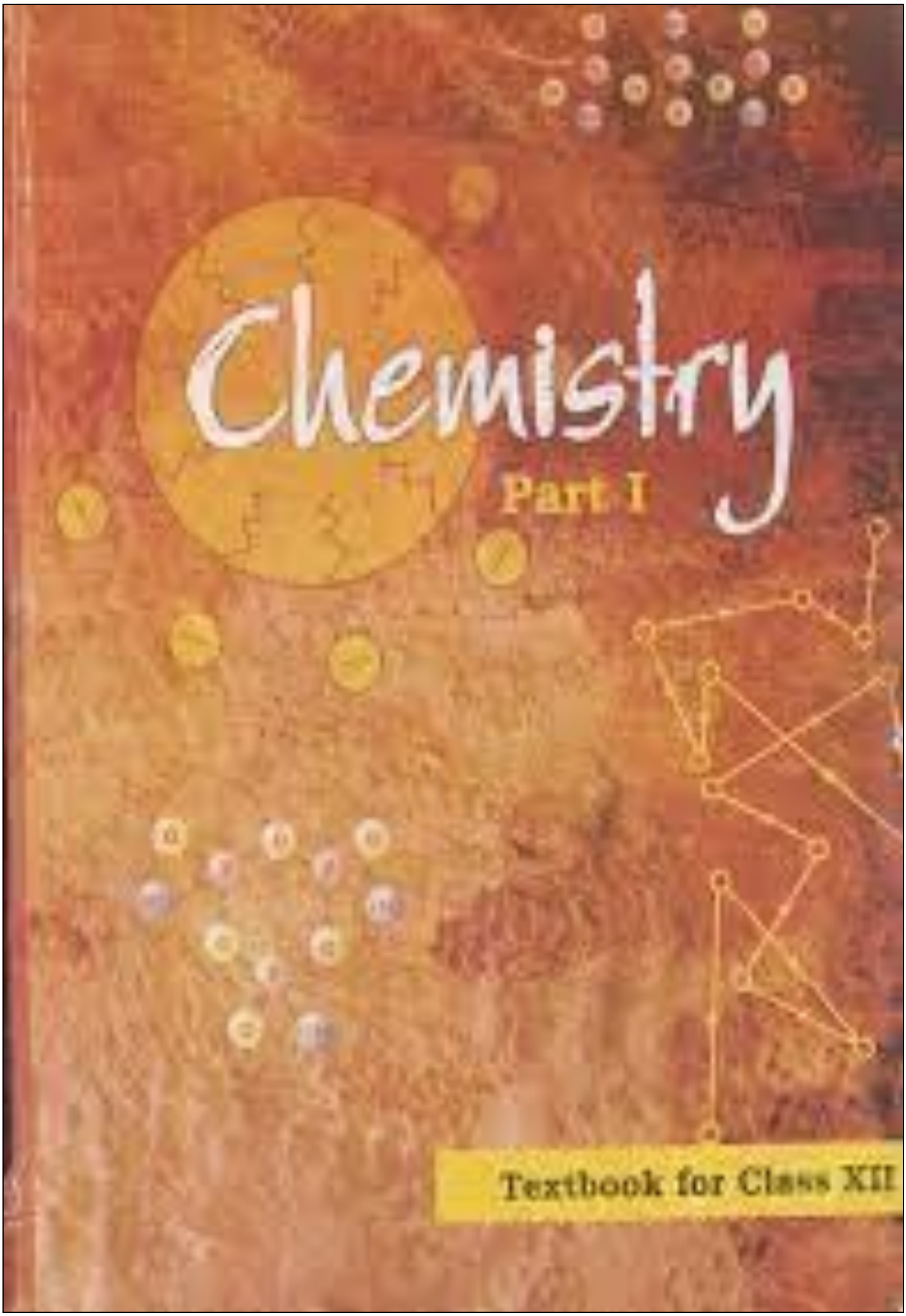

Chemistry
Part I
Textbook for Class XII

Chapter – 14 (Biomolecules)

Exercise Questions:

Question :1 What are monosaccharides?

Answer:

Monosaccharides (from Greek monos: single, sacchar: sugar), also called simple sugars, are the simplest form of sugar and the most basic units (monomers) of carbohydrates.[1] The general formula is $C_nH_{2n}O_n$, albeit not all molecules fitting this formula (e.g. acetic acid) are carbohydrates. [2] They are usually colorless, water-soluble, and crystalline solids. Contrary to their name (sugars), only some monosaccharides have a sweet taste.

