CHAPTER

13 BIOMOLECULES

Syllabus

- *Carbohydrates : Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.*
- *Proteins : Elementary idea of-amino acids, peptide bond, polypeptides, proteins, structure of proteins—primary, secondary, tertiary and quaternary structure, (qualitative idea only), denaturation of proteins; enzymes.*
- *Hormones : Elementary idea excluding structure.*
- *Vitamins : Classification and functions.*
- *Nucleic Acids : DNA and RNA.*

Chapter Analysis

List of Topics	2016		2017		2018
	D	OD	D	OD	D/OD
Monosaccharides, Starch, Cellulose, D-Glucose and Polysaccharides	1Q (3 marks)*	1Q (3 marks)#	–	–	1Q (3 marks) ^
Vitamin C	1Q (3 marks)*	–	–	–	–
Nucleic Acid	–	1Q (3 marks)#	–	–	–
Nucleoside and Nucleotide	–	1Q (3 marks)#	–	–	–
Fibrous and Globular Protein, Denatured Protein, Structure of Protein	–	–	–	–	1Q (3 marks) ^
Amino Acid	–	–	–	–	1Q (3 marks) ^

- * One question of 3 marks on Monosaccharides, Vitamin C and difference between Nucleoside and Nucleotide was asked.
- # One question of 3 marks on Structural difference between Starch and Cellulose, Linkage in Nucleic Acid, Fibrous protein and Globular protein was asked.
- ^ One question of 3 marks with two choices was asked. First choice was on definitions of Polysaccharides, Denatured Protein and Essential Amino Acids. Second choice was Miscellaneous type on D-glucose, Amino Acids and Structures of Proteins.

On the basis of above analysis, it can be said that from exam point of view, Carbohydrates, Amino Acids, Nucleoside and Nucleotide are the most important topics of the chapter.

TOPIC-1
Carbohydrates, their Classification and Importance

Revision Notes

- **Biomolecules :** Biomolecules are the naturally occurring organic compounds present as essential constituents of living organism in different cells. e.g., : polysaccharides, proteins etc.
- **Carbohydrates :** Carbohydrates may be defined as optically active polyhydroxy aldehydes or ketones or compound which produce such units on hydrolysis. *e.g.,* cellulose, glycogen, starch etc.
- **Classification of carbohydrates :** On the basis of the molecular size, carbohydrates have been classified into following four types :

(i) Monosaccharides : Monosaccharides include non-hydrolysable carbohydrates. They are soluble in water. Those containing aldehydic group are called aldoses while other containing a ketonic group are called ketoses. Some monosaccharides with example are given in the table as shown below :

Class	Molecular Formula	Structural formula	Example
		Aldoses	
Aldotriose	$C_3H_6O_3$	$CH_2OH.CHOH.CHO$	Glyceraldehyde
Aldotetrose	$C_4H_8O_4$	$CH_2OH.(CHOH)_2.CHO$	Erythrose, Threose
Aldopentose	$C_5H_{10}O_5$	$CH_2OH.(CHOH)_3\ CHO$	Arabinose, Ribose, Xylose, Lyxose
Aldohexose	$C_6H_{12}O_6$	$CH_2OH.(CHOH)_4CHO$	Glucose, Mannose, Galactose, Talose, Idose, Ilose, Altrose
		Ketoses	
Ketotriose	$C_3H_6O_3$	$CH_2OH.CO.CH_2OH$	Dihydroxyacetone
Ketotetrose	$C_4H_8O_4$	$CH_2OHCO\ CHOH\ CH_2OH$	Erythrulose
Ketopentose	$C_5H_{10}O_5$	$CH_2OH.CO(CHOH)_2CH_2OH$	Ribulose, Xylulose
Ketohexose	$C_6H_{12}O_6$	$CH_2OHCO(CHOH)_3.CH_2OH$	Fructose, Sorbose, Tagatose etc.

(ii) Disaccharides : Those carbohydrates, which on hydrolysis yields two molecules of monosaccharides are called disaccharides. They are crystalline, soluble in water and sweet in taste. *e.g.*, cane sugar, maltose etc.

(iii) Oligosaccharides : Those carbohydrates which yields 2 to 10 monosaccharide molecules on hydrolysis are called oligosaccharides. *e.g.*, raffinose on hydrolysis gives glucose, fructose and galactose.

(iv) Polysaccharides : Those carbohydrates, which produce large number of monosaccharide units on hydrolysis are called polysaccharides. They are formed by linking together a large number of monosaccharide units through glycosidic linkage. *e.g.,* starch, amylose and cellulose.

- **Sugar :** In general, monosaccharides and oligosaccharides are crystalline solids, soluble in water, sweet in taste. They are collectively called sugar. *e.g.,* glucose, fructose, sucrose etc. They are of two types :
  - **(i) Reducing sugars :** Those carbohydrates which contain free aldehydic or ketonic group and reduce Fehling's solution and Tollen's reagent are known as reducing sugars. *e.g.*, all monosaccharides, maltose.
  - **(ii) Non-reducing sugars :** Those carbohydrates which do not have free aldehydic or ketonic group and do not reduce Fehling's solution or Tollen's reagent are known as non-reducing sugars. *e.g.*, sucrose.
- **Glucose :** Glucose occurs in nature in free as well as in combined form. It is present in sweet fruits and honey.
  - **Methods of preparation of Glucose :**
    - **(i) From sucrose :**

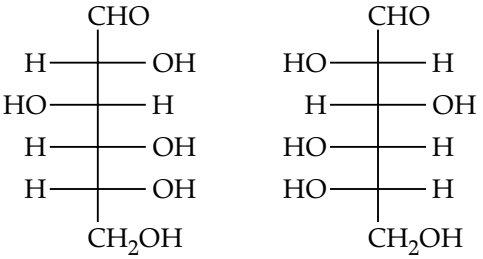
$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

(ii) From starch : Commercially, glucose is obtained by hydrolysis of starch by boiling it with dil H_2SO_4 at 393 K under pressure.

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow[393\ K,\ 2\text{-}3\ bar]{H^+} \underset{Glucose}{nC_6H_{12}O_6}$$

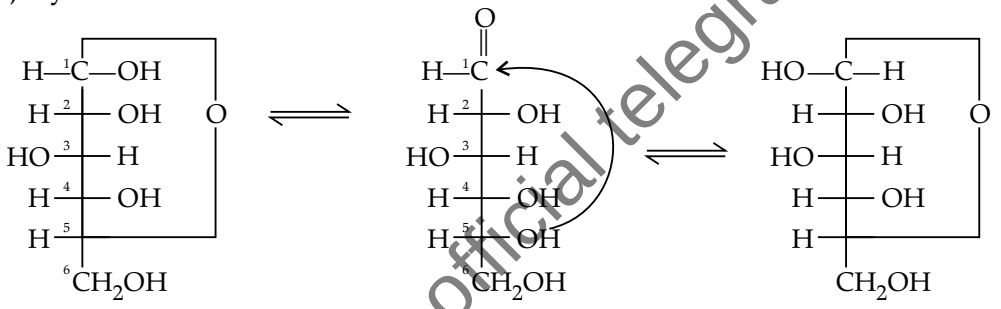
- **Structure of Glucose :** It is a six carbon straight chain aldose which has one aldehydic group (–CHO), one primary hydroxyl group (–CH_2OH) and four secondary hydroxyl groups (–CHOH).

(a) Open chain structure :



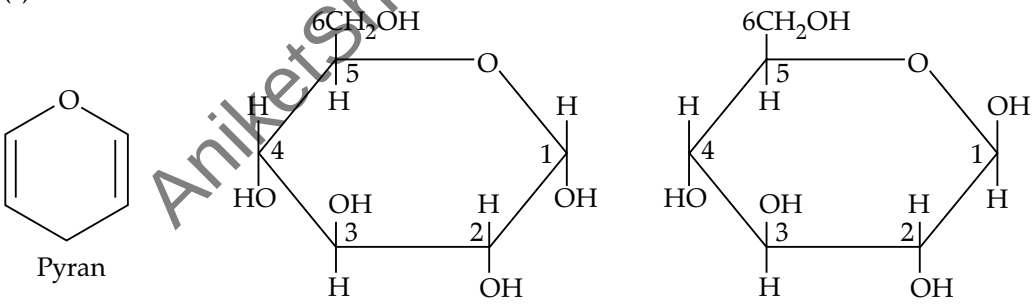
D–(+)–Glucose L–(–)–Glucose

(b) Cyclic structure :



α-D-(+)–Glucose β-D–(+)–Glucose

(c) Haworth structure :



