Class 12 Biomolecules Important Questions with Answers

Short Answer Type Questions

Q1. Name the sugar present in milk. How many monosaccharide units are present in it? What are such oligosaccharides called?

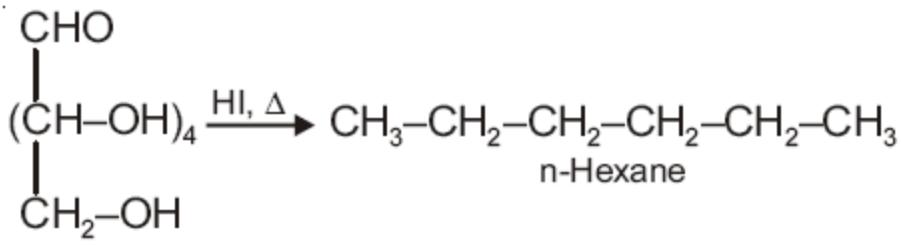
Answer:

(i) Lactose sugar is present in the milk.
(ii) There are two saccharide units present in the milk: glucose and galactose.
(iii) Such oligosaccharides are called disaccharides.

Q2. How do you explain the presence of all the six carbon atoms in glucose in a straight chain?

Answer:

The six carbon atoms in glucose in a straight chain can be explained by heating HI and red phosphorus.



It gives n-hexane.

Q3. A base is attached at the first position of sugar moiety in the nucleoside. A nucleotide is formed by linking the phosphoric acid unit to the sugar unit of the nucleoside. At which position of the sugar unit is the phosphoric acid linked in a nucleoside to give a nucleotide?

Answer:

Phosphoric acid is linked at the fifth position of the nucleoside's sugar moiety to give a nucleotide.

Q4. Name the linkage connecting monosaccharide units in polysaccharides.

Answer:

In polysaccharides, the linkage connecting monosaccharides is known as a glycosidic linkage.

Q5. Under what conditions glucose is converted to gluconic and saccharic acid?

Answer:

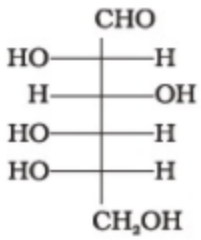
Glucose is converted to gluconic acid by oxidation with bromine water and saccharic acid when oxidation is carried by conc. HNO_3.

Q6. Monosaccharides contain carbonyl groups hence are classified as aldose or ketose. The number of carbon atoms present in the monosaccharide molecule is also considered for classification. In which class of monosaccharides will you place fructose?

Answer:

Since fructose has six carbon atoms and contains a keto group, fructose is called ketohexose.

Q7. The letters 'D' or 'L' before the name of a stereoisomer of a compound indicate the correlation of the configuration of that particular stereoisomer. This refers to their relationship with one of the isomers of glyceraldehyde. Predict whether the following compound has a 'D' or 'L' configuration.



Answer:

Since the OH group is present on the second last carbon on the left side, thus it will have an L configuration.

Q8. Aldopentoses named ribose and 2-deoxyribose are found in nucleic acids. What is their relative configuration?

Answer:

Aldopentoses like ribose and 2-deoxyribose are the sugar moieties in nucleic acids. Ribose is named β-D-ribose, and 2-deoxyribose. It has a D-configuration.

Q9. Which sugar is called invert sugar? Why is it called so?

Answer:

Sucrose is known as Invert Sugar.
Sucrose is dextrorotatory but, after hydrolysis, gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (−92.4°) is more than the dextrorotation of glucose (+52.5°), the mixture is a laevorotatory. Thus, the hydrolysis of sucrose changes the sign of rotation from dextro (+) to laevo (−), and the product is named invert sugar.

Q10. Amino acids can be classified as alpha, beta, gamma, delta, and so on, depending upon the relative position of the amino group concerning the carboxyl group. Which type of amino acids forms the polypeptide chain in proteins?

