10 Biomolecules

Fastrack Revision

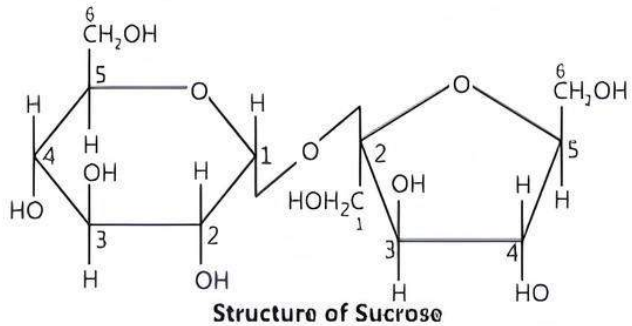
- Biomolecules are the organic compounds which form the basis of life, *i.e.*, they build up the living system and are responsible for their growth and maintenance.
- **Carbohydrates:** Optically active polyhydroxy aldehydes (aldoses) or ketones (ketoses) or compounds which on hydrolysis give these units are known as carbohydrates. They are also called **saccharides.**
- Depending upon their behaviour towards hydrolysis, carbohydrates can be of following three types:

  1. Monosaccharides: These cannot be hydrolysed to simpler molecules and further subdivided into tetroses, pentoses or hexoses depending upon the number of carbon atoms. These are also called homopolysaccharides.
  - **Aldotetroses:** Erythrose, Thriose
  - **Aldopentoses:** Xylose, Ribose
  - **Aldohexoses:** Glucose, Galactose
  - **Ketohexoses:** Fructose

  2. Oligosaccharides: On hydrolysis, they generally give two to nine monosaccharides (same or different) and are further classified as disaccharides, *e.g.*, sucrose, maltose, lactose, trisaccharides and so on.
  - $C_{12}H_{22}O_{11}$ is a disaccharide because it gives two monosaccharides.

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

  - The bond formed between two monosaccharides is called a glycosidic bond and normally it is (1, 4) bond.
  - Sucrose is most abundant in plants and is known as cane sugar or table sugar or invert sugar as equimolar mixture of glucose and fructose is obtained by hydrolysis of sucrose.



Structure of Sucrose

  - One important trisaccharide is raffinose ($C_{18}H_{32}O_{16}$).

$$(C_{18}H_{32}O_{16}) + 2H_2O \xrightarrow{H^{\oplus}} \text{Glucose} + \text{Fructose} + \text{Galactose}$$

3. Polysaccharides: These are polymers of monosaccharides. *e.g.* starch, cellulose, glycogen, etc.
  - **Reducing and Non-reducing Sugars:** Carbohydrates which reduce Fehling reagent or Tollens' reagent are termed as reducing carbohydrates, *e.g.*, all monosaccharides and disaccharides (except sucrose). But carbohydrates which do not reduce such reagents are known as non-reducing carbohydrates, *e.g.*, sucrose and polysaccharides.
  - **Sugars and Non-sugars:** The monosaccharides and oligosaccharides having sweet taste are collectively known as sugars. Polysaccharides which are insoluble in water and not sweet in taste, are non-sugars.

- **Monosaccharides**

  I. Glucose: Dextrose, grape sugar, corn sugar, blood sugar ($C_6H_{12}O_6$), etc., have glucose present in them.

- **Manufacture:** By hydrolysis of starch with hot dil. mineral acids and by hydrolysis of sucrose.

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

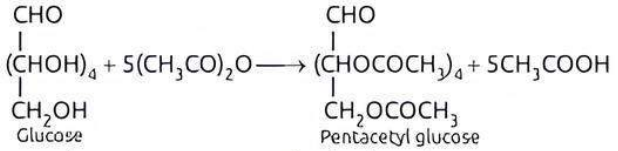
$$\underset{\text{Starch or Cellulose}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow[393\,K;\,2\text{-}3\,bar]{H^{\oplus}} n\,\underset{\text{Glucose}}{C_6H_{12}O_6}$$

- **Structure of Glucose**
  - In intermolecular hemiacetal formation (cyclic structure), —CHO is converted into —CHOH which can have two configurations as shown below:

$$\underset{\alpha\text{-form (i)}}{H-\overset{|}{\underset{|}{C_1}}-OH} \qquad \underset{\beta\text{-form (ii)}}{HO-\overset{|}{\underset{|}{C_1}}-H}$$

  - Glucose having (i) configuration about C_1 is the α-glucose and having (ii) configuration about C_1 is β-glucose.
  - The carbon C_1 is known as anomeric carbon and these compounds are called **anomers.** Both the forms are optically active. α-D-glucose has specific rotation $+111.5^{\circ}$ and β-D-glucose has specific rotation $+19.5^{\circ}$.
- **Properties of Glucose:** Glucose has one aldehyde group, one primary hydroxyl (—CH_2OH) and four secondary hydroxyl (—CHOH) groups and gives the following reactions:

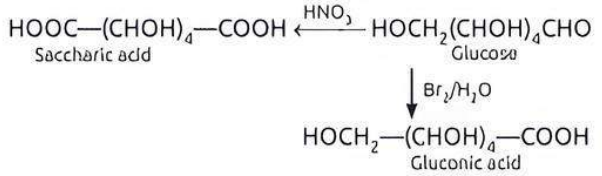
- Glucose on acetylation with acetic anhydride gives a pentaacetate confirming the presence of five hydroxyl groups in glucose.



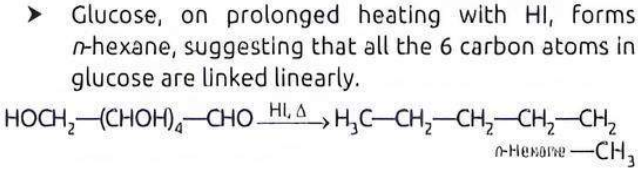
- Glucose reacts with hydroxylamine to give monoxime and adds with a molecule of hydrogen cyanide to give a cyanohydrin.

These reactions confirm the presence of a carbonyl group in glucose.

- Glucose reduces ammoniacal silver nitrate solution (Tollens' reagent) to metallic silver and also Fehling's solution or Benedict solution to reddish brown cuprous oxide (Cu_2O) and itself gets oxidised to gluconic acid. This confirms the presence of an aldehydic group in glucose.
- With mild oxidising agent like bromine water, glucose is oxidised to gluconic acid. Glucose on oxidation with nitric acid gives saccharic acid.

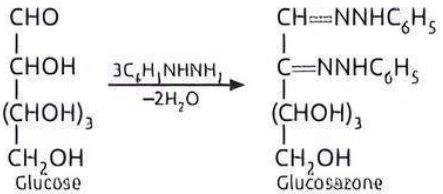


- Glucose, on prolonged heating with HI, forms *n*-hexane, suggesting that all the 6 carbon atoms in glucose are linked linearly.

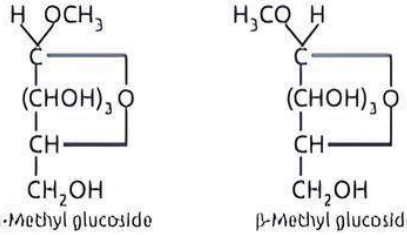


However, with Na/Hg and water, glucose is reduced to **Sorbitol** [$HOH_2C(CHOH)_4CH_2OH$].

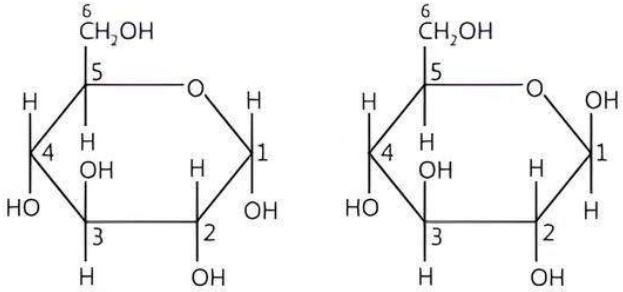
- D-glucose reacts with three molecules of phenyl hydrazine to give osazone (glucosazone).



- Glucose on reaction with methyl alcohol in the presence of dry HCl(g) forms α and β-methyl glycosides. The reaction occurs only at the —OH of hemiacetylic carbon.



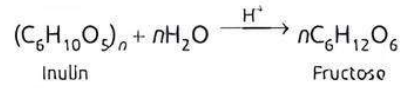
- **Cyclic Structure of Glucose:** It was given by Haworth and Fischer.



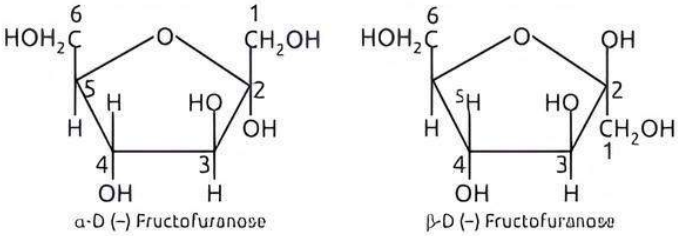
II. Fructose: It is a fruit sugar ($C_6H_{12}O_6$).

- **Manufacture**

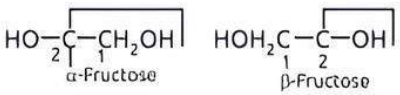
By hydrolysis of Inulin.

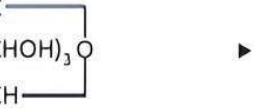


- **Structure of Fructose**
  - Fructose has furanose structure, *i.e.*, ring structure consisting of four C atoms and one O atom.



  - The two forms have different configuration about C_2.



  - Fructose does not reduce Br_2 water.
- **Epimers:** Monosaccharides differing in configuration at a carbon other than anomeric carbon are called epimers, *e.g.*, glucose and galactose differ in configuration at C_4, hence are called epimers.
- **Osazones:** Monosaccharides and reducing disaccharides react with excess of phenyl hydrazine to form crystalline substances of the structure which are known as osazones. Glucose and fructose give same osazone.
- **Molisch Test for Carbohydrates:** In aqueous solution of compound, add solution of α-naphthol in alcohol and then conc. H_2SO_4 along the walls of the test tube. Purple coloured ring is obtained at the junction.
- **Amino acids:** The compounds containing amino group (—NH_2) and carboxylic group (—COOH) are called amino acids.
- General formula is  where, R = H, alkyl or aryl group.

- Except glycine ($H_2N.CH_2COOH$), others are optically active in nature.

▶ **Classification of Amino Acids**

➤ **α, β, γ-amino Acids:** Depending upon the position of $—NH_2$ w.r.t. —COOH group.

- **Neutral:** Having one $—NH_2$ and one —COOH group *e.g.*, NH_2CH_2COOH(glycine).
- **Acidic:** Having one $—NH_2$ and two —COOH groups, *e.g.*,

$$HOOCCH_2\underset{\displaystyle NH_2}{\underset{|}{C}}H—COOH \text{ (Aspartic acid)}$$

- **Basic:** Having two or more $—NH_2$ and one —COOH group, *e.g.*,

$$H_2N(CH_2)_4—\underset{\displaystyle NH_2}{\underset{|}{C}}H—COOH \text{ (Lysine.)}$$

▶ **Essential and Non-essential Amino Acids:** Human body can synthesize ten amino acids, called non-essential amino acids. The remaining ten amino acids required for protein synthesis are not synthesized by body and are called essential amino acids. They are:

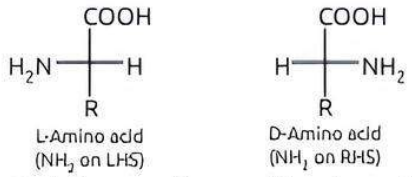
- Phenylalanine
- Histidine
- Tryptophan
- Valine
- Methionine
- Threonine
- Arginine
- Leucine
- Isoleucine
- Lysine

▶ **Nomenclature of Amino Acids:** They are known by their common names and abbreviated by first three letters of their common names *e.g.*, glycine as 'gly' and alanine as 'ala'.