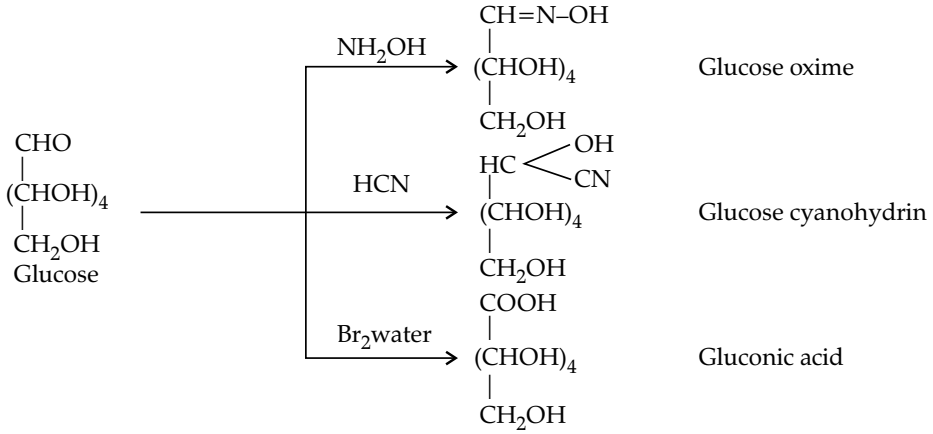
α-D–(+)–Glucopyranose β-D –(+)–Glucopyranose

- **Reactions of Glucose :**

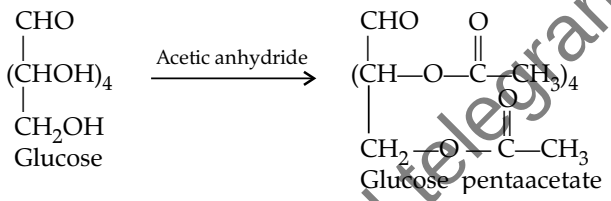
(i) With HI :

$$\underset{\text{Glucose}}{\overset{\overset{CHO}{|}}{(\overset{|}{C}HOH)_4}\overset{|}{CH_2OH}} \xrightarrow[\Delta]{HI} CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$$

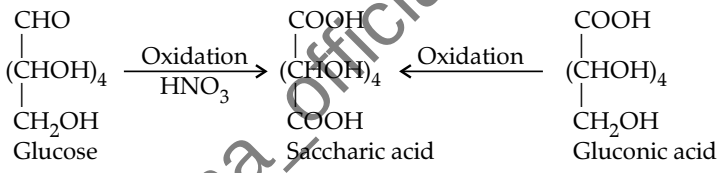
(ii) Reactions showing the presence of carbonyl group (> C = 0) :



(iii) Acetylation of glucose :



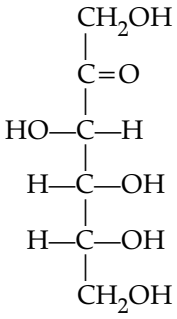
(iv) Reaction showing the presence of alcoholic (– OH) group :



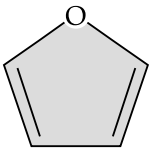
➢ **Fructose :** It is a ketohexose obtained by hydrolysis of disaccharide.

- **Structure of Fructose :**

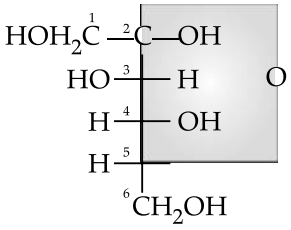
(a) Open chain structure



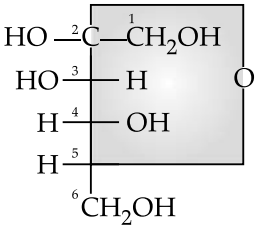
(b) Cyclic structure :



Furan

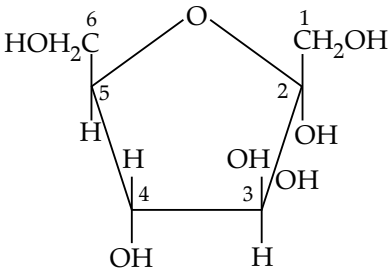


α-D–(–)–Fructofuranose

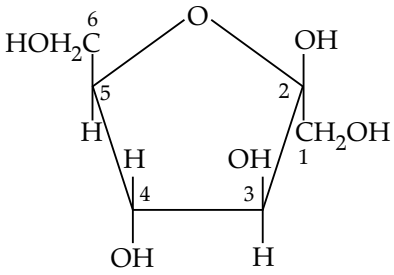


β-D–(–)–Fructofuranose

(c) Haworth structure :



α-D–(–)–Fructofuranose



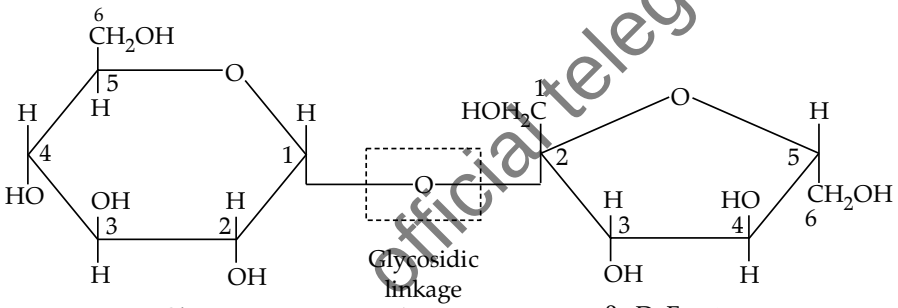
β-D–(–)–Fructofuranose

➢ **Sucrose :**

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

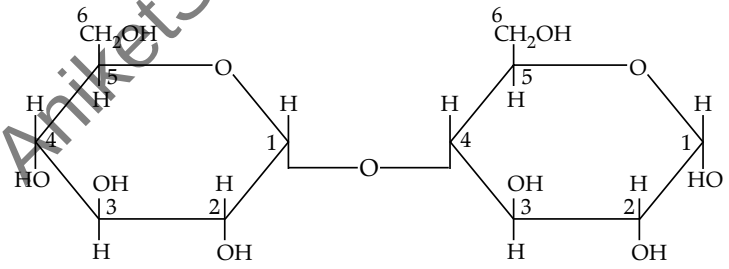
Sucrose D–(+)–Glucose D–(–)–Glucose

- **Structure :**



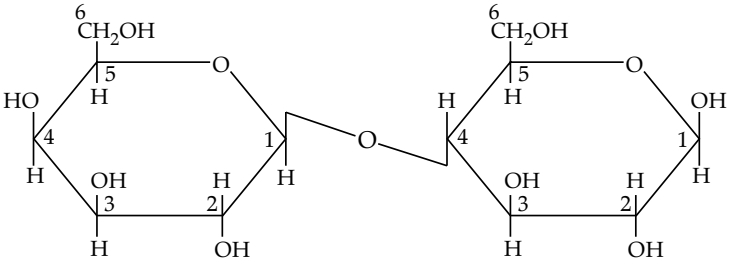
α – D–Glucose β –D–Fructose

➢ Maltose molecule is composed of two α-D-glucose units in which C1 of one glucose (I) is linked to C4 of another glucose unit (II).



α – D–Glucose I β – D–Glucose II

➢ Lactose is a reducing sugar

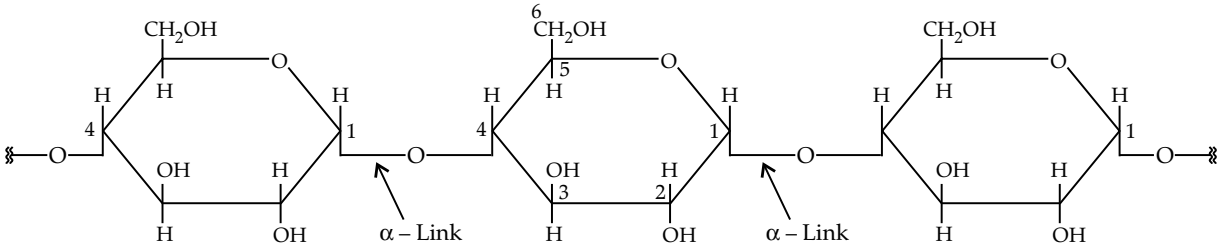


α – D–Galactose β – D–Glucose

➢ **Polysaccharides :** Carbohydrates which contain a large number of monosaccharide units joined together by glycosidic linkages.

