14

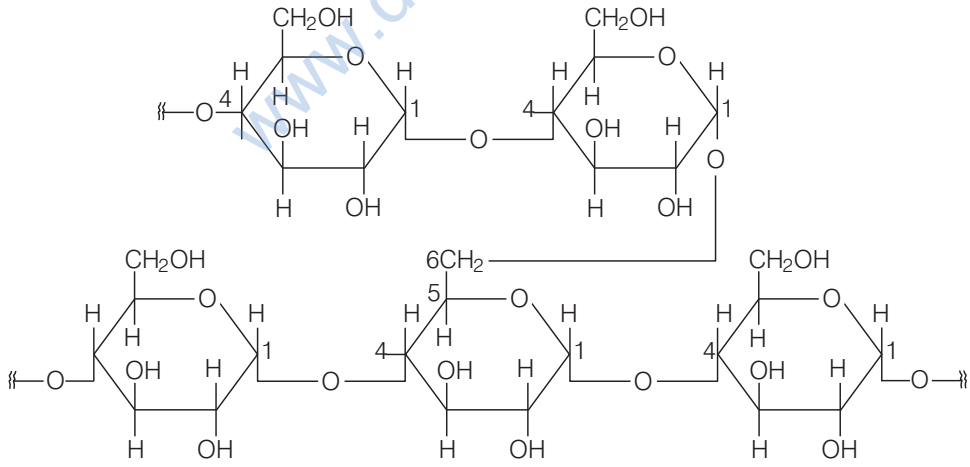
Biomolecules

Multiple Choice Questions (MCQs)

Q. 1 Glycogen is a branched chain polymer of α-D glucose units in which chain is formed by Cl—C4 glycosidic linkage where as branching occurs by the formation of C1-C6 glycosidic linkage. Structure of glycogen is similar to ..... .

(a) amylose (b) amylopectin (c) cellulose (d) glucose

Ans. *(b)* Glycogen is a branched chain polymer of α *D* glucose units in which chain is formed by C1 — C4 glycosidic linkage whereas branching occurs by the formation of C1 — C6 glycosidic linkage. Structure of glycogen can be shown below similar to the structure amylopectin.



Structure of amylopectine

Glycogen is also known as animal starch present in liver, muscles and brain.

Q. 2 Which of the following polymer is stored in the liver of animals?

(a) Amylose (b) Cellulose (c) Amylopectin (d) Glycogen

Ans. *(d)* Glycogen is a polymer of α-*D* glucose stored in the liver, brain and muscles of animals, also known as animal starch.

Q. 3 Sucrose (cane sugar) is a disaccharide. One molecule of sucrose on hydrolysis gives ..... .

(a) 2 molecules of glucose

(b) 2 molecules of glucose + 1 molecule of fructose

(c) 1 molecule of glucose +1 molecule of fructose

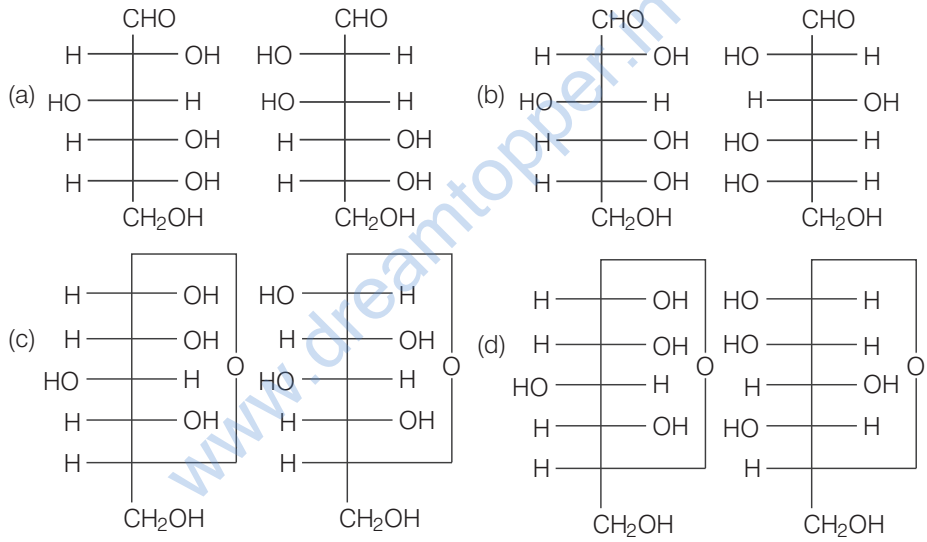
(d) 2 molecules of fructose

Ans. *(c)* Sucrose (cane sugar) is a disaccharide. One molecule of sucrose on hydrolysis gives one molecule of glucose and one molecule of fructose.

$$\underset{\text{Cane sugar}}{C_{12}H_{22}O_{11}} \xrightarrow[H^+]{H_2O} \underset{D(+)\text{ glucose}}{C_6H_{12}O_6} + \underset{D(-)\text{ fructose}}{C_6H_{12}O_6}$$

Note *Sucrose is a dextro-rotatory sugar on hydrolysis produces a laevorotatory mixture so, known as invert sugar. Sucrose is a non-reducing sugar while maltose and lactose are reducing sugar.*

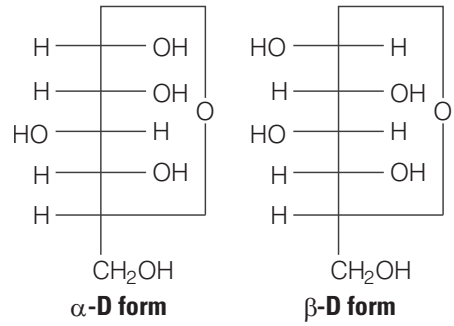
Q. 4 Which of the following pairs represents anomers?



Thinking Process

This problem is based on the concept of anomer. Saccharides which differ in configuration at C-1 are known as anomers.

Ans. *(c)* Anomers have different configuration at C-1. If OH is present at right side anomeric carbon is known as α- form and if OH is present at left side of anomeric carbon is known as β- form



α-D form **β-D form**

Q. 5 Proteins are found to have two different types of secondary structures viz α-helix and β-pleated sheet structure. α-helix structure of protein is stabilised by

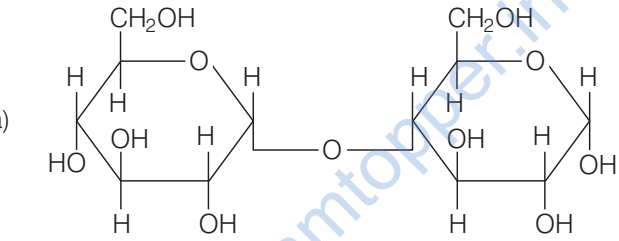
(a) peptide bonds
(b) van der Waals, forces
(c) hydrogen bonds
(d) dipole-dipole interactions

Ans. *(c)* Secondary structures of protein denotes the shape in which a long polypeptide chain exists. The secondary structure exist in two type of structure α- helix and β- pleated structure.

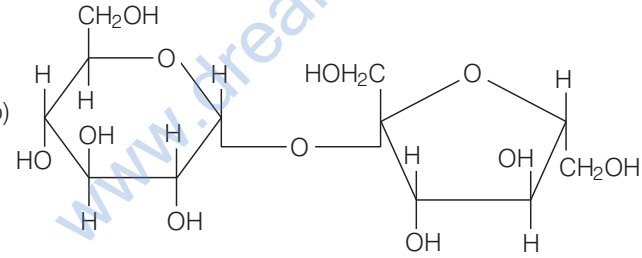
In α- helix structure, a polypeptide chain forms all possible hydrogen bonds by twisting into a right handed screw with —NH group of each amino acid rest hydrogen bonded to $>C = O$ of adjacent amino acid, which form a helix.

Q. 6 In disaccharides, if the reducing groups of monosaccharides, i.e., aldehydic or ketonic groups are bonded, these are non-reducing sugars. Which of the following disaccharide is a non-reducing sugar?

