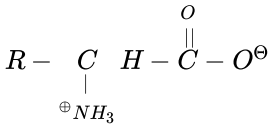
Solution

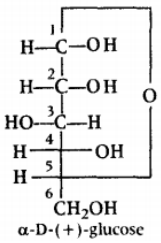
BIOMOLECULES CHEMISTRY

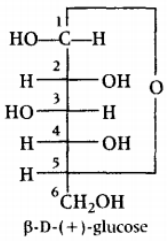
Class 12 - Chemistry

1. a. Nitrogeneous base linked with pentose sugar called as nucleoside while Nucleoside linked with phosphate group is called as nucleotide.
   b. Amylose is water soluble while amylopectin is water insoluble.
2. Polysaccharides are not sweet in taste & hence are called non-sugars.
3. a. Polysaccharides contain a large number of monosaccharide units joined together by glycosidic linkages.
   b. Sugar + Phosphate + base / Nucleoside linked to a phosphate group.
4. Example of Z witter Ion :

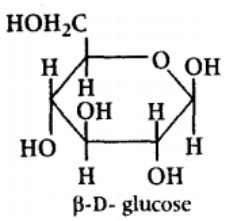


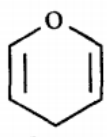
5. Vitamin C cannot be stored in our body because it is water soluble. As a result, it is readily excreted in the urine.
6. The 2 strands of DNA are attached to each other by hydrogen bonds that connect the nitrogenous bases of one strand to the bases of the other strand (this is called complementary base pairing) where Adenine pairs with Thymine by 2 hydrogen bonds and Guanine pairs with Cytosine using 3 hydrogen bonds.
   While nucleotides of DNA are held together by Phosphodiester linkages. The structure of DNA holds the nucleotides in place using phosphodiester bonds. A phosphodiester bond occurs when exactly two of the hydroxyl group in phosphoric acid react with hydroxyl groups on other molecules to form two ester bonds. The phosphodiester bond is the linkage between the 3' carbon atom of one sugar molecule and the 5 ' carbon atom of another, deoxyribose in DNA.
7. Glycogen is stored in liver of animals. In the liver, glycogen can make up 5-6% of the organ's fresh weight, and the liver of an adult, weighing 1.5 kg, can store roughly 100-120 grams of glycogen.
8. Primary structure of proteins tells about the sequence in which various amino acids are linked with each other.
9. 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.
10. Vitamin 'C' is water soluble vitamin and hence excess of it is readily excreted in the urine so, it cannot be stored in our body and hence, it should be regularly supplied in the diet.
11. **Difference between α- glucose and β- glucose**
    Glucose is found to exist in two different crystalline forms which are named as α and β. The two forms differ from each other in the orientation of -OH group al C-1. Moreover, the a-form (melting point 419 K) is obtained by crystallisation from a concentrated solution of glucose at 303 K while 13-form(melting point 423 K) is obtained by crystallisation from hot and saturated solution at 371 K.





Pyranose structure of glucose :
The six-membered cyclic structure of glucose is called pyranose structure (α or β),in analogy with pyran. Pyran is a cyclic compound with one oxygen atom and five carbon atoms in the ring.





12. **Functions of carbohydrates:**

i. Cellulose forms cell wall of plant cell.
ii. Store energy in the form of starch in plant cell and in the form of glycogen in animal cell.
iii. They are found in combination with proteins and lipids.
iv. They are essential for plants and animals as a primary source of energy.

13. i. Two good sources of vitamin A are butter and cod liver oil of fish.
ii. Nucleotides are the monomer units of nucleic acid present in nucleus of living cell.
iii. Vitamin C is essential to us as it is needful for healthy gums and teeths. Its deficiency causes scurvy. Sources of vitamin C- Cirtus fruits, green leafy vegetables.

