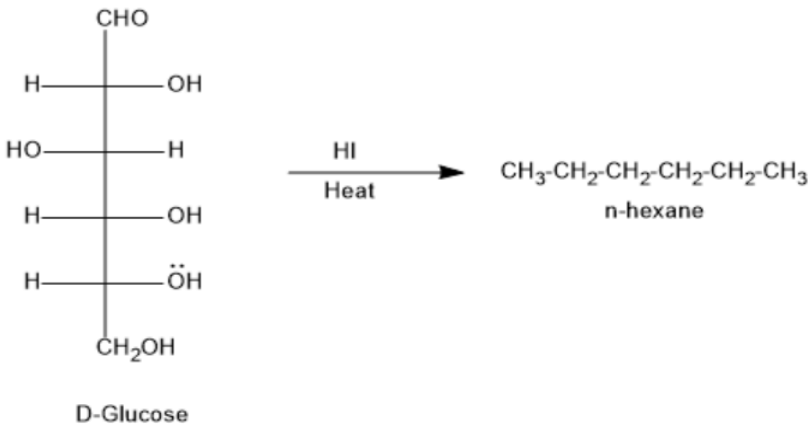
- It is a straight chain polysaccharide of β-D-glucose units linked by a glycosidic linkage at position 1 and 4 i.e., C1 – C4 linkage.



9. What happens when D-glucose is treated with the following reagents?

(i) HI

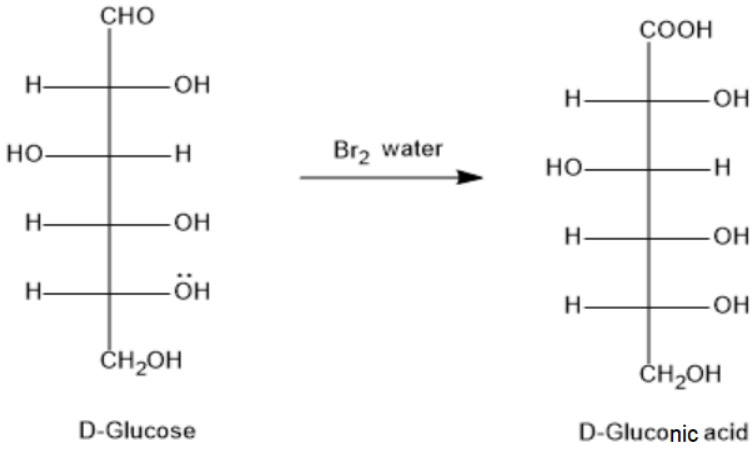
Ans: When heated with HI for a long time, D-glucose forms n-hexane as;



D-Glucose

(ii) Bromine water

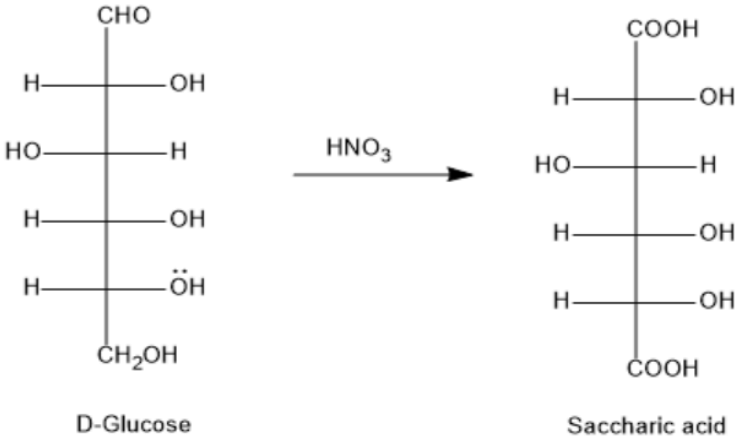
Ans: When treated with bromine water, D-glucose produces gluconic acid as;



D-Glucose D-Gluconic acid

(iii) HNO_3

Ans: D-glucose when treated with HNO_3, gets oxidized to give saccharic acid as;



D-Glucose Saccharic acid

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

Ans: The reactions of D-glucose which cannot be explained by its open structure are;

- 2, 4-DNP test, Schiff's test and reaction with $NaHSO_4$ to form hydrogen sulphite as addition product. Whereas, aldehydes give all of them.
- The pentaacetate of glucose does not react with hydroxylamine due to absence of free -CHO group.
- Glucose exists in two crystalline forms i.e., α and β which shows difference in their respective melting points. The same behavior cannot be executed by open structure.