Examples of monosaccharides include glucose (dextrose), fructose (levulose), and galactose. Monosaccharides are the building blocks of disaccharides (such as sucrose and lactose) and polysaccharides (such as cellulose and starch). Each carbon atom that supports a hydroxyl group is chiral, except those at the end of the chain. This gives rise to a number of isomeric forms, all with the same chemical formula. For instance, galactose and glucose are both aldohexoses, but have different physical structures and chemical properties.

The monosaccharide glucose plays a pivotal role in metabolism, where the chemical energy is extracted through glycolysis and the citric acid cycle to provide energy to living organisms. Some other monosaccharides can be converted in the living organism to glucose.

Question :2 What are reducing sugars?

Answer:

Reducing sugars are carbohydrates that reduces Fehling's solution and Tollen's reagent. All monosaccharides and disaccharides, excluding sucrose, are reducing sugars.

Question :3 Write two main functions of carbohydrates in plants.

Answer:

The two main functions of carbohydrates in plants are:

i.) Polysaccharides such as starch serve as storage molecules.

ii.) Cellulose, a polysaccharide, is used to build the cell wall.

Question :4 Classify the following into monosaccharides and disaccharides.

I. **Ribose**
II. **2-deoxyribose**
III. **Maltose**
IV. **Galactose**
V. **Fructose**
VI. **Lactose**

Answer:

Monosaccharides:

Ribose, 2-deoxyribose, galactose, fructose.

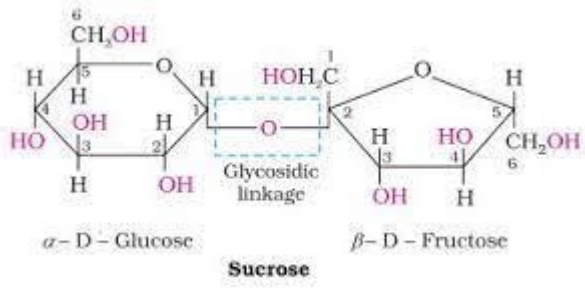
Disaccharides:

Maltose, lactose.

Question :5 What do you understand by the term glycosidic linkage?

Answer:

Glycosidic linkage refers to the linkage formed between two monosaccharide units through an oxygen atom by the loss of a water molecule.



Sucrose

For example, in a sucrose molecule, two monosaccharide units, ∝-glucose and β-fructose, are joined together by a glycosidic linkage.

Question :6 What us glycogen? How is it different from starch.

Answer:

Glycogen is a carbohydrate. In animals, carbohydrate are stored as glycogen. Starch is a carbohydrate consisting of two component – amylose and amylopectin. However, glycogen consists of only one component whose structure is similar is similar to amylopectin. Also, glycogen is more branched than amylopectin.

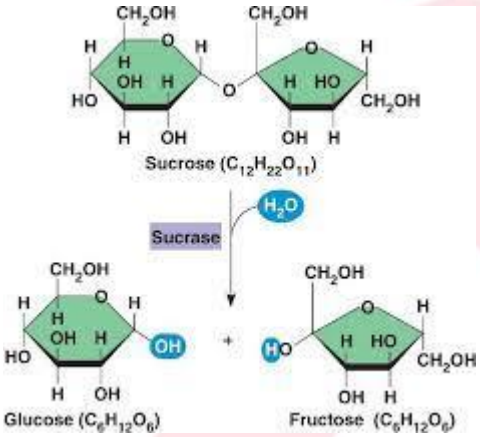
Question :7 What are hydrolysis product of

I. Sucrose

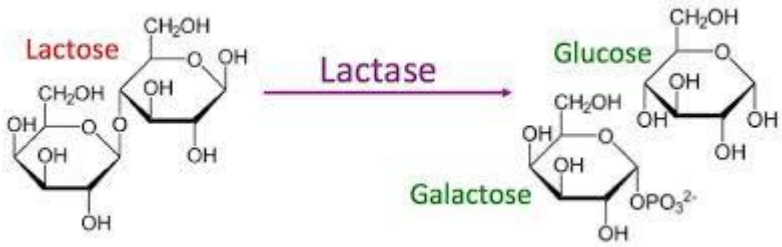
II. Lactose

Answer:

i.) On hydrolysis, sucrose gives one molecule of alpha-D-glucose and one molecule of beta-D-fructose.



