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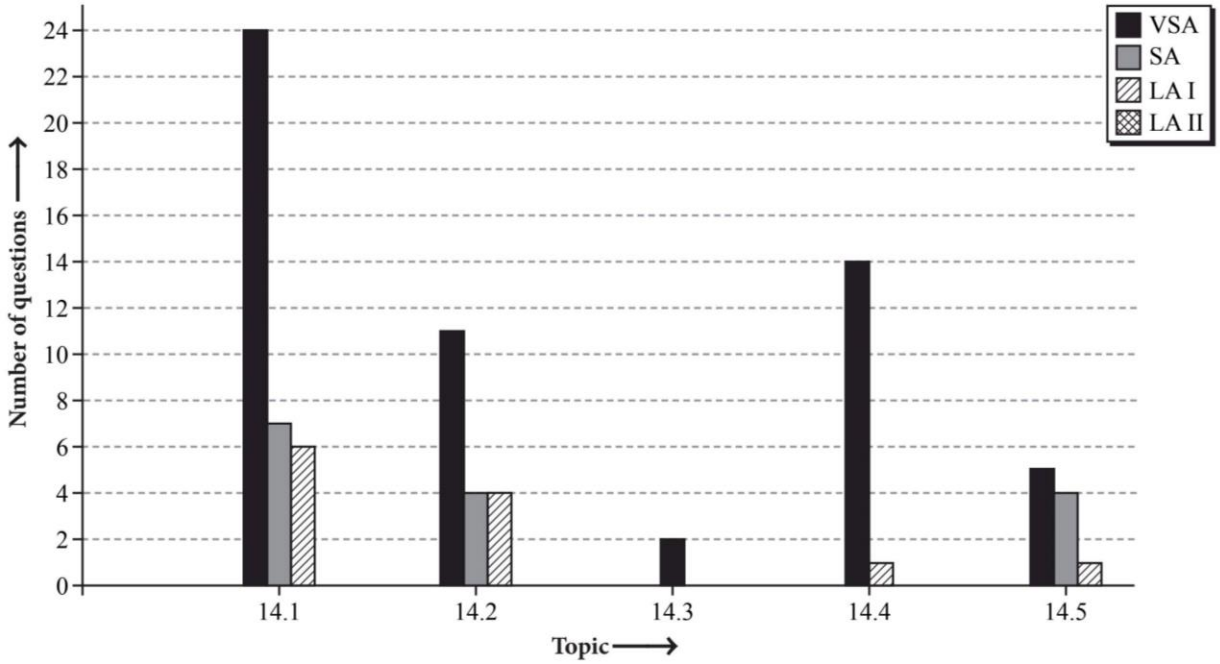
Topicwise Analysis of Last 10 Years' CBSE Board Questions (2020-2011)



- Maximum total weightage is of *Carbohydrates.*
- Maximum VSA type questions were asked from *Carbohydrates.*
- Maximum SA and LA I type questions were asked from *Carbohydrates and Proteins respectively.*

QUICK RECAP

CARBOHYDRATES

- **General formula :** $C_x(H_2O)_y$
- **Sugars or Saccharides :** They are optically active polyhydroxy aldehydes or ketones.

Classification :

Carbohydrates are classified as either reducing or non-reducing sugars :

Reducing sugars

- Free aldehydic or ketonic group.
- Reduce Fehling's solution and Tollens' reagent
- *e.g.*, maltose and lactose.

Non-reducing sugars

- Do not have free aldehydic or ketonic group.
- Do not reduce Fehling's solution and Tollens' reagent.
- *e.g.*, Sucrose.

▶ On the basis of their behaviour towards hydrolysis :

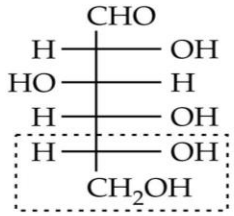
Carbohydrates

Monosaccharides	Oligosaccharides	Polysaccharides
Cannot be hydrolysed further. $(CH_2O)_n$, where, $n = 3\text{-}7$ *e.g.*, glucose, fructose, ribose, etc.	Yield 2-10 monosaccharides on hydrolysis. $(C_6H_{10}O_5)_n$, where, $n = 2\text{-}10$ *e.g.*, sucrose, maltose, etc.	Yield large number of monosaccharides on hydrolysis. $(C_6H_{10}O_5)_n$, where, $n = 100\text{-}3000$ *e.g.*, starch, cellulose, etc.

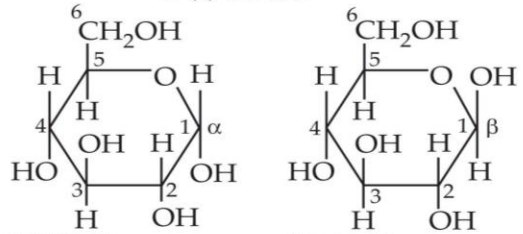
Monosaccharides :

▶ **Glucose ($C_6H_{12}O_6$) :** An aldohexose as it contains six carbon atoms and aldehydic group.