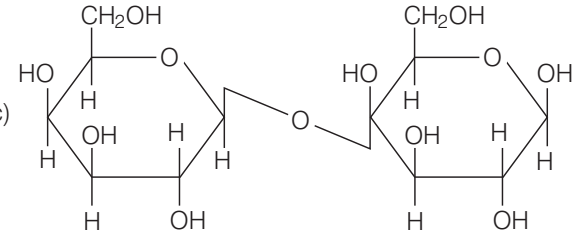
(a)



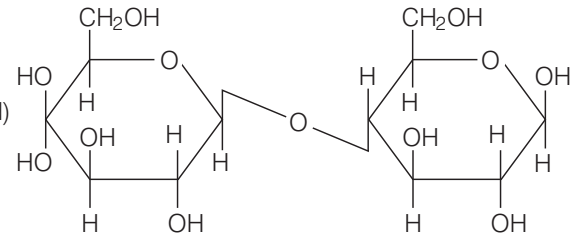
(b)



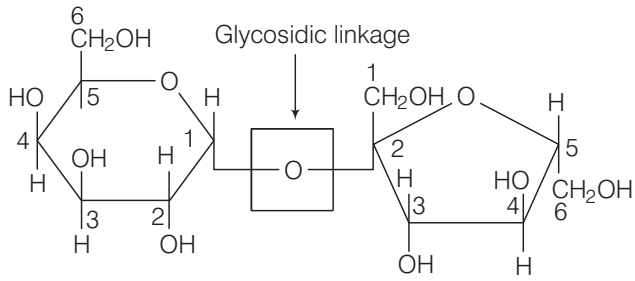
(c)



(d)



Ans. *(b)*



α-D-glucose **β-D-fructose**

This structure represents sucrose in which α–D glucose and β-D- fructose is attached to each other by C_1— C_2 glycosidic linkage.

Since, reducing groups of glucose and fructose are involved in glycosidic bond formation, this is considered as non-reducing sugar.

Q. 7 Which of the following acids is a vitamin?

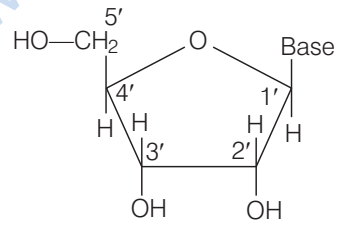
(a) Aspartic and (b) Ascorbic acid (c) Adipic acid (d) Saccharic acid

Ans. *(b)* Ascorbic acid is the chemical name of vitamin C. While others are not vitamins aspartic acid is an amino acid. Adipic acid is a dicarboxylic acid having 8 carbon chain. Saccharic acid is a dicarboxylic acid obtained by oxidation of glucose using HNO_3.

Q. 8 Dinucleotide is obtained by joining two nucleotides together by phosphodiester linkage. Between which carbon atoms of pentose sugars of nucleotides are these linkages present?

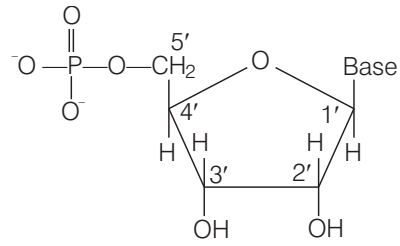
(a) 5′ and 3′ (b) 1′ and 5′ (c) 5′ and 5′ (d) 3′ and 3′

Ans. *(a)* **Nucleoside** Species formed by the attachment of a base to 1′ position of sugar is known as nucleoside. The sugar carbon are numbered as 1′, 2′, 3′, ...to distinguish them from bases.



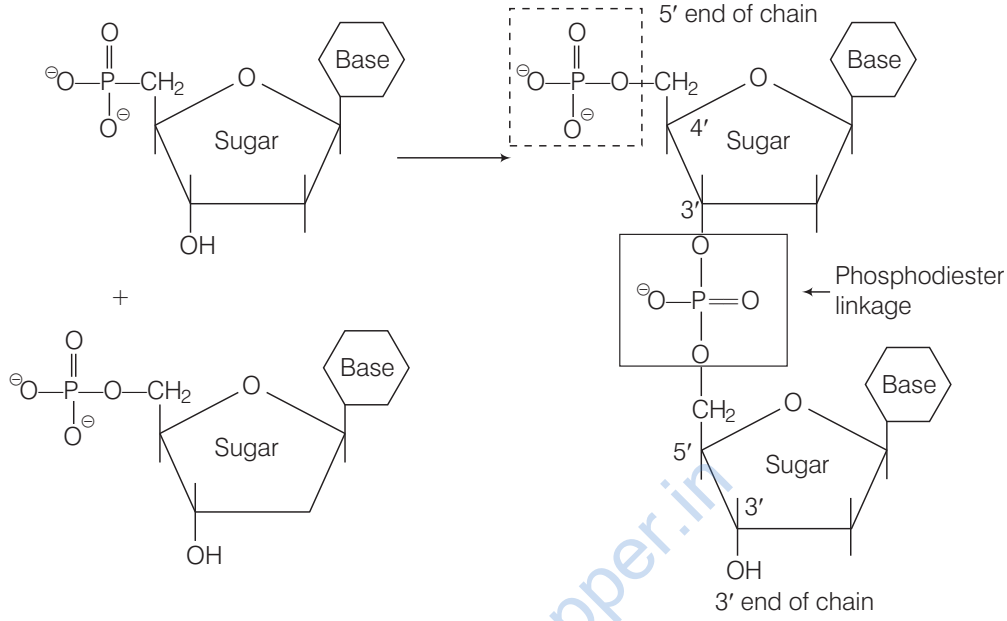
Structure of nucleoside

Nucleotide Species formed by attachment of phosphoric acid to nucleoside at 5′ position of sugar nucleotide.



Structure of nucleotide

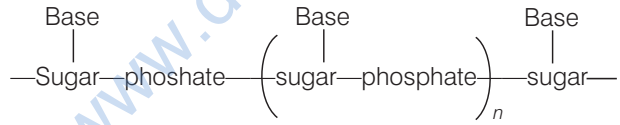
Dinucleotides are formed by phosphodiester linkage between 5′ and 3′ carbon atoms of the pentose sugar.



Q. 9 Nucleic acids are the polymers of

(a) nucleosides (b) nucleotides (c) bases (d) sugars

Ans. *(b)* Nucleic acids are polymer of nucleotides in which nucleic acids are linked together by phosphodiester linkage.



e.g., DNA, RNA etc.

Q. 10 Which of the following statements is not true about glucose?

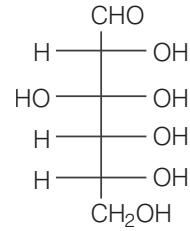
(a) It is an aldohexose

(b) On heating with HI it forms *n*-hexane

(c) It is present in furanose form

(d) It does not give 2, 4- DNP test

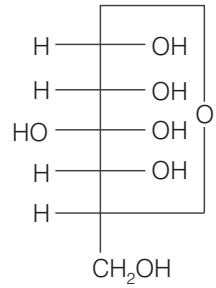
Ans. *(c)* Glucose is a aldohexose having structural formula.



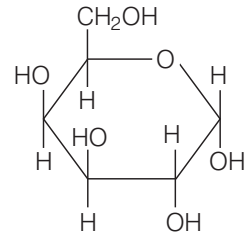
Glucose on heating with HI produces *n* hexane.

$$C_6H_{12}O_6 \xrightarrow{HI} C_6H_{14}$$

Glucose does not give 2, 4, DNP test due to its existence as cyclic structure shown below



It is present in pyranose form, as shown below



Pyranose means pyran (membered ring containing oxygen) like structure.

Q. 11 Each polypeptide in a protein has amino acids linked with each other in a specific sequence. This sequence of amino acids is said to be ..... .

(a) primary structure of proteins (b) secondary structure of proteins
(c) tertiary structure of proteins (d) quateranary structure of proteins

Ans. *(a)* In primary structure of proteins when each polypeptide in a protein has amino acids linked with each other in a specific sequence. This type of structure is known as primary structure of proteins.

Q. 12 DNA and RNA contain four bases each. Which of the following bases in not present in RNA?

(a) Adenine (b) Uracil (c) Thymine (d) Cytosine

Ans. *(c)* DNA contain four bases adenine, guanine, thymine and cytosine. While RNA contain four bases adenine, uracil, guanine and cytosine. Thus, RNA does not contain thymine.

Hence, statement (c) is the correct choice.

Q. 13 Which of the following B group vitamins can be stored in our body?

(a) Vitamin B_1 (b) Vitamin B_2 (c) Vitamin B_6 (d) Vitamin B_{12}

Ans. *(d)* Vitamin B_{12} can be stored in our body belongs to B group vitamins, because it is not water soluble.