Answer:

α amino acid forms a polypeptide chain by eliminating water molecules.

$$\alpha\text{amino acid} \rightarrow R - \overset{\alpha}{\underset{\underset{NH_2}{|}}{CH}} - COOH$$

$$nR - \underset{\underset{NH_2}{|}}{CH} - COOH \rightarrow H_2N - \overset{R}{\underset{|}{CH}} - \underbrace{\left(\begin{matrix} O \\ || \\ C - NH \end{matrix} \right)}_{\uparrow \text{ Peptide linkage}} - \overset{R}{\underset{|}{CH}} - COOH$$

Q11. α Helix is a secondary structure of proteins formed by twisting of the polypeptide chain into right-handed screw-like structures. Which type of interactions is responsible for making the α -helix structure stable?

Answer:

In α helix, a polypeptide chain is stabilised by forming hydrogen bonds between the −NH− group of amino acids in one turn with the >C−O groups of amino acids belonging to adjacent turn.

Q12. Some enzymes are named after the reaction, where they are used. What name is given to the class of enzymes that catalyse one substrate's oxidation with simultaneous reduction of another substrate?

Answer:

Oxidoreductase is a class of enzymes that catalyse the oxidation of one substrate with a simultaneous reduction of another substrate.

Q13. During milk curdling, what happens to the sugar present in it?

Answer:

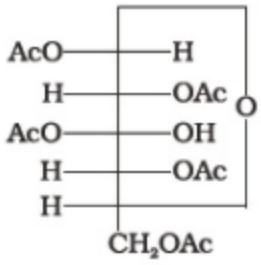
When milk is curdled, its sugar oxidises to form lactic acid.

Q14. How do you explain the presence of five -OH groups in glucose molecules?

Answer:

Acetylation of glucose with acetic anhydride gives glucose pentaacetate, confirming the presence of five−OH groups. Since it is a stable compound, five −OH groups should be attached to different carbon atoms.

Q15. Why does compound (A) given below not form an oxime?



(A)

Answer:

Glucose pentaacetate (structure A) doesn't have a free−OH group at C_1 and can't be converted to the open-chain form to give the −CHO group and hence doesn't form the oxime.

Q16. Why must vitamin C be supplied regularly in diet?

Answer:

Vitamin C should be consumed regularly because it is water-soluble and cannot be stored in the body. It gets flushed from our body; hence it should be consumed daily.

Q17. Sucrose is dextrorotatory, but the mixture obtained after hydrolysis is laevorotatory. Explain.

Answer:

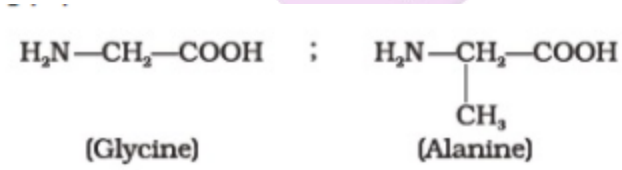
On hydrolysis, sucrose (dextrorotatory) gives glucose (dextrorotatory, + 52.5°) and fructose (laevorotatory, – 92.4°). Since laevorotation of fructose is more than the dextrorotation of glucose, the mixture is laevorotatory.

Q18. Amino acids behave like salts rather than simple amines or carboxylic acids. Explain.

Answer:

