Unit

14

BIOMOLECULES

I. Multiple Choice Questions (Type-I)

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

(i) Amylose

(ii) Amylopectin

(iii) Cellulose

(iv) Glucose

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

(i) Amylose

(ii) Cellulose

(iii) Amylopectin

(iv) Glycogen

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

(i) 2 molecules of glucose

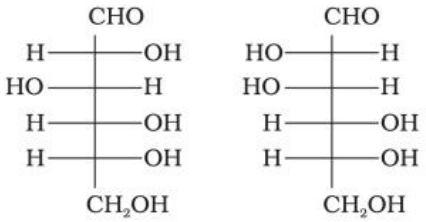
(ii) 2 molecules of glucose + 1 molecule of fructose

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

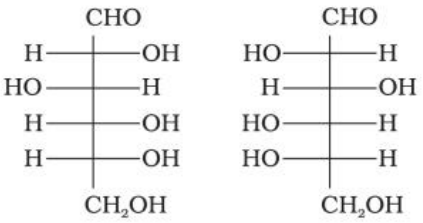
(iv) 2 molecules of fructose

4. Which of the following pairs represents anomers?

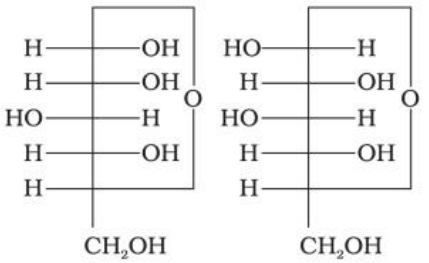
(i)



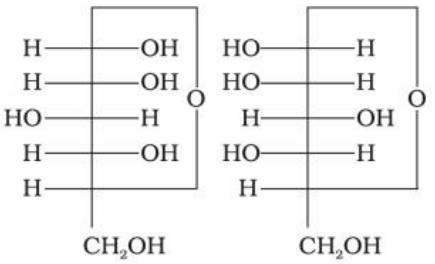
(ii)



(iii)



(iv)



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

(i) Peptide bonds

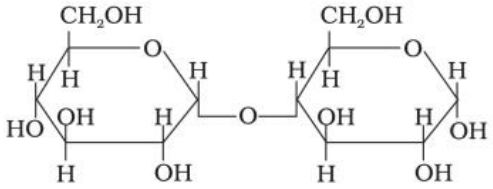
(ii) van der Waals forces

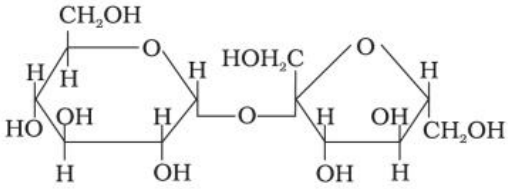
(iii) Hydrogen bonds

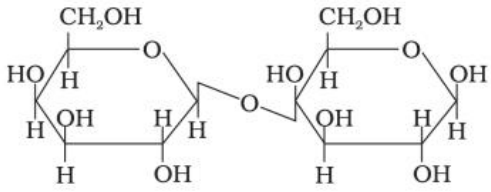
(iv) Dipole-dipole interactions

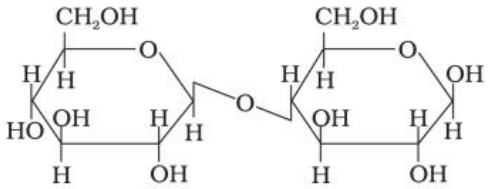
6. In disaccharides, if the reducing groups of monosaccharides i.e. aldehydic or ketonic groups are bonded, these are non-reducing sugars. Which of the following disaccharide is a non-reducing sugar?

(i)



(ii) 

(iii) 

(iv) 

7. Which of the following acids is a vitamin?

(i) Aspartic acid

(ii) Ascorbic acid

(iii) Adipic acid

(iv) Saccharic acid

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

(i) 5′ and 3′

(ii) 1′ and 5′

(iii) 5′ and 5′

(iv) 3′ and 3′

9. Nucleic acids are the polymers of _____.

(i) Nucleosides

(ii) Nucleotides

(iii) Bases

(iv) Sugars

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

(i) It is an aldohexose.