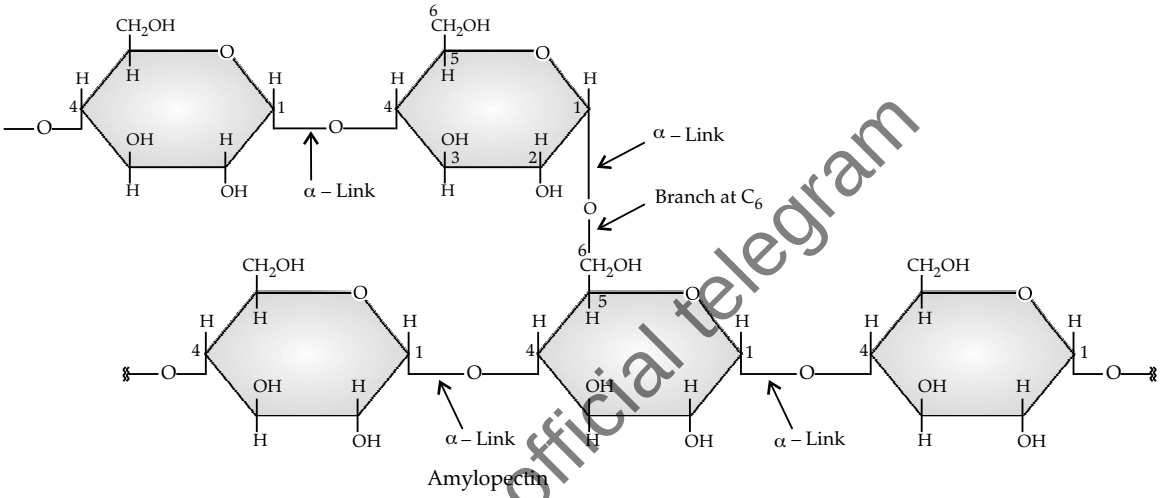
(a) Starch is a polymer of α-glucose and consists of two components – amylose and amylopectin.

Amylose is a long unbranched chain with 200 – 1000 α-D-(+)-glucose units held by Cl – C4 glycosidic linkage.



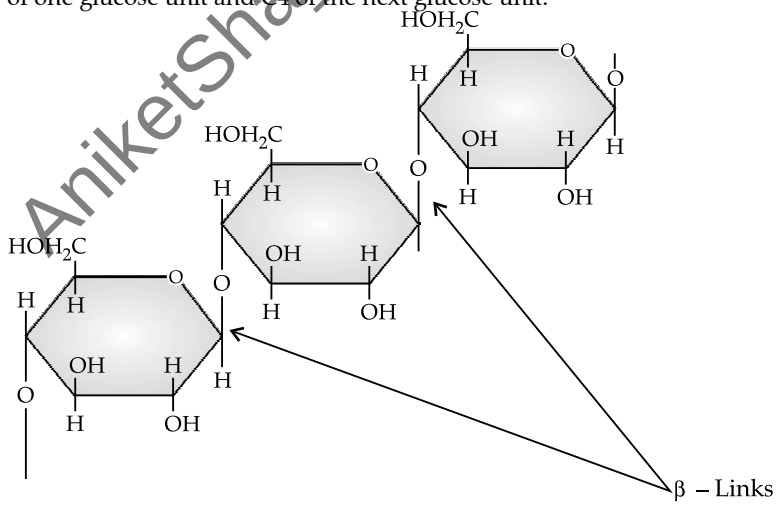
Amylose

Amylopectin is a branched chain polymer of α-D-glucose units in which the chain is formed by $C_1 – C_4$ glycosidic linkage whereas branching occurs by $C_1 – C_6$ glycosidic linkage.



Amylopectin

(b) Cellulose is a polysaccharide whose fundamental structural unit is β-D-glucose joined by glycosidic linkage between C1 of one glucose unit and C4 of the next glucose unit.



(c) Glycogen is an animal starch with structure similar to amylopectin and has more branches.

➢ **Importance of Carbohydrates :**

(i) They are essential for plants and animals as a source of energy.

(ii) They form structural materials for cells.

(iii) They provide raw materials for textile, paper and alcohol industry.

(iv) Monosaccharides are also present in nucleic acids which control the transmission of hereditary effects from one generation to other and biosynthesis of proteins as well.

➢ **Distinction between Glucose (monosaccharide), Sucrose (disaccharide) and Starch (polysaccharide) :**

S. No.	Test	Glucose (Monosaccharide)	Sucrose (Disaccharide)	Starch (Polysaccharide)
1.	On heating with Fehling's solution	Red precipitate is obtained.	No precipitate.	No precipitate.
2.	On heating with Tollens' reagent (ammonical $AgNO_3$)	Silver mirror is formed.	No silver mirror is formed.	No silver mirror is formed.
3.	On heating with phenyl hydrazine	Yellow coloured crystals of osazone are formed.	No osazone is formed.	No osazone is formed.
4.	On heating with resorcinol and HCl	No colour.	Wine red colour.	No colour.
5.	On adding NaOH solution and 1-2 drops of cobalt nitrate	No colour.	Violet colour.	No colour.
6.	On adding I_2 solution in aqueous solution	No colour.	No colour.	Blue-violet colour.
7.	On heating in a dry test tube	Melts into brown coloured substance and smells of burnt sugar. Turns black on heating further.	Melts at 463 K, becomes brown at 473 K, chars at high temperature.	Chars on heating strongly.

Know the Terms

➢ **Aldoses :** Monosaccharides which contain an aldehyde (—CHO) group are called aldoses.
➢ **Ketoses :** Monosaccharides which contain a keto (>C=O) group are called ketoses.
➢ **Invert Sugar :** An equimolar mixture of glucose and fructose which is formed as a result of hydrolysis of sucrose is known as Invert sugar.
➢ **Anomers :** Diastereomers of cyclic forms of sugar differing in configuration at the aromatic carbon, generally found in 2 forms α and β .
➢ **Glycosidic linkage :** It is an oxide linkage between two or more monosaccharide units in polysaccharides.

Very Short Answer-Objective Type Questions (1 mark each)

A. Multiple choice Questions:

Q. 1. 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 is similar to _____.
(a) Amylose (b) Amylopectin
(c) Cellulose (d) Glucose
U [NCERT Exemp. Q. 1., Page 282]

Ans. Correct option : (b)
Explanation : Structure of glycogen is similar to amylopectin. It is a branched chain polymer of α-D-glucose units in which chain is formed by C1– C4 glycosidic linkage and branching occurs by the formation of C1–C6 glycosidic linkage.

Q. 2. Which of the following polymer is stored in the liver of animals?
(a) Amylose (b) Cellulose
(c) Amylopectin (d) Glycogen
R [NCERT Exemp. Q. 2., Page 202]

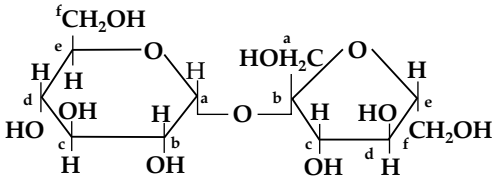
Ans. Correct option : (d)

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
R [NCERT Exemp. Q. 3., Page 202]

Ans. Correct option : (c)
Explanation : Sucrose (cane sugar) is a disaccharide. One molecule of sucrose on hydrolysis gives 1 molecule of glucose +1 molecule of fructose.

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

Q. 4. Structure of a 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.

A **[NCERT Exemp. Q. 18., Page 206]**

Ans. Correct option : (c)

Explanation : C-adjacent to oxygen atom in the cyclic structure of glucose or fructose is known as anomeric carbon. In above structure, 'a' and 'b' are present at adjacent to oxygen atom. Both carbons differ in configurations of the hydroxyl group.

Q. 5. 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.

R **[NCERT Exemp. Q. 10., Page 204]**

Ans. Correct option : (c)

Explanation : It is not present in furanose form instead present in pyranose form.

B. Answer the following:

Q. 1. Name the components of starch.

R**[CBSE Delhi 2013]**

Ans. There are two components of starch, *i.e.,* amylose and amylopectin. ½ + ½

Q. 2. Which of the two components of starch are water soluble ? U**[CBSE Delhi 2014]**

Ans. Amylose. **1**
[CBSE Marking Scheme 2014]

Q. 3. Which component of starch is branched polymer of a glucose and insoluble in water ?

U**[CBSE Delhi 2014]**

Ans. Amylopectin. **1**
[CBSE Marking Scheme 2014]

AI **Q. 4. Write the products of hydrolysis of maltose ?**

R**[CBSE OD 2014]**

Ans. 2 molecules of Glucose. **1**
[CBSE Marking Scheme 2014]

Q. 5. What are the products of hydrolysis of sucrose ?

R**[CBSE Delhi 2014]**

Ans. Fructose and Glucose are the products of hydrolysis of sucrose. **1**

Q. 6. What are the products of hydrolysis of lactose ?

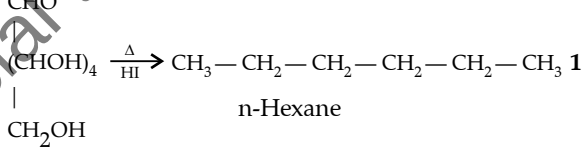
R**[CBSE OD 2013; OD 2014]**

Ans. It gives β-D galactose and β-D glucose. ½ + ½

Q. 7. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain.

U **[CBSE OD 2012]**

Ans.