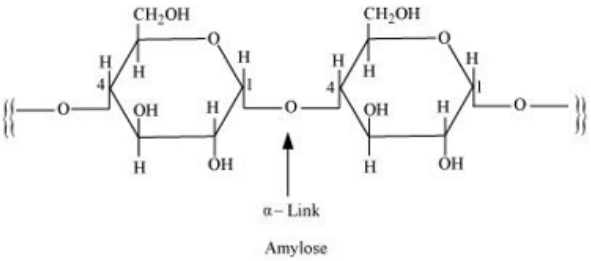
14. i. **Co-enxymes.** This prosthetic groups which get attached to enzymes at the time of reaction are called co-enzymes. They increase the activity of enzyme.
ii. **Mutation in biomolecules.** A difference of a single base in DNA molecules can change in amino acid sequence which leads to mutation.
iii. Nucleotides are monomers of nucleic acid. They consist of heterocyclic base, pentose sugar and phosphoric acid residue.

15. Enzymes are proteins that catalyse biological reactions. They are very specific in nature and catalyse only a particular reaction for a particular substrate. Enzymes are usually named after the particular substrate or class of substrate and sometimes after the particular reaction.
For example, the enzyme used to catalyse the hydrolysis of maltose into glucose is named as maltase.

$$\underset{Maltose}{C_{12}H_{22}O_{11}} \xrightarrow{Maltase} 2\underset{Glu\cos e}{C_6H_{12}O_6}$$

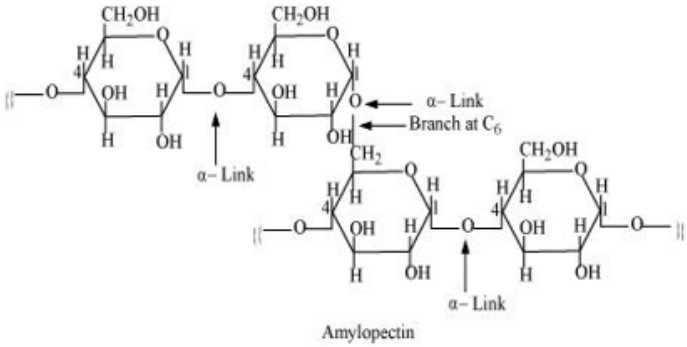
Again, the enzymes used to catalyse the oxidation of one substrate with the simultaneous reduction of another substrate are named as oxidoreductase enzymes.
The name of an enzyme ends with $-\text{ase}'$.

16. Starch consists of two components - amylose and amylopectin. Amylose is a long linear chain of $\propto$ -D-(+)-glucose units joined by C_1 - C_4 glycosidic linkage ($\propto$ -link).



Amylose

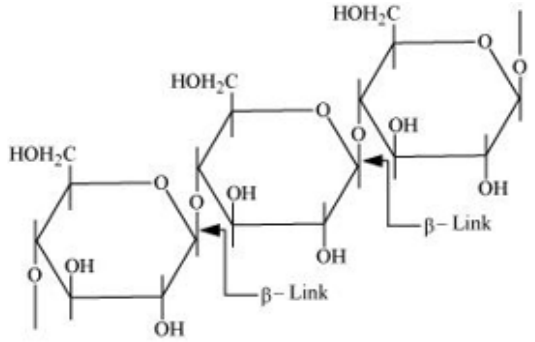
Amylopectin is a branched-chain polymer of $\propto$ -D-glucose units, in which the chain is formed by C_1 - C_4 glycosidic linkage and the branching occurs by $C_1 - C_4$ glycosidic linkage.



Amylopectin

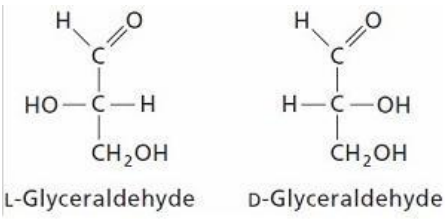
On the other hand, cellulose is a straight-chain polysaccharide of β -D-glucose units joined by C_1 - C_4 glycosidic linkage (β -

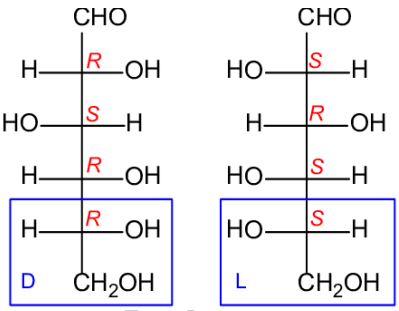
link).