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

(iii) It is present in furanose form.

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

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

(i) primary structure of proteins.

(ii) secondary structure of proteins.

(iii) tertiary structure of proteins.

(iv) quaternary structure of proteins.

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

(i) Adenine

(ii) Uracil

(iii) Thymine

(iv) Cytosine

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

(i) Vitamin B_1

(ii) Vitamin B_2

(iii) Vitamin B_6

(iv) Vitamin B_{12}

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

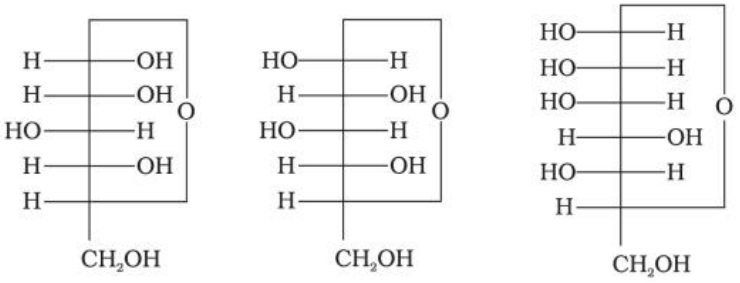
(i) Adenine

(ii) Thymine

(iii) Cytosine

(iv) Uracil

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



(I) (II) (III)

(i) I and II

(ii) II and III

(iii) I and III

(iv) III is anomer of I and II

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

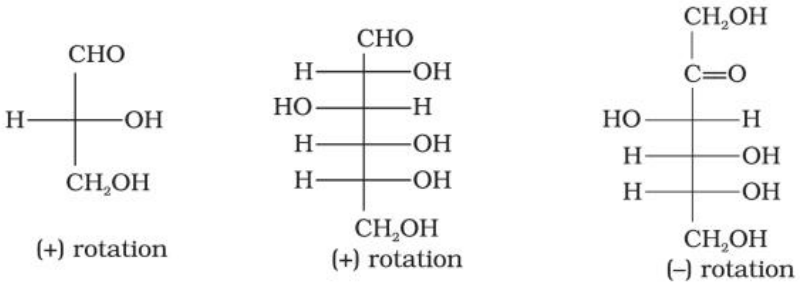
(i) Glucose forms pentaacetate.

(ii) Glucose reacts with hydroxylamine to form an oxime.

(iii) Pentaacetate of glucose does not react with hydroxylamine.

(iv) Glucose is oxidised by nitric acid to gluconic acid.

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



(I) (II) (III)