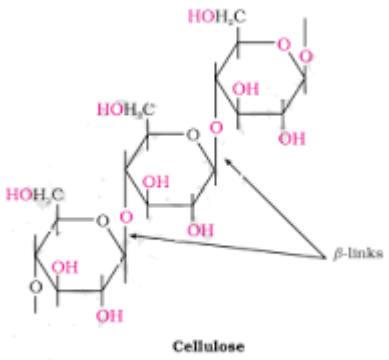
ii.) The hydrolysis of lactose gives beta-D-galactose and beta-D-glucose.



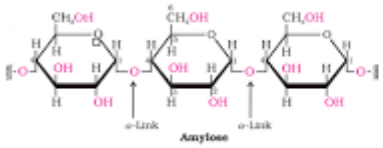
Question :8 What is the basic structural difference between starch and cellulose?

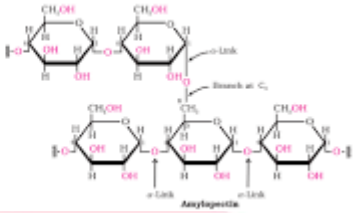
Answer:

Cellulose is a long straight-chain polysaccharide made of \beta - D - glucose units and has 1,4 - glycoside linkage.



Whereas starch is made up of 2 components :- Amylose and amylopectin.
Amylose is a long straight chain made of \alpha - D - glucose units and joined by 1,4 - glycosidic linkage.
Amylopectin is a branched structure and chains are formed at 1,4 - glycoside linkage and branching occurs at 1.6 - glycosidic linkage.





Question :9 What happens when D-glucose is treated with the following reagent?

I. HI

II. Bromine water

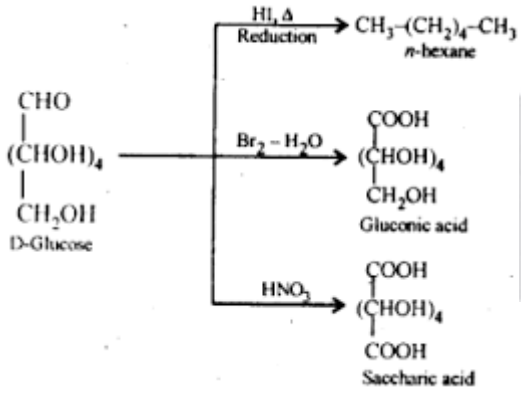
III. HNO3

Answer:

i.) When D-glucose is heated with HI for a long time, n-hexane is formed .

ii.) When D-glucose is treated with Br_2 water, D-gluconic acid is produced.

iii.) On being treated with HNO_3, D-glucose get oxidised to give saccharic acid.



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

Answer:
(1) Aldehydes give 2, 4-DNP test, Schiff's test, and react with NaHSO4to form the hydrogen sulphite addition product. However, glucose does not undergo these reactions.

(2) The pentaacetate of glucose does not react with hydroxylamine. This indicates that a free -CHO group is absent from glucose.

(3) Glucose exists in two crystalline forms - $\propto$ and β. The $\propto$-form (m.p. = 419 K) crystallises from a concentrated solution of glucose at 303 K and the β-form (m.p = 423 K) crystallises from a hot and saturated aqueous solution at 371 K. This behaviour cannot be explained by the open chain structure of glucose.

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

Answer:
Essential amino acids are required by the human body, but they cannot by synthesized in the body. They must be taken though food. For example, valine and leucine. Non-essential

Question :12 Define the following as related to proteins:

I. Peptide linkage

II. Primary structure

III. Denaturation

Answer:

(i) A peptide linkage is an amide (—CO— NH —) linkage formed between —COOH group of one amino acid and —NH2 group of other a-amino acid by loss of a water molecule.

(ii) The specific sequence in which various a-amino acids present in a protein are linked to one another is called its primary structure. Any change in its primary structure creates a new protein.

(iii) Denaturation of Proteins: When a protein in its native form is subjected to a change, such as change in temperature or change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation, 2° and 3° structures are destroyed but 1° structures remain intact, e.g., coagulation of egg while on boiling, curdling of milk, etc.

Question :13 What are the common types of secondary structures of proteins?

