

Biochemistry Chemistry Questions with Solutions

Q1: Mention the importance of Biochemistry.

Answer:

The following topics require a basic understanding of biochemistry.

- The chemical reactions convert food into molecules unique to the cells of a given species.
- The catalytic features of enzymes.
- Utilising the possible energy derived from foodstuff oxidation consumed for the living cell's many energy-demanding operations.
- The qualities and structure of chemicals make up tissues and cells' framework.
- To solve fundamental medical and biological challenges.

Q2: How are amino acids classified?

Answer:

Amino acids are divided into basic and non-essential amino acids.

Non-essential amino acids, including asparagine, glycine, and others, can be produced in the body.

Essential amino acids are amino acids that the body cannot produce and should be received from the diet. Histidine with lysine, for example.

Q3: What do you understand about the secondary structure of proteins?

Answer:

The secondary structure of a protein is the shape in which a long polypeptide chain can persist due to regular folding of the polypeptide chain's backbone due to hydrogen bonding between $>C=O$ and the polypeptide chain, $-N-H$ group.

Q4: Glucose or sucrose are soluble in water, but cyclohexane or benzene (simple six-membered ring compounds) are insoluble. Explain.

Answer:

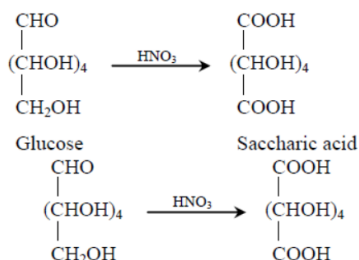
A glucose molecule includes five $-OH$ groups, whereas a sucrose molecule includes eight $-OH$ groups. As a result, glucose and sucrose form a lot of H-bonds with water. As a result, they are water-soluble.

On the other hand, Cyclohexane and benzene do not have -OH groups. As a result, they cannot form H-bonds with water and are hence water-insoluble.

Q5: Write the structure of the product obtained when glucose is oxidised with nitric acid.

Answer:

The structure of the product when glucose is oxidised with nitric acid.



Q6: Glycogen is a branched-chain polymer of α -D-glucose units in which the chain is formed by C1—C4 glycosidic linkage whereas branching occurs by the formation of C1—C6 glycosidic linkage. Structure of glycogen is similar to _____.

- (i) Amylose
- (ii) Glucose
- (iii) Cellulose
- (iv) Amylopectin

Answer: (iv) Amylopectin

Explanation: Polysaccharides are made up of several monosaccharide units linked by glycosidic bonds. These are the most frequent carbohydrates found in nature. Amylopectin is a water-insoluble starch that accounts for 80-85% of total starch. It's an α -D-glucose-based branched-chain polymer with C₁—C₄ glycosidic linkage for the chain and C₁—C₆ glycosidic linkage for the branching.

Q7: Proteins are found to have two different types of secondary structures viz. α -helix and β -pleated sheet structures. α -helix structure of a protein is stabilised by:

- (i) Hydrogen bonds
- (ii) van der Waals forces
- (iii) Peptide bonds
- (iv) Dipole-dipole interactions

Answer: (i) Hydrogen bonds

Explanation: α -helix and β -pleated sheet structures emerge due to the usual folding of the backbone of the polypeptide chain due to hydrogen bonding between >C—O and —NH— group of the peptide bond.

α -Helix is one of the most common methods in which a polypeptide chain constructs all potential hydrogen bonds by twisting into a right-handed screw (helix) with the -NH group of every amino acid residue hydrogen bonded to the $>C=O$ of an adjacent turn of the helix.

Q8: Which of the following acids is a vitamin?

- (i) Aspartic acid
- (ii) Adipic acid
- (iii) Ascorbic acid
- (iv) Saccharic acid

Answer: (iii) Ascorbic acid

Explanation: Vitamin C is also known as Ascorbic acid.

Q9: Give one example of each- Monosaccharide, disaccharide and polysaccharide.

Answer:

- Monosaccharide – Glucose, Fructose etc.
- Disaccharide – Sucrose, maltose etc.
- Polysaccharide – Cellulose, starch etc.

Q10: Name the reagents used to check the reducing nature of carbohydrates.

Answer:

Tollen's reagent and Fehling's solution can be utilised to confirm the reducing nature of sugars.

Q11: Which of the following B group vitamins can be stored in our body?

- (i) Vitamin B1
- (ii) Vitamin B12
- (iii) Vitamin B6
- (iv) Vitamin B2

Answer: (ii) Vitamin B12

Explanation: Water-soluble vitamins must be consumed regularly because they are excreted in urine and cannot be stored in the body (except for vitamin B12).

Q12: Describe what you understand by primary structure and secondary structure of proteins.

Answer:

Primary structure of proteins: Proteins could have one or more polypeptide chains. The basic structure is made up of amino acids linked together in a precise sequence in each polypeptide.

Secondary structure of proteins: The secondary structure of a protein refers to the conformation that polypeptide chains take due to hydrogen bonding.

The following two secondary structures are possible, depending on the size of the R groups:

- α -Helix structure: Intramolecular H-bonds observed between the C = O of one amino acid and N – H of the fourth amino acid.
- β -Pleated sheet structure: The two neighbouring polypeptide chains are retained together by intermolecular H-bonds.