Q. 14 Which of the following bases is not present in DNA?

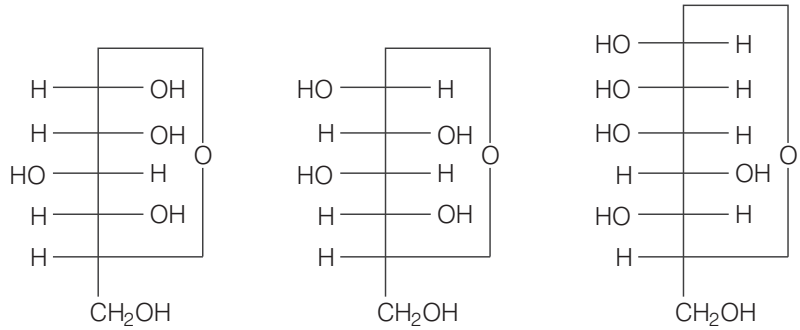
(a) Adenine (b) Thymine (c) Cytosine (d) Uracil

Ans. *(d)* DNA contains following four bases

(a) adenine (A) (b) thymine (T)
(c) guanine (G) (d) cytosine (C)

It does not contain uracil.

Q. 15 There cyclic structures of monosaccharides are given below which of these are anomers.



(i) (ii) (iii)

(a) I and II
(b) II and III
(c) I and III
(d) III is anomer of I and II

Ans. *(a)* **Anomers** Cyclic structures of monosaccharides which differ in structure at carbon-1 are known as anomers.

Here, I and II are anomer because they differ from each other at carbon- 1 only.

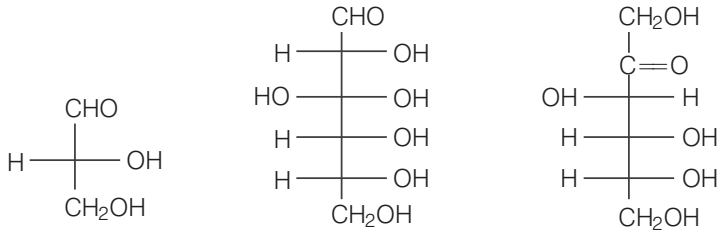
Q. 16 Which of the following reactions of glucose can be explained only by its cyclic structure?

(a) Glucose forms pentaacetate
(b) Glucose reacts with hydroxylamine to form an oxime
(c) Pentaacetate of glucose does not react with hydroxyl amine
(d) Glucose is oxidised by nitric acid to gluconic acid

Ans. *(c)* ''Pentaacetate of glucose does not react with hydroxylamine'' showing absence of free CHO group. This can not be explained by open structure of glucose. While all other properties are easily explained by open structure of glucose.

Hence, option (c) is the correct choice.

Q. 17 Optical rotations of some compounds alongwith their structures are given below which of them have D configuration.

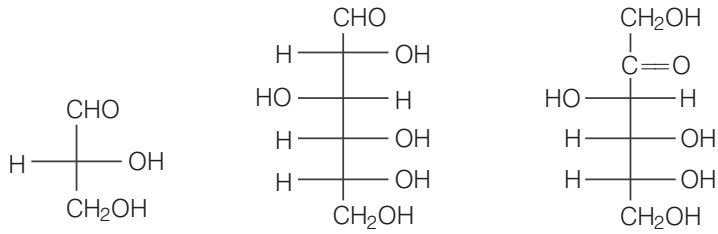


(+) rotation (+) rotation (–) rotation

(i) (ii) (iii)

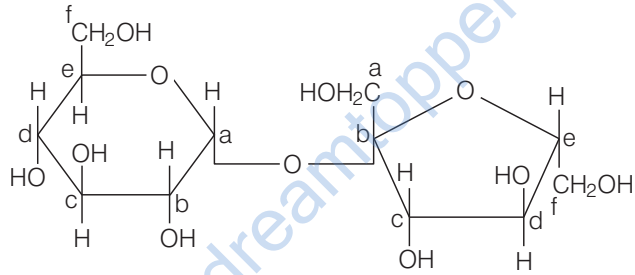
(a) I, II, III
(b) II, III
(c) I, II
(d) III

Ans. *(a)* *D* and *L* configuration are relative configuration decided by relating structure of given saccharide with *D* or *L* glyceraldehyde.



When OH an lowest asymmetric carbon is written at right hand side, it is represented as D configuration and when OH is written on left hand side, it is represented as L configuration.

Q. 18 Structure of disaccharide formed by glucose and fructose is given below. Identify anomeric carbon atoms in monosaccharide units.



(a) 'a' carbon of glucose and 'a' carbon of fructose

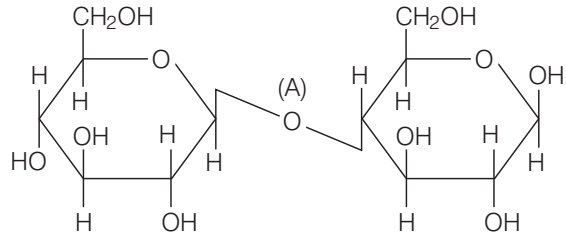
(b) 'a' carbon of glucose and 'e' carbon of fructose

(c) 'a' carbon of glucose and 'b' carbon of fructose

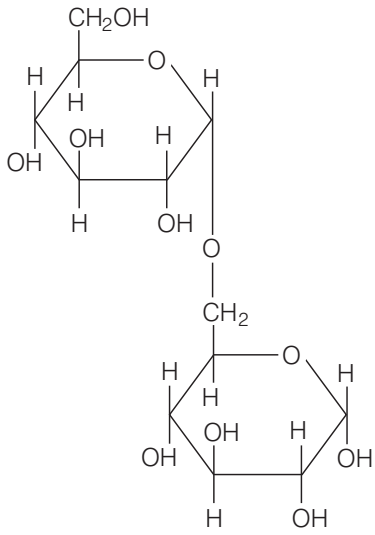
(d) 'f' carbon of glucose and 'f' carbon of fructose

Ans. *(c)* Carbon adjacent to oxygen atom in the cyclic structure of glucose or fructose is known as anomeric carbon. As shown in the structure above 'a' and 'b' are present at adjacent to oxygen atom. Both carbons differ in configurations of the hydroxyl group.

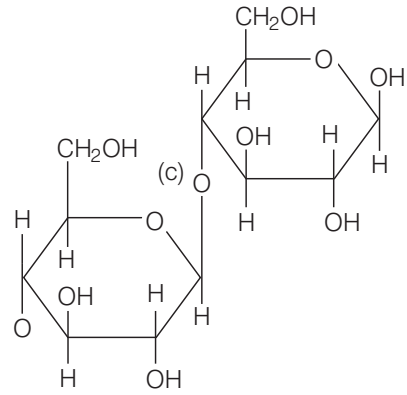
Q. 19 Three structures are given below in which two glucose units are linked. Which of these linkages between glucose units are between C_1 and C_4 and which linkages are between C_1 and C_6?



(i)



(ii)



(iii)

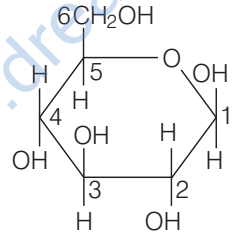
(a) (A) is between C1 and C4 , (B) and (C) are between C1 and C6

(b) (A) and (B) are between C1 and C4, (C) is between C1 and C6

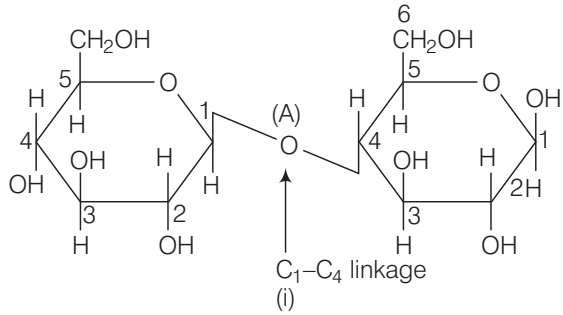
(c) (A) and (C) are between C1 and C4, (B) is between C1 and C6

(d) (A) and (C) are between C1 and C6, (B) is between C_1 and C_4

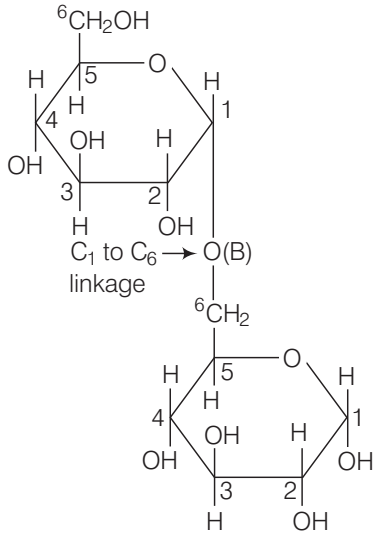
Ans. ***(c)*** Numbering of glucose starts from adjacent carbon of O-atom to the other carbon atom ending at last CH_2OH group as shown below