– **Structure :**



Fischer projection of *D*-(+)-Glucose



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

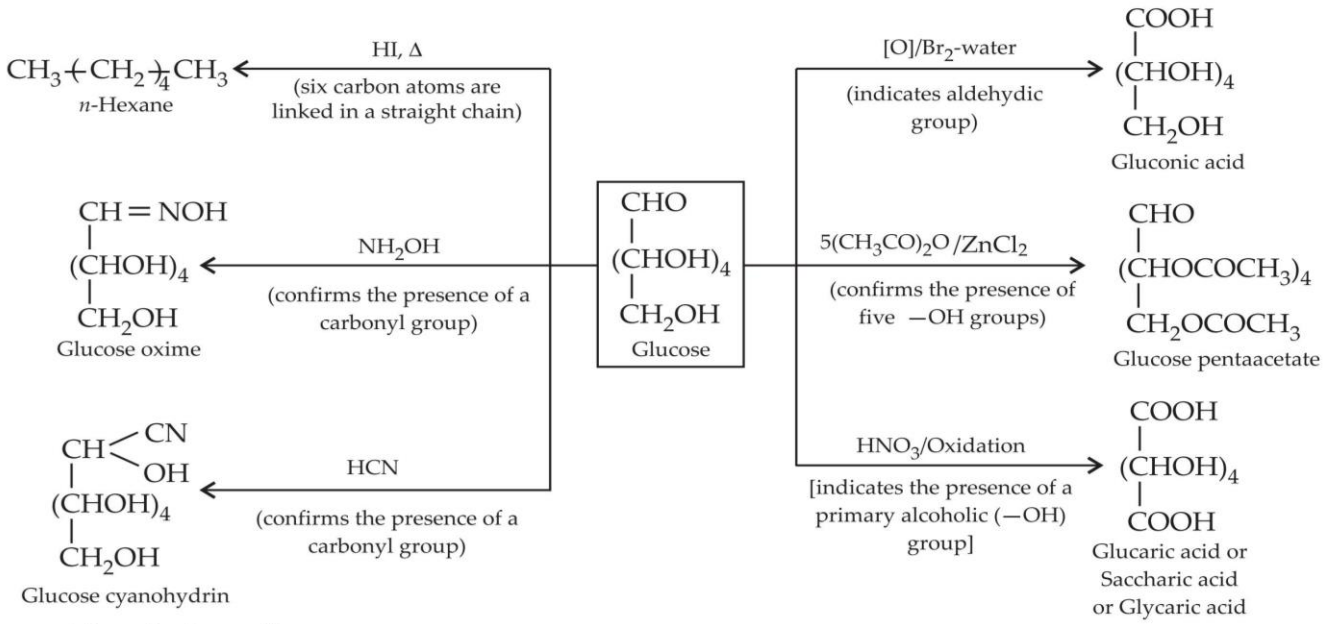
Haworth structures : (Anomers)

– **Preparation :**

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

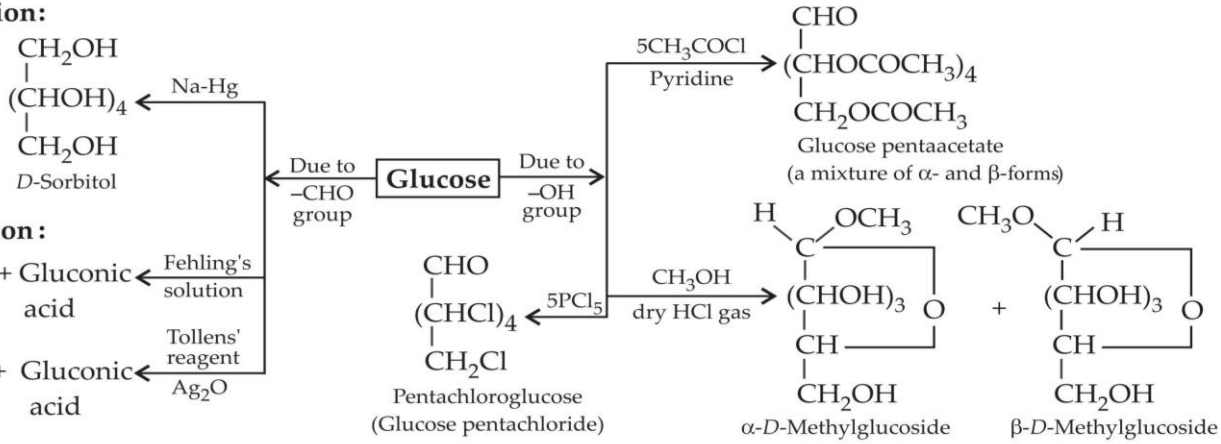
$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow[393\text{ K, 2-3 atm}]{H^+/\Delta} nC_6H_{12}O_6 \text{ (\textit{Commercial method})}$$
Starch or Cellulose — Glucose

– Glucose was assigned open chain structure on the basis of following evidences :



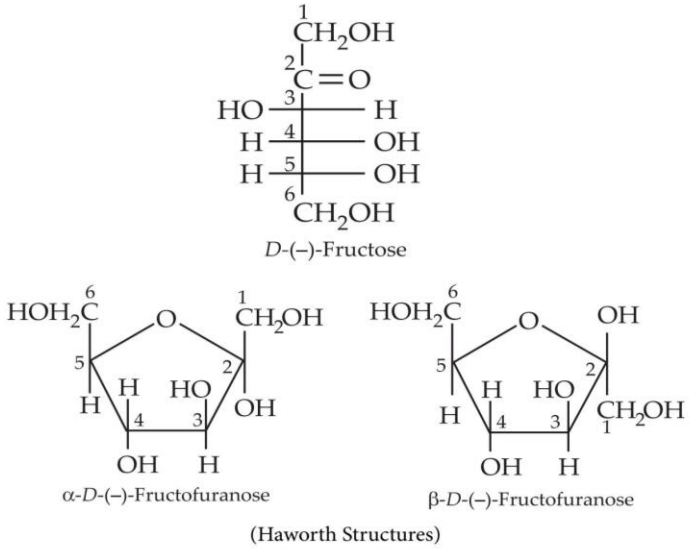
– **Chemical reactions :**

Reduction:



▶ **Fructose ($C_6H_{12}O_6$) :** A ketohexose as it contains six carbon atoms and a ketonic group.

– **Structure :**



(Haworth Structures)

▶ **Mutarotation :** The change in specific rotation of an optically active compound with time to an equilibrium value is called *mutarotation*.

$$\alpha\text{-}D\text{-Glucose} \rightleftharpoons \underset{\text{mixture}}{\text{Equilibrium}} \rightleftharpoons \beta\text{-}D\text{-Glucose}$$

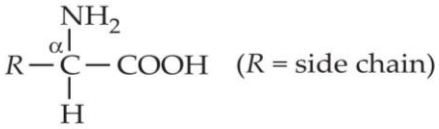
$$[\alpha]_D = +112^\circ \qquad [\alpha]_D = +52.7^\circ \qquad [\alpha]_D = +19^\circ$$

Disaccharides and Polysaccharides

Carbohydrate	Hydrolysis products	Linkage	Reducing property
Sucrose (Disaccharide)	α-*D*-Glucose and β-*D*-Fructose	C-1 (Glucose) and C-2(Fructose)	Non-reducing
Maltose (Disaccharide)	α-*D*-Glucose	C-1 (Glucose) and C-4 (glucose)	Reducing
Lactose (Disaccharide)	β-*D*-Galactose and β-*D*-Glucose	C-1 (Galactose) and C-4 (Glucose)	Reducing
Starch (Polysaccharide)	Amylose and amylopectin	Amylose (C-1 and C-4 glycosidic linkage betweeen α-D-Glucose) Amylopectin (C-1 and C-4 linkage between α-D-Glucose and branching occurs by C-1 and C-6 linkage)	Non-reducing
Cellulose (Polysaccharide)	β-*D*-Glucose	C-1(glucose) and C-4(glucose)	Non-reducing
Glycogen (Polysaccharide)	α-*D*-Glucose	C-1 (glucose) and C-4(glucose)	Non-reducing

PROTEINS

Proteins : They are the biomolecules of the living system made up of nitrogenous organic compounds by condensation polymerisation of α-amino acids.