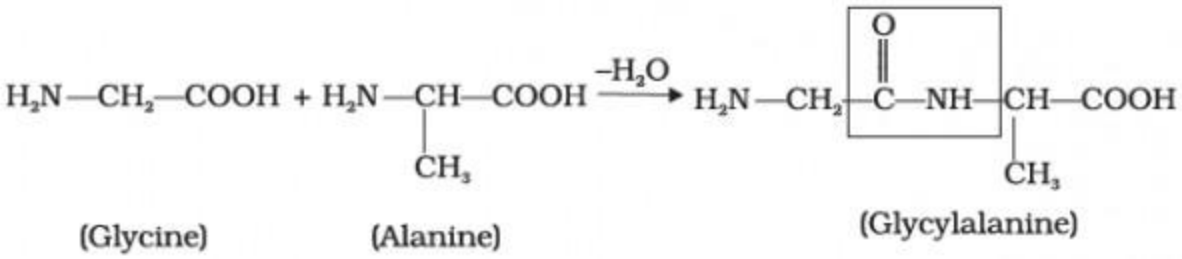
Amino acids behave like salts rather than simple amines or carboxylic acids due to the presence of both acidic (-COOH) and basic ($-NH_2$) groups. In solution, the -COOH group can lose a proton, and an amine group can accept a proton, giving rise to a dipolar ion called the Zwitter ion.

Q19. Structures of glycine and alanine are given below. Show the peptide linkage in glycylalanine.



Answer:

In glycylalanine, the carboxyl group of glycine combines with the amino group of alanine.



Q20. Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. Protein denaturation occurs when a protein in its native form is subjected to a physical change like a change in temperature or a chemical change like a change in pH. Explain the cause.

Answer:

Due to physical and chemical changes, hydrogen bonds in proteins are disturbed. Due to this, globules unfold, and the helix gets uncoiled, the protein loses its biological activity. This is known as the denaturation of proteins.

Q21. The activation energy for the acid catalysed hydrolysis of sucrose is 6.22 kJ mol^{-1}, while the activation energy is only 2.15 kJ mol^{-1} when the enzyme sucrase catalyses hydrolysis. Explain.

Answer:

Enzymes reduce the magnitude of activation energy by providing an alternative path in the hydrolysis of sucrose. The enzyme sucrase reduces the activation energy from kJ mol^{-1} to 2.15kJ mol^{-1}

Q22. How do you explain the presence of an aldehydic group in a glucose molecule?

Answer:

Glucose reacts with hydroxylamine to form a monoxime. It adds one molecule of hydrogen cyanide to give cyanohydrin, so it contains a carbonyl group which can be an aldehyde or a ketone.
On mild oxidation with bromine water, glucose gives gluconic acid, a six-carbon acid. This indicates that the carbonyl group present in glucose is an aldehydic group.

Q23. Which moieties of nucleosides are involved in the formation of phosphodiester linkages present in dinucleotides? What does the word diester in the name of linkage indicate? Which acid is involved in the formation of this linkage?

Answer:

Phosphoric acid is involved in the formation of phosphodiester linkage. The word 'diester' in this linkage indicates that two −OH groups of phosphoric acid are involved in forming two ester linkages. In the formation of dinucleotides, the 3−OH group of the pentose sugar of one nucleotide unit and the 5−OH group of the pentose sugar of the other nucleotide unit are involved in generating the phosphodiester linkage.

Q24. What are glycosidic linkages? In which type of biomolecules are they present?

Answer:

Two molecules of monosaccharides are joined together by an oxide linkage formed by the loss of water molecules. A linkage between two monosaccharide units through an oxygen atom is called glycosidic linkage. It is present in disaccharides, trisaccharides and polysaccharides.

Q25. Which monosaccharide units are present in starch, cellulose and glucose and which linkages link these units?

Answer:

In starch and glycogen, glycosidic α-linkage is present, and cellulose, glycosidic β-linkage is present between glucose units.

Q26. How do enzymes help a substrate to be attacked by the reagent effectively?

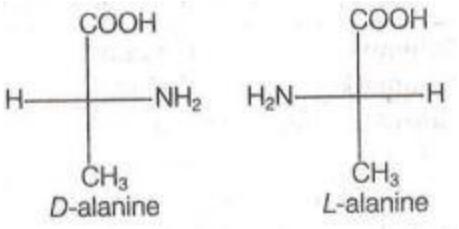
Answer:

The active site of enzymes holds the substrate molecule in a suitable position to be attacked by the reagent effectively.

Q27. Describe the terms D- and L- configuration used for amino acids with examples.