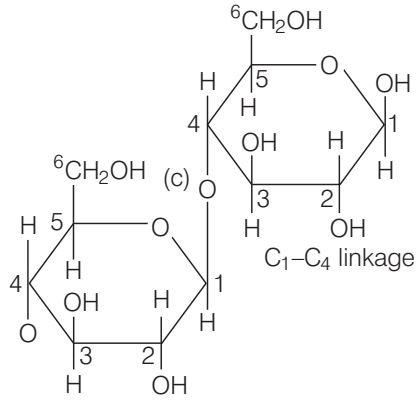
In this way, numbering for the disaccharides can be done as



(i)



(ii)



(iii)

Multiple Choice Questions (More Than One Options)

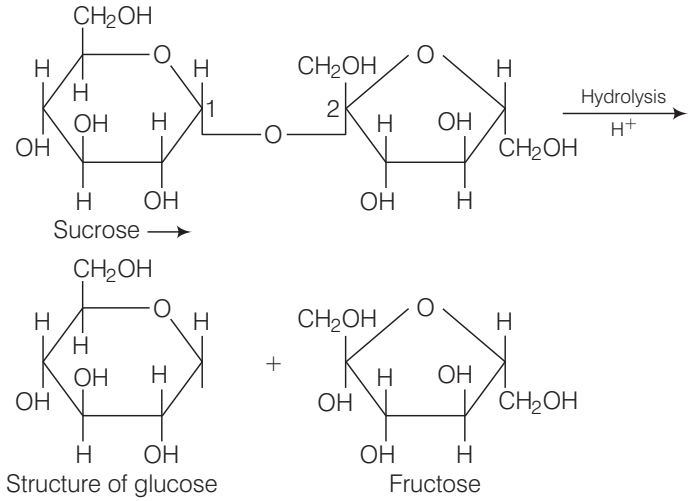
Q. 20 Carbohydrates are classified on the basis of their behaviour on hydrolysis and also as reducing or non-reducing sugar. Sucrose is a ..... .

(a) monosaccharide (b) disaccharide

(c) reducing sugar (d) non-reducing sugar

Ans. *(b, d)*

Sucrose on hydrolysis produces equimolar mixture of α — D(+) glucose and *B-D*(–)-. fructose. Since in sucrose C — 1 of glucose and C — 2 of fructose are linked with each other So, they are non-reducing in nature.



Structure of glucose Fructose

Q. 21 Proteins can be classified into two types on the basis of their molecular shape, i.e., fibrous proteins and globular proteins. Examples of globular proteins are

(a) insulin (b) keratin (c) albumin (d) myosin

Ans. *(a, c)*

The structure of protein which results when the chain of polypeptides coil around to give a spherical shape are known as globular protein. These proteins are soluble in water, *e.g.*, insulin and albumin are globular protein.

Hence, (a) and (c) are correct choices.

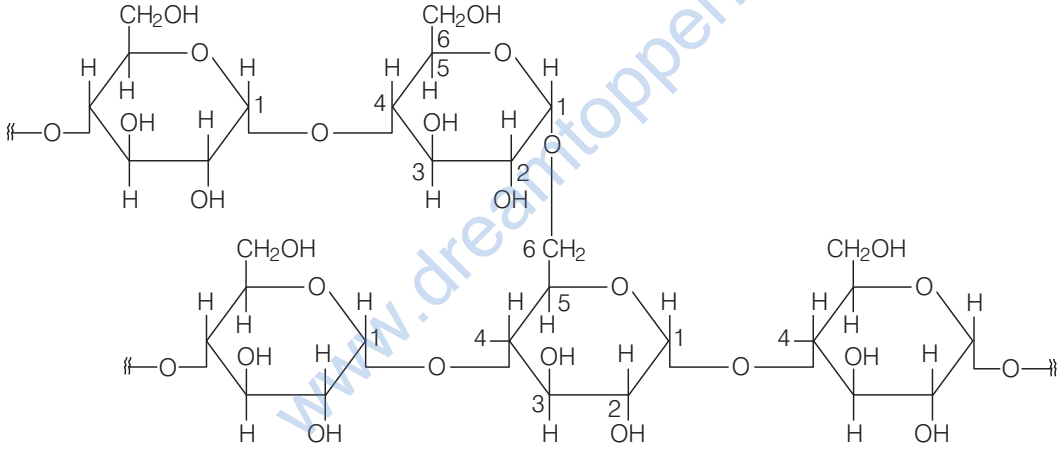
Q. 22 Which of the following carbohydrates are branched polymer of glucose?

(a) Amylose (b) Amylopectin

(c) Cellulose (d) Glycogen

Ans. *(b, d)*

Amylopectin and glycogen have almost similar structure in which glucose are linked linearly to each other by $C_1 — C_4$ glycosidic linkage and branched at $C_1 — C_6$ glycosidic linkage.



Structure of amylopectin

Glycogen are carbohydrates stored in animal body. The structure to similar to amylopectin and is rather more highly branched.

Q. 23 Amino acids are classified as acidic, basic or neutral depending upon the relative number of amino and carboxyl groups in their molecule. Which of the following are acidic?

(a) $(CH_3)_2CH — \underset{\displaystyle NH_2}{\underset{|}{CH}} — COOH$

(b) $HOOC — CH_2 — CH_2 — \underset{\displaystyle NH_2}{\underset{|}{CH}} — COOH$

(c) $H_2N — CH_2 — CH_2 — CH_2 — COOH$

(d) $HOOC — CH_2 — \underset{\displaystyle NH_2}{\underset{|}{CH}} — COOH$

Thinking Process

This problem is based on concept of nature of amino acid, that either it is acidic, basic or neutral.

Depending upon the number of acidic COOH *group, and basic* —NH_2 *group amino acid, proteins can be classified as*

(i) If number of COOH *groups = number of* NH_2 *groups, amino acid is neutral.*

(ii) If number of COOH *groups > number of* NH_2 *groups, amino acid is acidic.*

(iii) If number of COOH *group < number of* NH_2 *group, amino acid is basic.*

Ans. ***(b, d)***

(b) $HOOC - CH_2 - CH_2 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$

Number of COOH groups = 2

Number of NH_2 group = 1

Since, number of COOH groups (2) > number of NH_2 group (1). Therefore, this amino acid is acidic amino acid.

(d) $HOOC - CH_2 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$

Number of COOH groups = 2

Number of NH_2 groups = 1

Since, Number of COOH groups (2) > Number of NH_2 groups (1). Therefore, amino acid is acidic. While other two are neutral amino acid as number of NH_2 group in equal to number of COOH group in then.

Q. 24 Lysine, $H_2N - (CH_2)_4 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$ is ..... .

(a) α-amino acid (b) basic amino acid

(c) amino acid synthesised in body (d) β-amino acid

Ans. ***(a, b, c)***

Lysine whose structural formula is written below as

$$H_2N - (CH_2)_4 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - COOH$$

(a) It is an α amino acid.

(b) It is a basic amino acid because number of NH_2 groups (2) is greater than number of COOH group (1).

(c) It is a non-essential amino acid. Because it is synthesised in our body.

Q. 25 Which of the following monosaccharides are present as five membered cyclic structure (furanose structure)?

(a) Ribose (b) Glucose (c) Fructose (d) Galactose

Ans. ***(a, c)***

Ribose and fructose has five membered cyclic furanose structure because it include 5 carbon atom containing polyhydroxy carbonyl compound.

Hence (a) and (c) are correct choice.

Q. 26 In fibrous proteins, polypeptide chains are held together by ..... .

(a) van der Waals forces (b) disulphide linkage

(c) electrostatic forces of attraction (d) hydrogen bonds

Ans. ***(b, d)***

In fibrous proteins, polypeptide chains are held together by hydrogen and disulphide bond, in parallel manner. Due to which fibre-like structure is obtained. Such proteins are generally known as fibrous proteins. These proteins are generally insoluble in water. e.g., Keratin, myosin.

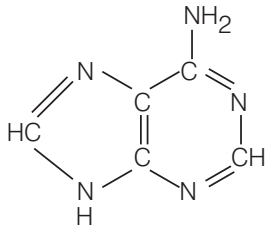
Q. 27 Which of the following are purine bases?

(a) Guanine (b) Adenine (c) Thymine (d) Uracil

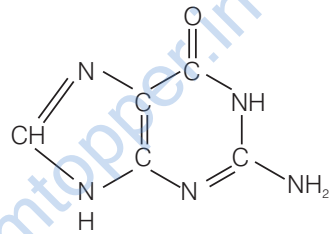
Ans. ***(a, b)***

Purines consist of six membered and five membered nitrogen containing ring fused together.