Answer:

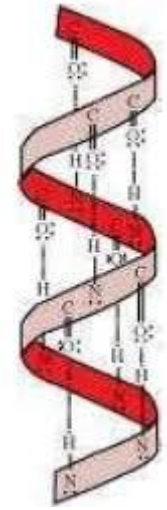
There are two common types of secondary structure of proteins:

(i) ∝-helix structure

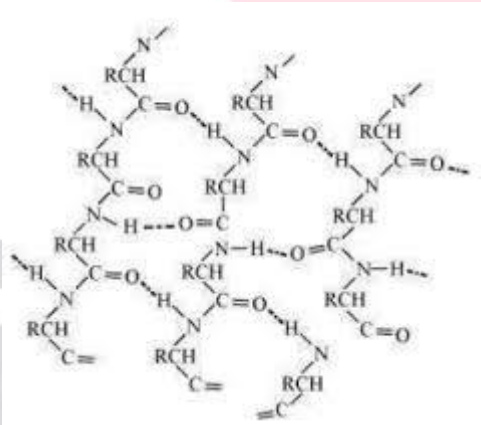
(ii) β-pleated sheet structure

∝- Helix structure:

In this structure, the -NH group of an amino acid residue forms H-bond with the group of the adjacent turn of the right-handed screw (∝-helix).



β-pleated sheet structure:



This structure is called so because it looks like the pleated folds of drapery. In this structure, all the peptide chains are stretched out to nearly the maximum extension and then laid side by side. These peptide chains are held together by intermolecular hydrogen bonds

Question :14 What type of bonding helps in stabilising the a-helix structures of proteins?

Answer:

The H- bonds formed between the –NH group of each amino acids residue and the C=O group of the adjacent terms of α – helix help in stabilizing the helix.

Question :15 Differentiate between globular and fibrous proteins.

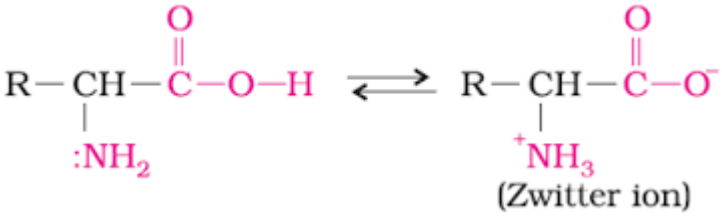
Answer:

Fibrous protein	Globular protein
It is fiber-like structure formed by the polypeptide chain. These proteins are held together by strong hydrogen and disulphide bonds.	The polypeptide chain in this protein is folded around itself, giving rise to a spherical structure.
It is usually insoluble in water.	It is usually soluble in water.
Fibrous proteins are usually used for structural purposes. For example, keratin is present in nails and hair, collagen in tendons, and myosin in muscles.	All enzymes are globular proteins. Some hormones such as insulin are also globular proteins.

Question :16 How do you explain the amphoteric behaviour of amino acids?

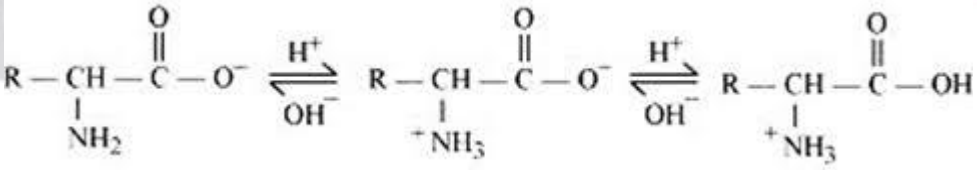
Answer:

In aqueous solution, the carboxyl group of an amino acid can lose a proton and the amino group can accept a proton to give a dipolar ion known as zwitter ion.



(Zwitter ion)

Therefore, in zwitter ionic form, the amino acid can act both as an acid and as a base.



Thus, amino acids show amphoteric behaviour.

Question :17 What are enzymes?

Answer:

An enzyme is a protein molecule in cells which works as a biological catalyst.[1] Enzymes speed up chemical reactions in the body, but do not get used up in the process, therefore can be used over and over again.

Almost all biochemical reactions in living things need enzymes. With an enzyme, chemical reactions go much faster than they would without the enzyme.[2]p39 Other biocatalysts are catalytic RNA molecules, called ribozymes.

The substances at the start of a reaction are called substrates. The substances at the end of a reaction are the products. Enzymes work on the substrates, and turn them into products. The study of enzymes is called enzymology

Question :18 What is the effect of denaturation on the structure of proteins?