(*R* = side chain)

α-Amino acid

Classification of Amino Acids :

Classification of amino acids

Depending upon the relative number of amino ($-NH_2$) and carboxyl ($-COOH$) groups

- **Neutral**: No. of $-COOH$ groups = No. of $-NH_2$ groups, *e.g.*, Glycine, Alanine, Valine
- **Acidic**: No. of $-COOH$ groups > No. of $-NH_2$ groups, *e.g.*, Aspartic acid, Asparagine, Glutamic acid
- **Basic**: No. of $-NH_2$ groups > No. of $-COOH$ groups, *e.g.*, Lysine, Arginine, Histidine

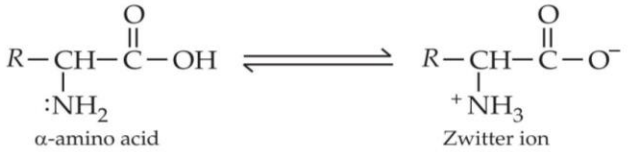
On the basis of their synthesis

Amino acids

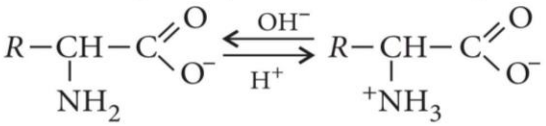
- **Essential amino acids**: Cannot be synthesised in the body and must be obtained through diet. *e.g.*, valine, leucine, lysine, isoleucine, arginine, etc.
- **Non-essential amino acids**: Can be synthesised in the body. *e.g.*, glycine, alanine, glutamic acid, aspartic acid, etc.

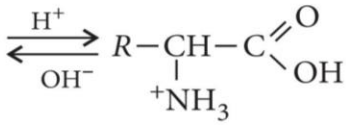
Properties :

- In aqueous solution, the carboxylic group can lose a proton and amino group can accept a proton giving rise to a dipolar ion known as *zwitter ion*. This is neutral but contains both positive and negative charges.

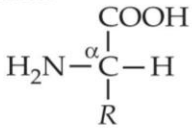


- Since these form salts with acids as well as with bases, their chemical reactions are similar to primary amines and carboxylic acids.



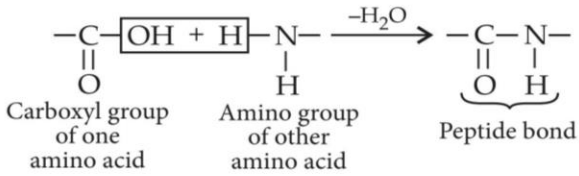


- **Isoelectric point :** The pH at which dipolar ion (zwitter ion) exists as neutral ion, *i.e.*, +ve and –ve charge is equal and it does not migrate to either electrode, is called *isoelectric point*. The amino acids have least solubility in water at isoelectric point which helps in their separation.
- Except glycine, all other naturally occurring α-amino acids are optically active because they contain chiral, asymmetric carbon atom.
- They exist in both *D*- and *L*-forms. Most naturally occurring α-amino acids have *L*-configuration.

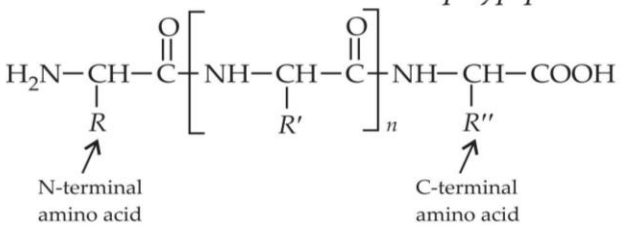


Peptides and their classification :

- **Peptide bond :** The bond formed between two amino acids by the elimination of a water molecule is called a *peptide linkage or bond.*



- The products formed by the linking of amino acids by peptide linkage are known as *peptides.*
- Peptides are further divided into *di*, *tri*, *tetra* depending upon the number of amino acids combined.
- **Oligopeptide :** It contains anywhere between 2-10 amino acids.
- **Polypeptides :** Structures with more than ten amino acids are known as *polypeptides.*



where, *R*, *R′*, *R″* may be same or different.

- A polypeptide with more than hundred amino acid residues, having molecular mass higher than 10,000 u is called a *protein*.

Classification of proteins : On the basis of molecular structure, proteins are classified as :

Fibrous proteins

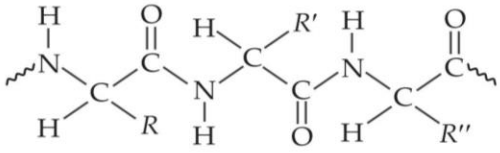
In fibrous proteins, polypeptide chains are parallel and are held together by hydrogen and disulphide bonds. These are insoluble in water, *e.g.*, keratin and myosin.

Globular proteins

Globular proteins result when the polypeptide chains coil around to give three dimensional spherical shape. These are soluble in water, *e.g.*, insulin and albumins.

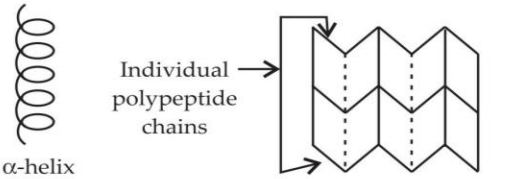
Structure :

- **Primary structure :** It refers to the number and linear sequence of amino acids held together by peptide bonds.



- **Secondary structure:** It is due to folding or coiling of the peptide chain. It is mainly of two types :
  - **α-helix :** These coils are stabilized by hydrogen bonds between carbonyl oxygen of first amino acid to amide nitrogen of fourth amino acid.

– **β-pleated sheet structure :** β-pleated sheet structure is formed when hydrogen bonds are formed between the carbonyl oxygens and amide hydrogens of two or more adjacent polypeptide chains. The bonding in β-pleated sheet structure is intermolecular H-bonding. The structure is not planar but is slightly pleated. Silk fibroin is rich in β-pleated sheets.



α-helix
e.g., myosin (nucleus), keratin (hair) etc.