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Short Answer Type Questions **(2 marks)**

AI **Q. 1. Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecule.** U **[CBSE Delhi 2012]**

Ans. Reactions of glucose that cannot be explained by open chain structure :

(i) Glucose gives the characteristic reaction of alcohols and carbonyl group (aldehydes and ketones). However, it does not form addition compound with ammonia and sodium bisulphite and does not respond to 2, 4-DNP test and Schiff's test. **1**

(ii) The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free – CHO group. **1**

Long Answer Type Questions-I **(3 marks each)**

AI **Q. 1. Define the following terms :**
(i) Glycosidic linkage
(ii) Invert sugar
(iii) Oligosaccharides. R **[CBSE OD 2014]**

Ans. (i) Glycosidic linkage : The two monosaccharides units are joined together through an oxide linkage formed by loss of a molecule of H_2O. **1**

(ii) Invert sugar : Hydrolysis of sucrose brings about a change in sign of rotation from dextro (+) to laevo (–) and the product is known as invert sugar. **1**

(iii) Carbohydrates that yield two to ten monosaccharides units on hydrolysis are called polysaccharides. Examples are starch, cellulose, glycogen etc. **1**

Answering Tip
- Write the precise definitions as given in the text.

Q. 2. Give three reactions of glucose which cannot be explained by its chain structure.

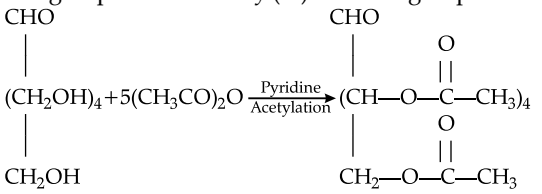
U**[CBSE SQP 2018-2019]**

Ans. (i) Glucose does not give 2,4- DNP test. **1**
(ii) Glucose does not give Schiff's test. **1**
(iii) The pentaacetate of glucose does not react with hydroxylamine. **1**
(iv) Glucose does not form the hydrogensulphite addition product with $NaHSO_3$.
(Any three points)
[CBSE Marking Scheme 2018]

Q. 3. How will you distinguish 1° and 2° hydroxyl groups present in glucose? Explain with reaction.

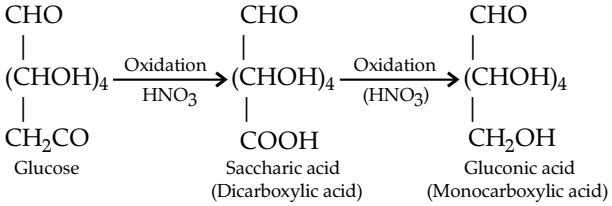
A **[NCERT Exemp. Q. 56., Page 211]**

Ans. Glucose on treatment with acetic anhydride in presence of pyridine or a few drops of conc. H_2SO_4. It forms penta-acetyl derivative indicating the presence of 5-OH groups. Out of which, one –OH group is primary (1^o) alcoholic and four (C_2, C_3, C_4 and C_5) –OH groups are secondary (2^o) alcoholic groups.



1½

Glucose (or gluconic acid) on oxidation with HNO_3 gives saccharic acid (a dicarboxylic acid) indicating that one of the primary (1^o) alcoholic group is oxidized to –COOH group but secondary (2^o) hydroxyl groups undergo oxidation only in drastic conditions.



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Long Answer Type Questions-II (5 marks each)

Q. 1. On the basis of which evidences D-glucose was assigned the following structure?

CHO
|
(CHOH)4
|
CH2OH

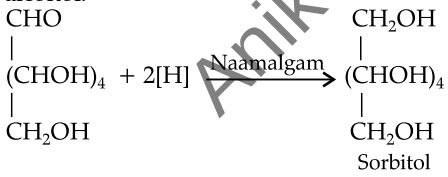
C **[NCERT Exemp. Q. 68., Page 213]**

Ans. This structure was assigned on the basis of the following evidences :

(i) Molecular formula : $C_6H_{12}O_6$ is molecular formula of glucose.

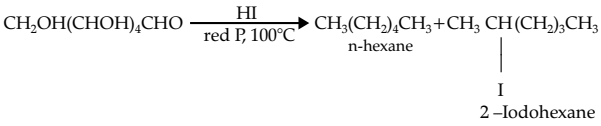
(ii) Straight chain structure :

(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.



1

(b) Prolonged heating with hydriodic acid and red phosphorous 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. **1**

(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. **1**

(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. **1**

(e) Presence of an aldehyde (–CHO) group : Glucose reacts with hydroxylamine, NH_2OH to form oxime. This suggest 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 :

CHO
|
(CHOH)4
|
CH2OH **1**

TOPIC-2
Proteins, Hormones, Vitamins and Nucleic Acids

Revision Notes

➢ **Proteins :** Proteins are complex polyamides formed from amino acids. They are essential for proper growth and maintenance of body. They have many peptide (— C — NH —) bonds.
‖
O

- **Amino Acids :** The compounds which contain carboxylic acid (–COOH) group and an amino group ($–NH_2$) are called amino acids. Amino acids form proteins.
- **α-Amino Acids :** Those amino acids in which —NH_2 group and —COOH group are attached to same carbon are called α-amino acids. These are obtained by hydrolysis of proteins *e.g.*, glycine.
- **Types of Amino Acids :**
  - **Acidic, Basic and Neutral Amino Acids :** Amino acids are acidic, basic or neutral depending upon the relative number of amino and carbonyl group in their molecule. If equal number of amino and carboxyl group is present, it is neutral. More number of amino than carbonyl group makes it basic and more carboxyl group as compared to amino makes it acidic.
  - **Essential and Non-essential Amino Acids :** The amino acids which can be synthesised in the body are known as non-essential amino acids. *e.g.,* glycine, alanine, glutamine etc. On the other hand, those which cannot be synthesised in the body and must be obtained by diet are known as essential amino acids.
- **Classification of Proteins :** Proteins are classified as follows :

(a) Based on molecular shape :

(i) Fibrous proteins : They have thread like molecules which tend to lie side by side to form fibres. *e.g.*, keratin, collagen etc.

(ii) Globular proteins : They have molecules which are folded into compact units that often approach spheroidal shape. *e.g.*, insulin, albumin, haemoglobin etc.

(b) Based on structure and shape :

(i) Primary structure : Each polypeptide in a protein has amino acids linked with each other in a specific sequence. This sequence of amino acids is called as primary structure of proteins.

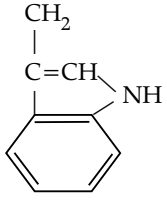
(ii) Secondary structure : It refers to the shape in which a long polypeptide chain exists. They are of two types :

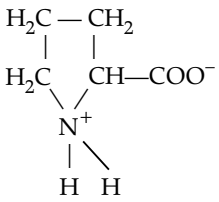
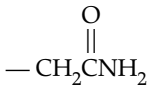
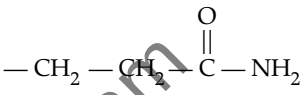
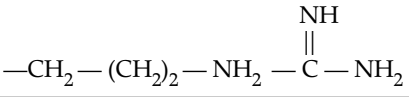
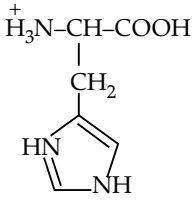
1. α-helix in which polypeptide chain forms intramolecular hydrogen bonds by twisting into a right handed helix with the — NH group of each amino acid residue hydrogen bonded to the >C = O of an adjacent turn of the helix. *e.g.*, keratin in hair, nails.
2. β-pleated sheet has all peptide chains stretched to nearly maximum extension and then arranged side by side held together with intermolecular hydrogen bonding. *e.g.*, silk.

(iii) Tertiary structure : It represents overall folding of polypeptide chains by H-bonds, disulphide linkages, van der Waals and electrostatic form of attraction. *e.g.*, Fibrous and globular proteins.

(iv) Quaternary structure : The spatial arrangement of two or more polypeptide chains with respect to each other is known as quaternary structure.

- **Name and structure of some naturally occurring α-Amino Acids :** $(H_2N — \underset{\displaystyle R}{\underset{|}{CH}} — COOH)$

S. No.	Amino acids	Isoelectric point (Hydrophobic)	One alphabet code	Three alphabet code	—R (Side chain)
1.	**Non-polar** Glycine	5.97	G	Gly	—H
2.	Alanine	6.02	A	Ala	$—CH_3$
3.	Valine*	5.97	V	Val	$—CH(CH_3)_2$
4.	Leucine*	5.90	L	Leu	$—CH_2—CH(CH_3)_2$
5.	Isoleucine*	6.02	I	Ile	$—CH(CH_3)—CH_2—CH_3$
6.	Phenylalanine*	5.84	F	Phe	$—CH_2—Ph$
7.	Methionine*	5.06	M	Met	$—CH_2—CH_2—S—CH_3$
8.	Tryptophan*	5.88	W	Trp	

9.	Proline	6.30	P	Pro	
10.	**Polar (Neutral)** Serine	5.68	S	Ser	—CH_2OH
11.	Cysteine	5.02	C	Cys	—CH_2—SH
12.	Asparagine	5.41	N	Asn	
13.	Glutamine	5.70	Q	Gln	
14.	Threonine*	5.60	T	Thr	—CH(OH)—CH_3
15.	Tyrosine	5.67	Y	Tyr	
16.	**Acidic** Aspartic acid	2.98	D	Asp	—CH_2—COOH
17.	Glutamic acid	3.22	E	Glu	—CH_2CH_2COOH
18.	Basic Lysine*	9.47	K	Lys	—CH_2—$(CH_2)_3$—NH_2
19.	Arginine*	10.76	R	Arg	
20.	Histidine*	7.59	H	His	

* These are essential amino acids.