Answer:

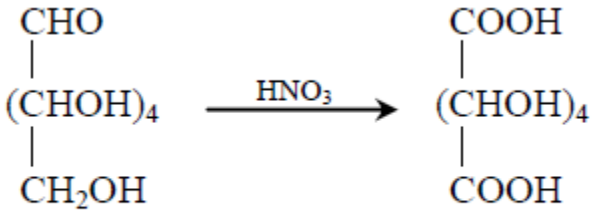
All naturally occurring α−Amino acids (except glycine) are optically active due to chiral carbon atoms. These have either D- or L-configuration. D-form means that the amino ($-NH_2$) Group is present towards the right-hand side. L-form shows the amino ($-NH_2$) Group on the left-hand side.



Q28. How will you distinguish 1° and 2° hydroxyl groups present in glucose? Explain with reactions.

Answer:

1° and 2° hydroxyl groups present in glucose can be identified by the reaction of glucose with nitric acid. Primary OH group present in glucose oxidise quickly to -COOH group while secondary OH group does not.



Hence, one OH is the primary OH group.

Q29. Coagulation of egg white on boiling is an example of the denaturation of protein. Explain it in terms of structural changes.

Answer:

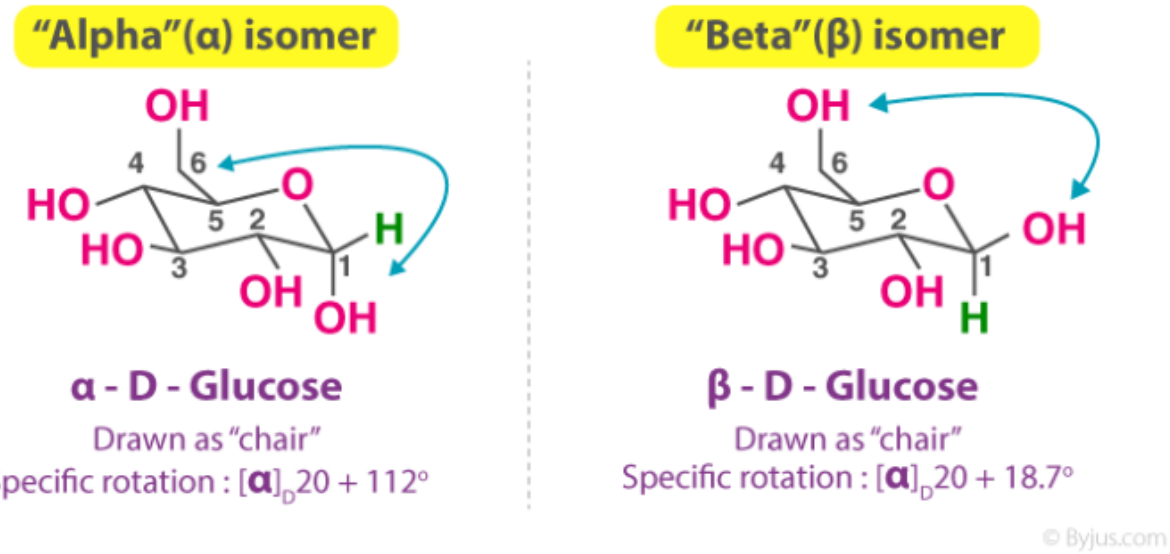
When the egg white is boiled, the soluble globular protein albumin is converted into insoluble fibrous protein. During this denaturation, (i) biological activity is lost and (ii) secondary and tertiary structures of albumin protein are destroyed while the primary structure (representing the sequence of amino acids) remains intact.

Long Answer Type Questions

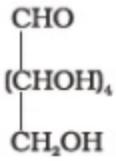
Q1. Enumerate the reactions of D-Glucose, which its open-chain structure cannot explain.