β-pleated sheet
e.g., silk protein (fibroin)

- **Tertiary structure :** It represents overall folding of the polypeptide chains *i.e.*, further folding of the secondary structure and the bonds responsible for such interaction are hydrophobic interactions, hydrogen bonds, ionic interactions, van der Waals' forces and disulphide bonds.
- **Quaternary structure :** The spatial arrangement of the subunits (two or more polypeptide chains) with respect to each other.

Denaturation of proteins :

- When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes 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 *denaturation of protein*.
- The denaturation causes change in secondary and tertiary structures but primary structure remains intact, *e.g.*, coagulation of egg white on boiling, curdling of milk, formation of cheese, when an acid is added to milk.

ENZYMES

The enzymes are *biocatalysts* produced by living cells which catalyse biochemical reactions in living organisms. Chemically, enzymes are naturally occurring simple or conjugated proteins. Some enzymes may be non-proteins also.

HORMONES

Hormones : They are the molecules that act as intercellular messengers and are poured directly in the blood stream by endocrine glands.

Types of hormones :

- **Steroids :** Estrogens and androgens
- **Polypeptides :** Insulin and endorphins
- **Amino acid derivatives :** Epinephrine and norepinephrine.

VITAMINS

Vitamins: These are complex organic molecules which cannot be produced by the body and must be supplied in small amounts in diet to carry out essential metabolic reactions which are required for normal growth and maintenance of the body.

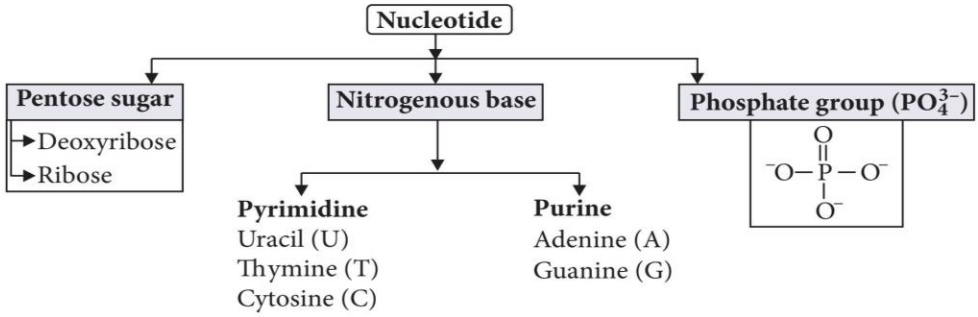
Classification :

- **Water soluble vitamins :** Soluble in water. Must be supplied regularly in diet as they are regularly excreted in urine (except vitamin B_{12}), *e.g.*, Vitamin– B_1, B_2, B_6, B_{12} and C.
- **Fat soluble vitamins :** Soluble in fat and oils. Stored in liver and adipose tissues, *e.g.*, Vitamin – A, D, E and K.

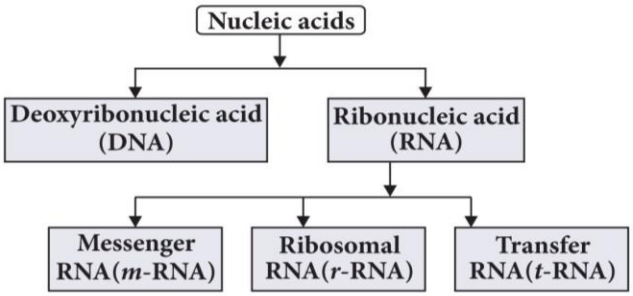
Deficiency of more than one vitamin in the body causes *avitaminosis* while excess intake of vitamins (A and D) may cause *hypervitaminoses*.

NUCLEIC ACIDS

Nucleic acids are the polymers of nucleotides present in nucleus of all living cells and play an important role in transmission of the hereditary characteristics and biosynthesis of proteins.



Types of nucleic acids :



Chargaff's rule : Amount of purine bases is always equal to that of pyrimidine bases. Purine base of one strand of DNA molecule pairs with pyrimidine base of the other strand. Adenine (A) pairs with thymine (T) through two H-bonds (A = T) and guanine (G) pairs with cytosine (C) through three H-bonds (G ≡ C). In case of RNA, adenine (A) pairs with uracil (U), (A = U).

Replication : It is the process by which a single DNA molecule produces two identical copies of itself.

Protein synthesis : It occurs in two steps :

- **Transcription :** It is the process of synthesis of RNA.
- **Translation :** The synthesis of proteins occur in the cytoplasm of the cell. The *m*-RNA directs protein synthesis with the help of *r*-RNA and *t*-RNA.

Previous Years' CBSE Board Questions

14.1 Carbohydrates

VSA (1 mark)

1. Name the disaccharide which on hydrolysis gives two molecules of glucose. *(One word, 2020)*
2. Write the name of linkage joining two monosaccharides. *(One word, 2020)*
3. α–D(+) glucose and β–D(+) glucose are
   (a) geometrical isomers
   (b) enantiomers
   (c) anomers
   (d) optical isomers *(2020)*
4. **Assertion (A) :** Sucrose is a non-reducing sugar.
   Reason (R) : Sucrose has glycosidic linkage.
   (a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
   (b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
   (c) Assertion (A) is correct, but Reason (R) is incorrect statement.
   (d) Assertion (A) is incorrect, but Reason (R) is correct statement. *(2020)*
5. What is the basic structural difference between glucose and fructose? *(Delhi 2019)*
6. Write the products obtained after hydrolysis of lactose. *(Delhi 2019)*
7. Define the following with an example of :
   Polysaccharides *(1/3, 2018)*
8. Write the product when *D*-glucose reacts with conc. HNO_3. *(1/3, 2018, AI 2012)*
9. Write the name of two monosaccharides obtained on hydrolysis of lactose sugar. *(Delhi 2016)*
10. Write the structural difference between starch and cellulose. *(AI 2016)*
11. Which one of the following is a disaccharide : Starch, Maltose, Fructose, Glucose? *(Delhi 2015)*
12. Write the product obtained when *D*-glucose reacts with $H_2N—OH$. *(AI 2015)*
13. Which one of the following is a monosaccharide :
    starch, maltose, fructose, cellulose *(Foreign 2015)*
14. Which of the two components of starch is water soluble? *(Delhi 2014)*
15. Write the product formed on reaction of *D*-glucose with Br_2 water. *(Delhi 2014)*
16. Write the product formed when glucose is treated with HI. *(Delhi 2014)*
17. Define the following term :
    Anomers *(AI 2014, Foreign 2014)*
18. Define the following term :
    Polysaccharides *(Foreign 2014)*
19. Define the following term : Invert sugar *(Foreign 2014)*
20. What is a glycosidic linkage? *(Delhi 2013)*
21. Name two components of starch. *(Delhi 2013C)*
22. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain. *(AI 2012)*
23. State two functions of carbohydrates. *(AI 2012C)*
24. Explain what is meant by the following :
    Pyranose structure of glucose? *(AI, Foreign 2011)*