▶ **Structure of Amino Acids**

$$\underset{\text{as anion (high pH)}}{\ddot{N}H_2—\underset{\displaystyle R}{\underset{|}{C}}H—COO^-} \xrightleftharpoons{\bar{O}H} \underset{\text{Zwitter ion (isoelectric point)}}{\overset{+}{H_3}N—\underset{\displaystyle R}{\underset{|}{C}}H—COO^-} \xrightleftharpoons{\overset{+}{H}} \underset{\text{as cation (low pH)}}{\overset{+}{H_3}N—\underset{\displaystyle R}{\underset{|}{C}}H—COOH}$$

▶ **Configuration of α-Amino Acids**



▶ **Proteins:** Proteins are polymers of L-amino acids. Naturally occurring proteins are made from L-amino acids only.

▶ **Peptides**

➤ Peptides are condensation products of two or more amino acids.

$$H_2N—\underset{\displaystyle R}{\underset{|}{C}}H—COOH + H_2N—\underset{\displaystyle R}{\underset{|}{C}}H—COOH \xrightarrow{-H_2O}$$

$$H_2N—\underset{\displaystyle R}{\underset{|}{C}}H—\overset{\displaystyle O}{\overset{\|}{C}}—NH\text{⋯}\underset{\displaystyle R}{\underset{|}{C}}H—COOH$$

Dipeptide

➤ $—\overset{\displaystyle O}{\overset{\|}{C}}—NH\text{⋯}$ is known as peptide linkage and C—N is a peptide bond.

➤ Two molecules of different amino acids can form two dipeptides. Three molecules of different amino acids can give six tripeptides.

▶ **Polypeptides:** Condensation products of many amino acids (≈10000) is known as polypeptide and those polypeptides which have molecular mass higher than 10000 u are called proteins.

▶ **Structure of Proteins**

➤ **Primary Structure:** It simply reveals the sequence of amino acids.

➤ **Secondary Structure:** It is α-helix structure maintained by hydrogen bonds or β-pleated sheet structure when R is small group.

➤ **Tertiary Structure:** The folding and superimposition of polypeptide chains form a compact globular shape, termed as tertiary structure. It is stabilised by covalent, ionic, hydrogen and disulphide bonds.

➤ **Quaternary Structure:** The precise arrangement constitutes the quaternary structure.

▶ **Classification of Proteins:** On the basis of hydrolysis products, the proteins are classified as:

(i) Simple: These yield only α-amino acids upon hydrolysis. *e.g.*, albumin.

(ii) Conjugated Proteins: These yield α-amino acids and non-protein part, called prosthetic group.

➤ **Protein:** Prosthetic group

➤ **Nucleoproteins:** Nucleic acid

➤ **Phosphoproteins:** Phosphoric acid

➤ **Glycoproteins:** Carbohydrates

(iii) Derived Proteins: These are obtained by partial hydrolysis of simple or conjugated proteins.

Proteins → Proteoses → Peptones → Polypeptides

▶ **On the Basis of Functions:**

(i) Structural Proteins: Fibrous proteins.

(ii) Enzymes: Serve as biological catalyst *e.g.* pepsin, trypsin, etc.

(iii) Hormones: Insulin

(iv) Contractile Proteins: Found in muscles, *e.g.* myosin, actin, etc.

(v) Antibodies: Globulins present in blood

(vi) Blood Protein: Albumin, haemoglobin and fibrinogen.

➤ Haemoglobin is a globular protein and its prosthetic group is heme.

➤ It contains 574 amino acid units distributed in four polypeptide chains.

➤ Sickle cell anaemia is caused by defective haemoglobin obtained by replacing only one amino acid, *i.e.*, glutamic acid by valine.

▶ **Denaturation of Proteins**

➤ The process that changes the three dimensional structure of native proteins is called denaturation of proteins.

➤ It can be caused by change in pH, addition of electrolyte, heating or addition of solvent like water, alcohol or acetone.

▶ **Tests of Proteins**

➤ **Biuret Test:** Protein solution + NaOH + dil. $CuSO_4$ → Pink or violet colour.

➤ **Millon's Test:** Protein solution + Millon's reagent → Pink colour

Millons' reagent is solution of mercuric nitrate and nitrite in nitric acid containing traces of nitrous acid.

$$\begin{array}{l} CH\text{⋯}NNHC_6H_5 \\ | \\ C\text{⋯}NNHC_6H_5 \\ | \\ (CHOH)_x \\ | \\ CH_2OH \end{array}$$

- **Iodine Reaction:** Protein solution + Iodine in potassium iodide solution → Yellow colour.
- **Xanthoproteic Test:** Protein solution + Conc. HNO_3 → Yellow colour $\xrightarrow{NaOH}$ Orange colour.

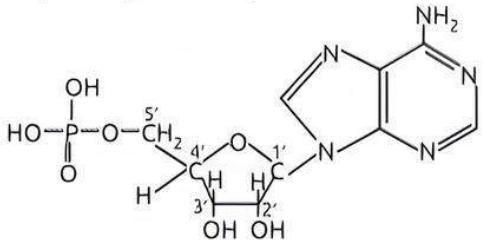
- **Enzymes:** Enzymes are the biocatalysts which are needed to catalyse biochemical reactions. Almost all the enzymes are globular proteins. Enzymes are very specific for a particular substrate and reaction.
- **Vitamins:** Vitamins are required in small amounts for the growth, life and health of human beings and animals.
  - Vitamins can be water soluble (vitamin B and C) or fat soluble (vitamin A, D, E and K) depending upon their solubility. Water soluble vitamins must be supplied regularly in diet because they are readily excreted in urine and cannot be stored (except B_{12}) in our body.
  - Deficiency of vitamins in diet may cause various type of deficiency diseases.
  - Some important vitamins, their sources and their deficiency diseases.

Vitamins	Sources	Deficiency Diseases
Vitamin A	Fish liver oil, carrots, butter and milk	Xerophthalmia, night blindness
Vitamin B_1	Milk, yeast, green vegetables and cereals	Beri-beri
Vitamin B_2	Milk, egg white, liver	Cheilosis, digestive disorders
Vitamin B_6	Yeast, milk, cereals	Convulsions
Vitamin B_{12}	Meat, fish, egg and Curd	Pernicious anaemia
Vitamin C	Citrus fruits, amla and green leafy vegetables	Scurvy
Vitamin D	Exposure to sunlight, fish	Rickets and osteomalacia
Vitamin E	Vegetable oils	Muscular weakness and increased fragility of RBCs.
Vitamin K	Green leafy vegetables	Delayed blood clotting.

- **Hormones:** Hormones are the chemical substances, produced by endocrine glands in the body and are released directly in blood stream. On the basis of chemical constitution, hormones can be divided into two classes: (i) steroids (ii) non-steriod hormones.

Nucleic Acids

- **Nucleotides:** Nucleotides consist of 5-carbon sugar + Nitrogenous base + 1, 3-phosphate groups.
- **Pentose Sugar:** It is either ribose or deoxy ribose (not having oxygen at C_2).
- **Nitrogenous Base**
  - Derived from purines having two rings in their structure, *e.g.* Adenine (A) and Guanine (G) and derived from pyrimidines having one ring in their structure, *e.g.* Thymine (T), Uracil (U) and Cytosine (C).
  - Two H-bonds are present between A and T (A ═ T) while three H-bonds are present between C and G (C ≡ G).
- **Ribonucleotide:** Phosphate unit + Ribose + One base unit from A, G, C or U.
- **Deoxyribonucleotide:** Phosphate unit + Deoxyribose + One base unit from A, G, C or T.
- **Nucleoside**: Ribose/deoxyribose + One base unit from A, G, C, T or U.
- **DNA and RNA:** Nucleic acid is a polynucleotide present in the living cells or bacterial cells having no nucleus and in viruses having no cells.
- **DNA (Deoxyribonucleic acid)**
  - Phosphoric acid + Deoxyribose + A, G, C, T
  - It consists of two polynucleotide chains, each chain form a right handed helical spiral with ten bases in one turn of the spiral.
  - The two chains coil to double helix and run in opposite direction. These are held together by hydrogen bonding.
- **RNA (Ribonucleic acid)**
  - Phosphoric acid + Ribose + A, G, C, U
  - It is usually a single strand of ribonucleotides and take up right handed helical conformation. Up to 12000 nucleotides constitute an RNA.
  - It can base pair with complementary strands of DNA or RNA.
  - According to standard base pairing rules, G pairs with C and A pairs with U or T.
  - In both DNA and RNA, heterocyclic base and phosphate ester linkages are at C_1 and C_5 respectively of the sugar molecule.



- **Types of RNA**
  - **Messenger RNA (*m*RNA):** It is produced in the nucleus and carries information for the synthesis of proteins.
  - **Transfer RNA (Soluble or Adoptive RNA) (*s*RNA, *t*RNA):** It is found in cytoplasm. Its function is to collect amino acids from cytoplasm for protein synthesis.
- **Functions of Nucleic Acids**
  - Direct the synthesis of proteins.
  - Transfer the genetic information (hereditary characters).
- **Replication:** It is a process in which a molecule of DNA can duplicate.

- **Template:** It means pattern. In the process of replication of DNA, the parent strand serves as template.
- **Gene:** The portion of DNA carrying information about a specific protein is called gene.
- **Genetic Code:** The relation between the amino acid and the nucleotide triplet is called genetic code.
- **Codons:** The nucleotide bases in RNA, function in groups of three (triplet) in coding amino acids. These base triplets are called codons.

  The word 'code' is used with reference to DNA, 'codon' with reference to *m*RNA and 'anticodon 'with reference to *t*RNA'.

Practice Exercise

Multiple Choice Questions

Q 1. Sucrose is a:

a. monosaccharide b. disaccharide
c. trisaccharide d. polysaccharide

Q 2. The pair of compounds in which both the compounds give positive test with Tollen's reagent, is:

a. glucose and sucrose b. fructose and sucrose
c. glucose and fructose d. All of these

Q 3. The sugar (disaccharide) present in milk is:

a. glucose b. sucrose
c. lactose d. maltose

Q 4. Which of the following sugar is known as dextrose? *(CBSE 2021 Term-1)*

a. Glucose b. Fructose
c. Ribose d. Sucrose

Q 5. Glucose on reaction with Br_2 water gives: *(CBSE 2021 Term-1)*

a. saccharic acid b. hexanoic acid
c. gluconic acid d. salicylic acid

Q 6. In the ring structure of glucose, the anomeric carbon is: *(CBSE 2023)*

a. C-2 b. C-3
c. C-4 d. C-1

Q 7. On hydrolysis, which of the following carbohydrates gives only glucose? *(CBSE 2023)*

a. Maltose b. Sucrose
c. Lactose d. Galactose

Q 8. In the following reaction, identify *A* and *B*: *(CBSE SQP 2021 Term-1)*

$C_6H_{12}O_6 \xrightarrow{\text{Acetic anhydride}} A$

$C_6H_{12}O_6 \xrightarrow{\text{conc. nitric acid}} B$

a. A = $COOH—(CH_2)_4—COOH$,
B = $OHC—(CHOCOCH_3)_4—CH_2OCOCH_3$

b. A = $COOH—(CH_2)_4—CHO$,
B = $OHC—(CHOCOCH_3)_4—CH_2OCOCH_3$

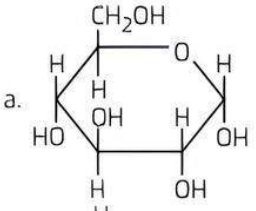
c. A = $OHC—(CHOCOCH_3)_3—CH_2OCOCH_3$
B = $COOH—(CH_2)_4—CHO$,

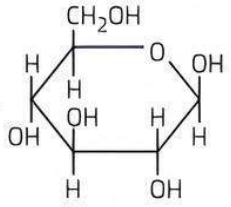
d. A = $OHC—(CHOCOCH_3)_4—CH_2OCOCH_3$
B = $COOH—(CHOH)_4—COOH$

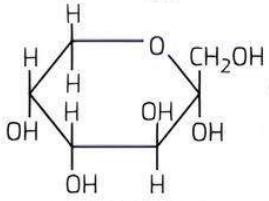
Q 9. Which one of the following reactions is not explained by the open chain structure of glucose? *(CBSE SQP 2021 Term-1)*

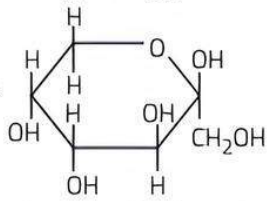
a. Formation of pentaacetate of glucose with acetic anhydride.
b. Formation of addition product with 2,4-DNP reagent
c. Silver mirror formation with Tollen's reagent
d. Existence of alpha and beta forms of glucose.

