CHAPTER
9

Biomolecules

9.1 How to Analyse Chemical Composition?

1. Identify the basic amino acid from the following.
(a) Tyrosine (b) Glutamic Acid
(c) Lysine (d) Valine *(NEET 2020)*

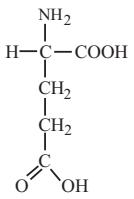
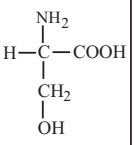
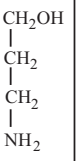
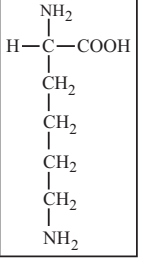
2. The two functional groups characteristic of sugars are
(a) hydroxyl and methyl
(b) carbonyl and methyl
(c) carbonyl and phosphate
(d) carbonyl and hydroxyl. *(NEET 2018)*

3. A typical fat molecule is made up of
(a) one glycerol and one fatty acid molecule
(b) three glycerol and three fatty acid molecules
(c) three glycerol molecules and one fatty acid molecule
(d) one glycerol and three fatty acid molecules. *(NEET-I 2016)*

4. A phosphoglyceride is always made up of
(a) a saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(b) a saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule
(c) only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(d) only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached. *(NEET 2013)*

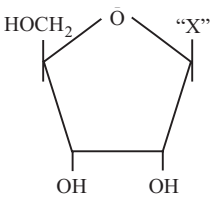
5. Uridine, present only in RNA is a
(a) nucleoside (b) nucleotide
(c) purine (d) pyrimidine.
(Karnataka NEET 2013)

6. Which one out of A – D given below correctly represents the structural formula of the basic amino acid?

A	B	C	D
			

(a) C (b) D
(c) A (d) B *(2012)*

7. The given diagrammatic representation shows one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component "X" in it.

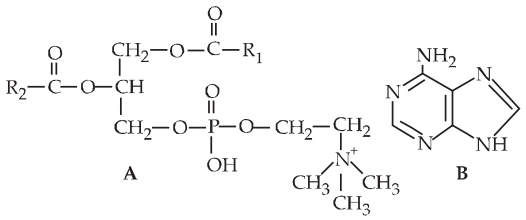


	Category	**Component**
(a)	Cholesterol	Guanine
(b)	Amino acid	NH_2
(c)	Nucleotide	Adenine
(d)	Nucleoside	Uracil

(2012)

8. Which one of the following biomolecules is correctly characterized?
(a) Lecithin-a phosphorylated glyceride found in cell membrane.
(b) Palmitic acid - an unsaturated fatty acid with 18 carbon atoms.
(c) Adenylic acid - adenosine with a glucose phosphate molecule.
(d) Alanine amino acid - contains an amino group and an acidic group anywhere in the molecule.
(Mains 2012)

9. Which one of the following structural formulae of two organic compounds is correctly identified along with its related function?



(a) B : Adenine - A nucleotide that makes up nucleic acids
(b) A : Triglyceride - Major source of energy
(c) B : Uracil - A component of DNA
(d) A : Lecithin - A component of cell membrane *(2011)*

10. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and
(a) sulphur and magnesium
(b) magnesium and sodium
(c) calcium and phosphorus
(d) phosphorus and sulphur. *(2007)*

11. Which of the following is the simplest amino acid?
(a) Alanine (b) Asparagine
(c) Glycine (d) Tyrosine *(2005)*

12. The major role of minor elements inside living organisms is to act as
(a) co-factors of enzymes
(b) building blocks of important amino acids
(c) constituent of hormones
(d) binder of cell structure. *(2003)*

13. Lipids are insoluble in water because lipid molecules are
(a) hydrophilic (b) hydrophobic
(c) neutral (d) zwitter ions. *(2002)*

14. Spoilage of oil can be detected by which fatty acid?
(a) Oleic acid (b) Linolenic acid
(c) Linoleic acid (d) Erucic acid. *(2001)*

15. Essential amino acid is
(a) phenylalanine (b) glycine
(c) aspartic acid (d) serine. *(2000)*

16. What are the most diverse molecules in the cell?
(a) Lipids (b) Mineral salts
(c) Proteins (d) Carbohydrates *(1996)*