Guanine and adenine are purine bases whose structures are



Adenine (A)



Guanine [G]

While thymine and uracil are pyrimidene bases.

Hence (a) and (b) are correct choices.

Q. 28 Which of the following terms are correct about enzyme?

(a) Proteins (b) Dinucleotides (c) Nucleic acids (d) Biocatalysts

Ans. ***(a, d)***

Enzymes are proteins which acts as biocatalyst having specific role/action in specific biochemical reaction.

e.g., (i) Maltase decomposes maltose to glucose.

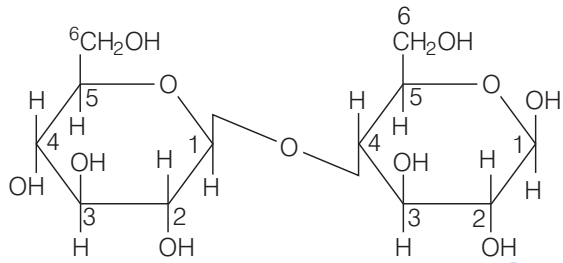
$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} \xrightarrow{\text{Maltase}} 2\underset{\text{Glucose}}{C_6H_{12}O_6}$$

Short Answer Type Questions

Q. 29 Name the sugar present in milk. How many monosaccharide units are present in it? What are such oligosaccharides called?

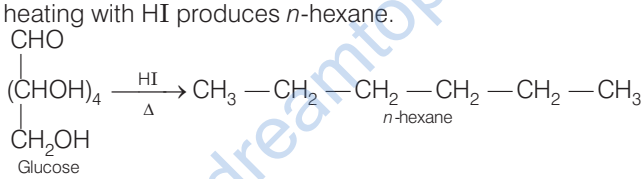
Ans. Sugar present in milk is known as lactose sugar. Two units of monosaccharides β-D-galactose and β -D-glucose are linked together.

Hence, are known as disaccharides.



Q. 30 How do you explain the presence of all the six carbon atoms in glucose in a straight chain?

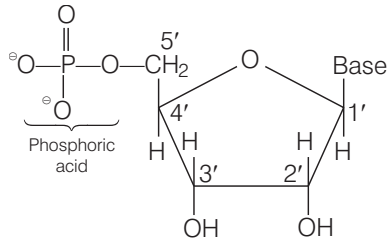
Ans. Glucose on heating with HI produces *n*-hexane.



This suggests that all the six carbon atoms of glucose are linked in a straight chain.

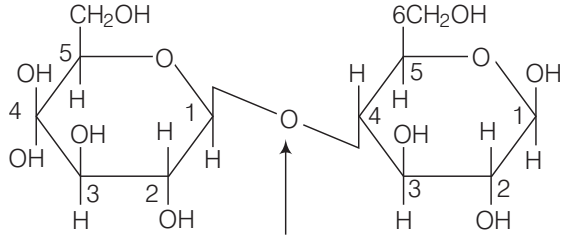
Q. 31 In nucleoside, a base is attached at 1′ position of sugar moiety. Nucleotide is formed by linking of phosphoric acid unit to the sugar unit of nucleoside. At which position of sugar unit is the phosphoric acid linked in a nucleoside to give a nucleotide?

Ans. Phosphoric acid is linked at 5′- position of sugar moiety of nucleoside to give a nucleotide.



Q. 32 Name the linkage connecting monosaccharide units in polysaccharides.

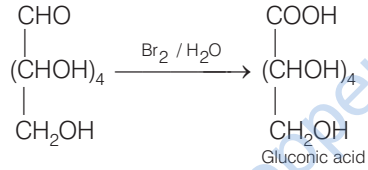
Ans. Glycosidic linkage connects monosaccharide units in polysaccharides.



Glycoside linkage in lactose

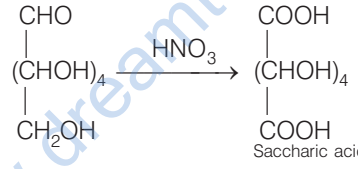
Q. 33 Under what condtions glucose is converted to gluconic acid and saccharide acid?

Ans. Glucose on oxidation with Br_2 / H_2O produces gluconic acid (six carbon carboxylic acid).



Gluconic acid

Glucose on oxidation with nitric acid produces saccharic acid. (dicarboxylic acid)



Saccharic acid

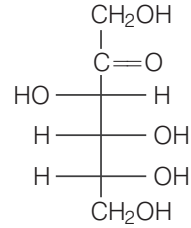
Q. 34 Monosaccharides contain carbonyl group hence are classified, as aldose or ketose. The number of carbon atoms present in the monosaccharide molecule are also considered for classification. In which class of monosaccharide will you place fructose?

Ans. Monosaccharides contain carbonyl group.

Hence, are classified as aldose or ketose.

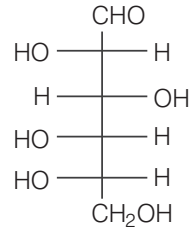
When aldehyde group is present, the monosaccharides are known as aldose.

When ketone group is present, the monosaccharides are known as ketose. Fructose has molecular formula $C_6H_{12}O_6$ containing 6 carbon and keto group and is classified as ketohexose.



D (–) fructose

Q. 35 The letters 'D' or 'L' before the name of a stereoisomer of a compound indicate the correlation of configuration of that particular stereoisomer. This refers to their relation with one of the isomers of glyceraldehyde. Predict whether the following compound has 'D' or 'L' configuration.



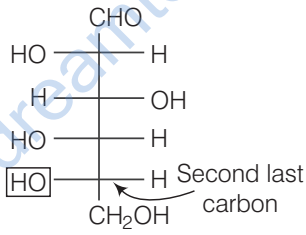
Thinking Process

This problem is based on relative configuration i.e., D and L configuration. This can be done by relating structure of monosaccharides with structure of glyceraldehyde.

If OH *is present at right side of second last carbon of monosaccharide is considered as D configuration.*

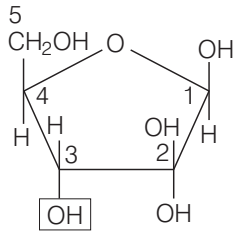
If OH *is present at left side of second last carbon of monosaccharide is considered as L configuration.*

Ans. Here, OH group present on second last carbon in at left side hence this has L configuration.

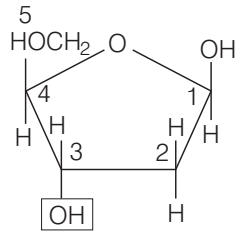


Q. 36 Aldopentoses named as ribose and 2-deoxyribose are found in nucleic acids. What is their relative configuration?

Ans.



β-D-ribose



β-D-2-deoxyribose

In case of cyclic structure of saccharide, if — OH group present at second last carbon is present at bottom side, then it is considered as *D* configuration (as shown above)

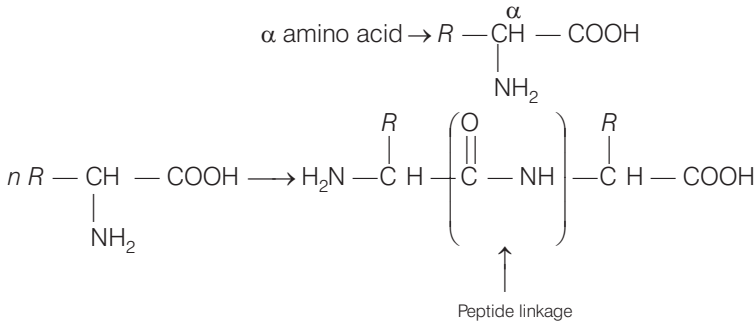
Q. 37 Which sugar is called invert sugar? Why is it called so?

Ans. Sucrose is dextrorotatory but sucrose on hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Hence, mixture becomes laevorotatory.

This sugar which on hydrolysis changes its sign of rotation from dextro to laevo is known as invert sugar.

Q. 38 Amino acids can be classified as α-, β-, γ-, δ- and so on depending upon the relative position of amino group with respect to carboxyl group. Which type of amino acids form polypeptide chain in proteins?

Ans. α amino acid forms polypeptide chain by elimination of water molecules.



Q. 39 α-helix is a secondary structure of proteins formed by twisting of polypeptide chain into right handed screw like structure. Which type of interactions are responsible for making the α-helix structure stable?

Ans. α-helix is a secondary structure of proteins formed by twisting of polypeptide chain to right handed screw like structure. Hydrogen bonds formed between —NH— group of amino acids in one turn with the $>C = O$ groups of amino acids belonging to adjacent turn is responsible for making the α-helix structure stable.