SA (2 marks)

25. Define the following terms :
    (i) Oligosaccharides
    (ii) Invert sugar *(2020)*
26. Write the reactions showing the presence of following in the open structure of glucose :
    (i) an aldehyde group
    (ii) a primary alcohol *(2020)*
27. Enumerate the reactions of glucose which cannot be explained by its open chain structures. *(Delhi 2014C, AI 2011)*
28. Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecule. *(Delhi 2012)*

29. Write down the structures and names of the products formed when *D*-glucose is treated with (i) Hydroxylamine (ii) Acetic anhydride. *(AI 2012C)*

30. Write down the structures and names of the products formed when *D*-glucose is treated with
(i) Bromine water
(ii) Hydrogen iodide (Prolonged heating).
(AI 2012C)

31. What is essentially the difference between α-form and β-form of glucose? Explain. *(Delhi 2011)*

LA I (3 marks)

32. Give the plausible explanation for the following :
(a) Glucose doesn't give 2,4-DNP test.
(b) The two strands in DNA are not identical but are complementary.
(c) Starch and cellulose both contain glucose unit as monomer, yet they are structurally different. *(2020)*

33. Write chemical reactions to show that open structure of *D*-glucose contains the following :
(i) Straight chain
(ii) Five alcohol groups
(iii) Aldehyde as carbonyl group. *(Delhi 2019)*

34. What happens when *D*-glucose is treated with the following reagents?
(a) Br_2 water
(b) HCN
(c) $(CH_3CO)_2O$ *(AI 2019)*

35. Define the following terms :
(i) Glycosidic linkage
(ii) Invert sugar
(iii) Oligosaccharides *(AI 2014)*

36. What is essentially the difference between α-glucose and β-glucose? What is meant by pyranose structure of glucose? *(AI 2012)*

37. Mention the structural feature characterising reducing sugar. *(Delhi 2011C)*

14.2 Proteins

VSA (1 mark)

38. Peptide linkage is present in
(a) carbohydrates (b) vitamins
(c) protein (d) rubber. *(2020)*

39. What is the difference between fibrous protein and globular protein? *(1/3, AI, 2017C, Delhi 2015)*

40. Give one example each for fibrous protein and globular protein. *(AI 2016, Delhi 2014, AI 2013C)*

41. Amino acids show amphoteric behaviour. Why? *(AI 2015)*

42. What is the difference between acidic amino acids and basic amino acids? *(Foreign 2015)*

43. What type of linkage is responsible for the formation of proteins? *(Delhi, Foreign 2014)*

44. Define the following term :
Essential amino acids *(AI 2014)*

45. Define the following term :
Denaturation of proteins *(Foreign 2014)*

46. Define the following term :
Amino acids *(Foreign 2014)*

47. Define a 'peptide linkage'. *(AI 2014C, 2011, Foreign 2011)*

48. Where does the water present in the egg go after boiling the egg? *(Delhi 2012C)*

SA (2 marks)

49. Define the following with an example of each :
(i) Denatured protein
(ii) Essential amino acids *(2/3, 2018)*

50. (a) Amino acids show amphoteric behaviour. Why?
(b) Write one difference between α-helix and β-pleated structures of proteins. *(2/3, 2018)*

51. Describe what you understand by primary structure and secondary structure of proteins? *(Delhi 2011, Foreign 2011)*

52. Explain what is meant by a peptide linkage. *(Delhi 2011)*

LA I (3 marks)

53. Differentiate between the following :
(i) Amylose and Amylopectin
(ii) Peptide linkage and Glycosidic linkage
(iii) Fibrous proteins and Globular proteins. *(Delhi 2019)*

54. Define the following terms as related to proteins :
(i) Peptide linkage
(ii) Primary structure
(iii) Denaturation *(AI 2015, 2014)*

55. What are essential and non-essential amino acids? Give two examples of each. *(AI 2014C, Delhi 2012C)*

56. (a) Give two differences between globular and fibrous proteins.
(b) What change occurs in the nature of egg protein on boiling? *(Delhi 2013C)*

14.3 Enzymes

VSA (1 mark)

57. Define the following term :
Enzymes *(Foreign 2014, AI 2014 C)*

58. What is meant by biocatalysts? *(Delhi 2012)*

14.4 Vitamins

VSA (1 mark)

59. Why vitamin C cannot be stored in our body? *(Delhi 2016)*

60. Write the name of vitamin whose deficiency causes bone deformities in children. *(Delhi 2015)*

61. Write the name of the vitamin whose deficiency causes bleeding of gums. *(Foreign 2015)*

62. Deficiency of which vitamin causes night-blindness? *(Delhi 2014)*

63. Deficiency of which vitamin causes rickets? *(Delhi 2014)*

64. Deficiency of which vitamin causes scurvy? *(Delhi 2014)*

65. Define the following term :
Vitamins *(Foregin 2014)*

66. Why are vitamin A and vitamin C essential for us? *(Delhi 2014C)*

67. Name the deficiency diseases resulting from lack of vitamins A and E in the diet. *(Delhi 2013C)*

68. Name one of the water soluble vitamin which is powerful antioxidant. Give its one natural source. *(Delhi 2013C, AI 2012C)*

69. Name the only vitamin which can be synthesized in our body. Name the disease caused due to the deficiency of this vitamin. *(Delhi 2013C)*

70. How are hormones and vitamins different in respect of their source and functions? *(AI 2013C)*

71. Name the deficiency disease resulting from lack of vitamin A in the diet. *(Delhi 2011C)*

72. The deficiency of which vitamin causes the disease, 'pernicious anaemia'? *(AI 2011C)*

LA I (3 marks)

73. How are vitamins classified? Name the vitamin responsible for the coagulation of blood. *(Delhi 2015C)*

14.5 Nucleic Acids

VSA (1 mark)