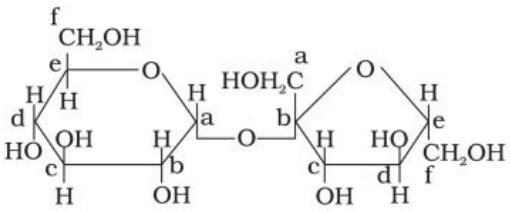
(i) I, II, III

(ii) II, III

(iii) I, II

(iv) III

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



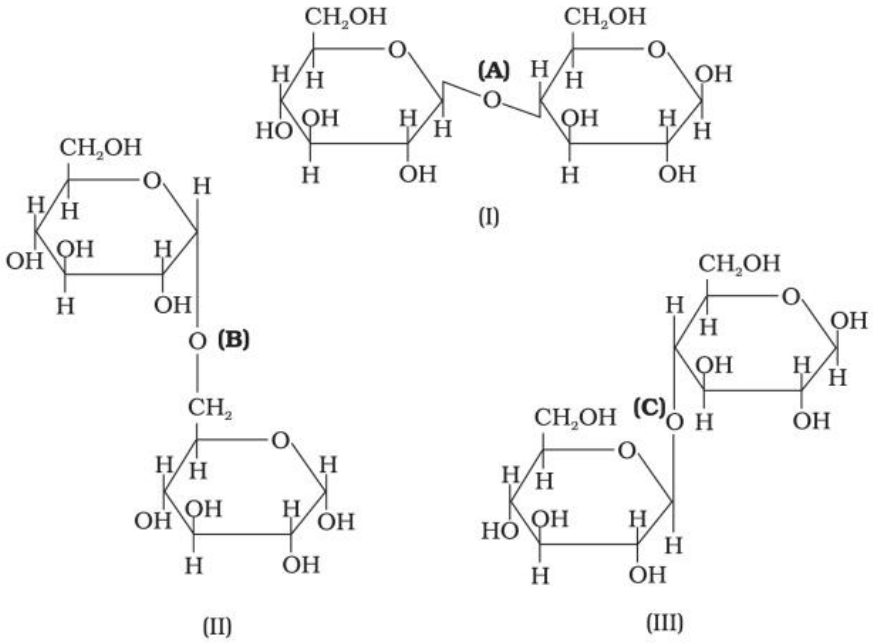
(i) 'a' carbon of glucose and 'a' carbon of fructose.

(ii) 'a' carbon of glucose and 'e' carbon of fructose.

(iii) 'a' carbon of glucose and 'b' carbon of fructose.

(iv) 'f' carbon of glucose and 'f' carbon of fructose.

19. 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?



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

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

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

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

II. Multiple Choice Questions (Type-II)

Note : In the following questions two or more options may be correct.

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

(i) monosaccharide

(ii) disaccharide

(iii) reducing sugar

(iv) non-reducing sugar

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

(i) Insulin

(ii) Keratin

(iii) Albumin

(iv) Myosin

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

(i) Amylose

(ii) Amylopectin

(iii) Cellulose

(iv) Glycogen

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

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

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

(iii) $H_2N—CH_2—CH_2—CH_2—COOH$

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

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

(i) α-Amino acid

(ii) Basic amino acid

(iii) Amino acid synthesised in body

(iv) β-Amino acid

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

(i) Ribose

(ii) Glucose

(iii) Fructose

(iv) Galactose

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

(i) van der Waals forces

(ii) disulphide linkage

(iii) electrostatic forces of attraction

(iv) hydrogen bonds

27. Which of the following are purine bases?

(i) Guanine

(ii) Adenine

(iii) Thymine

(iv) Uracil

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

(i) Proteins

(ii) Dinucleotides

(iii) Nucleic acids

(iv) Biocatalysts

III. Short Answer Type

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

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

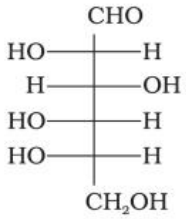
31. In nucleoside a base is attached at 1′ position of sugar moiety. Nucleotide is formed by linking of phosphoric acid unit to the sugar unit of nucleoside. At which position of sugar unit is the phosphoric acid linked in a nucleoside to give a nucleotide?

32. Name the linkage connecting monosaccharide units in polysaccharides.

33. Under what conditions glucose is converted to gluconic and saccharic acid?

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

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



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

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

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

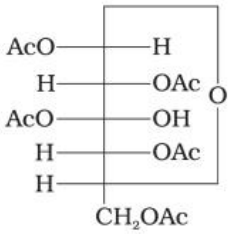
39. α-Helix is a secondary structure of proteins formed by twisting of polypeptide chain into right handed screw like structures. Which type of interactions are responsible for making the α-helix structure stable?

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

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

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

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



(A)

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

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

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

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



(Glycine) (Alanine)

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

49. Activation energy for the acid catalysed hydrolysis of sucrose is 6.22 kJ mol^{-1}, while the activation energy is only 2.15 kJ mol^{-1} when hydrolysis is catalysed by the enzyme sucrase. Explain.

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

51. Which moieties of nucleosides are involved in the formation of phosphodiester linkages present in dinucleotides? What does the word diester in the name of linkage indicate? Which acid is involved in the formation of this linkage?

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

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

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

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

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

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

IV. Matching Type

Note : Match the items of Column I and Column II in the following questions. More than one option in Column II may match with the items given in Column I.