11. What are essential and non-essential amino acids? Give two examples of each type.

Ans: There are two types of amino acids in the human body:

Essential amino acids:

- They are required by the body but cannot be synthesized within.
- These must be taken up via food.
- For example, leucine and valine.

Non-essential amino acids:

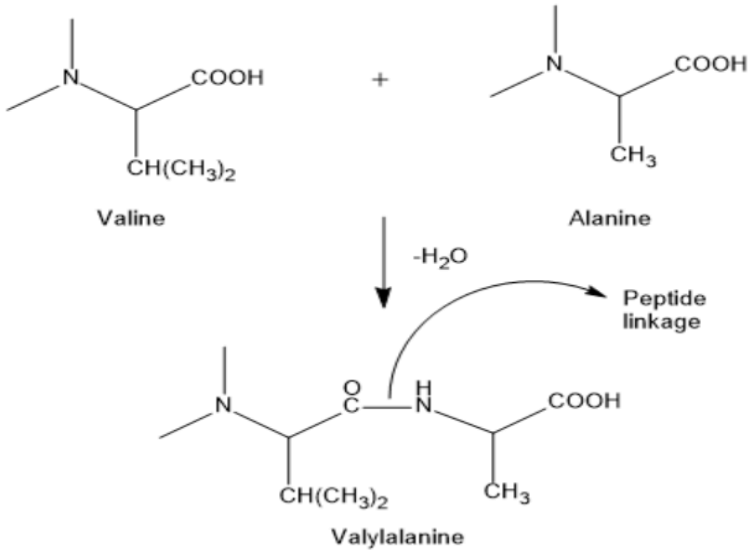
- They too are required by the body but can be synthesized within.
- For example, alanine and glycine.

12. Define the following as related to proteins

(i)Peptide linkage

Ans: The peptide linkage is formed when -COOH group of one amino acid is attached to the $-NH_2$ group of another amino acid by the elimination of water molecule.

This can be easily illustrated as;



(ii) Primary structure

Ans: The specific sequence (the sequence of linkages between amino acids in a polypeptide chain) in which various amino acids are present is called as primary structure of protein. The slight change in this sequence creates a new protein.

(iii) Denaturation.

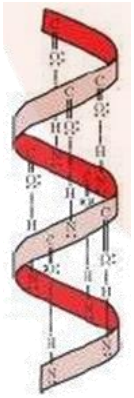
Ans: A protein has unique 3D structure and thus, specific biological activity in living systems. When such proteins are subjected to some changes i.e., change in temperature (physical) or change in pH (chemical), the H-bonds are disturbed. These disturbances unfold the globules and uncoils the helix which results in lost of biological activity by that protein molecule. This is known as denaturation of protein.Denaturation only destroys the secondary and tertiary structures of protein whereas the primary structure remains unaltered.