Q. 40 Some enzymes are named after the reaction, where they are used. What name is given to the class of enzymes which catalyse the oxidation of one substrate with simultaneous reduction of another substrate?

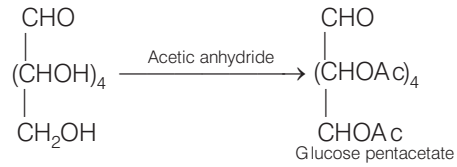
Ans. **Oxidoreductase enzymes** A class of enzymes which catalyses the oxidation of one substrate with simultaneous reduction of another substrate is known as oxidoreductase enzymes.

Q. 41 During curdling of milk, what happens to sugar present in it?

Ans. Curdling of milk is caused due to formation of lactic acid by the bacteria present in milk. It is an example of denaturation of protein, *i.e.,* when a protein is subjected is some physical or chemical chages. Hydrogen bond get disturbed. Globules unfold and helix uncoil and protein loss its biological acturty.

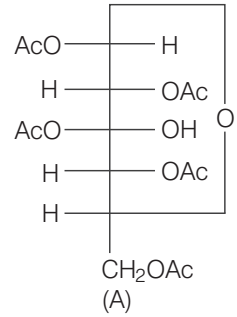
Q. 42 How do you explain the presence of five —OH groups in glucose molecule?

Ans. Glucose on reaction with acetic anhydride produces glucose pentaacetate.



This reaction explain presence of five — OH groups.

Q. 43 Why does compound (A) given below not form an oxime?



(A)

Ans. Compound (*A*) does not form an oxime on reaction with NH_2OH due to absence of CHO group or $>C = O$ group.

Q. 44 Why must vitamin C be supplied regularly in diet?

Ans. Vitamin C is water soluble hence, they are regularly excreted in urine and can not be stored in our body, so, they are supplied regularly in diet.

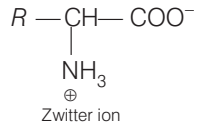
Q. 45 Sucrose is dextrorotatory but the mixture obtained after hydrolysis is laevorotatory. Explain.

Ans. Sucrose is dextrorotatory. On hydrolysis, it produces a mixture of glucose and fructose having specific rotation +52.5° and –92.4°. Thus, the respectively net resultant mixture become laevorotatory.

Hence, the mixture is laevorotatory and product is known as invert sugar.

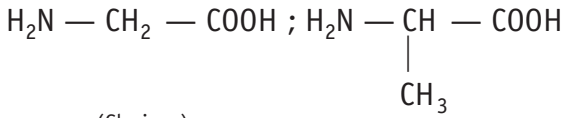
Q. 46 Amino acids behave like salts rather than simple amines or carboxylic acids. Explain.

Ans. Amino acids have acidic COOH group as well as NH_2 group hence, COOH looses its H to NH_2, hence they exist as Zwitter ion.



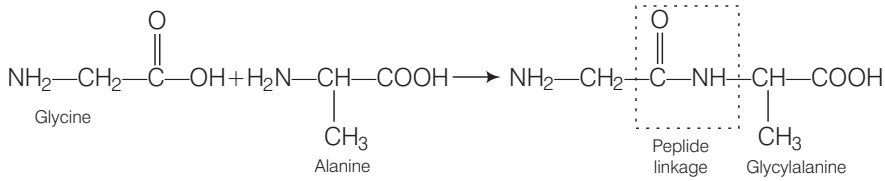
Zwitter ion

Q. 47 Structures of glycine and alanine are given below. Show the peptide linkage in glycylalanine.



(Glycince) (Alanine)

Ans. Glycine and alanine on reaction with each other produces glycylalanine as



Glycine Alanine Peplide linkage Glycylalanine

Q. 48 Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. When a protein in its native form, is subjected to a physical change like change in temperature or a chemical change like, change in pH, denaturation of protein takes place. Explain the cause.

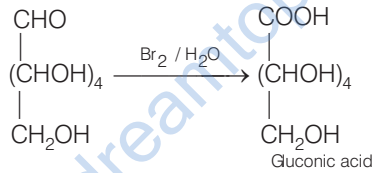
Ans. Due to physical and chemical change, hydrogen bonds in proteins are disturbed. Due is this globules unfold and helix gets uncoiled and therefore, protein loses its biological activity. This is known as denaturation of **proteins**.

Q. 49 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 hydrolysis is catalysed by the enzyme sucrase. Explain.

Ans. Enzymes, the biocatalysts reduce the magnitude of activation energy by providing alternative path. In the hydrolysis of sucrose, the enzyme sucrase reduces the activation energy from 6.22 kJ mol^{-1} to 2.15 kJ mol^{-1}.

Q. 50 How do you explain the presence of an aldehydic group in a glucose molecule?

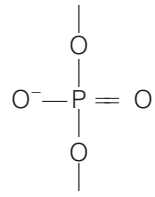
Ans. Glucose on reaction with bromine water produces gluconic acid. This indicates the presence of CHO group.



Q. 51 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?

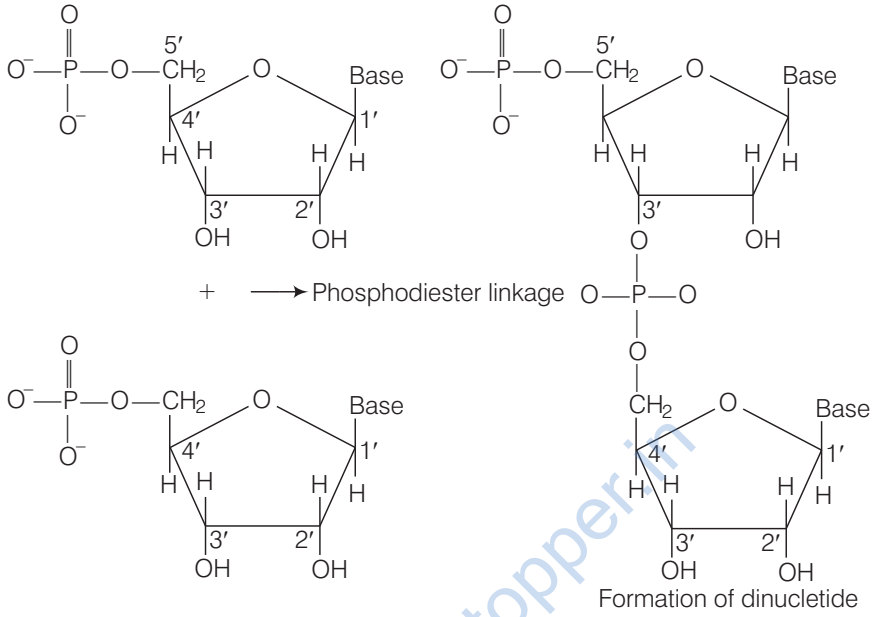
Ans. (i) 5′ and 3′ carbon atoms of pentose sugar.

(ii) Most probably the resemblance of with 2 ester $(—COO)^{2-}$ groups joined together.



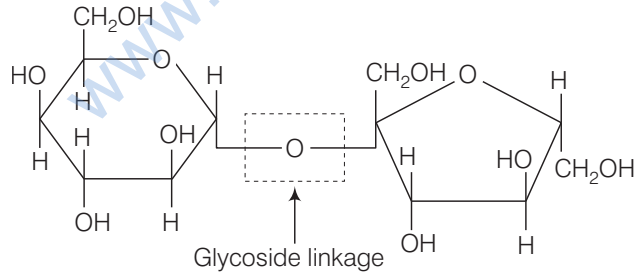
(iii) Phosphoric acid (H_3PO_4).

Nucleosides are joined together by phosphodiester linkage between 5' and 3' carbon atoms of pentose sugar and a dinucleotide with phosphoric acid (CH_3PO_4) is formed



Q. 52 What are glycosidic linkages? In which type of biomolecules are they present?

Ans. Linkage between two monosaccharides due to oxide linkage formed by the loss of a water molecule, is known as glycosidic linkage as shown below



Q. 53 Which monosaccharide units are present in starch, cellulose and glucose and which linkages link these units?

Ans. Monosaccharides units present in starch, cellulose and glucose can be determined by knowing the product of their hydrolysis.

(i) Starch is a polysaccharide of α-glucose in which two types of linkage are observed *i.e.*, $C_1 - C_6$ and $C_1 - C_4$ glycosidic linkage.

(ii) Cellulose is a straight chain polysaccharide of β-D glucose in which glucose are linked together by C_1 — C_4 glycosidic linkage.