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

Column I (Vitamins)	**Column II (Diseases)**
(i) Vitamin A	(a) Pernicious anaemia
(ii) Vitamin B_1	(b) Increased blood clotting time
(iii) Vitamin B_{12}	(c) Xerophthalmia
(iv) Vitamin C	(d) Rickets
(v) Vitamin D	(e) Muscular weakness
(vi) Vitamin E	(f) Night blindness
(vii) Vitamin K	(g) Beri Beri
	(h) Bleeding gums
	(i) Osteomalacia

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

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

V. Assertion and Reason Type

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

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

(ii) Both assertion and reason are wrong statements.

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

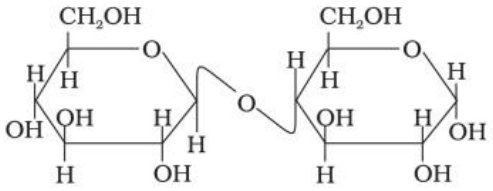
(iv) Assertion is wrong statement and reason is correct statement.

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

60. **Assertion** : D (+) – Glucose is dextrorotatory in nature.
Reason : 'D' represents its dextrorotatory nature.

61. **Assertion** : Vitamin D can be stored in our body.
Reason : Vitamin D is fat soluble vitamin.

62. **Assertion** : β-glycosidic linkage is present in maltose,



Reason : Maltose is composed of two glucose units in which C–1 of one glucose unit is linked to C–4 of another glucose unit.

63. **Assertion** : All naturally occurring α-aminoacids except glycine are optically active.

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

64. **Assertion** : Deoxyribose, $C_5H_{10}O_4$ is not a carbohydrate.

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

65. **Assertion** : Glycine must be taken through diet.

Reason : It is an essential amino acid.

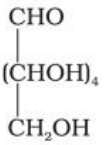
66. **Assertion** : In presence of enzyme, substrate molecule can be attacked by the reagent effectively.

Reason : Active sites of enzymes hold the substrate molecule in a suitable position.

VI. Long Answer Type

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

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



69. Carbohydrates are essential for life in both plants and animals. Name the carbohydrates that are used as storage molecules in plants and animals, also name the carbohydrate which is present in wood or in the fibre of cotton cloth.

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

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

ANSWERS

I. Multiple Choice Questions (Type-I)

1. (ii) 2. (iv) 3. (iii)

4. (iii), **Hint :** Cyclic hemiacetal forms of monosaccharide which differ only in the configuration of the hydroxyl group at C1 are anomers.

5. (iii), **Hint :** In α-helix, hydrogen bonds are present between –NH group of one amino acid residue to the >C═O group of another aminoacid residue.

6. (ii) 7. (ii) 8. (i) 9. (ii) 10. (iii) 11. (i)

12. (iii) 13. (iv) 14. (iv) 15. (i) 16. (iii) 17. (i)

18. (iii) 19. (iii)

II. Multiple Choice Questions (Type-II)

20. (ii), (iv) 21. (i), (iii) 22. (ii), (iv) 23. (ii), (iv)

24. (i), (ii) 25. (i), (iii) 26. (ii), (iv) 27. (i), (ii) 28. (i), (iv)

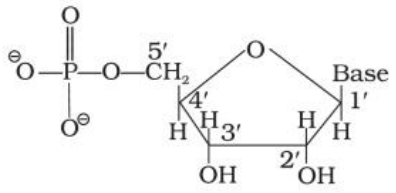
III. Short Answer Type

29. Lactose, two monosaccharide units are present. Such oligosaccharides are called disaccharides.

30. On prolonged heating with HI, glucose gives *n*-hexane.

$$\text{Glucose} \xrightarrow[\Delta]{HI} \underset{(n\text{-Hexane})}{CH_3—CH_2—CH_2—CH_2—CH_2—CH_3}$$

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



(Nucleotide)

32. Glycosidic linkage.

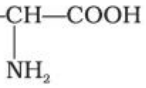
33. Glucose is converted to gluconic acid by bromine water and to saccharic acid by conc. HNO_3.