13. What are the common types of secondary structure of proteins?

Ans: The two common types of secondary structure of protein are

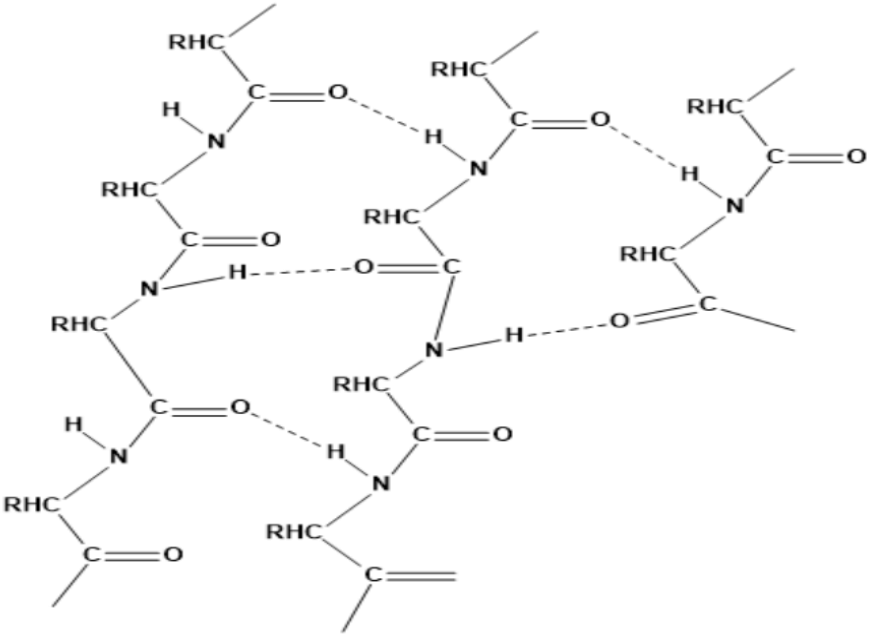
α - helix structure:

Here, the $-NH_2$ group of amino acid residue forms H – bond with -COOH group of adjacent turn in right direction (right-handed screw).



- β - pleated sheet structure:

It looks like pleated folds of drapery hence, the name β pleated sheet structure. Here, all the peptide chains are stretched out to nearly the maximum extension and then laid side by side. They are held together by intermolecular hydrogen bonds.



14. What type of bonding helps in stabilizing the $\alpha-$ helix structure of proteins?

Ans: The H - bonding formed between the $-NH_2$ group of a amino acid and the COOH group of adjacent amino acid helps in the stabilization of α-helix.

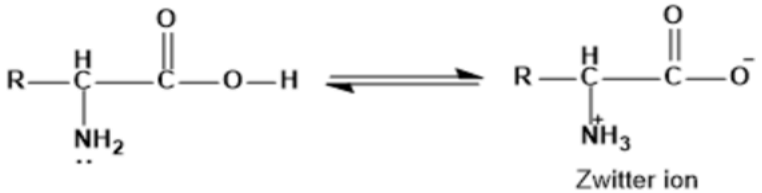
15. Differentiate between globular and fibrous proteins.

Ans:

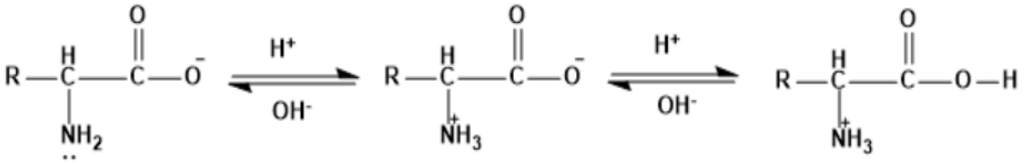
Fibrous protein		Globular protein	
1	It is a fiber-like structure formed by the polypeptide chain. They held together by strong hydrogen and disulphide bonds.	1	The polypeptide chain in this protein is folded around itself, which gives rise to a spherical structure
2	Insoluble in water.	2	Soluble in water.
3	Used for structural purposes. For example, keratin present in nails and hair; collagen present in tendons; and myosin present in muscles.	3	All enzymes along with some hormones such as insulin are globular proteins.

16. How do you explain the amphoteric behavior of amino acids?

Ans: The amino acids when mixed with water, shows the dipolar behavior i.e., the carboxyl group of an amino acid loses a proton and the amino group of another can accept the same proton to give a zwitter ion. This can be shown as;



In this zwitter ionic form, the amino acid acts as both acid as well as base showing its amphoteric behavior.



17. What are enzymes?

Ans: The proteins that catalyze the biological reactions or biological catalysts are known as enzymes. They are very specific in nature and catalyze only a particular reaction for a particular substrate.

They are named according to the particular substrate or specific reaction taking place and always ends with '-ase'.

For example,

- Maltase: The enzyme used to catalyze the hydrolysis of maltose into glucose.
- Oxidoreductase: the enzymes used to catalyze the oxidation of one substrate with the simultaneous reduction of another substrate.