(iii) Glucose is a monosaccharide.

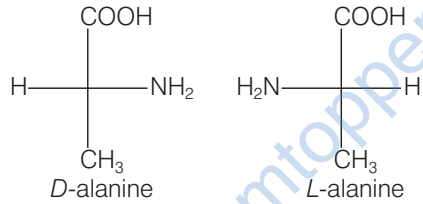
Q. 54 How do enzymes help a substrate to be attacked by the reagent effectively?

Ans. At the surface of enzyme, active sites are present. These active sites of enzymes hold the substrate molecule in a suitable position, so that it can be attacked by the reagent effectively. This reduces the magnitude of activation energy.

Enzymes contains cavities of characteristics shape and possessing active groups known as active centre on the surface. The molecules of the reactant (substrate) having complementary shape, fit into these cavities. On account of these active groups, an activated complex is formed which then decomposes to yield the products.

Q. 55 Describe the term D- and L-configuration used for amino acids with examples.

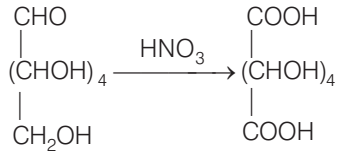
Ans. All naturally occurring α-amino acids (except glycine) are optically active due to the presence of chiral carbon atom. These have either *D*- or *L*-configuration. *D*-form means that, the amino (—NH_2) group is present towards the right hand side. *L*-form shows the presence of —NH_2 group on the left hand side.



D-alanine *L*-alanine

Q. 56 How will you distinguish 1° and 2° hydroxyl groups present in glucose? Explain with reactions.

Ans. 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 are easily oxidise to —COOH group while secondary OH group does not.



Hence, one OH is primary OH group.

Q. 57 Coagulation of egg white on boiling is an example of denaturation of protein. Explain it in terms of structural changes.

Ans. **Denaturation of proteins** Protein present in egg white has an unique three dimensional structure. When it is subjected to physical change like change in temperature. *i.e.,* on boiling, coagulation of egg white occurs due to denaturation of protein.

During denaturation hydrogen bonds are disturbed due to this globules unfold and helix gets uncoiled and protein looses its biological activity.

Matching The Columns

Q. 58 Match the vitamins given in Column I with the deficiency disease they cause given in Column II.

	Column I (Vitamins)		Column II (Diseases)
A.	Vitamin A	1.	Pernicious anaemia
B.	Vitamin B_1	2.	Increased blood clotting time
C.	Vitamin B_{12}	3.	Xerophthalmia
D.	Vitamin C	4.	Rickets
E.	Vitamin D	5.	Muscular weakness
F.	Vitamin E	6.	Night blindness
G.	Vitamin K	7.	Beri-beri
		8.	Bleeding gums
		9.	Osteomalacia

Ans. **A.** → (3, 6) **B.** → (7) **C.** → (1) **D.** → (8) **E.** → (4, 9) **F.** → (5) **G.** → (2)

	Column I (Vitamins)	Column II (Diseases)
A.	Vitamin A	Xerophthalmia Night blindness
B.	Vitamin B_1	Beri beri
C.	Vitamin B_{12}	Pernicious anaemia
D.	Vitamin C	Bleeding gums
E.	Vitamin D	Rickets Osteomalacia
F.	Vitamin E	Muscular weakness
G.	Vitamin K	Incresed blood clotting time

Q. 59 Match the following enzymes given in Column I with the reactions they catalyse given in Column II.

	Column I (Enzymes)		Column II (Reactions)
A.	Invertase	1.	Decomposition of urea into NH_3 and CO_2.
B.	Maltase	2.	Conversion of glucose into ethyl alcohol.
C.	Pepsin	3.	Hydrolysis of maltose into glucose.
D.	Urease	4.	Hydrolysis of cane sugar.
E.	Zymase	5.	Hydrolysis of proteins into peptides.

Ans. **A.** → (4) **B.** → (3) **C.** → (5) **D.** → (1) **E.** → (2)

	Column I (Enzymes)	Column II (Reaction)
A.	Invertase	Hydrolysis of cane sngar.
B.	Maltase	Hydrolysis of maltose into glucose.
C.	Pepsin	Hydrolysis of protein into peptides.
D.	Urease	Decomposition of urea into NH_3 and CO_2
E.	Zymase	Conversion of glucose into ethyl alcohol.

Assertion and Reason

In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason explains the assertion.

(b) Both assertion and reason are wrong statements.

(c) Assertion is correct statement and reason is wrong statement.

(d) Assertion is wrong statement and reason is correct statement.

(e) Assertion and reason both are correct statements but reason does not explain assertion.

Q. 60 Assertion (A) D (+) – Glucose is dextrorotatory in nature.

Reason (R) 'D' represents its dextrorotatory nature.

Ans. ***(c)*** Assertion is correct but reason is wrong statement *D* (+) glucose is dextrorotatory because it rotates the plane polarised light to right.

Here, D represents relative configuration of glucose with respect to glyceraldehyde.

Q. 61 Assertion (A) Vitmin D can be stored in our body.

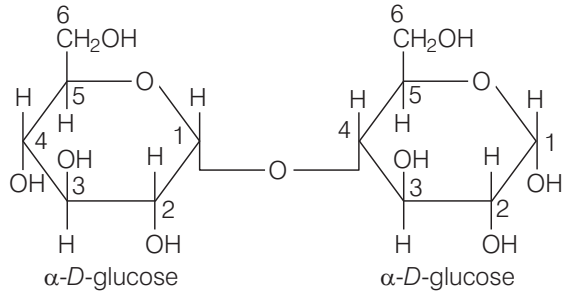
Reason (R) Vitamin D is fat soluble vitamin.

Ans. ***(a)*** Assertion and reason both are correct statements and reason explains assertion. Vitamin D can be stored in our body because vitamin D is fat soluble vitamin.

Q. 62 Assertion (A) β-glycosidic linkage is present in maltose.

Reason (R) Maltose is composed of two glucose units in which C - 1 of one glucose unit is linked to C - 4 of another glucose unit.

Ans. ***(d)*** Assertion is wrong statement and reason is correct statement. α-glycosidic linkage is present in maltose



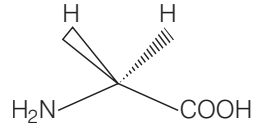
Because maltose is composed of two glucose unit in which C-1 of one glucose unit is linked to C-4 of another glucose unit.

Q. 63 Assertion (A) All naturally occurring α-aminoacids except glycine are optically active.

Reason (R) Most naturally occurring amino acids have L-configuration.

Ans. ***(e)*** Assertion and reason both are correct and reason does not explain assertion. All naturally occurring α-amino except glycine are optically active.

Glycine is optically inactive because glycine does not have all four different substituent as shown below.

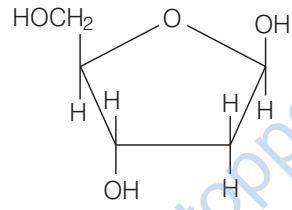


Glycine

Q. 64 Assertion (A) Deoxyribose, $C_5H_{10}O_4$ is not a carbohydrate.

Reason (R) Carbohydrates are hydrates of carbon so compounds which follow $C_x(H_2O)_y$ formula are carbohydrates.

Ans. ***(b)*** Both assertion and reason are wrong statements. Deoxyribose $C_5H_{10}O_4$ is a carbohydrate because it follow $C_5(H_2O)_2$ formula and exist as polyhydroxy carbonyl compound whose cyclic structure is as shown below



β-*o*-2 deoxyribose

Q. 65 Assertion (A) Glycine must be taken through diet.

Reason (R) It is an essential amino acid.

Ans. ***(b)*** Both assertion and reason are wrong statements. Correct asserstion and reason are Glycine must not be taken through diet because it can be synthesised in our body and a non-essential amino acid.

Q. 66 Assertion (A) In presence of enzyme, substrate molecule can be attacked by the reagent effectively.

Reason (R) Active sites of enzymes hold the substrate molecule in a suitable position.

Ans. ***(a)*** Assertion and reason both are correct and reason explains assertion. In presence of enzyme, substrate molecule can be attacked by a reagent effectively because active sites of enzymes hold the substrate molecule in a suitable position. So, enzyme catalysed reactions are stereospecific reactions.

Long Answer Type Questions

Q. 67 Write the reactions of D-glucose which can't be explained by its open chain structure. How can cyclic structure of glucose explain these reactions?