34. Fructose is a ketohexose.

35. 'L' configuration

36. 'D' configuration

37. Sucrose, see page no. 409 of NCERT textbook for the explanation.

38. α-amino acids, 

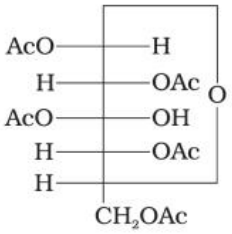
39. In α-helix,a polypeptide chain is stabilised by the formation of hydrogen bonds between —NH— group of amino acids in one turn with the >C= O groups of amino acids belonging to adjacent turn.

40. Oxidoreductase

41. Lactic acid.

42. Glucose gives pentaacetate derivative on acetylation with acetic anhydride. This confirms the presence of five —OH groups.

43. Glucose pentaacetate (structure A) doesn't have a free —OH group at C1 and so can't be converted to the open chain form to give —CHO group and hence doesn't form the oxime.

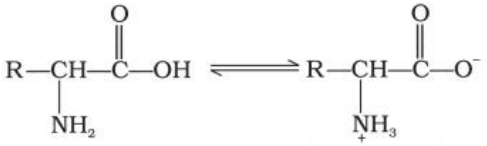


(Structure A)

44. Vitamin C is water soluble therefore it is readily excreted in urine and can't be stored in our body.

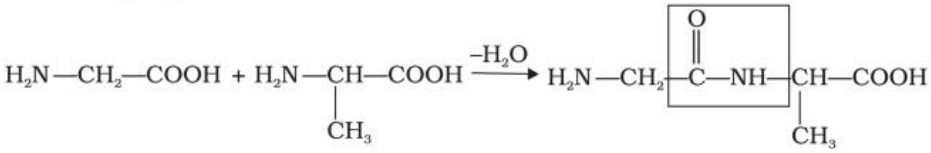
45. On hydrolysis sucrose (dextrorotatory), gives glucose (dextrorotatory, + 52.5°) and fructose (laevorotatory, – 92.4°). Since laevorotation of fructose is more than the dextrorotation of glucose, the mixture is laevorotatory.

46. In aqueous solution, the carboxyl group loses a proton and amino group accepts a proton to form a zwitter ion.



(Zwitter ion)

47. In glycylalanine, carboxyl group of glycine combines with the amino group of alanine.



(Glycine) (Alanine) (Glycylalanine)

48. Due to physical or chemical change, hydrogen bonds in proteins are disturbed, globules unfold and helix gets uncoiled therefore protein loses its biological activity. This is called denaturation of proteins.

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

50. Glucose reacts with hydroxylamine to form a monoxime and adds one molecule of hydrogen cyanide to give cyanohydrin so it contains a carbonyl group which can be an aldehyde or a ketone. On mild oxidation with bromine water, glucose gives gluconic acid which is a six carbon carboxylic acid. This indicates that carbonyl group present in glucose is an aldehydic group.

51. See page no. 420 of NCERT textbook.

52. See page no. 409 of NCERT textbook.

53. In starch and glycogen, glycosidic α-linkage is present and in cellulose, glycosidic β-linkage is present between glucose units.

54. Active site of enzymes hold the substrate molecule in a suitable position, so that it can be attacked by the reagent effectively.

55. See the NCERT textbook for Class XII.

56. For answer see page no. 406 of NCERT textbook for Class XII.

57. For answer see page no. 416-417 of NCERT textbook for Class XII.

IV. Matching Type

58. (i) → (c), (f) (ii) → (g) (iii) → (a) (iv) → (h) (v) → (d), (i) (vi) → (e), (vii) → (b)

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

V. Assertion and Reason Type

60. (iii) 61. (i) 62. (iv) 63. (v) 64. (ii) 65. (ii) 66. (i)

VI. Long Answer Type

67. See NCERT textbook for Class XII.

68. See NCERT textbook for Class XII.

69. **Hint :** Carbohydrate used as storage molecule in plants is starch and in animals, it is glycogen. Cellulose is present in wood or in the fibre of cotton cloth.

70. See NCERT textbook for Class XII.

71. See NCERT textbook for Class XII.