Q 10. Which of the following structures represents α-D-glucose? *(CBSE 2023)*

a. 

b. 

c. 

d. 

Q 11. The glycosidic linkage involved in linking the glucose units in amylase part of starch is: *(CBSE 2023)*

a. $C_1 - C_6$ α linkage b. $C_1 - C_6$ β linkage
c. $C_1 - C_4$ α linkage d. $C_1 - C_4$ β linkage

Q 12. Which one of the following statement is correct about sucrose? *(CBSE SQP 2021 Term-1)*

a. It can reduce Tollen's reagent however cannot reduce Fehling's reagent
b. It undergoes mutarotation like glucose and fructose
c. It undergoes inversion in the configuration on hydrolysis
d. It is laevorotatory in nature

Q 13. Which of the following is a polysaccharide? *(CBSE SQP 2021 Term-1)*

a. Glucose b. Maltose
c. Glycogen d. Lactose

Q 14. The carbohydrate which acts as reserve glucose for our body is:

a. sucrose b. starch
c. glycogen d. fructose

Q 15. When D-glucose reacts with HI, it forms: *(CBSE 2023)*

a. gluconic acid b. n-hexane
c. saccharic acid d. iodohexane

Q 16. Cellulose on complete hydrolysis gives:

a. L-glucose b. D-fructose
c. D-ribose d. D-glucose

Q 17. Amino acids which cannot be synthesised in the body and must be obtained through diet are known as: *(CBSE 2021 Term-1)*

a. acidic amino acid
b. essential amino acids
c. basic amino acids
d. non-essential amino acids

Q 18. An α-helix is a structural feature of: *(CBSE 2023)*

a. sucrose b. polypeptides
c. nucleotides d. starch

Q 19. Which of the following statement is correct? *(CBSE SQP 2021 Term-1)*

a. Fibrous proteins are generally soluble in water
b. Albumin is an example of fibrous proteins
c. In fibrous proteins, the structure is stabilised by hydrogen bonds and disulphide bonds
d. pH does not affect the primary structure of protein

Q 20. 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: *(NCERT EXEMPLAR)*

a. peptide bond
b. van der Waals' forces
c. hydrogen bond
d. dipole-dipole interactions

Q 21. Proteins are polymers of: *(CBSE 2023)*

a. nucleic acids b. amino acids
c. monosaccharides d. amines

Q 22. Complete the following analogy:
Curdling of milk : *A* :: α-helix : *B*
(CBSE SQP 2021 Term-1)

a. *A* : Primary structure *B* : Secondary structure
b. *A* : Denatured protein *B* : Primary structure
c. *A* : Secondary structure *B* : Denatured protein
d. *A* : Denatured protein *B* : Secondary structure

Q 23. Which of the following acids is a vitamin? *(NCERT EXEMPLAR)*

a. Aspartic acid b. Ascorbic acid
c. Adipic acid d. Saccharic acid

Q 24. Deficiency of which of the following vitamins causes Pernicious anaemia? *(CBSE 2023)*

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

Q 25. The vitamins which can be stored in our body are: *(CBSE SQP 2023-24)*

a. vitamins A, B, D and E b. vitamins A, C, D and K
c. vitamins A, B, C and D d. vitamins A, D, E and K

Q 26. Deficiency of vitamin B causes: *(CBSE 2023)*

a. rickets b. muscular weakness
c. scurvy d. beri-beri

Q 27. Nucleic acids are polymer of: *(CBSE 2021 Term-1)*

a. amino acids b. nucleosides
c. nucleotides d. glucose

Q 28. The base which is present in DNA but not in RNA, is: *(CBSE 2021 Term-1)*

a. cytosine b. guanine
c. adenine d. thymine

Q 29. Nucleosides are composed of:

a. a pentose sugar and phosphoric acid
b. a nitrogenous base and phosphoric acid
c. a nitrogenous base and a pentose sugar
d. a nitrogenous base, a pentose sugar and phosphoric acid

Q 30. Match the following: *(CBSE SQP 2021 Term-1)*

	Column I		Column II
(A)	Amino acids	(i)	Protein
(B)	Thymine	(ii)	Nucleic acid
(C)	Insulin	(iii)	DNA
(D)	Phosphodiester linkage	(iv)	Zwitter ion
(E)	Uracil		

Which of the following is the best matched options?

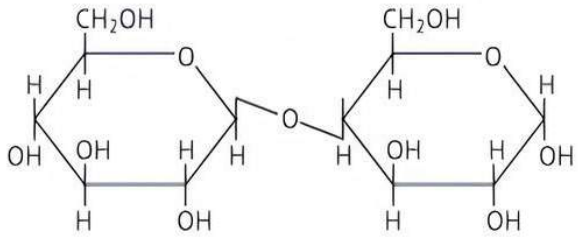
a. (A) → (i), (E) → (iv), (C) → (iii), (D) → (ii)
b. (A) → (iv), (B) → (iii), (C) → (i), (D) → (ii)
c. (A) → (iv), (E) → (iv), (C) → (i), (D) → (ii)
d. (A) → (i), (B) → (iii), (C) → (iv), (D) → (ii)

Assertion & Reason Type Questions

Directions (Q. Nos. 31-38): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Give answer:*

a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 31. 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.

Q 32. Assertion (A): All naturally occurring α-amino acids except glycine are optically active.

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

Q 33. 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.

Q 34. Assertion (A): Enzymes are very specific for a particular reaction and for a particular substrate.

Reason (R): Enzymes are biocatalysts.

(CBSE SQP 2023-24)

Q 35. Assertion (A): Only α-amino acids are obtained on hydrolysis of proteins.

Reason (R): In zwitter ionic form, amino acids show amphoteric behaviour.

Q 36. Assertion (A): Proteins are found to have two different types of secondary structures viz alpha-helix and beta-pleated sheet structure.

Reason (R): The secondary structure of proteins is stabilized by hydrogen bonding. *(CBSE SQP 2022-23)*

Q 37. Assertion (A): Vitamin D can be stored in our body.

Reason (R): Vitamin D is fat soluble vitamin.

Q 38. Assertion (A): DNA has a double strand helix structure.

Reason (R): The two strands in a DNA molecule are exactly similar.

Answers

1. (b) disaccharide

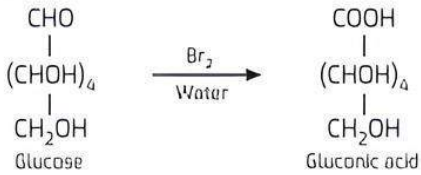
2. (c) glucose and fructose

All monosaccharides (glucose, fructose, etc.) give positive test with Tollen's reagent.

3. (c) lactose

4. (a) Glucose

5. (c) Gluconic acid

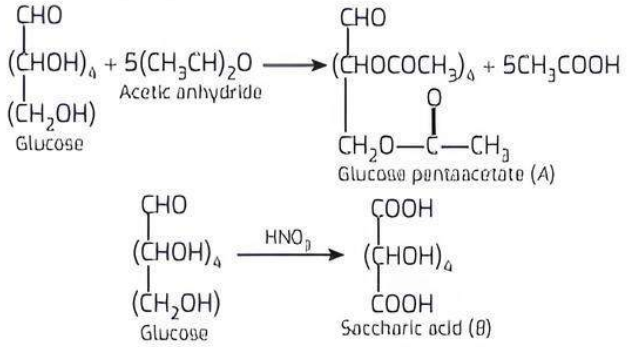


6. (d) The carbon of —CHO *i.e.*, Ist carbon atom is anomeric carbon in cyclic structure of glucose.

7. (a) Maltose is made up of 2 glucose units. Sucrose is made of glucose and fructose, lactose is made up of glucose and galactose.

8. (d) A = OHC—$(CHOCOCH_3)_4$—CH_2OCOCH_3

B = COOH—$(CHOH)_4$—COOH



9. (d) Existence of α and β forms of glucose.

10. (a) α-D-glucose is an isomer of D-glucose that has the —OH group of the first carbon atom positioned on the same side as the —CH_2OH group.

11. (c) Amylase is a polysaccharide made up of α-D-glucose units bonded to each other through $\alpha(1 \rightarrow 4)$ or $C_1 \rightarrow C_4$ α linkage.

12. (c) Hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar. Sucrose is dextrorotatory in nature.

13. (c) Starch, Cellulose and Glycogen are some important polysaccharides.

14. (c) glycogen

15. (b) When glucose is heated in the presence of HI, it reduces to n-hexane.

16. (d) D-glucose

17. (b) Essential amino acids

18. (b) An α-helix is a right-handed coil of amino-acid residues on a polypeptide chain.

19. (d) pH does not affect the primary structure of protein.

The primary structure of protein refers to the sequence of individual amino acids that make up the protein. Upon being transferred to an acidic solution, the protein does indeed unfold, but it doesn't break apart into individual amino acids. Therefore, the unfolded protein remains as a single, long chain, but its sequence of amino acids is still intact. Thus, there is no change in primary structure.

20. (c) hydrogen bond

21. (b) Amino acids

22. (d) A : Denatured protein

B : Secondary structure

23. (b) Ascorbic acid

24. (d) Vitamin B_{12}

25. (d) Vitamins A, D, E and K

These are fat soluble vitamins.

26. (d) beri-beri

27. (c) nucleotides

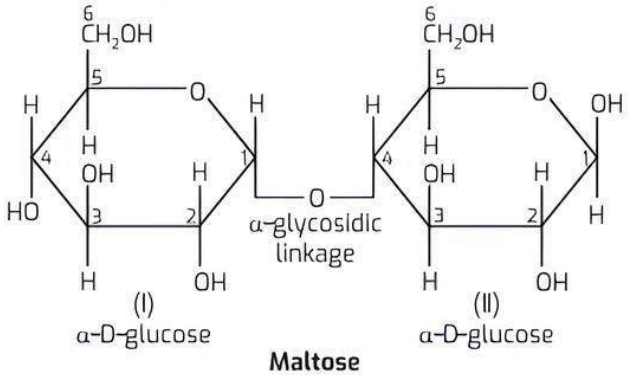
28. (d) Thymine

29. (c) a nitrogenous base and a pentose sugar

30. (b) A → (iv), B → (iii), (C) → (i), (D) → (ii)

Amino acids form proteins and exist as zwitter ion. Thymine is a nitrogenous base in DNA. Insulin is a protein. Phosphodiester linkage is found in nucleic acids so also in DNA and Uracil is nitrogenous base found in RNA which is a nucleic acid.

31. (d) In maltose, the two glucose units are joined together by α-glycosidic linkage.



Maltose

32. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

33. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

34. (b) Enzymes are very specific for a particular reaction and a particular substrate. Also enzymes are biocatalysts. Both assertion and reason are true but reason is not the correct explanation of assertion because each enzyme contains an active site which is an area of an enzyme that has specific shape and size and differs from one enzyme to another.

35. (b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

36. (b) All naturally occurring α-amino acids are optically active because the α-carbon atom is asymmetric. Also, most naturally occurring amino acids have L-configuration. Hence, assertion and reason both are true but reason is not the correct explanation of assertion.

37. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

38. (c) Reason (R) is false because the two strands are complementary to each other as the hydrogen bonds are formed between specific pairs of bases.

Case Study Based Questions

Case Study 1

Polysaccharides may be very large molecules. Starch, glycogen, cellulose and chitin are examples of polysaccharides.

Starch is the stored form of sugars in plants and is made up of amylose and amylopectin (both polymers of glucose). Amylose is soluble in water and can be hydrolysed into glucose units breaking glycosidic bonds, by the enzymes α-amylase and β-amylase. It is straight chain polymer. Amylopectin is a branched chain polymer of several D-glucose molecules. 80% of amylopectin is present in starch. Plants are able to synthesize glucose and the excess glucose is stored as starch in different plant parts, including roots and seeds. The starch that is consumed by animals is broken down into smaller molecules, such as glucose. The cells can then absorb the glucose.

Glycogen is the storage form of glucose in humans and other vertebrates and is made up of monomers of glucose. It is structurally quite similar to amylopectin. Glycogen is the animal equivalent of starch. It is stored in liver and skeletal muscles.