- **Different Proteins and their functions :**

S. No.	Type of Protein	Example	Function
1.	Enzyme	Trypsin, Pepsin	As a catalyst in biochemical reactions.
2.	Structural	Collagen, Keratin	Structural and protective action in teeth, nails and hairs.
3.	Transport	Haemoglobin	Transport of oxygen from lungs by blood stream to different tissues.
4.	Motion	Myosin, Actin	For motion of muscles.
5.	Hormone	Insulin	Regulate body metabolism.
6.	Storage	Ferritin, Casein	Store nutrients.

- **Denaturation of Proteins :** When a protein in its native form is subjected to change, like change in temperature or pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. It is called denaturation of protein. *e.g.* coagulation of egg white on boiling, curding of milk etc.
- **Enzymes :** Enzymes are essential biological catalysts which are needed to catalyse biochemical reactions *e.g.*, maltase, lactase, invertase etc. Almost all enzymes are globular proteins.

- **Some specific Enzymes and the reactions catalysed by them :**

Enzyme	Reaction catalysed
Maltase	Maltose $\rightarrow$ Glucose
Lactase	Lactose $\rightarrow$ Glucose + Galactose
Amylase or Ptyalin	Starch $\rightarrow$ Glucose
Invertase	Sucrose $\rightarrow$ Glucose + Fructose
Urease	Urea $\rightarrow$ $NH_3 + CO_2$
Trypsin, Pepsin	Protein $\rightarrow$ Amino acid

- **Vitamins :** Vitamins are group of organic compounds which are required in a very small amount for the healthy growth and functioning of animal organism. They cannot be made by organism and so have to be part of our diet.
- **Types of Vitamins :**
  - **(i) Fat soluble vitamins :** Vitamins A, D, E and K are fat soluble but insoluble in water.
  - **(ii) Water soluble vitamins :** Vitamins belonging to group B (B_1, B_2, B_6, B_{12} etc.) and vitamin C are soluble in water.
- **Different Vitamins :**

Vitamin	Name and Formula	Sources	Function	Deficiency Diseases
Vitamin A	Retinol or Excerophytol $C_{20}H_{30}O$	Milk, butter, egg, fish, spinach, green vegetables, carrot etc.	Essential for vision and growth. Develops resistance against diseases.	Night blindness, xerophthalmia, retarded growth and decreases the immunity of body towards various diseases.
Vitamin B_1	Thiamine or Aneurin $C_{12}H_{17}N_4OS$	Egg, fish, meat, rice, wheat, yeast etc.	For proper functioning of nervous system.	Beri-beri, anaemia, weakness of muscles, etc.
Vitamin B_2	Riboflavin or Lactoflavin $C_{17}H_{20}N_4O_6$	Milk, cheese, egg, meat, green vegetables, liver etc.	Essential for growth of body.	Cracking skin particularly at the corners of mouth (Cheilosis), glossitis, dermatitis.
Vitamin B_6	Pyridoxine $C_8H_{11}O_3N$	Wheat, maize, husk of rice, meat, fish, egg etc.	In blood formation.	Convulsions, paralysis.
Vitamin B_{12}	Cyanocobalamin $C_{63}H_{88}CoN_{14}O_{14}P$	Liver, egg, fish, meat etc.	In blood formation.	Macrocytic anaemia or pernicious anaemia.
Vitamin C	Ascorbic acid $C_6H_8O_6$	Citrus fruits such as lemon, orange, tomatoes, amla etc.	For bones, teeth and healing of wounds, healthy skin.	Scurvy, pyria, pain in joints, loosening of teeth, mental depression, anaemia, bleeding of gums.
Vitamin D	Calciferol or Ergocalciferol or Vitamin D_2, $C_{27}H_{44}O$	Egg, meat, fish, liver oil, butter etc.	Control of metabolism of calcium and phosphorus in the formation of bones.	Rickets, osteomalacia.
Vitamin E	α-Tocopherol $C_{29}H_{50}O_2$	Milk, egg, meat, pulses, green vegetables, seeds, beans etc.	Anti sterility or reproduction.	Loss of reproductive ability or infertility.
Vitamin K (Vitamin K_1 or K_2)	Vitamin K_1 or Phylloquinone $C_{31}H_{46}O_2$, Vitamin K_2, $C_{41}H_{56}O_2$	Cabbage, spinach, green vegetables, egg, fish etc.	Helps in clotting of blood.	Delay in blood clotting (Haemophilia).

- **Hormones :** Hormones are the chemical substances produced by ductless glands called endocrine glands such as thyroid, adrenals etc. They find their way into the blood stream and influence and regulate the functions of the other organs of the body. Hormonal deficiency leads to specific biological disorders which can be cured by the administration of the specific hormones.

- **Steroid hormones :** Those hormones which have structure similar to steroids. *e.g.*, cortisone, testosterone, estrogen and progesterone.
- **Various hormones, gland of secretion and their functions :**

S. No.	Hormones	Gland	Function
1.	**Steroid hormones :**		
	(i) Testosterone (androgens)	Testes	Responsible for development of male sex organs.
	(ii) Estrogen and progesterone	Ovary	Influences development of sex organs, maintains pregnancy.
	(iii) Cortisone	Adrenal cortex	Regulates metabolism of water, mineral salts.
2.	**Amine hormones :**		
	(i) Adrenalin	Adrenal medulla	Increases blood pressure and pulse rate. It also releases glucose from glycogen and fatty acids from fats.
	(ii) Thyroxine	Thyroid	Stimulates rate of oxidative metabolism and regulates general growth and development.
3.	**Peptide hormones :**		
	(i) Oxytocin	Posterior pituitary	Causes constriction of some smooth muscles. It causes contraction of uterus during child birth.
	(ii) Vasopressin (ADH)	Posterior pituitary	Controls the reabsorption of water in kidneys.
	(iii) Insulin	Pancreas	Controls blood glucose level.
	(iv) Glucagon	Pancreas	Increases blood glucose level.

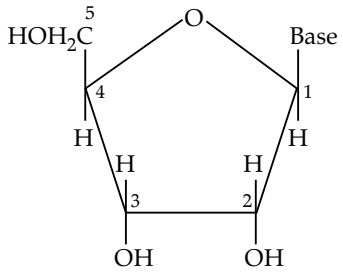
- **Nucleic acid :** The polymers of nucleotides help in synthesis of protein and transfer genetic traits.

  Nucleic acids are of two types :

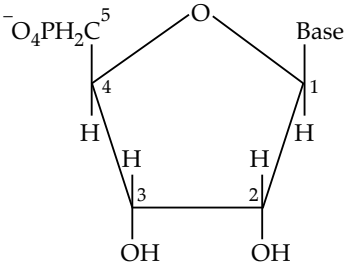
  (i) Deoxyribonucleic acid (DNA)

  (ii) Ribonucleic acid (RNA)

  (a) Constituents of nucleic acids : Pentose sugar, phosphoric acid and nitrogenous bases.
- **Nitrogen containing bases :**
  - **Pyrimidines :** These are three bases derived from pyrimidines. These are cytosine (C), thymine (T) and uracil (U). In DNA, T is present but in RNA, U is present.
  - **Purines :** There are two bases derived from purine. These are adenine (A) and guanine (G).
  - **Nucleoside :** A unit formed by the attachment of a base to 1′-position of sugar is known as nucleoside.



  - **Nucleotide :** When nucleoside is linked to phosphoric acid at 5′-position of sugar moiety, the unit obtained is called nucleotide.



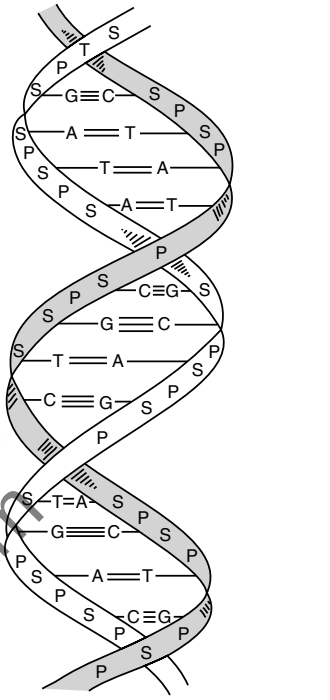
- Simple structure of nucleic acid chain :

Base Base Base
| | |
— Sugar — Phosphate — [Sugar — Phosphate —]$_n$ Sugar —

- **DNA :** James Watson and Francis Crick gave double helix structure of DNA.