74. What is difference between a nucleoside and nucleotide? *(Delhi 2016, 2014C)*

75. What type of linkage is present in nucleic acids? *(AI 2016)*

76. Name of the base that is found in nucleotide of RNA only. *(Delhi 2014)*

77. Define the following term :
Nucleoside *(Foregin 2014)*

78. Mention one important function of nucleic acids in our body. *(AI 2013C)*

SA (2 marks)

79. Write the structural and functional difference between DNA and RNA. *(Delhi 2013C)*

80. Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA? *(Delhi 2012)*

81. Name the bases present in RNA. Which one of these is not present in DNA? *(Delhi 2011)*

82. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA. *(AI 2011)*

LA I (3 marks)

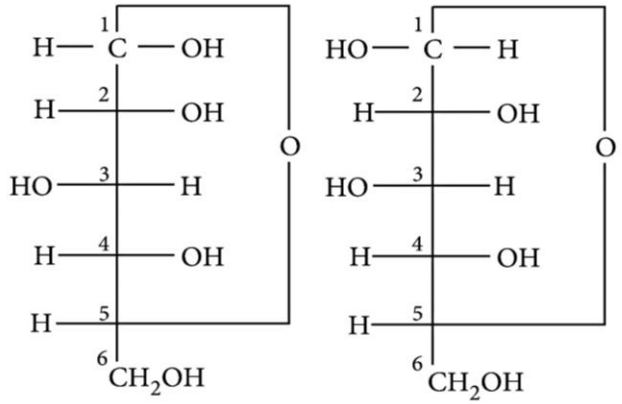
83. What are the different types of RNA found in cells of organisms? State the functions of each type. *(Delhi 2012C)*

Detailed Solutions

1. Maltose

2. Glycosidic linkage.

3. **(c) :**The pair of stereoisomers which differ only in the configuration of the hydroxyl group at C_1 are called anomers.



α-*D*-(+) Glucose β-*D*-(+) Glucose

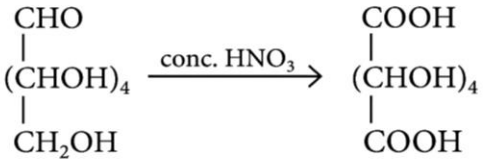
4. **(a) :** Sucrose is disaccharide and its two monosaccharides are held together by a glycosidic linkage. Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, therefore, sucrose is a non-reducing sugar.

5. Glucose contains an aldehydic group while fructose contains a ketonic group.

6. Lactose on hydrolysis gives β-*D*-glucose and β-*D*-galactose.

7. Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called polysaccharides, *e.g.*, cellulose.

8. On oxidation with nitric acid, *D*-glucose yields saccharic acid.



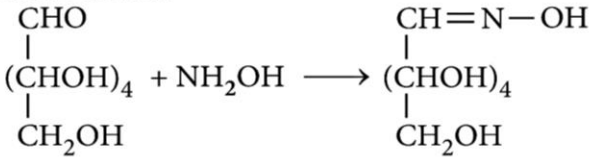
D-glucose *D*-saccharic acid

9. *Refer to answer 6.*

10. The basic structural difference between starch and cellulose is of linkage between the glucose units. In starch, there is α-*D*-glycosidic linkage. Both the components of starch-amylose and amylopectin are polymer of α-*D*-glucose. On the other hand, cellulose is a linear polymer of β-*D*-glucose in which C_1 of one glucose unit is connected to C_4 of the other through β-*D*-glycosidic linkage.

11. Maltose is a disaccharide as it consists of two α-*D*-glucose units.

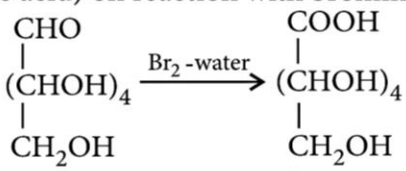
12. *D*-Glucose reacts with $H_2N—OH$ to give glucose oxime.



13. Fructose is a monosaccharide because it cannot be hydrolysed to simpler polyhydroxy aldehydes or ketones.

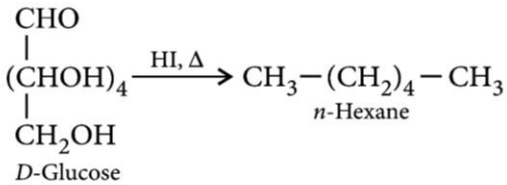
14. Amylose is water soluble and amylopectin is insoluble in water.

15. *D*-Glucose gets oxidised to carboxylic acid (gluconic acid) on reaction with bromine water.



D-Glucose Gluconic acid

16. On prolonged heating with HI, *D*-glucose forms *n*-hexane.



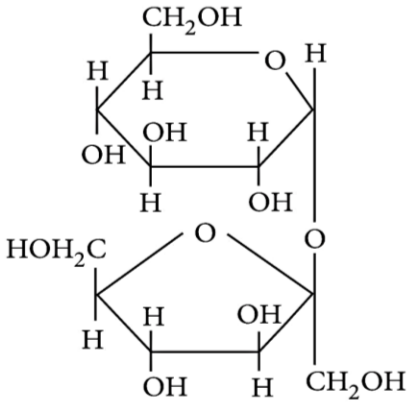
D-Glucose *n*-Hexane

17. *Refer to answer 3.*

18. *Refer to answer 7.*

19. An equimolar mixture of glucose and fructose, obtained by hydrolysis of sucrose in presence of an acid or the enzyme invertase is called invert sugar.

20. The two monosaccharides are joined together by an oxide linkage formed by the loss of water molecule. Such linkage is called glycosidic linkage.



21. Amylose and amylopectin are the two components of starch.

22. Glucose when heated with red P and HI gives *n*-hexane.

$$C_6H_{12}O_6 \xrightarrow[\Delta]{\text{Red P-HI}} CH_3CH_2CH_2CH_2CH_2CH_3$$

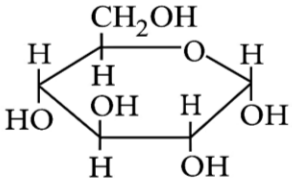
n-Hexane

It indicates the presence of straight chain of six carbon atoms in glucose.

23. (i) Carbohydrates act as storage molecules as starch in plants and glycogen in animals.

(ii) They act as constituent of cell membrane.

24. The six membered cyclic structure of glucose is called pyranose structure (α- or β –), in analogy with heterocyclic compound pyran.