17. The four elements that make up 99% of all elements found in a living system are
(a) C, H, O and P (b) C, N, O and P
(c) H, O, C and N (d) C, H, O and S. *(1994)*

18. Amino acids are mostly synthesised from
(a) mineral salts (b) fatty acids
(c) volatile acids (d) α-ketoglutaric acid. *(1992)*

19. Living cell contains 60 – 95% water. Water present in human body is
(a) 60 – 65% (b) 50 – 55%
(c) 75 – 80% (d) 65 – 70%. *(1992)*

9.2 Primary and Secondary Metabolites

20. Secondary metabolites such as nicotine, strychnine and caffeine are produced by plants for their
(a) nutritive value (b) growth response
(c) defence action (d) effect on reproduction. *(NEET 2020)*

21. Concanavalin A is
(a) a pigment (b) an alkaloid
(c) an essential oil (d) a lectin. *(NEET 2019)*

9.4 Proteins

22. Which one of the following is the most abundant protein in the animals?
(a) Haemoglobin (b) Collagen
(c) Lectin (d) Insulin *(NEET 2020)*

23. Which of the following glucose transporters is insulin-dependent?
(a) GLUT IV (b) GLUT I
(c) GLUT II (d) GLUT III *(NEET 2019)*

24. Which one is the most abundant protein in the animal world?
(a) Trypsin (b) Haemoglobin
(c) Collagen (d) Insulin *(2012)*

25. Which of the following have carbohydrate as prosthetic group?
(a) Glycoprotein (b) Chromoprotein
(c) Lipoprotein (d) Nucleoprotein *(2000)*

9.5 Polysaccharides

26. Which one of the following statements is wrong?
(a) Uracil is a pyrimidine.
(b) Glycine is a sulphur containing amino acid.
(c) Sucrose is a disaccharide.
(d) Cellulose is a polysaccharide. *(NEET-I 2016)*

27. The chitinous exoskeleton of arthropods is formed by the polymerisation of
(a) N - acetyl glucosamine
(b) lipoglycans
(c) keratin sulphate and chondroitin sulphate
(d) D - glucosamine. *(2015)*

28. Which one of the following is a non - reducing carbohydrate?
(a) Maltose (b) Sucrose
(c) Lactose (d) Ribose 5-phosphate *(2014)*

29. Macromolecule chitin is
(a) sulphur containing polysaccharide
(b) simple polysaccharide
(c) nitrogen containing polysaccharide
(d) phosphorus containing polysaccharide. *(NEET 2013)*

30. Carbohydrates are commonly found as starch in plants storage organs. Which of the following five properties of starch (1-5) make it useful as a storage material?
(1) Easily translocated
(2) Chemically non-reactive
(3) Easily digested by animals
(4) Osmotically inactive
(5) Synthesized during photosynthesis
The useful properties are
(a) (1), (3) and (5) (b) (1) and (5)
(c) (2) and (3) (d) (2) and (4). *(2008)*

31. Cellulose is the major component of cell walls of
(a) *Pseudomonas* (b) *Saccharomyces*
(c) *Pythium* (d) *Xanthomonas*. *(2008)*

32. Carbohydrates, the most abundant biomolecule on earth, are produced by
(a) some bacteria, algae and green plant cells
(b) fungi, algae and green plant cells
(c) all bacteria, fungi and algae
(d) viruses, fungi and bacteria. *(2005)*

33. Which of the following is a reducing sugar?
(a) Galactose (b) Gluconic acid
(c) β-methyl galactoside
(d) Sucrose *(2002)*

34. Cellulose, the most important constituent of plant cell wall is made up of
(a) branched chain of glucose molecules linked by β-1, 4 glycosidic bond in straight chain and α-1, 6 glycosidic bond at the site of branching
(b) unbranched chain of glucose molecules linked by β-1, 4 glycosidic bond
(c) branched chain of glucose molecules linked by α-1, 6 glycosidic bond at the site of branching
(d) unbranched chain of glucose molecules linked by α-1, 4 glycosidic bond. *(1998)*

35. Lactose is composed of
(a) glucose + galactose (b) fructose + galactose
(c) glucose + fructose (d) glucose + glucose. *(1998)*