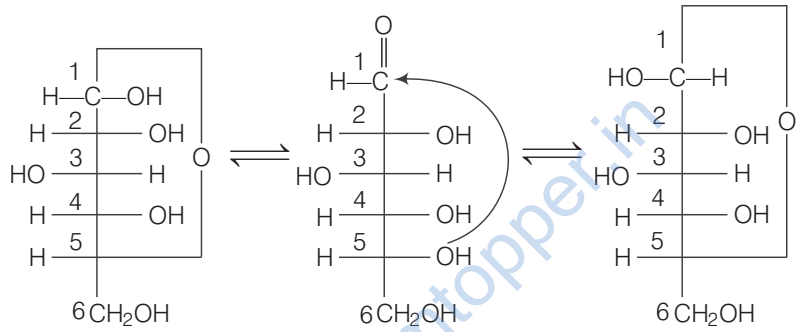
Ans. Chemical reactions of D-glucose which can't be explained by its open chain structure are

(i) Glucose does not give Schiff's test and does not produce hydrogensulphite addition product with $NaHSO_3$, despite having aldehyde group

(ii) The pentaacetate of glucose does not react with hydroxylamine.

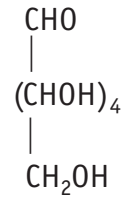
In actual, glucose exist in two different crystalline form α form and β form. It was proposed that one of the OH groups may add to the —CHO group and form cyclic hemiacetal structure. Glucose forms a 6 membered pyranose structure.

Cyclic structure exist in equilibrium with open structure and can be represented as



Due to formation of cyclic structure of glucose CHO group of glucose remain no longer free due to which they do not show above given reactions.

Q. 68 On the basis of which evidences D-glucose was assigned the following structure?



Ans. *Evidences on the basis of which glucose was assigned the following structure are as follows*

(i) Glucose on reaction with HI produces *n* hexane which indicates presence of six carbon atom linked in a having straight chain.

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

(ii) Glucose on reaction with acetic anhydride produces glucose penta acetate which indicates presence of five OH groups.

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

(iii) Glucose on oxidation with bromine water produces gluconic acid indicates presence of —CHO group.

$$\text{Glucose} \xrightarrow{Br_2/H_2O} \text{Gluconic acid}$$

(iv) Glucose on reaction with HNO_3 produces saccharic acid which indicates presence of one primary OH group.

Q. 69 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 which is present in wood or in the fibre of cotton cloth.

Ans. Carbohydrates that are used as storage molecules in plants and animals are as follows

(i) Plant contains mainly starch, cellulose, sucrose etc.

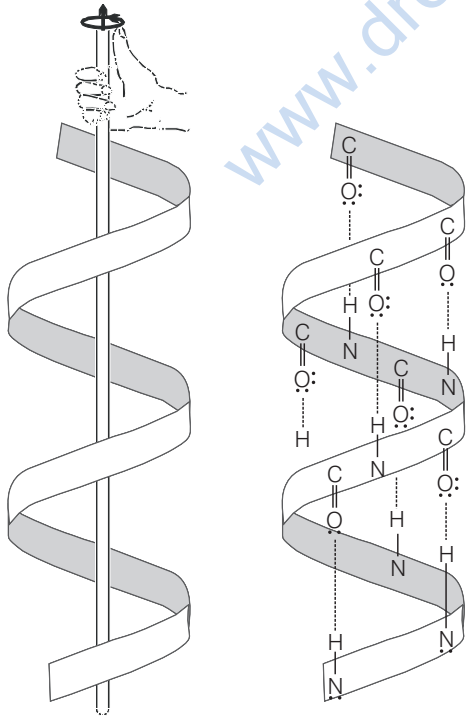
(ii) Animal contain glycogen in their body. So, glycogen is also known as animal starch. Glycogen is present in liver, muscles and brain when body needs glucose, enzyme breaks glycogen down to glucose.

(iii) Cellulose is present in wood, and fibre of clothes.

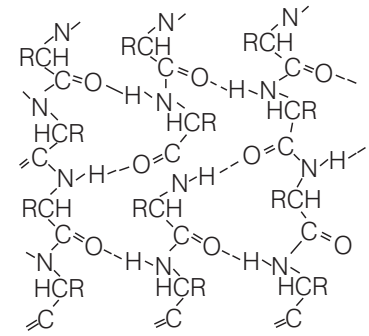
Q. 70 Explain the terms primary and secondary structure of proteins. What is the difference between α-helix and β-pleated sheet structure of proteins?

Ans. **Primary structure of proteins** Proteins consist of one or more polypeptide chains. Each polypeptide is a protein contains **amino acids** joined with each other in a **specific sequence**. **Secondary structure of proteins** It refers to the **shape** in which **a long polypeptide chain** can exist.

α-helix structure	β-pleated sheet structure
A structure of twisting of all a polypeptide chain formed by possible H-bonds into a right handed screw (helix) with the —NH group of each amino acid, and residue hydrogen bonded to the — CO — of an adjacent turn of the helix. Hence, called α-helix.	All peptide chains are stretched out to nearly maximum extension and then laid side by side which are held together by intermolecular hydrogen bonds. This structure resembles the pleated folds of the drapery. Hence, called β-pleated sheet structure.



α-helix structure of proteins



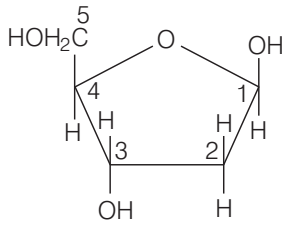
β-pleated sheet structure of proteins

Q. 71 Write the structures of fragments produced on complete hydrolysis of DNA. How are they linked in DNA molecule? Draw a diagram to show pairing of nucleotide bases in double helix of DNA.

Ans. On complete hydrolysis of DNA, following fragments are formed a pentose sugar (β-D-2-deoxyribose) phosphoric acid (H_3PO_4) and bases (nitrogen containing heterocyclic compounds).

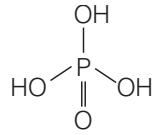
Structures

(i) **Sugar**



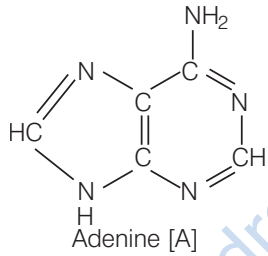
β-D-2-deoxyribose

(ii) **Phosphoric acid**

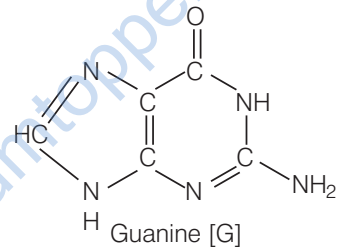


(iii) **Nitrogen bases** DNA contains four bases

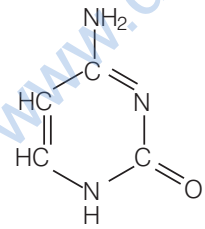
Adenine (A), Guanine (G), Cytosine (C) and thymine (T).



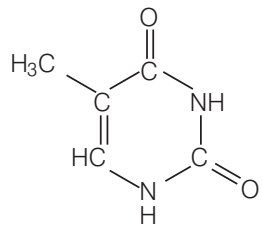
Adenine [A]



Guanine [G]



Cytosine [C]

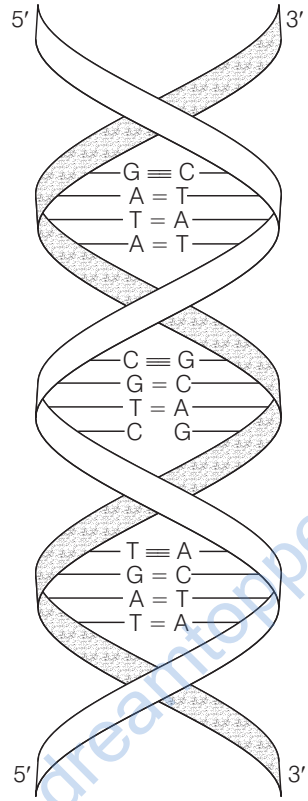


Thymine [T]

A unit formed by the attachment of a base to 1′-position of sugar is called **nucleoside**. When nucleoside links to phosphoric acid at 5′-position of sugar moiety, a **nucleotide** is formed. Nucleotides are joined together by phosphodiester linkage between 5′ and 3′ carbon atoms of the pentose sugar.

In DNA two nucleic acid chains are wound about each other and held together by hydrogen bonds between pairs of bases.

The two strands are complementary to each other because hydrogen bonds are formed between specific pair of base adenine form hydrogen bonds with thymine whereas cytosine form hydrogen bonds with guanine.



Double strarded helix structure of DNA