Cellulose is one of the most abundant natural biopolymers. The cell walls of plants are mostly made of cellulose, which provides structural support to the cell. Wood and paper are mostly cellulosic in nature.

Like amylose, cellulose is a linear polymer of glucose. Cellulose is made up of glucose monomers that are linked by bonds between particular carbon atoms in the glucose molecule. Every other glucose monomer in cellulose is flipped over and packed tightly as extended long chains. This gives cellulose its rigidity and high tensile strength—which is so important to plant cells. Cellulose passing through our digestive system is called dietary fiber.

Read the given passage carefully and give the answer of the following questions:

Q 1. In animals, glycogen is stored in:

a. liver
b. spleen
c. lungs
d. small intestine

Q 2. Amylose is:

a. straight chain, water insoluble component of starch, which constitutes 20% of it.
b. straight chain, water soluble component of starch, which constitutes 20% of it.
c. branched chain, water insoluble component of starch, which constitutes 80% of it.
d. branched chain, water insoluble component of starch, which constitutes 80% of it.

Q 3. The linkages which join monosaccharides to form long chain polysaccharides:

a. peptide linkage b. disulphide bonds
c. hydrogen bonds d. glycosidic linkage

Q 4. Cellulose on complete hydrolysis yields:

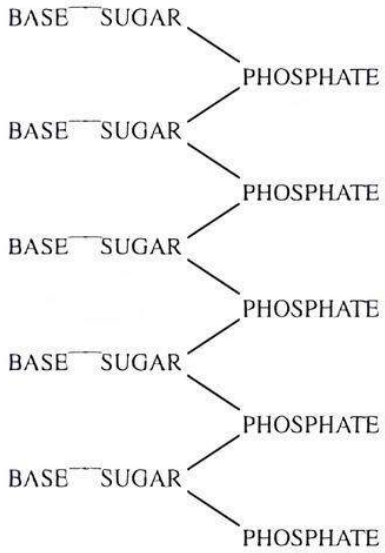
a. amylose
b. amylopectin
c. glucose
d. amylose and amylopectin

Answers

1. (a) liver
2. (b) straight chain, water soluble component of starch, which constitutes 20% of it.
3. (d) glycosidic linkage
4. (c) glucose

Case Study 2

The basic chemical formula of DNA is now well established. As shown in figure, it consists of a very long chain, the backbone of which is made up of alternate sugar and phosphate groups, joined together in regular 3'5' phosphate di-ester linkages. To each sugar is attached a nitrogenous base, only four different kinds of which are commonly found in DNA. Two of these — adenine and guanine — are purines and the other two thymine and cytosine-are pyrimidines. A fifth base, 5-methyl cytosine, occurs in smaller amounts in certain organisms, and a sixth, 5-hydroxy-methyl-cytosine is found instead of cytosine in the T even phages. It should be noted that the chain is unbranched, a consequence of the regular internucleotide linkage. On the other hand, the sequence of the different nucleotides is, as far as can be ascertained, completely irregular. Thus, DNA has some features which are regular and some which are irregular. A similar conception of the DNA molecule as a long thin fiber is obtained from physicochemical analysis involving sedimentation, diffusion, light scattering and viscosity measurements. These techniques indicated that DNA is a very asymmetrical structure approximately 20. A wide and many thousands of angstroms long. Estimates of its molecular weight currently center between 5×10^6 and 10^7 (approximately 3×10^4 nucleotides). Surprisingly each of these measurements tend to suggest that the DNA is relatively rigid, a puzzling finding in view of the large number of single bonds (5 per nucleotide) in the phosphate-sugar back bone. Recently these indirect inferences have been confirmed by electron microscopy.



Read the given passage carefully and give the answer of the following questions:

Q 1. Purines present in DNA are:

a. adenine and thymine
b. guanine and thymine
c. cytosine and thymine
d. adenine and guanine

Q 2. DNA molecules has ..... internucleotide linkage and ..... sequence of the different nucleotides.

a. regular, regular b. regular, irregular
c. irregular, regular d. irregular, irregular

Q 3. DNA has a ..... backbone.

a. phosphate -purine
b. pyrimidines- sugar
c. phosphate- sugar
d. purine- pyrimidine

Q 4. Out of the four different kinds of nitrogenous bases which are commonly found in DNA, ... has been replaced in some organisms.

a. adenine b. guanine
c. cytosine d. thymine

Answers

1. (d) adenine and guanine
2. (b) regular, irregular
3. (c) phosphate- sugar
4. (c) cytosine

Case Study 3

Strengthening the Foundation: Chargaff Formulates His "Rules"

Many people believe that James Watson and Francis Crick discovered DNA in the 1950s. In reality, this is not the case. Rather, DNA was first identified in the late 1860s by Swiss chemist Friedrich Miescher. Then, in the decades following

Miescher's discovery, other scientists-notably, Phoebus Levene and Erwin Chargaff-carried out a series of research efforts that revealed additional details about the DNA molecule, including its primary chemical components and the ways in which they joined with one another. Without the scientific foundation provided by these pioneers, Watson and Crick may never have reached their groundbreaking conclusion of 1953: that the DNA molecule exists in the form of a three-dimensional double helix.

Chargaff, an Austrian biochemist, as his first step in this DNA research, set out to see whether there were any differences in DNA among different species. After developing a new paper chromatography method for separating and identifying small amounts of organic material, Chargaff reached two major conclusions:

(i) The nucleotide composition of DNA varies among species.

(ii) Almost all DNA, no matter what organism or tissue type it comes from maintains certain properties, even as its composition varies. In particular, the amount of adenine (A) is similar to the amount of thymine (T) and the amount of guanine (G) approximates the amount of cytosine (C). In other words, the total amount of purines (A + G) and the total amount of pyrimidines (C + T) are usually nearly equal. This conclusion is now known as 'Chargaff's rule.'

Chargaff's rule is not obeyed in some viruses. These either have single-stranded DNA or RNA as their genetic material.

Read the given passage carefully and give the answer of the following questions:

Q 1. A segment of DNA has 100 adenine and 150 cytosine bases. What is the total number of nucleotides present in this segment of DNA?

Q 2. A sample of hair and blood was found at two sites. Scientists claim that the samples belong to same species. How did the scientists arrive at this conclusion?

Q 3. The sample of a virus was tested and it was found to contain 20% adenine, 20% thymine, 20% guanine and the rest cytosine. Is the genetic material of this virus (i) DNA-double helix, (ii) DNA-single helix, (iii) RNA? What do you infer from this data?

OR

How can Chargaff's rule be used to infer that the genetic material of an organism is double-helix or single-helix? *(CBSE SQP 2022-23)*

Answers

1. Given: Number of adenine bases, A = 100
   So, Number of thymine bases, T = 100
   Again, Number of cytosine bases, C = 150
   So, Number of guanine bases, G = 150
   Total nucleotides = 100 + 100 + 150 + 150 = 500
2. Scientists studied the nucleotide composition of DNA. It was the same so they concluded that the samples belong to same species.
3. Since A = T = 20% but G is not equal to C so double helix is ruled out. The base pairs are ATGC and not AUGC so it is not RNA. So, it can be inferred that the virus is a single helix DNA virus.

   OR

   According to Chargaff rule, all double helix DNA will have the same amount of A and T as well as C will be of same amount as G. If this is not the case, then the helix is single stranded.

Case Study 4

Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by the hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of α-amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

Read the given passage carefully and give the answer of the following questions:

Q 1. The pentaacetate of glucose does not react with hydroxylamine. What does it indicate?

Q 2. Why cannot vitamin C be stored in our body?

Q 3. Define the following as related to proteins:

(i) Peptide linkage

(ii) Denaturation

OR

Define the following as related to carbohydrates:

(i) Anomers

(ii) Glycosidic linkage *(CBSE 2023)*

Answers

1. The pentaacetate of glucose does not react with hydroxylamine indicates the absence of free —CHO group.
2. Vitamin C cannot be stored in our body because it is a water-soluble vitamin and gets excreted from the body with sweat or urine.

3. **(i) Peptide linkage :** It is a peptide bond that connects the polymers of α-amino acids i.e., proteins. Chemically, peptide linkage is an amide formed between —COOH group and —NH_2 group.

(ii) Denaturation : When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix gets uncoiled and protein loses its biological activity. This is called as denaturation.

OR

(i) Anomers : These are cyclic monosaccharides differing from each other in the configuration of C-1 or C-2 carbon. It is C-1 for aldoses and C-2 for ketoses.

(ii) Glycosidic linkage : Glycosidic linkage is a bond used to link different monosaccharides in disaccharides and polysaccharides through oxygen atom. For example, glycosidic linkage is present in sucrose, lactose, maltose, etc. These are all disaccharides.

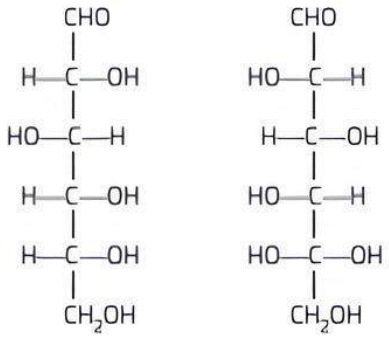
Very Short Answer Type Questions

Q 1. Write formula and name of a disaccharide.

Ans. Sucrose ($C_{12}H_{22}O_{11}$).

Q 2. Write structures of D(+) and L(–) glucose.

Ans.



D (+) glucose L (–) glucose

Q 3. Write general test for carbohydrates.

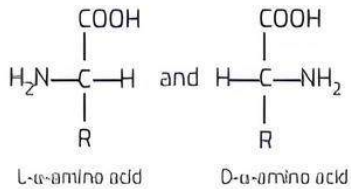
OR

Write short note on Molisch's test.

Ans. The general test for carbohydrates is **Molisch test**. In this test, aqueous solution of the organic compound is mixed with Molisch's reagent (alcoholic solution of α-naphthol) and then concentrated H_2SO_4 is added by the sides of the walls of the test tube. If a purple ring is formed between the layers of two liquids, then the organic compound is a carbohydrate.

Q 4. Write D and L-configuration in α-amino acids.

Ans.



L-α-amino acid D-α-amino acid

Q 5. What are the different types of RNA found in the cell? *(NCERT EXERCISE)*

Ans. Following three types of RNA are found in the cell:

(i) Ribosomal RNA (*r* RNA)

(ii) Messenger RNA (*m*RNA)

(iii) Transfer RNA (*t* RNA).

Q 6. Sketch the Zwitter ion form of α-amino acetic acid.

Ans. $\overset{\cdot\cdot}{N}H_2—CH_2—COOH \rightleftharpoons \overset{+}{N}H_3—CH_2—COO^-$

Q 7. Why is cellulose not a source of nourishment to the human body?

Ans. Our body does not have enzymes which can help in the digestion of cellulose. So, it is not a source of nourishment to the human body.

Q 8. Write the major classes in which carbohydrates are classified based upon hydrolysis.

Ans. There are three main classes. These are: monosaccharides, oligosaccharides and polysaccharides.

Q 9. Write two major functions of carbohydrates in plants. *(NCERT EXERCISE)*

Ans. Functions:

(i) Cell walls of plants are made up of cellulose.

(ii) In the form of starch, carbohydrates act as storage molecules in plants.

Q 10. What do you understand by the term glycosidic linkage? *(NCERT EXERCISE)*

Ans. Glycosidic linkage is a bond used to link different monosaccharides in disaccharides and polysaccharides through oxygen atom. For example, glycosidic linkage is present in sucrose, lactose, maltose etc. These are all disaccharides.

Q 11. Give one example of fat soluble vitamin.

Ans. Vitamin D is a fat soluble vitamin.

Q 12. What type of linkage holds together the monomers in DNA?

Ans. Monomers in DNA are linked by phosphate linkages.

Q 13. Name the type of bonding which stabilises α-helix structure in proteins.

Ans. α-helix structure in proteins is held together and stabilised through hydrogen bonding.

Q 14. Write a disease caused due to deficiency of vitamin C and name one source of vitamin C.

Ans. Vitamin C deficiency in the body generally leads to Scurvy (bleeding gums). Citrus fruits are the major sources of vitamin C.

Q 15. What are disaccharides? Give an example.

Ans. Disaccharides are the carbohydrates in which two molecules of monosaccharides (same or different) are combined with the loss of a molecule of H_2O. The monosaccharides are linked to each other by glycosidic linkage. e.g., Sucrose, Lactose, Maltose, etc.