17. The sugars are divided into two families: the D-family and L-family which have definite configurations. These relative configurations are represented with respect to glyceraldehyde as the standard. The glyceraldehydes may be represented in two forms as:
    i. All the compound which can be chemically correlated to (+) isomers of glyceraldehyde are said to be D- configuration
    ii. All the compound which can be chemically correlated to (-) isomers are said to be L-configuration.

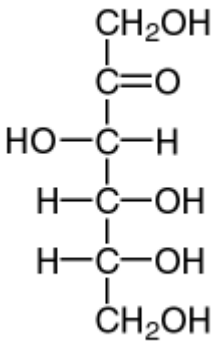
    The D-configuration has -OH attached to the carbon adjacent to $-CH_2OH$ on the right while L - configuration has - OH attached to the carbon adjacent to $-CH_2OH$ on left. The sugars are called D - or L - depending upon whether the configuration of the molecule is related to D-glyceraldehyde or L-glyceraldehyde. It has been found that all naturally occurring sugars belong to D-series, e.g., D-glucose and D-fructose.





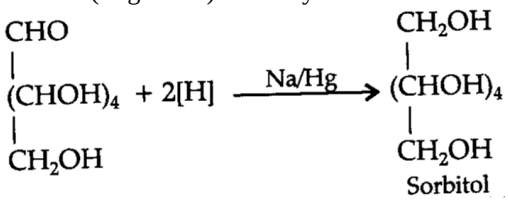
(D-glucose and L- glucose)

Fructose

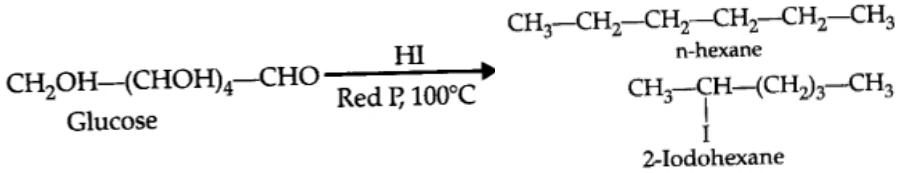


(D-fructose).

18. This structure was assigned on the basis of the following evidences:
    i. **Molecular formula:** $C_6H_{12}O_6$ is molecular formula of glucose.
    ii. **Straight chain structure:**
        a. When aqueous solution of glucose is treated with sodium amalgam (Na/Hg) or sodium borohydride, it is reduced to sorbitol (or glucitol) a hexahydric alcohol.



b. Prolonged heating with hydroiodic acid and red phosphorus at 100°C gives a mixture of n-hexane and 2-iodohexane.

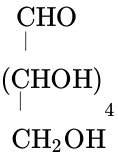


The formation of n-hexane suggests that all the six carbon atoms in glucose are arranged in a straight chain structure.

c. **Presence of five -OH groups:** On acetylation with acetic anhydride, glucose gives a pentaacetate. This confirms that glucose contains five -OH groups. We know that the presence of two or more -OH groups on the same carbon atom makes the molecules unstable.
Since glucose is a stable compound, therefore, the five -OH groups must be present on different carbon atoms.

d. **Presence of one primary alcoholic group:** On oxidation with conc. HNO_3, both glucose and gluconic acid give the same dicarboxylic acid and saccharic acid. The primary alcoholic group ($-CH_2OH$) is always present at the end of the carbon chain.

e. **Presence of an aldehyde (-CHO) group:** Glucose reacts with hydroxylamine, NH_2OH to form oxime. This suggests that glucose contains a carbonyl (>C=O) group.
On the basis of above observations, the following open CH_2OH chain structure for glucose can be written as follows:



19. The structural differences between DNA and RNA are as follows:

DNA	RNA
1. The sugar moiety in DNA molecules is β -D-2 deoxyribose.	1. The sugar moiety in RNA molecules is β -D-ribose.
2. DNA contains thymine (T). It does not contain uracil (U).	2. RNA contains uracil (U). It does not contain thymine (T).
3. The helical structure of DNA is double-stranded.	3. The helical structure of RNA is single-stranded.

The functional differences between DNA and RNA are as follows:

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