18. What is the effect of denaturation on the structure of proteins?

Ans: Denaturation results in unfolding of globules and uncoiling of helixes. During this process, secondary and tertiary proteins are destroyed but the primary ones remain unaltered. Sometimes, secondary and tertiary proteins get converted to primary structured proteins during denaturation.

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

Ans: Vitamins are classified on the basis of their solubility in water or fat as follows;

- Vitamins such as A, D, E and K are soluble in fats and oils but not in water.
- B group vitamins (B_1, B_2, B_6, B_{12} , etc.) and vitamin C are water soluble vitamins.
- The exceptional cases are of biotin or vitamin H, as they are neither

soluble in water nor in fat.The vitamin responsible for the coagulation of blood is Vitamin K.

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

Ans: Both vitamin A and C are essential to us as their deficiency cause some serious health problems. The deficiency of vitamin A leads to xerophthalmia (hardening of the cornea of the eye) and night blindness whereas, deficiency of vitamin C leads to scurvy (bleeding gums).

The sources of vitamin A are fish liver oil, carrots, butter, and milk; whereas, that of vitamin C are citrus fruits and green leafy vegetables.

21. What are nucleic acids? Mention their two important functions.

Ans: The biomolecules found in nuclei of living cells (as one of the important constituent of chromosomes) are known as nucleic acids. There are mainly two types of nucleic acids i.e., deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

Functions:

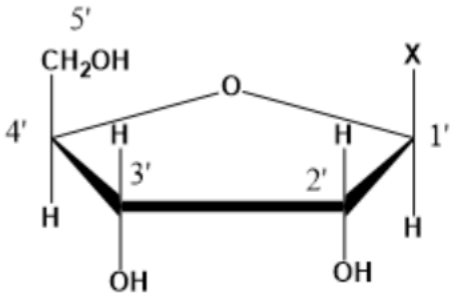
- DNA is responsible for the transmission of inherent characters from one generation to another. This is known as heredity.
- DNA and RNA, both are responsible for the protein synthesis in the cell.

22. What is the difference between a nucleoside and a nucleotide ?

Ans: Nucleoside:

- It is formed by the attachment of a base to 1' position of sugar. Its generalized formulation and structure are given as;

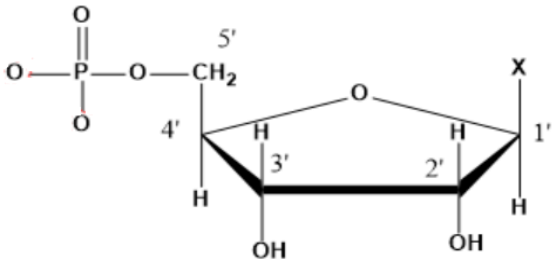
Nucleoside = sugar + base (X).



Nucleotide:

- It is formed by al the three components of nucleic acids i.e., base, sugar and phosphoric acid. Its generalized formulation and structure are given as;

Nucleotide = sugar + base (X) + phosphoric acid.



23. The two strands in DNA are not identical but are complementary. Explain.

Ans: DNA has double-stranded helical structure where those strands are held together by H – bonds between the specific base pairs. Cytosine forms H – bonds with guanine and Adenine form H – bonds with thymine. Thus, the two strands are complementary to each other.

24. Write the important structural and functional differences between DNA and RNA.

Ans:

Structural differences:

DNA		RNA	
1	The sugar present here is β-D-2- deoxyribose.	1	The sugar present here is β-D-ribose.
2	It contains thymine (T).	2	It contains uracil (U).
3	The helical structure is double-stranded.	3	The helical structure is single-stranded.

Functional differences:

DNA		RNA	
1	It is the chemical basis of heredity.	1	It is not responsible for heredity.
2	They do not synthesize proteins, but transfer coded message for the synthesis of proteins in the cells.	2	Proteins are synthesized by RNA molecules in the cells.

25. What are the different types of RNA found in the cell?

Ans: Types of RNA found in cell are;

- Messenger RNA (m-RNA)
- Ribosomal RNA (r-RNA)
- Transfer RNA (t-RNA).