Q 16. Name two water soluble vitamins, their sources and diseases caused due to their deficiency in diet.

Ans.

Vitamins	Sources	Causes
Thiamine (B_1)	milk, yeast, cereals	Beri-Beri
Ascorbic acid (C) :	citrus fruits, amla	Scurvy

Q 17. Name the four bases present in DNA. Which one of these is not present in RNA?

Ans. The four bases present in DNA are: Adenine, Thymine, Guanine and Cytosine. Out of these, Thymine is not present in RNA.

Q 18. Name two fat soluble vitamins, their sources and the diseases caused due to their deficiency in diet.

Ans.

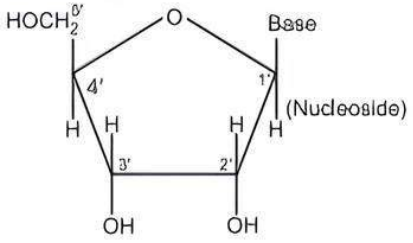
Vitamins	Sources	Causes
Vitamin A	Fish oil, carrot, milk, egg yolk	Night blindness and xerophthalmia
Vitamin D	sunlight, fish, egg yolk	Rickets and Osteomalacia

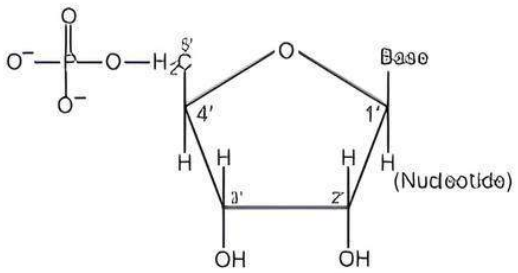
Q 19. What is structural feature which characterises a reducing sugar?

Ans. Sugars which contain either a free aldehydic group (e.g., glucose) or α-ketonic group (e.g., fructose) are regarded as reducing sugars.

Q 20. What is the structural difference between a nucleoside and nucleotide?

Ans.





Structural difference between a nucleoside and a nucleotide

Q 21. What are essential and non-essential amino acids? Give an example of each type.

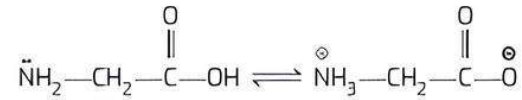
Ans. The amino acids which can be synthesised by the body are called non-essential amino acids (e.g., glycine). The amino acids which the body fails to synthesise are known as essential amino acids (indicated by sign e or °). e.g., leucine.

Q 22. Differentiate between keratin and insulin.

Ans. Keratin is a fibrous protein while insulin is a globular protein.

Q 23. Write the Zwitter ion structure of glycine.

Ans. Glycine is also called dipolar ion and its structure is as follows:



Q 24. Name the vitamin whose deficiency causes (i) Night blindness (ii) Poor coagulation of blood.

Ans. (i) Deficiency of Vitamin A cause night blindness.

(ii) Deficiency of Vitamin K causes poor coagulation of blood.

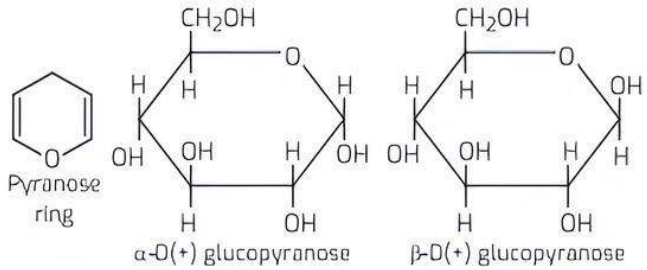
Q 25. Write the structure of the product when glucose is oxidised with conc. nitric acid.

Ans. Glucose is oxidised to saccharic acid, a dicarboxylic acid upon oxidation with conc. nitric acid.

$$CH_2OH(CHOH)_4CHO \xrightarrow{HNO_3(conc.)} HOO(CHOH)_4COOH$$

Q 26. What is meant by pyranose ring of glucose?

Ans. Pyranose ring is six membered heterocyclic ring with an oxygen atom. It is present in the cyclic structure of both α-D (+) glucose and β-D(+) glucose.



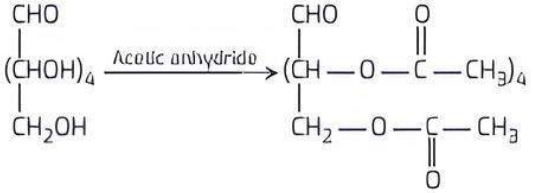
Short Answer Type-I Questions

Q 1. Account for the following:

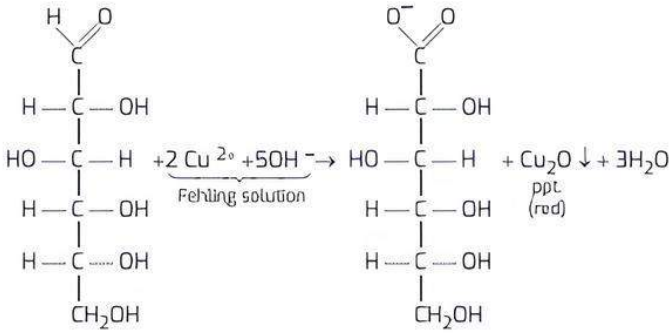
(i) There are 5 OH groups in glucose.

(ii) Glucose is a reducing sugar. *(CBSE SQP 2022-23)*

Ans. (i) Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five —OH groups. Since, it exists as a stable compound, five —OH groups should be attached to different carbon atoms.



(ii) Glucose has a free aldehyde group which can be oxidized to the acidic groups. Hence, glucose is a reducing sugar. Glucose reduces Fehling's reagent as shown:

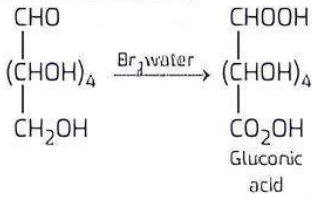


Q 2. What happens when D - glucose is treated with the following reagents:

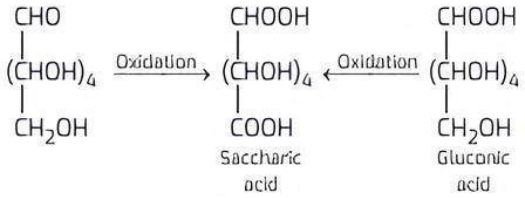
(i) Bromine water

(ii) HNO_3 *(CBSE SQP 2022-23)*

Ans. (i) When D-glucose is treated with bromine water, gluconic acid is formed.



(ii) When D-glucose is treated with HNO_3, saccharic acid is formed. Gluconic acid also gives saccharic acid on oxidation.

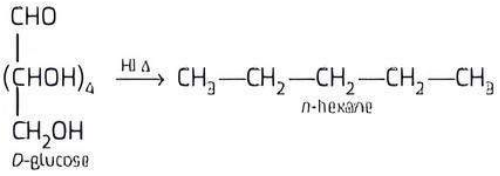


Q 3. What happens when D-glucose is treated with the following? Give equation to support your answer.

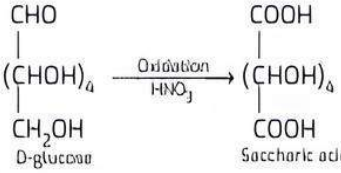
(I) HI

(ii) HNO_3 *(CBSE 2019)*

Ans. (i) *n*-hexane is formed.



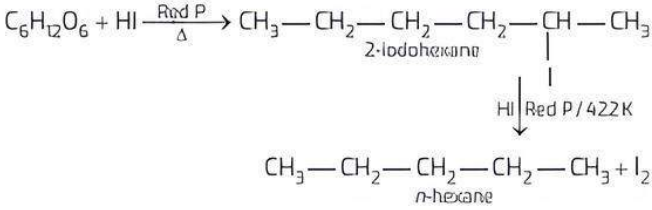
(ii) Saccharic acid is formed



Q 4. (i) Write chemical reaction to show that open structure of D-glucose contains the straight chain.

(ii) What type of linkage is responsible for the formation of protein? *(CBSE 2023)*

Ans. (i) The required chemical reaction is:



(ii) Proteins are the polymers of α-amino acids and they are connected to each other by peptide linkage. Hence, peptide linkage is responsible for the formation of protein.

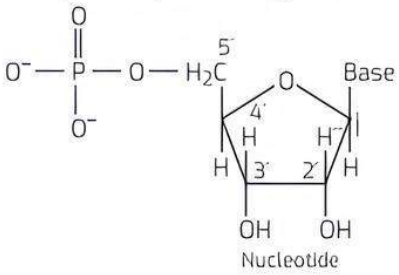
Q 5. Define the following terms:

(i) Polysaccharides

(ii) Nucleotides. *(CBSE 2019)*

Ans. (i) Polysaccharides: Carbohydrates which give a large number of monosaccharide units on hydrolysis are called polysaccharides, e.g., starch, cellulose, glycogen, etc. These are not sweet in taste, therefore they are also called non-sugar.

(ii) Nucleotides: When nucleoside is linked to phosphoric acid at 5 position of sugar moiety, a nucleotide is obtained. They are joined together by phosphodiester linkage between 5' and 3' carbon atoms of the pentose sugar.



Q 6. Differentiate between:

(i) Peptide linkage and Glycosidic linkage

(ii) Nucleoside and Nucleotide *(CBSE 2023)*

Ans. (i) When either of the carboxylic acid group or an amine group attach with the opposite group of other amino acids, an amide bond is formed with loss of water called as peptide linkage.

Whereas, a glycosidic linkage is a type of covalent bond that joins a carbohydrate or sugar molecule to other group which may or may not be different carbohydrate.

(ii) A nitrogenous base is attached to a sugar and somewhere between one to three phosphate groups in case of a nucleotide. A nitrogenous base is covalently attached to sugar which is either ribose or deoxyribose, however, there is no presence of the phosphate group here in case of a nucleoside.

Nucleotide = Sugar + Base + Phosphate

Nucleoside = Sugar + Base

Q 7. (I) How are carbohydrates stored in animal body? Mention any one organ where they are present.

(ii) What is the basic structural difference between starch and cellulose? *(CBSE 2023)*

Ans. (i) Carbohydrates are stored in the form of glycogen in animal body which is made up of long polymer chains of glucose subunits bonded together by alpha acetal linkage. Glycogen is stored in the liver and the muscles.

(ii) Starch is a long branched or unbranched chain polymer of α-D glucose units in which chain is formed by $C_1 - C_4$ glycosidic linkage. On the other hand, cellulose is a straight chain polysaccharide composed only of β-D glucose units which are joined by glycosidic linkage between C_1 of one glucose unit and C_4 of the next glucose unit.

Q 8. Differentiate between:

(i) Nucleotide and Nucleoside

(ii) Amylose and Amylopectin. *(CBSE 2019)*

Ans. (i) A nitrogenous base is attached to a sugar and somewhere between one to three phosphate groups in case of a nucleotide. A nitrogenous base is covalently attached to sugar which is either ribose or deoxyribose, however, there is no presence of the phosphate group here in case of a nucleoside.

Nucleotide = Sugar + Base + Phosphate

Nucleoside = Sugar + Base

(ii)

S.No.	Amylose	Amylopectin
1.	It is a straight chain polymer of D-glucose units	It is a branched-chain polymer of D-glucose units.
2.	Constitutes 20% of starch.	Constitutes 80% of starch.
3.	Solubility in water is less.	More soluble in water.

COMMON ERROR

Do not be confused with amylose which is a water soluble component of starch.

Q 9. (i) What is the difference between a nucleoside and nucleotide?

(ii) What products would be formed when a nucleotide from DNA containing thymine is hydrolysed? *(CBSE 2023)*

Ans. (i) A nitrogenous base is attached to a sugar and somewhere between one to three phosphate groups in case of a nucleotide. A nitrogenous base is covalently attached to sugar which is either ribose or deoxyribose, however, there is no presence of the phosphate group here in case of a nucleoside.

Nucleotide = Sugar + Base + Phosphate

Nucleoside = Sugar + Base

(ii) When a nucleotide from DNA containing thymine is hydrolysed, thymine β-D-2-deoxyribose and phosphoric acid are obtained as products.