Answer:

The open-chain structure of D-glucose could not explain the following reactions:
1. The pentaacetate of glucose does not react with hydroxylamine, indicating the absence of the free -CHO group.
2. Despite having an aldehyde group, glucose does not form hydrogen sulphite addition product with sodium hydrogen sulphite, and glucose does not give Schiff's test.
3. Glucose exists in two different crystalline forms, i.e. α-D-glucose and β-D- glucose



Q2. Based on which evidence D-glucose was assigned the following structure?



Answer:

D glucose was assigned the following structure based on the following evidence.

(i) Glucose on reaction with HI produces n-hexane, which indicates the presence of six carbon atoms linked in a straight chain.

$C_6H_{12}O_6 \xrightarrow{HI}$ n-hexane

(ii) Glucose on reaction with acetic anhydride produces glucosepentaacetate, indicating five OH groups presence.

$C_6H_{12}O_6 \xrightarrow{Ac_2O}$ Glucose pentaacetate

(iii) Glucose on oxidation with bromine water produces gluconic acid, indicating the CHO group's presence.

$C_6H_{12}O_6 \xrightarrow{Br_2/H_2O}$ Br_2/H_2O Gluconic acid

(iv) Glucose on reaction with HNO_3 produces saccharic acid, indicating one primary OH group.

Q3. Carbohydrates are essential for life in both plants and animals. Name the carbohydrates that are used as storage molecules in plants and animals. Also, name the carbohydrate present in wood or the fibre of cotton cloth.

Answer:

Starch is the primary storage polysaccharide of plants. It is the most important dietary source for human beings. The high content of starch is found in cereals. Cellulose occurs exclusively in plants, and it is the most abundant organic substance in the plant kingdom. The cell wall of bacteria and plants is made up of cellulose. We build furniture from cellulose in the form of wood and clothe ourselves with cellulose in the form of cotton fibre.

Q4. Explain the terms primary and secondary structure of proteins. What is the difference between the alpha-helix and beta-pleated sheet structure of proteins?

Answer:

Protein primary structure is the linear sequence of amino acids in a peptide or protein. In contrast, Secondary structure refers to regular, recurring arrangements in the space of adjacent amino acid residues in a polypeptide chain. It is maintained by hydrogen bonds between amide hydrogens and carbonyl oxygens of the peptide backbone. The major secondary structures are α-helices and β-structures.

Differences between Alpha-Helix and Beta-Sheet

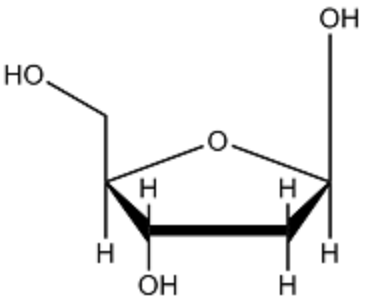
S No.	Alpha-Helix	Beta-Sheet
1	Amino acids exist in the right-handed coiled rod-like structure.	Amino acids exist in an almost entirely extended conformation, i.e. linear or

		sheet-like structure.
2	Intramolecular hydrogen bonding forms within the polypeptide chain to create a spiral structure.	Beta sheets are formed by linking two or more beta strands by intermolecular hydrogen bonds.
3	3.6 amino acids residues are winded to form an alpha-helix polypeptide.	Three to ten amino acids are combined to form a beta-strand polypeptide.
4	Alpha-Helix can be a single chain polypeptide.	Beta-Sheet cant is a single chain Polypeptide. There must be two or more beta-strands.
5	Alkyl groups of alpha-helix are oriented outside of the helix.	Alkyl groups are oriented both inside and outside of the sheet.
6	Example: Keratin, Myoglobin and Haemoglobin.	Example: Skin Fibres or Fibroin.