Answer:

As a result of denaturation, globules get unfolded and helixes get uncoiled. Secondary and tertiary structures of proteins are destroyed, but the primary structures remain unaltered. It can be said that during denaturation, secondary and tertiary – structured proteins get converted into primary structured proteins. Also, as the secondary and tertiary structures of a protein are destroyed, the enzyme loses its activity.

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

Answer:

On the basis of their solubility in water or fat, vitamins are classified into two types:

i.) Fat – soluble vitamins: Vitamins that are soluble in fat and oils, but not in water, belongs to this group. For example: Vitamin A, D, E and K.

ii.) Water – soluble vitamins: Vitamins that are soluble in water belongs to this group. For example: B group vitamins and vitamins C.

However, biotin or vitamin H is neither soluble in water nor in fat,.

Vitamin K is responsible for the coagulation of blood.

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

Answer:

The deficiency of vitamin A leads to xerophthalmia and night blindness. The deficiency of vitamin C leads to scurvy .

The sources of vitamin A are fish liver oil, carrot, butter and milk. The sources of vitamin C are citrus fruits, amla and green leafy vegetables.

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

Answer:

Nucleic acids are biomolecules found in the nuclei of all living cells, as one of the constituents of chromosomes. There are mainly two types of nucleic acids - deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Nucleic acids are also known as polynucleotides as they are long-chain polymers of nucleotides.

Two main functions of nucleic acids are:

(i) DNA is responsible for the transmission of inherent characters from one generation to the next. This process of transmission is called heredity.

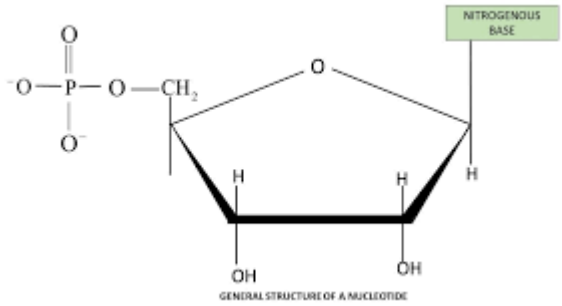
(ii) Nucleic acids (both DNA and RNA) are responsible for protein synthesis in a cell. Even though the proteins are actually synthesised by the various RNA molecules in a cell, the message for the synthesis of a particular protein is present in DNA

Question :22 What is the difference between a nucleoside and a nucleotide?

Answer:

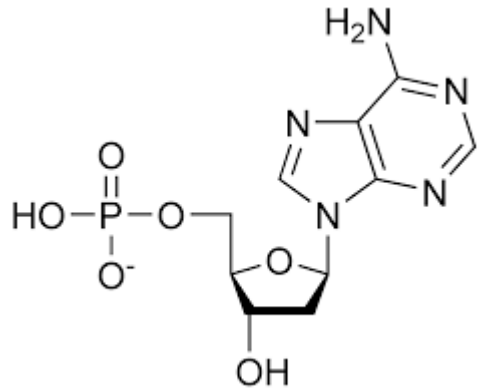
A nucleoside is formed by the attachment of a base to 1 position of sugar.

Nucleoside = Sugar + Base.



On the other hand, all the three basic components of nucleic acids are present in a nucleotide.

Nucleotide = Sugar + Base + Phosphoric acid.



Question :23 The two stands in DNA are not identical but are complementary. Explain.

Answer:

In the helical structure of DNA, the two strands are held together by hydrogen bonds between specific pairs of bases. Cytosine forms hydrogen bond with guanine, while adenine forms hydrogen bond with thymine. As a result, the two strands are complementary to each other.

Question :24 Write the important structural and functional difference between DNA and RNA.

Answer:

The structural difference between DNA and RNA are as follows:

DNA	RNA
The sugar present in DNA molecules is β-D-2-deoxyribose.	The sugar present in RNA molecules is β-D-ribose.
DNA contains thymine. It does not contain uracil.	RNA contains uracil. It does not contain thymine.
The helical structure of DNA is double-stranded.	The helical structure of RNA is single stranded.

The functional difference between DNA and RNA are as follows:

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

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

Answer:

i.) Messenger RNA (m-RNA)

ii.) Ribosomal RNA (r-RNA)

iii.) Transfer RNA (t-RNA).