Q 10. How is fructose obtained from inulin? Write equation.

Ans. Inulin is a polysaccharide just like starch with general formula $(C_6H_{10}O_5)_n$. When inulin is hydrolysed with dilute H_2SO_4, fructose is obtained.

$$\underset{\text{Inulin}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{\text{dil } H_2SO_4} n\underset{\text{fructose}}{(C_6H_{12}O_6)}$$

Q 11. Glucose and sucrose are soluble in water but cyclohexane and benzene (simple six membered ring compounds) are insoluble in water. Explain. *(NCERT INTENT)*

Ans. Both glucose ($C_6H_{12}O_6$) and sucrose ($C_{12}H_{22}O_{11}$) are organic compounds and are expected to be insoluble in water. But quite surprisingly, they readily dissolve in water. This is due to the presence of a number of OH group (five in case of glucose and eight in sucrose) which are of polar nature. These are involved in the intermolecular hydrogen bonding with the molecules of H_2O (water). As a result, both of them readily dissolve in water.

Benzene (C_6H_6) and cyclohexane (C_6H_{12}) are hydrocarbons which do not have any polar group. They therefore do not dissolve in water since there is hardly any scope of hydrogen bonding in their molecule with those of H_2O (water).

Q 12. What are essential and non-essential amino acids? Give two examples of each type. *(NCERT EXERCISE)*

Ans. The amino acids which cannot be synthesised in the body and must be obtained through diet, are called essential amino acids, *e.g.*, valine, leucine, arginine, etc. whereas the amino acids which can be synthesised in the body are called non-essential amino acids *e.g.*, glycine, alanine, aspartic acid, etc.

Q 13. What type of bonding helps in stabilising the α-helix structure of proteins?

Ans. α-helix structure of proteins is a structure in which a polypeptide chain forms all possible hydrogen bonds. In it, polypeptide chain is twisted into a right handed screw (helix). Consequently, —NH group of each amino acid residue form hydrogen bonds with >C=O group present at next (adjacent) turn of the helix. Thus, α-helix structure of proteins get stabilised by these hydrogen bonds.

Q 14. What is the effect of denaturation on the structure of proteins? *(NCERT EXERCISE)*

OR

Define denaturation of protein. What is the effect of denaturation on the structure of protein?

(CBSE 2023)

Ans. Denaturation of proteins is done either by change in temperature (upon heating) or by bringing a change in the pH of the medium. As a result, the hydrogen bonding is disturbed and the proteins lose their biological activity *i.e.*, their nature changes.

During the denaturation, both the tertiary and secondary structures of proteins are destroyed while the primary structures remain intact.

Q 15. Give any two points of difference between globular and fibrous proteins. *(CBSE 2019)*

Ans.

S.No.	Fibrous Protein	Globular Protein
1.	The polypeptide chains run parallel and are held together by hydrogen and disulphide bonds.	The polypeptide chains coil around to give a spherical shape.
2.	Insoluble in water.	Soluble in water.

Q 16. (i) DNA fingerprinting is used to determine paternity of an individual. Which property of DNA helps in the procedure?

(ii) What structural change will occur when a native protein is subjected to change in pH?

(CBSE SQP 2023-24)

Ans. (i) Replication of DNA helps in the procedure. A sequence of bases on DNA is unique for a person and is the genetic material transferred to the individual from the parent which helps in the determination of paternity.

(ii) During denaturation, secondary and tertiary structures are destroyed but the primary structure remains intact.

Q 17. Write two differences between DNA and RNA. *(CBSE 2023, 19)*

Ans.

S.No.	DNA	RNA
1.	It is deoxyribose sugar.	It is ribose sugar.
2.	It contain base ATGC.	It contain bases AUGC.

TiP

Try to give difference in tabular form if possible and provide separate points.

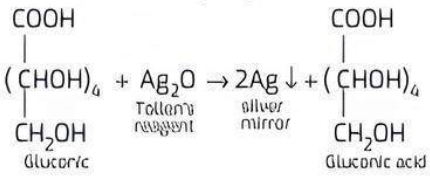
COMMON ERROR

Do not be confused with amylose which is a water soluble component of starch.

Short Answer Type-II Questions

Q 1. What are reducing sugars ? Justify your answer by giving chemical reactions.

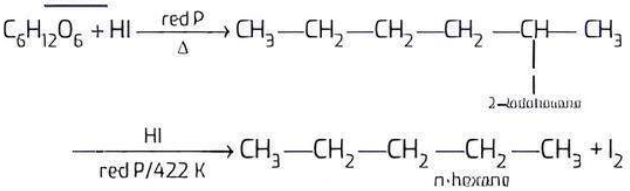
Ans. All those carbohydrates which reduce Fehling solution into red precipitate of cuprous oxide (Cu_2O) or Tollen's reagent into silver are called reducing sugars. All monosaccharides and disaccharides (except sucrose) are reducing sugars.



Sucrose ($C_{12}H_{22}O_{11}$) does not reduce Fehling solution or Tollen's reagent, so it is not a reducing sugar.

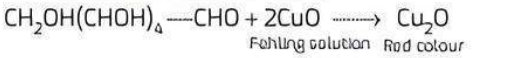
Q 2. Prove the presence of a straight chain of 6 carbon atoms in glucose.

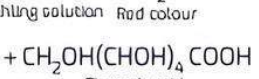
Ans. When reduced with red phosphorus and HI, glucose gives n-hexane, which shows that all the six carbon atoms in the glucose molecule are present in straight chain.

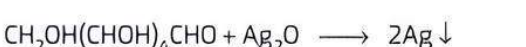


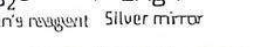
Q 3. Write short note on oxidation of glucose.

Ans. Glucose contains a —CHO group in its structure so it acts as a reducing agent. Hence, it gets oxidised by weak oxidising agents like Fehling solution and Tollen's reagent and reduces them.







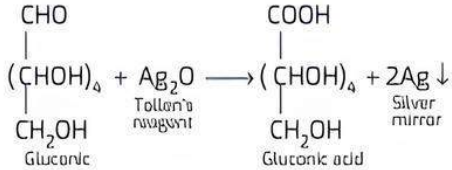


When it is oxidised by concentrated HNO_3, it gives saccharic acid.

Q 4. What is Tollen's reagent ? What changes take place when it reacts with glucose? Write related chemical equation.

Ans. Tollen's Reagent: When NaOH solution is added to 10% silver nitrate solution, a brown precipitate is formed, which when dissolved in a minute quantity of NH_4OH forms a transparent solution. This solution is called ammoniacal silver nitrate or Tollen's reagent.

Reaction with Glucose: Tollen's reagent reacts with glucose in the following manner and forms silver mirror.



Q 5. When sucrose is hydrolysed the optical rotation values are measured using a polarimeter and are given in the following table:

S.No.	Time (hours)	Specific rotation
1.	0	+ 66.5°
2.	∞	–39.9°

(i) Account for the two specific rotation values.

(ii) What is the specific name given to sucrose based on the above observation?

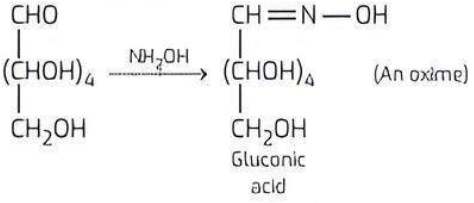
(iii) One of the products formed during the hydrolysis of sucrose is a glucose, that reacts with hydroxylamine to give compound A. Identify compound A. *(CBSE SQP 2023-24)*

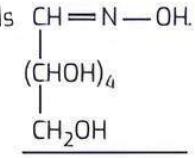
Ans. (i) The reactant sucrose is dextrorotatory. On hydrolysis, it give glucose which is dextrorotatory and fructose which is laevorotatory. The specific rotation of fructose is higher than glucose.

Sucrose is dextrorotatory but after hydrolysis it gives dextrorotatory glucose and laevorotatory fructose. Since, the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), so the mixture is laevorotatory.

(ii) The specific name is invert sugar. The hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar.

(iii) Glucose reacts with hydroxylamine to give compound A *i.e.*, an oxime as shown :



So, the compound A is 

Q 6. Write the structure of product when D-Glucose reacts with the following: (Any Three)

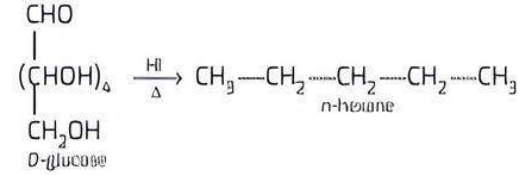
(i) HI

(ii) Conc. HNO_3

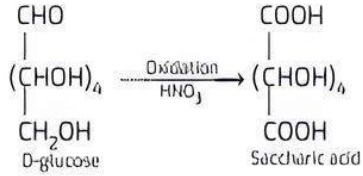
(iii) Br_2 water

(iv) HCN *(CBSE SQP 2023-24)*

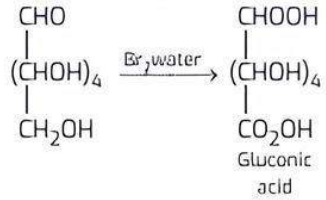
Ans. (i) *n*-hexane is formed.



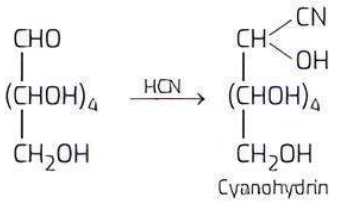
(ii) Saccharic acid is formed.



(iii) Gluconic acid is formed.



(iv) Cyanohydrin is formed.

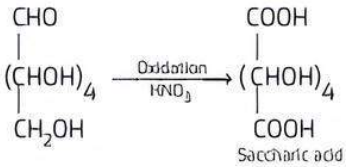


Q 7. (i) Write the product when D-glucose reacts with conc. HNO_3.

(ii) Amino acids show amphoteric behaviour. Why?

(iii) Write one difference between α-helix and β-pleated structures of proteins. *(CBSE 2018)*

Ans. (i) Saccharic acid is formed when D-glucose reacts with conc. HNO_3.



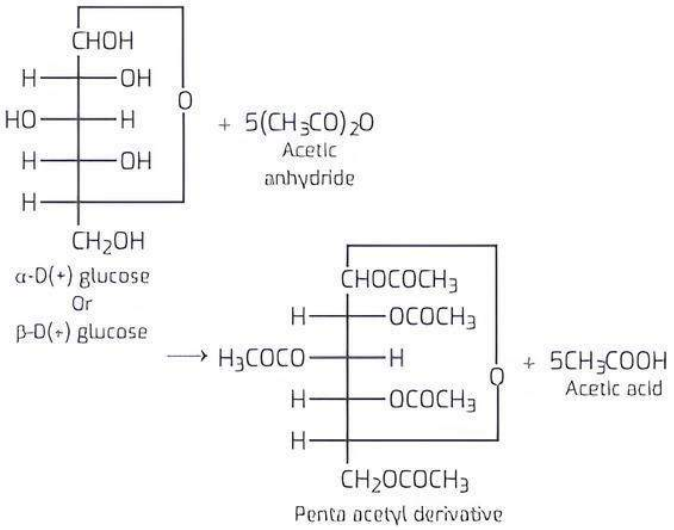
(ii) Amino acids may be acidic, basic or neutral depending upon the relative number of active and carboxyl group present in their molecules. Equal number of amino and carboxyl groups makes it neutral, more amino group means basic and more carboxylic group means acidic amino acid. Hence, amino acids show amphoteric behaviour.

(iii) α-helix structure of protein is formed by the folding of a single polypeptide chain due to hydrogen bonding. β-pleated structure is formed by the folding in more than one polypeptide chain due to hydrogen bonding.