Nucleic acid (DNA)
↓ hydrolysis
Nucleotide
↓ hydrolysis
Phosphoric acid + Nucleoside
↓ hydrolysis

Sugar	Purine base	Pyrimidine base
(2-deoxy ribose)	(Adenine + Guanine)	(Cytosine + Thymine)



Double helix structure of DNA molecule

- **RNA : (i)** *m*-RNA (Messenger RNA)
  (ii) *r*-RNA (Ribosomal RNA)
  (iii) *t*-RNA (Transfer RNA)
- **Nucleic acid (RNA)**
  ↓ hydrolysis
  Nucleotide
  ↓ hydrolysis

Phosphoric acid | Nucleoside
Nucleoside ↓ hydrolysis

Sugar	Purine base	Pyrimidine base
(Ribose)	(Adenine + Guanine)	(Cytosine + Uracil)

Properties of Nucleic Acids :

(i) Nucleic acids are very important constituents (polynucleotide) found in nucleus of cell which help in biosynthesis of protein and act as carriers for transfer of hereditary characters.

(ii) A molecule formed by the combination of one pentose sugar unit, a purine or pyrimidine base and a phosphate nucleotides combine among themselves to manufacture polynucleotide (nucleic acid).

(iii) A polynucleotide (DNA) which has a thymine base but not a uracil base. It contains deoxyribose sugar but not ribose sugar. It has double helix structure.

(iv) A polynucleotide (RNA) which contains uracil base and ribose sugar but thymine base and deoxyribose sugar are absent. It has single stranded structure.

Know the Terms

- **N-Terminal end :** There is a free amino group at one end of molecule of amino acid which is known as N-Terminal end.
- **C-Terminal end :** There is a free carboxyl group at the end of amino acid molecule which is known as C-Terminal end.
- **Conjugated proteins :** In this case, a protein part is linked to a non-protein part called prosthetic group which is mostly concerned with the special biological function of protein.
- **Derived proteins :** These are the proteins formed by the partial hydrolysis of simple conjugated proteins such as proteases, peptones, peptides etc.
- **Enzyme inhibitors :** These are the chemical substances which tend to reduce the activity of a particular enzyme instead of increasing it.
- **Transcription :** Process of synthesis of RNA.
- **Replication :** Process by which a single DNA molecule produces two identical copies of itself.
- **Native protein :** Protein found in biological system with a unique 3-dimensional structure and biological activity.
- **Gene :** Sequence of bases or nucleotides in the DNA molecule which regulates the synthesis of a specific protein.

Very Short Answer-Objective Type Questions (1 mark each)

A. Multiple choice Questions:

Q. 1. Proteins are found to have two different types of secondary structures, viz. α-helix and β-pleated sheet structure. γ-helix structure of protein is stabilised by
(a) Peptide bonds
(b) van der Waals forces
(c) Hydrogen bonds
(d) Dipole-dipole interactions
[NCERT Exemp. Q. 5., Page 203]

Ans. Correct option : (c)
Explanation : α-helix structure of protein is stabilised by hydrogen bonds. A polypeptide chain forms all possible hydrogen bonds by twisting into right-handed helix with the –NH group of each amino acid residue hydrogen bonded to >C=O of an adjacent turn of helix.

Q. 2. 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) quaternary structure of proteins
[NCERT Exemp. Q. 11., Page 205]

Ans. Correct option : (a)
Explanation : The sequence of amino acids in a polypeptide chain is called primary structure of proteins.

Q. 3. Which of the following acids is a vitamin?
(a) Aspartic acid **(b) Ascorbic acid**
(c) Adipic acid **(d) Saccharic acid**
[NCERT Exemp. Q. 7., Page 204]

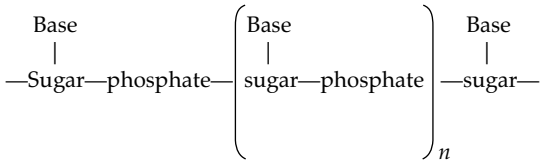
Ans. Correct option : (b)
Explanation : Ascorbic acid is vitamin C. Aspartic acid is amino acid. Adipic acid and saccharic acid are dicarboxylic acids.

Q. 4. 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}**
[NCERT Exemp. Q. 13., Page 205]

Ans. Correct option : (d)
Explanation : Vitamin B_{12} can be stored in our body because it is insoluble in water.

Q. 5. Nucleic acids are the polymers of
(a) Nucleosides **(b) Nucleotides**
(c) Bases **(d) Sugars**
[NCERT Exemp. Q. 9., Page 204]

Ans. Correct option : (b)
Explanation : Nucleic acids are the polymers of nucleotides in which nucleic acids are linked together by phosphodiester linkage.



Q. 6. 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′**
[NCERT Exemp. Q. 8., Page 204]

Ans. Correct option : (a)

Q. 7. DNA and RNA contain four bases each. Which of the following bases is not present in RNA?
(a) Adenine **(b) Uracil**
(c) Thymine **(d) Cytosine**
[NCERT Exemp. Q. 12., Page 204]

Ans. Correct option : (c)
Explanation : DNA contains four bases: Adenine, guanine, thymine and cytosine. While RNA contains four bases : Adenine, guanine, uracil and cytosine.

Q. 8. Which of the following bases is not present in DNA?
(a) Adenine **(b) Thymine**
(c) Cytosine **(d) Uracil**
[NCERT Exemp. Q. 13., Page 204]

Ans. Correct option : (d)
Explanation : Uracil is not present in DNA, instead thymine is present.

B. Match the following :

Q. 1. Match the species given in Column I with those mentioned in Column II.

	Column I (Enzymes)		Column II (Reactions)
(i)	Invertase	(a)	Decomposition of urea into NH_3 and CO_2.
(ii)	Maltase	(b)	Conversion of glucose into ethyl alcohol.
(iii)	Pepsin	(c)	Hydrolysis of maltose into glucose
(iv)	Urease	(d)	Hydrolysis of cane sugar
(v)	Zymase	(e)	Hydrolysis of proteins into peptides

[NCERT Exemp. Q. 59, Page 212]

Ans. (i) → (d), (ii) → (c), (iii) → (e), (iv) → (a), (v) → (b)

Column I	Column II	Explanation
Invertase	D	Invertase is an enzyme that catalyses the hydrolysis (breakdown) of sucrose (table sugar).
Maltase	C	The maltase enzyme is a protein that is perfectly shaped to accept a maltose molecule and break the bond. The two glucose molecules are released.
Pepsin	E	Pepsin is an enzyme present in stomach. It degrades food proteins into peptides.
Urease	A	It is an enzyme that catalyses the hydrolysis of urea into carbon dioxide and ammonia.
Zymase	B	It is a mixture of enzymes obtained from yeast which catalyse the breakdown of sugars in alcoholic fermentation.

C. Answer the following:

Q. 1. Write the linkage joining amino acids ?

[CBSE OD 2013]

Ans. Peptide bond. **1**

Q. 2. What are the different types of RNA molecules which perform different functions ?

[CBSE Delhi 2013]

Ans. (i) Messenger RNA (*m*–RNA)

(ii) Transfer RNA (*t*–RNA)

(iii) Ribosomal RNA (*r*–RNA) **1**

Q. 3. What type of bonding help in stabilising the α-helix structure of proteins ?

[CBSE Delhi 2013]

Ans. Intramolecular hydrogen bonding present between —NH group of each amino acid residue and the >C=O of an adjacent turn of the helix mainly helps in stabilising the α-helix structure of proteins. **1**

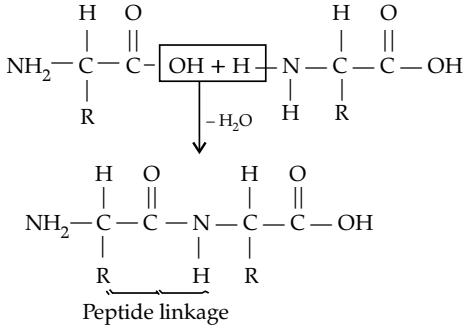
Short Answer Type Questions (2 marks each)

Q. 1. What is meant by :

(i) Peptide linkage,

(ii) Biocatalysts. **[CBSE Delhi 2012; DDE]**

Ans. (i) Peptide linkage : Proteins are complex nitrogenous polymeric substances present in all forms of living matter. These are obtained by the condensation polymerisation of α-amino acids through the formation of peptide bonds.