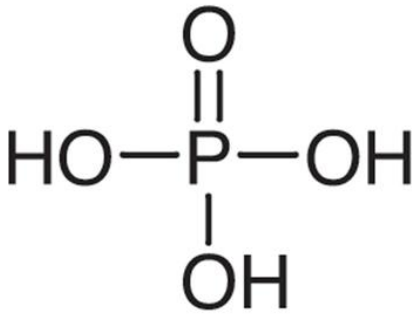
Q5. Write the structures of fragments produced on the complete hydrolysis of DNA. How are they linked in DNA molecules? Draw a diagram to show the pairing of nucleotide bases in the double helix of DNA.

Answer:

On complete hydrolysis of DNA, a pentose sugar (β−D−2−deoxyribose), phosphoric acid (H2PO4) and nitrogenous bases are formed.



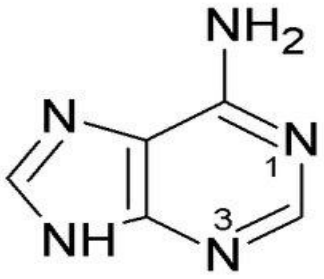
β-D-2-deoxyribose sugar



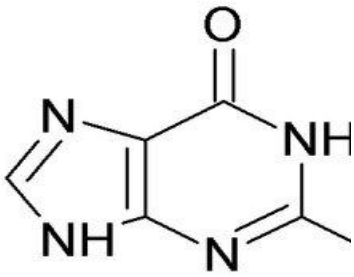
Present in D.N.A

DNA contains four bases

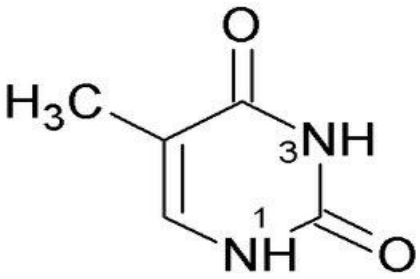
Adenine (A), Guanine (G), Cytosine (C) and thymine (T).



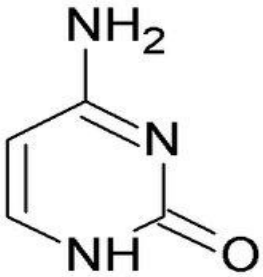
Adenine



Guanine



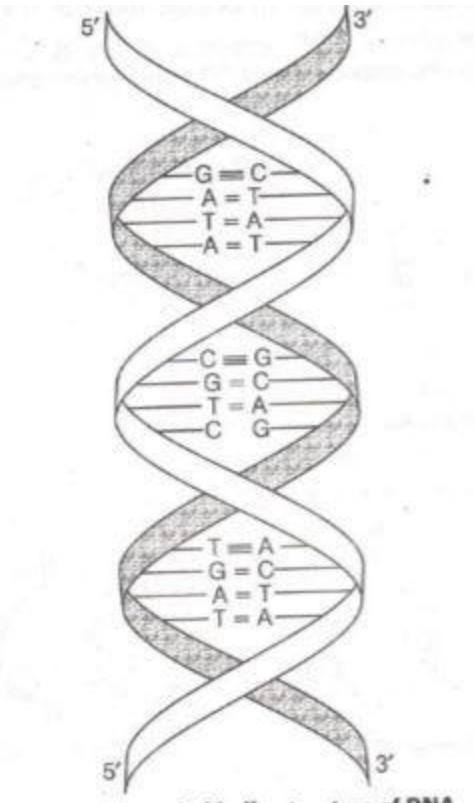
Thymine



Cytosine

A unit formed by attaching a base to the 1'-position of sugar is a nucleoside. When a nucleoside links to phosphoric acid at 5'-position of the sugar moiety, a nucleotide is formed. Nucleotides are joined together by phosphodiester linkage between the pentose sugar's 5' and 3' carbon atoms.
In DNA, two nucleic acid chains are wound about each other and held together by hydrogen bonds between bases.

The two strands complement each other as a hydrogen bond forms between specific base pairs. Adenine forms hydrogen bonds with Thymine. In contrast, Cytosine forms hydrogen bonds with Guanine.



Double strarded helix structure of DNA