Q 8. How do you explain the absence of aldehydic group in the pentaacetate of D-glucose? *(NCERT INTEXT)*

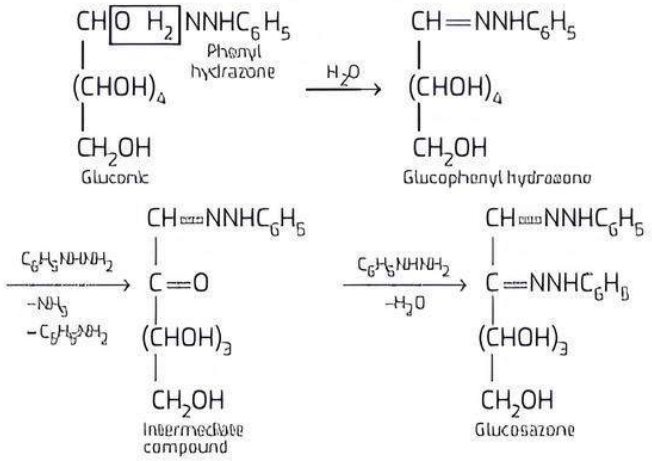
Ans. Glucose, as we know, is an aldohexose and it is expected to give the characteristic reactions of the aldehydic group e.g., action with NH_2OH, HCN, Tollen's reagent, Fehling reagent etc. However, the pentaacetyl glucose formed by the acylation of glucose with acetic anhydride does not give these reactions.

This means that the aldehydic group is either absent or is not available in the pentaacetyl glucose for chemical reactions. In fact, the aldehydic group is a part of the hemiacetal structure which the pentaacetyl derivatives has. It is therefore, not free or available to take part in these reactions.

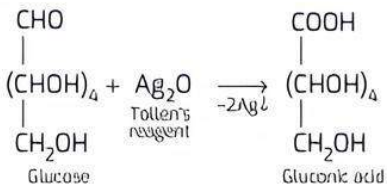


Q 9. How will you obtain glucosazone, gluconic acid and sorbitol from glucose?

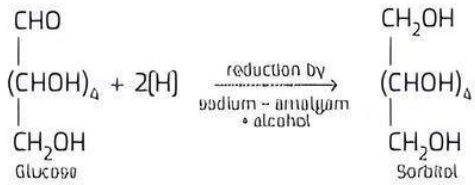
Ans. (i) Glucosazone from Glucose:



(ii) Gluconic acid from glucose:



(iii) Sorbitol from glucose:



Q 10. Give the plausible explanation for the following:

(i) Glucose doesn't give 2, 4-DNP test.

(ii) The two strands in DNA are not identical but are complementary.

(iii) Starch and cellulose both contain glucose unit as monomer, yet they are structurally different.

(CBSE 2020)

OR

What are nucleic acids? Why two strands in DNA are not identical but are complementary?

(CBSE 2023)

Ans. (i) Because the —CHO group in glucose is involved in hemiacetal formation and cyclic structure of glucose, hence it is not free to react with 2, 4-DNP reagent.

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

(iii) Starch consists of two ingredients—amylose and amylopectin. Amylose is a long linear chain of -D-(+) glucose units joined by glycosidic association C_1–C_4 (α link). Amylopectin is a branched-chain polymer consisting of D-glucose units in which the chain is formed by glycosidic connection C_1–C_4 and glycosidic connection C_1–C_6 branches. Cellulose, on the other hand, is a straight-chain polysaccharide with β-D-glucose units joined by glycosidic linkage C_1–C_4 (β-link). Hence, both are structurally different.

OR

Nucleic acids: These are polynucleotides i.e., long chain like molecules composed of a series of identical building blocks called nucleotides which store genetic information in biological systems.

Two strands of DNA are complementary: Refer to part (ii) above.

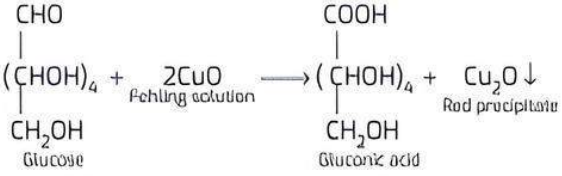
Q 11. What is Fehling's solution ? What happens when it is heated with glucose? Also give chemical equation.

Ans. Fehling solution is an equimolar mixture of two solutions. Fehling solution '*A*' and Fehling solution '*B*'. Fehling solution '*A*' is an alkaline solution of $CuSO_4$ and Fehling solution '*B*' is alkaline solution of sodium potassium tartrate salt (Rochelle salt).

$$CuSO_4 + 2NaOH \longrightarrow \underset{\text{Fehling solution}}{Cu(OH)_2} + Na_2SO_4$$

$$Cu(OH)_2 \xrightarrow[\text{'B'}]{\text{Fehling solution}} \underset{\substack{\text{Cupric oxide solution}\\ \text{(Fehling solution)}}}{CuO + H_2O}$$

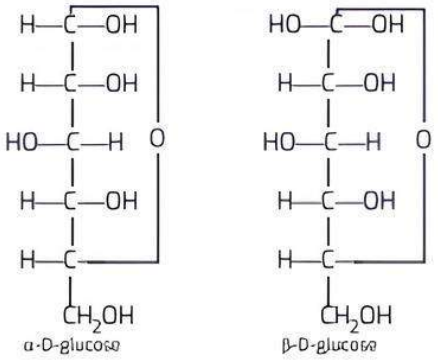
When heated with glucose, Fehling solution gives gluconic acid and red precipitate of cuprous oxide is formed.



Q 12. Although glucose contains a —CHO group but it neither give Schiff's test nor react with sodium bisulphite and ammonia. Explain with reason.

Ans. Glucose does not give pink colour with Schiff's reagent. Also it does not give addition reaction with sodium bisulphite and ammonia (NH_3). This is because it does not contain free —CHO group in its cyclic structure.

Cyclic Structures of Glucose



Q 13. (i) Write tests to distinguish between glucose and starch.

(ii) Fructose can reduce Fehling solution, although it contains ketone group. Why?

Ans. (i) Distinction between Glucose and Starch:

(a) Starch is a polysaccharide whereas glucose is a monosaccharide.

(b) Starch gives blue colour with iodine solution, which disappears on heating upto 80°C and reappears on cooling, whereas glucose gives no such reaction and no colour is obtained in this case.

(c) Glucose reduces Fehling solution to give red precipitate of cuprous oxide whereas starch does not react with it.

(ii) Although fructose contains ketonic group, but it reduces Fehling's solution. This is because, **it rearranges to give glucose** in alkaline medium. The process is called enolisation.

Q 14. (i) What are the hydrolysis products of (a) Lactose, (b) Maltose?

(ii) Give the basic structural difference between starch and cellulose. *(CBSE 2023)*

Ans. (i) The hydrolysis products of lactose are β-D-galactose and β-D-glucose while the hydrolysis product of maltose is β-D-glucopyranose.

(ii) Starch is a long branched or unbranched chain polymer of α-D glucose unit in which chain is formed by $C_1 - C_4$ glycosidic linkage. On the other hand, cellulose is a straight chain polysaccharide composed only of β-D glucose units which are joined by glycosidic linkage between C_1 of one glucose unit and C_4 of the next glucose unit.

Q 15. Classify peptides and explain their importance in our life.

Ans. Classification of Peptides: These are classified depending upon the number of α-amino acids taking part in the peptide bond formation. Thus, these are classified as oligopeptides and polypeptides.

(i) Oligopeptides: These are the peptides in which 2-10 α-amino acids condense to form peptide bonds. These are further classified as dipeptide (which is made up of two molecules of same or different amino acids), tripeptide (containing 3 same or different amino acids) and so on.

(ii) Polypeptides: These are the peptides in which 100-1000 α-amino acid molecules condense to form peptide bond. The polypeptide having molecular mass more than 10,000 are called proteins.

Importance of Peptides: These are used mainly in protein synthesis.

Q 16. Define the following with an example of each:

(i) Polysaccharides

(ii) Denatured protein

(iii) Essential amino acids *(CBSE 2018)*

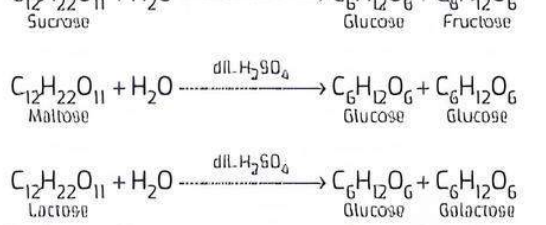
Ans. (i) Polysaccharides: Carbohydrates which give a large number of monosaccharide units on hydrolysis are called polysaccharides. *e.g.*, starch cellulose, glycogen, etc. These are not sweet in taste, therefore also known as non-sugars.

(ii) Denatured Protein: When a native protein is subjected to physical change like change in temperature or chemical change, the hydrogen bonds get disturbed. Due to this globules unfold and helix get uncoiled and protein loses its biological activity. Such protein is known as denatured protein.

(iii) Essential Amino Acids: Those amino acids which cannot be synthesised in the human body and are supplied through our diet, are called essential amino acids. *e.g.*, Arginine, lysine etc. They are required for proper health and growth.

Q 17. What are disaccharides? Write their type and chemical tests for any one.

Ans. Disaccharides: The carbohydrates which give two molecules of monosaccharides on hydrolysis are called disaccharides. These are in general of three types: sucrose, maltose and lactose. Their molecular formula is $C_{12}H_{22}O_{11}$.

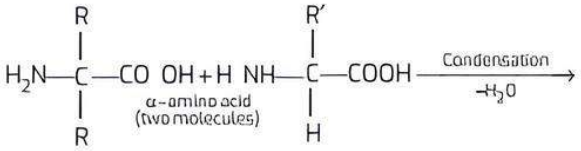


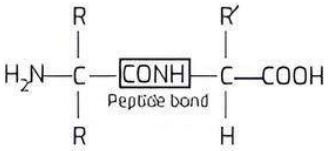
Chemical tests for sucrose: It gets charred and gives smell of burnt sugar on heating. On further heating sugar coal remains as residue.

Q 18. What are peptides and peptide bond? Explain with an example.

Ans. Peptides and Peptide Bond: When two molecules of similar or different amino acids condense together then carboxylic group of one molecule reacts with

the amino group of the other to form an amide bond. This type of amide linkage is called peptide bond and the products formed by the condensation of amino acids are called peptides.

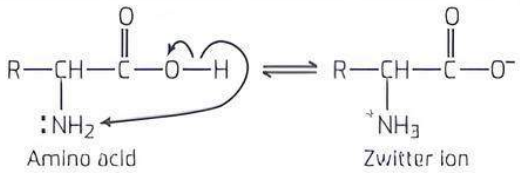




Q 19. Describe the amphoteric nature of amino acids.

Ans. Amphoteric Nature of Amino Acids: Carboxylic (—COOH) group present in the amino acids is acidic in nature whereas amino ($—NH_2$) group is basic in nature. Thus, they do not behave like common carboxylic acids or/and amines.

In aqueous solution, the carboxylic acid group present in them can lose a proton, whereas amino group can accept a proton. Hence, a dipolar (bipolar) ion, called **amphoteric** or **Zwitter ion**, is formed. It is neutral but contains both positive charge and negative charge.



In the Zwitter ion form, amino acids exhibit amphoteric nature, *i.e.*, react with acids as well as bases.

Q 20. What are proteins? Write their important uses.

Ans. Proteins: These are nitrogenous complex organic compounds. These are the polymers of α-amino acids, which are joined together through peptide bonds.

Uses of Proteins:

(i) The main function of proteins is to take part in body building. They form the main parts of the body like hairs, nails, muscles etc.

(ii) They are required for repairing body tissues.

(iii) Enzymes act as biocatalyst in metabolic reactions occurring in the body. All enzymes are globular proteins.

(iv) If present more than that required, proteins give energy to the body (but only in absence of carbohydrates and fats).

Q 21. Differentiate between fibrous and globular proteins.

Ans.

S. No.	Fibrous proteins	Globular proteins
1.	Polypeptide chains are parallel in it.	Polypeptide chains coil around to give a spherical shape in it.
2.	These form thread like structure.	These achieve spherical shape.
3.	These remain unaffected by minor changes in temperature and pH.	These are sensitive towards minor changes in temperature and pH.
4.	These are insoluble in water.	These are soluble in water.
5.	Fibrous proteins are the main structural units in animal tissues, although these do not show any biological activity.	These show biological activities.
6.	Some common examples of them are keratin (present in hair, wood and silk) and myosin (present in muscles)	Some common examples of them are insulin and albumin.