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(ii) Biocatalyst : Enzymes are complex nitrogenous substances (proteins) having molecular weight of 10,000 or even more. Enzymes increase the rate of biochemical reactions by providing alternative path of lower activation energy. Therefore, enzymes are termed as biochemical catalyst and phenomenon is known as biochemical catalysis. **1**

Q. 2. Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA ?

[CBSE Delhi 2012]

Ans. Structural differences between DNA and RNA

S. No.	RNA	DNA
1.	The sugar is D - ribose.	Sugar is -2-deoxy ribose.
2.	It exists as a single chain structure.	It has a double helix structure.
3.	The base units are : * Adenine (A) and guanine (G) as purine bases. * Cytosine (C) and uracil (U) as pyrimidine bases.	The base units are : * Adenine (A) and guanine (G) as purine bases. * Cytosine (C) and thymine (T) as pyrimidine bases.

(Any one) 1

Thymine is present in DNA. **1**

Long Answer Type Questions-I (3 marks each)

Q. 1. Define the following as related to proteins :
(i) Peptide linkage, (ii) Primary structure, (iii) Denaturation R **[CBSE OD 2015; OD 2014]**

Ans. (i) Peptide linkage – Refer SATQ. 1 (i) **1**

(ii) Primary structure - each polypeptide in a protein molecule having amino acids which are linked with each other in a specific sequence. **1**

(iii) Denaturation - When a protein is subjected to physical change like change in temperature or chemical change like change in pH, protein loses its biological activity. **1**

[CBSE Marking Scheme 2014]

Q. 2. Define the following with an example of each :
(a) Polysaccharides
(b) Denatured protein
(c) Essential amino acids R

OR

(a) Write the product when D-glucose reacts with conc. HNO_3.
(b) Amino acids show amphoteric behaviour. Why ?
(c) Write one difference between α-helix and β-pleated structures of proteins.
R + A&E + U **[CBSE Delhi/OD 2018]**

Ans. (i) (a)Carbohydrates that give large number of monosaccharide units on hydrolysis / large number of monosaccharides units joined together by glycosidic linkage ½

Starch/ glycogen/ cellulose (or any other) ½

(b) Proteins that lose their biological activity / proteins in which secondary and tertiary structures are destroyed ½

Curdling of milk (or any other) ½

(c) Amino acids which cannot be synthesised in the body. ½

Valine / Leucine (or any other) ½

OR

(a) Saccharic acid / COOH-$(CHOH)_4$-COOH **1**

(b) Due to the presence of carboxyl and amino group in the same molecule / due to formation of zwitter ion or dipolar ion. **1**

(c) α-helix has intramolecular hydrogen bonding while β pleated has intermolecular hydrogen bonding / α-helix results due to regular coiling of polypeptide chains while in β pleated all polypeptide chains are stretched and arranged side by side. **1**

[CBSE Marking Scheme 2018]

AI **Q. 3. (i) Write the name of two monosaccharides obtained on hydrolysis of lactose sugar.**
(ii) Why vitamin C cannot be stored in our body ?
(iii) What is the difference between a nucleoside and nucleotide ? R + A&E + U **[CBSE Delhi 2016; DDE]**

Ans. (i) β-D-Glucose and β–D–Galactose. **1**

(ii) It is water soluble, hence it is excreted through urine. **1**

(iii) Nucleoside : It is formed when pentose sugar combines with nitrogen base.
Nucleotide : When nucleoside bonds with phosphate group. **1**

[CBSE Marking Scheme 2016]

Q. 4. (i) Write the structural difference between starch and cellulose.
(ii) What type of linkage is present in Nucleic acids ?
(iii) Give one example each for fibrous protein and globular protein. U + R **[CBSE OD 2016]**

Ans. (i) In starch, the glucose monomers are in alpha configuration while in cellulose the glucose monomers are in beta configuration. Starch is a polymer consisting of amylose and amylopectin while cellulose is a long chain composed only of β—D— glucose units. **1**

(ii) Phosphodiester linkage between the 5′ and 3′ atoms is present in nucleic acids. **1**

(iii) Example of fibrous protein—Collagen, keratin, myosin. **(Any one)**
Example of globular protein—Insulin, haemoglobin, egg albumin. **(Any one) 1**

[CBSE Marking Scheme 2016]

Q. 5. How are vitamins classified ? Name the vitamin responsible for the coagulation of blood.
R **[CBSE Comptt. Delhi 2015; NCERT]**

Ans. Vitamins are classified into :

(i) Water soluble vitamins : Vitamins which are soluble in water but insoluble in fat and oils. *e.g.*, vitamin B and C.

(ii) Fat soluble vitamins : Vitamins are soluble in fat and oils but insoluble in water. *e.g.*, vitamin A, D, E and K.

Vitamin K is responsible for coagulation of blood. **2 + 1**

AI **Q. 6. (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 B_{12}. R + U **[CBSE OD 2015]**

Ans. (i) Starch. **1**

(ii) α- Helix polypeptide chains are stabilized by intramolecular H-bonding whereas β-pleated sheet is stabilized by intermolecular H-bonding. (or any other difference) **1**

(iii) Pernicious anaemia. **1**

Answering Tips

- (iii) Understand the deficiency related diseases of different vitamins in detail.

Q. 7. (i) Deficiency of which vitamin causes night blindness ?

(ii) Name the base that is found in nucleotide of RNA only.

(iii) Glucose on reaction with HI gives n-hexane. What does it suggest about the structure of glucose ?

R + U **[CBSE Delhi 2014; DDE]**

Ans. (i) Vitamin A **1**

(ii) Uracil **1**

(iii) It suggests that six carbon atoms are in straight chain/CHO—$(CHOH)_4$—CH_2OH **1**

[CBSE Marking Scheme 2014]

Q. 8. (i) Deficiency of which vitamin causes scurvy ?

(ii) What type of linkage is responsible for the formation of proteins ?

(iii) Write the product formed when glucose is treated with HI. R **[CBSE Delhi 2014; DDE]**

Ans. (i) Vitamin C. **1**

(ii) Peptide linkage. **1**

(iii) *n*-hexane or its structure. **1**

[CBSE Marking Scheme 2014]

Q. 9. (i) A non reducing disaccharide 'A' on hydrolysis with dilute acid gives an equimolar mixture of D–(+)–glucose and D-(-)-Fructose.

$$A + H_2O \xrightarrow{HCl} C_6H_{12}O_6 + C_6H_{12}O_6$$

$[\alpha]_D = +66.5^0 \quad +52.5° \quad -92.4°$

Identify A. What is the mixture of D–(+)–glucose and D-(-)-Fructose known as ? Name the linkage that holds the two units in the disaccharide.

(ii) α-amino acids have relatively higher melting points than the corresponding halo acids. Explain. A + A&E **[CBSE SQP 2016]**

Ans. (i) A–Sucrose ($C_{12}H_{22}O_{11}$) ½

The mixture of D-(+)-glucose and D-(-)-Fructose is known as invert sugar. ½

The linkage which holds the two monosaccharide units through oxygen atom is called glycosidic linkage. **1**

(ii) The amino acids exits as dipolar Zwitter ion. Due to their dipolar salt like character they have strong dipole-dipole attractions. Thus, their melting points are higher than the corresponding halo acids which do not exist as Zwitter ions. **1**

Q. 10. (i) Which one of the following is a disaccharide : Starch, Maltose, Fructose, Glucose ?

(ii) What is the difference between fibrous protein and globular protein ?

(iii) Write the name of vitamin whose deficiency causes bone deformities in children.

R + U **[CBSE Delhi 2015]**

Ans. (i) Maltose **1**

(ii) Fibrous proteins : parallel polypeptide chain, insoluble in water, Globular proteins: spherical shape, soluble in water, (or any 1 suitable difference) **1**

(iii) Vitamin D **[CBSE Marking Scheme 2015] 1**

Detailed Answer :

(ii)

Fibrous protein	Globular protein
It contains linear thread like molecules which tend to lie side by side to form fibres.	It contains compact form of molecules which are folded together.
Example : keratin, collagen.	Example : enzymes, hormones.

1

AI **Q. 11. (i) Why water soluble vitamins must be supplied regularly in the diet? Give one example of it.**

(ii) Differentiate between the follwing:

(a) Essential and non-essential amino acids.

(b) Fibrous and globular proteins.

A&E + U **[CBSE Comptt OD Set-1, 2, 3 2017]**

Ans. (i) Because they are excreted in urine and cannot be stored in body; Vitamin $C/B_1/B_6$ ½ + ½

(ii)(a) Essential amino acids are those which cannot be synthesized in the body and are supplied through diet whereas non-essential amino acid can be synthesized in the body **1**

(b) In fibrous proteins, the polypeptide chains run parallel and are held together by hydrogen or disulphide bonds while in globular, polypeptide chains coil around to give a spherical shape **1**

[CBSE Marking Scheme 2017]

Q 12. (i) What type of linkage is present in disaccharides?