α-*D*-(+)-Glucopyranose

25. (i) These are the carbohydrates which on hydrolysis give 2 - 10 monosaccharides. For example, sucrose, lactose, maltose, etc.

(ii) *Refer to answer 19.*

26. (i) Glucose on oxidation with a mild oxidising agent like bromine water gives gluconic acid containing the same six carbon atoms as present in glucose. This indicates presence of aldehyde group.

$$\begin{matrix}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{matrix} + [O] \xrightarrow{Br_2/H_2O} \begin{matrix}COOH\\|\\(CHOH)_4\\|\\CH_2OH\end{matrix}$$

Gluconic acid

(ii) On acetylation with acetic anhydride, glucose gives a pentaacetate. This confirms that glucose contains five – OH groups.

$$\begin{matrix}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{matrix} + 5(CH_3CO)_2O \longrightarrow$$

Glucose

$$\begin{matrix}CHO & & O\\|& & \|\\(CH-O-C-CH_3)_4\\|\\CH_2-O-C-CH_3\\& & \|\\& & O\end{matrix} + 5CH_3COOH$$

Glucose pentaacetate

27. The following reactions of *D*-glucose cannot be explained on the basis of its open chain structure :

(i) *D*-Glucose does not react with sodium bisulphite ($NaHSO_3$).

(ii) It does not give 2, 4-DNP test and Schiff's test.

(iii) The pentaacetate of *D*-glucose does not react with hydroxylamine.

(iv) *D*-Glucose shows the phenomenon of mutarotation *i.e.*, when its aqueous solution is kept for sometime its optical activity changes.

(v) On reaction with 1 mole of methanol, it yield two monomethyl derivatives which are known as methyl α-*D*-glucoside and methyl-β-*D*-glucoside.

28. *Refer to answer 27.*

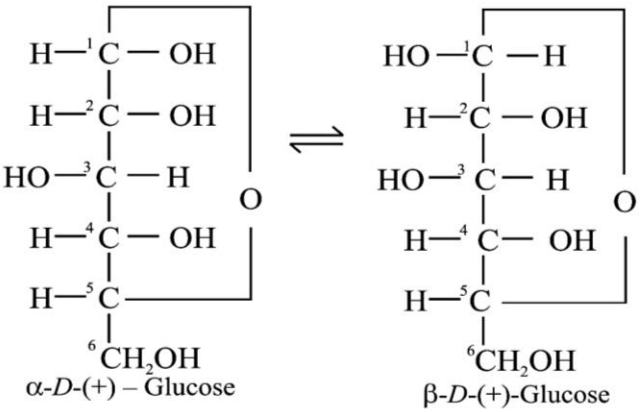
29. (i) *Refer to answer 12.*

(ii) $\begin{matrix}CHO\\|\\(CHOH)_4\\|\\CH_2OH\end{matrix} \xrightarrow{(CH_3CO)_2O} \begin{matrix}CHO & & O\\|& & \|\\(CHO-C-CH_3)_4\\|\\CH_2-O-C-CH_3\\& & \|\\& & O\end{matrix}$

Glucose pentaacetate

30. (i) *Refer to answer 15.*
(ii) *Refer to answer 16.*

31. In α-*D* Glucose, the –OH group at C_1 is towards right whereas in β-glucose, the –OH group at C_1 is towards left. Such a pair of stereoisomers which differ in the configuration only at C_1 are called anomers.



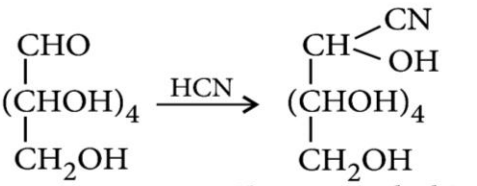
32. (a) Actually, glucose exists in the cyclic hemiacetal form with only a small amount (< 0.05%) of the open chain form. Since, the concentration of the open chain form is low and its reaction with 2,4-DNP is reversible, therefore, formation of 2,4-DNP derivative cannot disturb the equilibrium to regenerate more of the open chain form from the cyclic hemiacetal form and hence, does not give this test.

(b) The two strands in DNA molecule are held together by the hydrogen bonds between purine base of one strand and pyrimidine base of the other and *vice versa*. Because of different sizes and geometries of the bases, the only possible pairing in DNA are G (guanine) and C (cytosine) through three H-bonds, *i.e.*, (C ≡ G) and between A (adenine) and T (thymine) through two H-bonds (*i.e.*, A = T) . Due to this base-pairing principle, the sequence of bases in one strand automatically fixes the sequence of bases in the other strand. Thus, the two strands are complementary and not identical.

(c) The basic structural difference between starch and cellulose is of linkage between the glucose units. In starch, there is α-*D*-glycosidic linkage. Both the components of starch-amylose and amylopectin are polymers of α-*D*-glucose. On the other hand, cellulose is a linear polymer of β-*D*-glucose in which C1 of one glucose unit is connected to C4 of the other through β-*D*-glycosidic linkage.

33. (i) *Refer to answer 22.*
(ii) *Refer to answer 26(ii).*
(iii) *Refer to answer 26(i).*

34. (a) *Refer to answer 15.*

(b) 
Glucose cyanohydrin

(c) *Refer to answer 26(ii).*

35. (i) *Refer to answer 20.*
(ii) *Refer to answer 19.*
(iii) *Refer to answer 25(i).*

36. *Refer to answers 31 and 24.*

37. The sugars which reduce Fehling's solution and Tollens' reagent are called reducing sugars. For example, all monosaccharides containing free —CHO or $-\overset{|}{C}=O$ group are reducing sugars.

38. (c) Peptide linkage is present in proteins.

39. Characteristic differences between globular and fibrous proteins can be given as :

S. No.	Globular proteins	Fibrous proteins
1.	These are cross-linked proteins and are condensation product of acidic and basic amino acids.	These are linear condensation polymer.
2.	These are soluble in water, mineral acids and bases.	These are insoluble in water but soluble in strong acids and bases.

3.	These proteins have three dimensional folded structure. These are stabilised by internal hydrogen bonding, *e.g.*, egg albumin, enzymes.	These are linear polymers held together by intermolecular hydrogen bonds, *e.g.*, hair, silk.

40. Globular protein – Insulin
Fibrous protein – Keratin

41. As amino acids have both acidic (carboxyl group) and basic groups (amino group) in the same molecule, they react with both acids and bases. Hence, they show amphoteric behaviour.