Q 22. Distinguish between DNA and RNA. *(CBSE 2018)*

OR

Write the important structural and functional differences between DNA and RNA. *(NCERT EXERCISE)*

Ans. Structural differences between DNA and RNA

S. No.	DNA	RNA
1.	It contains 2-deoxy-D-(–)- ribose sugar.	It contains D-(–)-ribose sugar.
2.	In it pyrimidine bases are cytosine (C) and thymine (T).	In RNA, cytosine (C) and uracil (U) are present as pyrimidine base.
3.	It has double coiled α-helix structure.	It has single coiled α-helix structure.
4.	These are giant molecules having molar mass from 6×10^6 u to 16×10^6 u.	Its molecules are comparatively small with molar mass 20,000 to 40,000 u.

Functional differences between DNA and RNA

S. No.	DNA	RNA
1.	It shows replication.	It generally does not replicate.
2.	DNA controls the transmission of genetic traits.	RNA controls protein synthesis

Long Answer Type Questions

Q 1. (i) What happens when (give only chemical equations):

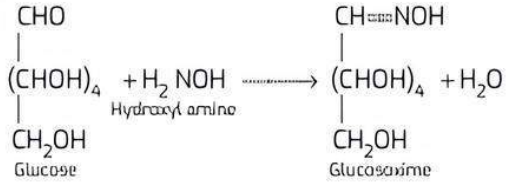
(a) Glucose is treated with hydroxyl amine?

(b) Fructose is treated with phenyl hydrazine?

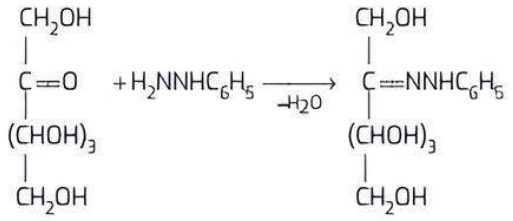
(c) Sucrose is hydrolysed in the presence of mineral acid?

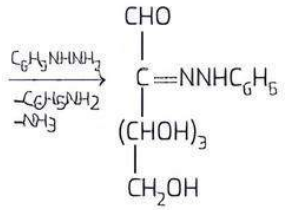
(ii) What are amino acids ? How are they related with protein? Explain by giving chemical formula.

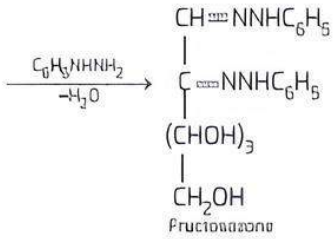
Ans. (i) (a)



(b)







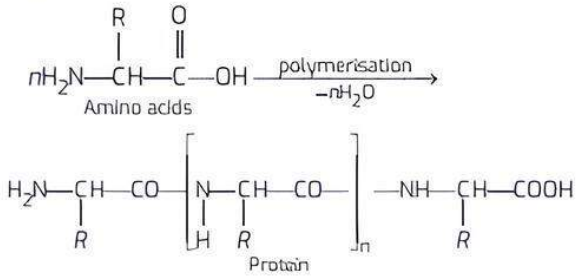
(c) $C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{of mineral acid}]{\text{dilute solution}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$
Sucrose

(ii) Amino Acids: Derivatives of carboxylic acids which are obtained by substituting hydrogen atoms of alkyl group of carboxylic acid by amino group (NH_2 group) are called amino acids. Molecules of these compounds contain amino as well as carboxylic acid groups.

$$\underset{\text{Acetic acid}}{CH_3COOH} \xrightarrow[+NH_2]{-H} \underset{\text{Amino acetic acid}}{H_2N{-}CH_2{-}COOH}$$

Thus, the compounds, one molecule of which contains one or more amino group(s) and one or more carboxylic group(s), are called amino acids.

Relation between Amino Acid and Protein: α-amino acids polymerise to give proteins. By the polymerisation of α-amino acids, polypeptides are formed and the polypeptide having molecular mass more than 10,000 are called proteins.



Q 2. (i) What are hormones? Classify them. Explain their physiological functions.

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

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

(iii) Write the names of two water soluble vitamins.

Ans. (i) Hormones: These are the compounds which are secreted by endocrine glands in the body and are poured directly into the blood stream which transports them to the site of action.

Classification: Depending upon their chemical nature hormones are classified into following three classes:

(a) Steroid Hormones: These are secreted by adrenal cortex and gonads (testes in males and ovaries in females). *e.g.*, estrogens and androgens.

(b) Polypeptide Hormones: *e.g.*, insulin and endorphins.

(c) Amino Acid Derivatives: *e.g.*, epinephrine and norepinephrine.

Functions of hormones: Hormones shows following functions in the body:

(a) They help in maintaining the balance of biological activities in the body. *e.g.*, Insulin maintains the blood glucose level.

(b) Glucagon also raises the blood glucose level.

(c) Epinephrine and norepinephrine mediate responses to external stimuli.

(d) Growth hormones and sex hormones play a role in growth and development.

(ii) (a) In acidic amino acids, carboxyl groups are more than the amino groups. In basic amino acids, amino groups are more as compared to carboxyl groups.

(b) The linkage is known as phosphodiester linkage.

(iii) Vitamin B_{12} (Cyanocobalamin); Vitamin C (Ascorbic acid).

Q 3 (i) Name the disease caused by the deficiency of vitamin C.

(ii) What are the products of hydrolysis of sucrose?

(iii) Write the name of the linkage of joining two α-amino acids?

(iv) What are the three types of RNA molecules which perform different functions?

(v) Give one example each for a disaccharide and a polysaccharide.

Ans. (i) The deficiency of vitamin C causes scurvy which leads to bleeding from the gums.

(ii) The products of hydrolysis of sucrose are glucose and fructose.

(iii) The linkage of joining two a-amino acids is called peptide (—CO—NH—) linkage.

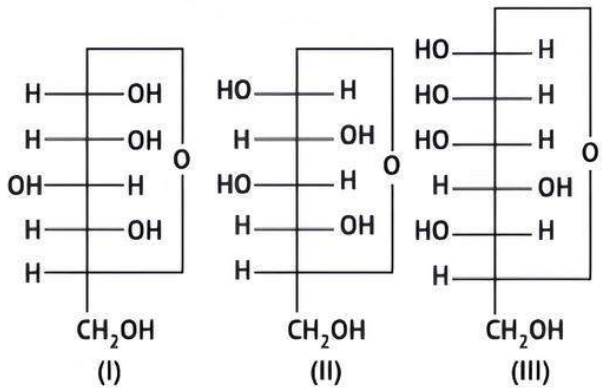
(iv) Three types of RNA molecules are:
(a) t-RNA (transfer RNA)
(b) r-RNA (ribosomal RNA)
(c) m-RNA (messenger RNA).

(v) **Disaccharide:** Sucrose
Polysaccharide: Starch.

Chapter Test

Multiple Choice Questions

Q 1. Three cyclic structure 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

Q 2. Amino acids are classified as acidic, basic or neutral depending upon the relative number of amino and carboxyl group in their molecule. Which of the following are acidic?

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

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

(iii) $H_2N—CH_2—CH_2—CH_2—COOH$

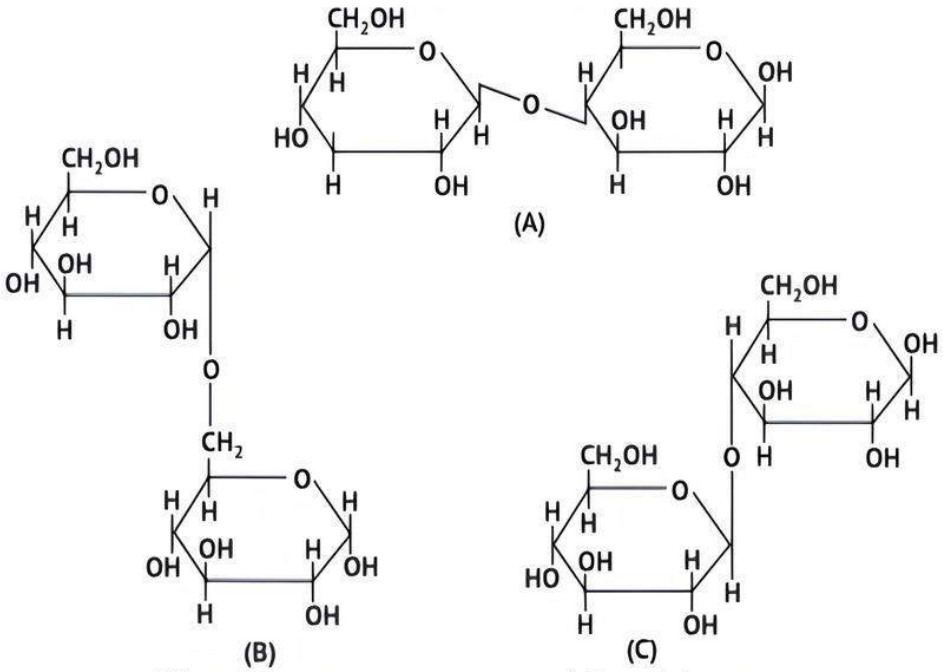
(iv) $HOOC—CH_2—\underset{\underset{NH_2}{|}}{CH}—COOH$

a. (i) and (iv)
b. (ii) and (iii)
c. (II) and (Iv)
d. (I), (II) and (Iv)

Q 3. Which of the following acids is a vitamin?

a. Aspartic acid
b. Ascorbic acid
c. Adipic acid
d. Saccharic acid

Q 4. Three structures are given below in which two glucose units are linked. Which of these linkages between glucose units are between C1 and C4 and which linkages are between C1 and C6?



(A) (B) (C)

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 C1 and C4

Assertion and Reason Type Questions

Directions (Q. Nos. 5-6): *Each of the following questions consists of two statements, one is Assertion (A) and the other is Reason (R). Give answer:*

a. Both Assertion (A) and Reason are true and Reason (R) is the correct explanation of Assertion (A).
b. Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).
c. Assertion (A) is true but Reason (R) is false.
d. Assertion (A) is false but Reason (R) is true.

Q 5. **Assertion (A):** The two strands in double strand helix structure of DNA are complementary to each other.
Reason (R): Disulphide bonds are formed between specific pairs of bases.

Q 6. **Assertion (A):** Glucose reacts with hydroxylamine to form an oxime and also adds a molecule of hydrogen cyanide to give cyanohydrin.
Reason (R): The carbonyl group is present in the open chain structure of glucose.

Case Study Based Question

Q 7. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups ..... monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellulose.

Another biomolecule proteins are polymers of α-amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. Structure and shape of proteins can be studied at four different levels *i.e.*, primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

Read the given passage carefully and give the answer of the following questions:

(i) What is the difference between a glycosidic linkage and peptide linkage?
(ii) Which amino acids are called essential amino acids?
(iii) What are the common types of secondary structures of proteins? Write any two forces which stabilise the secondary and tertiary structures of protein.

OR

Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity? *(CBSE 2023)*

Very Short Answer Type Questions

Q 8. Amino acids show amphoteric behaviour. Why?
Q 9. How are hormones and vitamins different in respect of their source and functions?

Short Answer Type-I Questions

Q 10. Write such reactions and facts about glucose which cannot be explained by its open chain structure.
Q 11. (i) What is meant by denaturation of proteins?
(ii) Deficiency of which vitamins cause
(a) convulsions and
(b) pernicious anaemia?
Q 12. Describe what do you understand by primary and secondary structure of proteins?

Short Answer Type-II Questions

Q 13. (i) What is the structural difference between a nucleoside and a nucleotide?
(ii) Differentiate between globular and fibrous proteins?
Q 14. What happens when D-glucose is treated with the following reagents:
(i) Br_2 water (ii) HCN
(iii) $(CH_3CO)_2O$
Q 15. (i) What is glycogen? How is it different from starch?
(ii) What type of bonding helps in stabilising the α-helix structure of proteins?

Long Answer Type Questions

Q 16. (i) Explain what is meant by:
(a) pyranose structure of glucose
(b) glycosidic linkage
(ii) What are essential and non-essential amino acids?
(iii) What is the biological effect of denaturation of proteins?
Q 17. (i) How can reducing and non-reducing sugars be distinguished?
(ii) Compare amylose with amylopectin in terms of constituting structure.
(iii) Write the name of the vitamin responsible for coagulation of blood.
(iv) What are enzymes? Name two diseases which are caused due to deficiency of enzymes.