(ii) Write one source and deficiency disease of vitamin B_{12}.

(iii) Write the difference between DNA and RNA.

R **[CBSE Comptt. Delhi Set-1, 3 2017]**

Ans. (i) Glycosidic linkage. **1**

(ii) Source: Meat, fish, egg, curd (any one); Pernicious anemia ½ + ½

(iii) DNA is a double strand while RNA is a single strand molecule (or any other correct difference)**1**

[CBSE Marking Scheme 2017]

Q. 13. (i) What type of linkage is present in proteins?

(ii) Give one example each of water soluble and fat soluble vitamins.

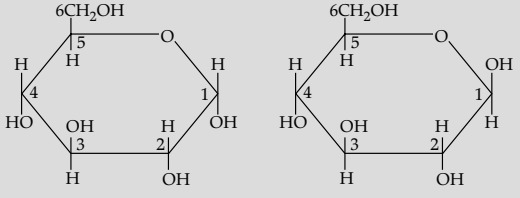
(iii) Draw pyranose structure of glucose.

R **[CBSE Comptt. Delhi Set- 2 2017]**

Ans. (i) Peptide linkage **1**

(ii) Water soluble – Vit B/C, Fat soluble – Vit A/D/E/K/ B_{12} ½ + ½

(iii)



[CBSE Marking Scheme 2017] 1

Q. 14. (i) Which vitamin deficiency causes rickets?

(ii) Name the base that is found in nucleotide of RNA only.

(iii) Glucose on reaction with acetic acid gives glucose penta acetate. What does it suggest about the structure of glucose? R + U **[CBSE SQP 2017]**

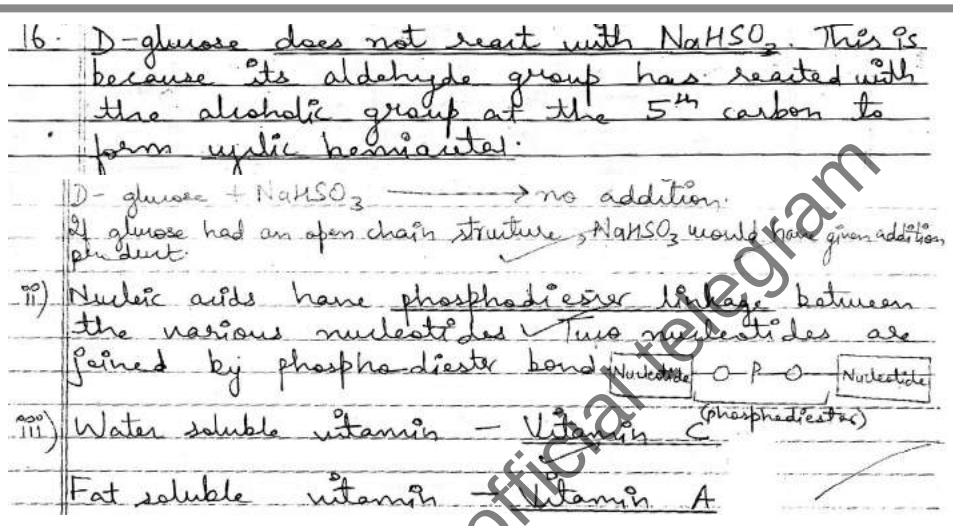
Ans (i) Vitamin D **1**
(ii) Uracil **1**
(iii) 5 OH groups are present **1**
[CBSE Marking Scheme 2017]

Commonly Made Error

- (ii) Students often get confused between the bases present in RNA and DNA.

Q. 15. (i) Write one reaction of D-Glucose which cannot be explained by its open chain structure.
(ii) What type of linkage is present in Nucleic acids?
(iii) Give one example each for water-soluble vitamins and fat-soluble vitamins? R **[CBSE OD Set-2 2016]**

Ans.



3
[Topper's Answer 2016]

Detailed Answer:

(i) Glucose does not give 2,4-DNP test inspite of having aldehyde group and does not form the hydrogen sulphite addition product with $NaHSO_3$. **1**

(ii) Phosphodiester linkages are present between the 5′ and 3′ carbon atoms in nucleic acids. **1**

(iii) Water soluble vitamin – Vitamin C/Vitamin B1 (Thiamine) **(Any one)** ½
Fat soluble vitamin – A/Vitamin D. **(Any one)** ½

Q. 16. (a) Name the branched chain component of starch.
(b) Ribose in RNA and deoxyribose in DNA differ in the structure around which carbon atom?
(c) How many peptide linkages are present in a tripeptide? R **[CBSE SQP 2018-2019]**

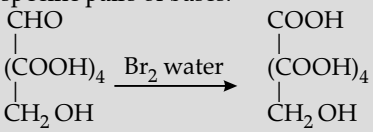
Ans. (a) Amylopectin. **1**
(b) C- 2 **1**
(c) Two peptide linkages. **1**
[CBSE Marking Scheme 2018]

AI **Q. 17. Explain the following :**
(i) Amino acids behave like salts rather than simple amines or carboxylic acids.
(ii) The two strands of DNA are complementary to each other.
(iii) Reaction of glucose that indicates that the carbonyl group is present as an aldehydic group in the open structure of glucose.
A&E **[CBSE Comptt. Delhi/OD 2018]**

Ans. (i) Due to the formation of zwitter ion. **1**

(ii) The two strands are complementary to each other because the hydrogen bonds are formed between specific pairs of bases. **1**

(iii)



Gluconic acid

Or glucose gets oxidised to gluconic acid on reaction with mild oxidising agent like Bromine water. **1**
[CBSE Marking Scheme 2018]

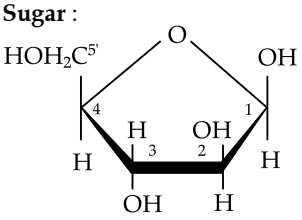
Long Answer Type Questions-II **(5 marks each)**

Q. 1. 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.
C **[NCERT Exemp. Q. 71., Page 213]**

Ans. Complete hydrolysis of DNA yields a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compounds called bases.

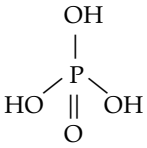
Structures :

(i) Sugar :



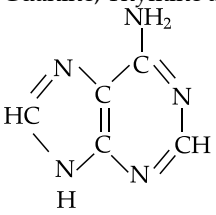
β-D-2-deoxyribose **1**

(a) Phosphoric acid :

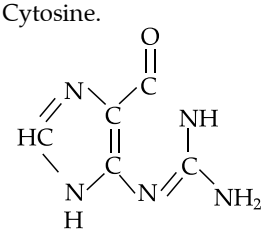


1

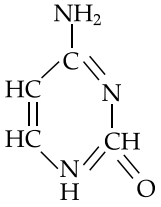
(b) Nitrogen base : DNA contains four bases : Adenine, Guanine, Thymine and Cytosine.



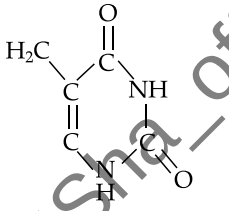
Adenine [A]



Guanine [G]



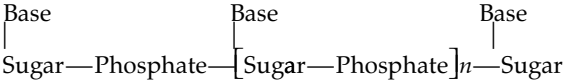
Cytosine [C]



Thymine [T] **1**

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.



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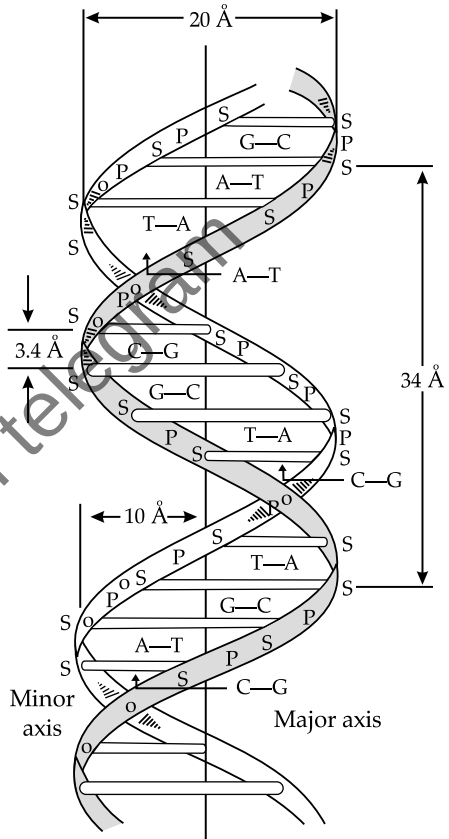
In DNA, two chains of nucleic acid coil around each other and held together by H-bonds between bases of two chains.



Double Helical Structure for DNA (Watson and Crick) **1**

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