Q13: Differentiate between fibrous proteins and globular proteins. What is meant by the denaturation of a protein?

Answer:

Globular Proteins	Fibrous Proteins
Globular proteins almost have a spheroidal shape due to the folding of the polypeptide chain.	Polypeptide chains of fibrous proteins comprise thread-like molecules that tend to lie side by side to form fibres.
Globular proteins are soluble in water.	Fibrous proteins are insoluble in water.
Globular proteins are susceptible to limited changes in temperature and pH. As a result, denaturation occurs when they are heated or treated with acids or bases.	Fibrous proteins are stable to moderate changes in temperature and pH.
They acquire biological activity; that's why they act as enzymes.	They do not possess any biological activity but serve as the chief structural material of animal tissues.
Example: Maltase, invertase etc., hormones (insulin) antibodies, transport agents (haemoglobin), etc.	Example: Keratin in skin, hair, nails and wool, collagen in tendons, fibroin in silk etc.

Denaturation of protein: The native shape of the protein is destroyed, and biological function is lost due to globular protein coagulation under the influence of temperature, pH, and other factors. The produced protein is called denatured proteins, and the phenomenon is denaturation.

Q14: Define the following as related to proteins:

- (i) Peptide linkage
- (ii) Primary structure
- (iii) Denaturation

Answer:

(i) **Peptide linkage:** A peptide linkage is an amide linkage created by the loss of a molecule of water between the – COOH group of one amino acid and the NH₂ group of the second α -amino acid. The CO–NH bond constituted is termed peptide linkage.

(ii) The primary structure of a protein refers to the exact sequence in which distinct amino acids are present inside it, i.e. the sequence of amino acid linkages in a polypeptide chain. Each protein has a particular order in which amino acids are organised. A change in the sequence results in the production of a different protein.

Primary structure:

(iii) **Denaturation:** A protein is determined to have a distinct 3-dimensional structure and biological activity in a biological system. In this instance, the protein is considered a native protein. When the native protein is exposed to physical changes, such as temperature changes, or chemical changes, such as pH changes, the H-bonds are disrupted. The globules are uncoiling, and the helix is unfolding due to this disruption. As a result, the protein ends up losing its biological activity. Denaturation refers to a protein's loss of biological activity. The secondary and tertiary structures of the protein are destroyed during denaturation, while the fundamental structure is unaltered.

- Q15:** (a) Write the structural and functional differences between DNA and RNA
(b) Name two starch components.

Answer:

- (a) Structural differences:

DNA	RNA
The sugar found in DNA is 2-deoxy(-) ribose.	The sugar found in RNA is D(-) ribose.
DNA consists of cytosine and thymine as pyrimidine bases.	RNA consists of cytosine and uracil as pyrimidine bases.
DNA has a double standard α -helix structure.	RNA has a single-stranded α -helix structure.

Adenine (A), the prevalent base in both DNA and RNA is:

1. Guanine (G)
2. Cytosine (C)

Functional difference: The primary function of DNA is to regulate cell activity, such as telling each organ what to manufacture and do. The primary function of RNA is to produce protein.

(b) Components of starch: Amylose and Amylopectin.

Practise Questions on Biochemistry

Q1: How are enzymes named? Give an example.

Answer:

Enzymes are called by the chemical with which they react. Maltase, for example, is an enzyme that catalyses the conversion of maltose to glucose.

Enzymes are sometimes named after the reaction in which they are utilised. Oxidoreductases, for example, are enzymes that catalyse the reduction of other molecules.

Q2: What is glycogen? How is it different from starch?

Answer:

Glycogen is a carbohydrate (polysaccharide). Carbohydrates are stored as glycogen in animals. Starch is a carbohydrate made up of two components: amylose (15–20%) and amylopectin (80–85%).

On the other hand, Glycogen only has one component with a structure similar to amylopectin. In addition, glycogen has a higher branching structure than amylopectin.

Q3: (i) Which one of the following is a disaccharide:

starch, maltose, fructose, glucose?

(ii) What is the difference between acidic and basic amino acids?

(iii) Write the name of the linkage joining two nucleotides.

Answer:

(i) Maltose

(ii) Acidic amino acid includes 2 carboxylic acids groups and 1 amino group. Basic amino acids comprise 2 amino and one —COOH group.

(iii) Phospho diester linkage.

Q4: The two strands in DNA are not identical but are complementary. Explain.

Answer:

In the helical structure of DNA, the two strands are retained together by hydrogen bonds among specific pairs of bases. Adenine and thymine make a hydrogen bond, while cytosine and guanine form a hydrogen bond. As a result, both strands are complementary to one another.

- Q5:** (i) Which one of the following is a polysaccharide: starch, maltose, fructose, glucose
(ii) Write one difference between α -helix and β -pleated sheet structures of protein.
(iii) Write the name of the disease caused by the deficiency of vitamin B12

Answer:

- (i) Starch
(ii) α -helix configuration has intra-molecular H-bonding in polypeptide chains of globular proteins.
 β -pleated structure has inter-molecular H-bonding among polypeptide chains of fibrous proteins.
(iii) Pernicious Anaemia.