42. Acidic amino acids are those which contain more number of carboxyl groups as compared to amino groups whereas basic amino acids are those which contains more number of amino groups than carboxyl groups.

43. Peptide linkage.

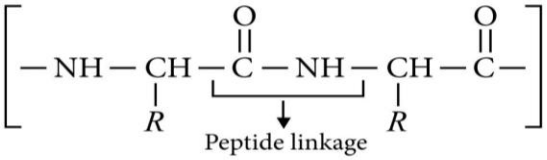
44. **Essential amino acids :** Amino acids which cannot be synthesized in the body and must be obtained through diet are known as essential amino acids, *e.g.*, valine, leucine, etc.

45. **Denaturation :** The loss of biological activity of a protein by changing the pH, temperature or by adding some salt due to disruption of the native structure of protein is called denaturation. During denaturation, secondary and tertiary structure of protein is destroyed but primary structure remains intact.

46. Organic compounds containing both amino ($-NH_2$) and carboxyl ($-COOH$) functional groups are called amino acids.

$$R-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$$

47. Proteins are the polymers of α-amino acids linked by amide formation between carboxyl and amino group. This is called peptide linkage or peptide bond, *e.g.*,



48. An egg contains a soluble globular protein called albumin which is present in the white part. On boiling, denaturation (loss of biological activity) of this protein takes place which results in the formation of insoluble fibrous proteins. The water molecules are utilized in this process.

49. (i) *Refer to answer 45.*
(ii) *Refer to answer 44.*

50. (a) *Refer to answer 41.*
(b) In α-helix structure, intramolecular H-bonding takes place whereas in β-pleated structure, intermolecular H-bonding takes place.

51. **Primary structure :** The specific sequence in which the various amino acids present in a protein are linked to one another is called its primary structure. Any change in the primary structure creates a different protein.
Secondary structure : The conformation of the polypeptide chain is known as secondary structure. The two types of secondary structure are α-helix and β-pleated sheet structure.
In α-helix structure, the polypeptide chain forms all the possible hydrogen bonds by twisting into a right handed screw (helix) with the — NH groups of each amino acid residue hydrogen bonded to the $>C=O$ group of an adjacent turn of the helix.
In β-pleated sheet structure, all peptide chains are stretched out to nearly maximum extension and then laid side by side which are held together by intermolecular hydrogen bonds.

52. *Refer to answer 47.*

53. (i) Amylose is a linear condensation polymer of α-*D*-glucose in which C_1 of one glucose unit is attached to C_4 of the other through α-glycosidic linkage while amylopectin is a highly branched polymer in which C_1 of terminal glucose unit in each chain is further linked to C_6 of some other

glucose unit in the next chain through C_1-C_6 α-glycosidic linkage.

(ii) Peptide linkage is an amide linkage formed between – COOH group of one α-amino acid and $-NH_2$ group of the other amino acid by loss of a molecule of water whereas a linkage between two monosaccharides units through oxygen atom is called glycosidic linkage.

(iii) *Refer to answer 39.*

54. (i) *Refer to answer 47.*

(ii) *Refer to answer 51.*

(iii) *Refer to answer 45.*

55. Amino acids which cannot be synthesised in the body and must be obtained through diet are known as essential amino acids, *e.g.*, valine and leucine. There are ten essential amino acids. Amino acids which can be synthesised in the body are known as non-essential amino acids, *e.g.*, alanine and glutamic acids.

56. (a) *Refer to answer 39.*

(b) Protein is denatured and its biological activity is lost.

57. Most of the chemical reactions which occur in living systems process at very slow rates under mild condition of temperature and pH. These reactions are catalysed by a group of biomolecules called enzymes.

58. Substances which catalyse chemical reactions taking place in living organisms are called biocatalysts, *e.g.*, enzymes.

59. Vitamin C is soluble in water and regularly excreted in urine and hence cannot be stored in body.

60. Vitamin D

61. Vitamin C

62. Vitamin A

63. Vitamin D

64. Vitamin C

65. Organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism are called vitamins.

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

67. Vitamin – A : Night blindness

Vitamin E : Muscular weakness.

68. Vitamin C is water soluble and powerful antioxidant. Natural source of vitamin C is amla.

69. Vitamin D

Disease caused due to deficiency of Vitamin D is rickets.

70.

	Hormones	Vitamins
(i)	The biomolecules which transfer information from one group of cell to distant tissue or organ.	These are essential dietary factors required by an organism in minute quantities.
(ii)	They are produced in the body in ductless glands.	They are supplied to the body from the food eaten.

71. *Refer to answer 67.*

72. Vitamin B_{12}

73. Vitamins are classified into two groups depending upon their solubility in water or fat.

(i) Fat soluble vitamins, (*e.g.*, vitamin A and D)

(ii) Water soluble vitamins, (*e.g.*, vitamin B and C) vitamin K is responsible for the coagulation of blood.

74. Nucleoside contains pentose sugar, and base whereas nucleotide contains pentose sugar, base as well as phosphate group.

Nucleoside = Base + Sugar

Nucleotide = Base + Sugar + Phosphate

75. Ester linkage

76. Uracil

77. *Refer to answer 74.*

78. DNA is reserve of genetic information and responsible for heredity transmission.

79. Structural differences between DNA and RNA

(i) The sugar in DNA is deoxyribose while that in RNA is ribose.

(ii) DNA has a double-stranded helical structure, while RNA has a single-stranded helical structure.

Functional differences between DNA and RNA

(i) DNA is the chemical basis of heredity and is responsible for maintaining the identity of different species.

(ii) RNA molecules are responsible for protein synthesis but the message for the synthesis of a particular protein is present in DNA.

80. *Refer to answer 79.*

In DNA, thymine is present.

81. The bases present in RNA are adenine (A), guanine (G) cytosine (C) and Uracil (U).

Uracil is not present in DNA.

82. *Refer to answer 79.*

Common bases in DNA and RNA are adenine, guanine and cytosine.

83. RNA are of three types :

(i) Messenger RNA (*m*-RNA) : Function as messenger carrying the information in a gene to the protein synthesizing machinery.

(ii) Transfer RNA (*t*-RNA) : They transfer the amino acids from cytoplasm to the protein synthesizing machinery.

(iii) Ribosomal RNA (*r*-RNA) : They associates with a set of proteins to form ribosomes. These complex structures, which physically move among an *m*-RNA molecule, catalyze the assembly of amino acids into protein chains. They also bind *t*-RNAs and various molecules necessary for protein synthesis.