36. In which of the following groups are all polysaccharides?
(a) Sucrose, glucose and fructose
(b) Maltose, lactose and fructose
(c) Glycogen, sucrose and maltose
(d) Glycogen, cellulose and starch *(1996)*

37. Glycogen is a polymer of
(a) galactose (b) glucose
(c) fructose (d) sucrose. *(1993)*

9.6 Nucleic Acids

38. Which of the following are not polymeric?
(a) Proteins (b) Polysaccharides
(c) Lipids (d) Nucleic acids *(NEET 2017)*

39. Nucleotides are building blocks of nucleic acids. Each nucleotide is a composite molecule formed by
(a) base-sugar-phosphate
(b) base-sugar-OH
(c) (base-sugar-phosphate)$_n$
(d) sugar-phosphate. *(2005)*

40. Which purine base is found in RNA?
(a) Thymine (b) Uracil
(c) Cytosine (d) Guanine *(1996)*

41. Which of the following nucleotide sequences contains 4 pyrimidine bases?
(a) GATCAATGC (b) GCUAGACAA
(c) UAGCGGUAA (d) Both (b) and (c) *(1994)*

42. In RNA, thymine is replaced by
(a) adenine (b) guanine
(c) cytosine (d) uracil. *(1992)*

43. Adenine is
(a) purine (b) pyrimidine
(c) nucleoside (d) nucleotide. *(1992)*

44. A nucleotide is formed of
(a) purine, pyrimidine and phosphate
(b) purine, sugar and phosphate
(c) nitrogen base, sugar and phosphate
(d) pyrimidine, sugar and phosphate. *(1991)*

45. DNA is composed of repeating units of
(a) ribonucleosides
(b) deoxyribonucleosides
(c) ribonucleotides
(d) deoxyribonucleotides. *(1991)*

46. The basic unit of nucleic acid is
(a) pentose sugar (b) nucleoid
(c) nucleoside (d) nucleotide. *(1991)*

47. RNA does not possess
(a) uracil (b) thymine
(c) adenine (d) cytosine. *(1988)*

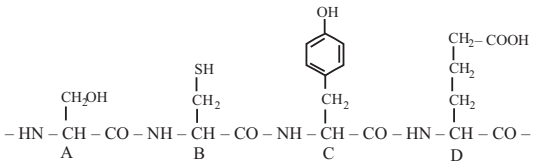
9.7 Structure of Proteins

48. "Ramachandran plot" is used to confirm the structure of
(a) RNA (b) proteins
(c) triacylglycerides (d) DNA. *(Odisha NEET 2019)*

49. Which of the following is the least likely to be involved in stabilising the three-dimensional folding of most proteins?

(a) Hydrogen bonds
(b) Electrostatic interaction
(c) Hydrophobic interaction
(d) Ester bonds *(NEET-II 2016)*

50. The figure shows a hypothetical tetrapeptide portion of a protein with parts labelled A-D. Which one of the following options is correct?



(a) D is the acidic amino acid-glutamic acid.
(b) C is an aromatic amino acid-tryptophan.
(c) A is the C-terminal amino acid and D is N-terminal amino acid.
(d) A is a sulphur containing amino acid methionine. *(Karnataka NEET 2013)*

9.8 Nature of Bond Linking Monomers in a Polymer

51. Identify the substances having glycosidic bond and peptide bond, respectively in their structure.
(a) Chitin, cholesterol (b) Glycerol, trypsin
(c) Cellulose, lecithin (d) Inulin, insulin
(NEET 2020)

52. Which of the following biomolecules does have a phosphodiester bond?
(a) Amino acids in a polypeptide
(b) Nucleic acids in a nucleotide
(c) Fatty acids in a diglyceride
(d) Monosaccharides in a polysaccharide *(2015)*

53. Which is wrong about nucleic acids?
(a) DNA is single stranded in some viruses.
(b) RNA is double stranded occasionally.
(c) Length of one helix is 45 Å in B-DNA.
(d) One turn of Z-DNA has 12 bases. *(1993)*

54. A segment of DNA has 120 adenine and 120 cytosine bases. The total number of nucleotides present in the segment is
(a) 120 (b) 240
(c) 60 (d) 480. *(1991)*

55. Which is not consistent with double helical structure of DNA?
(a) A = T, C = G
(b) Density of DNA decreases on heating.
(c) A + T/C + G is not constant.
(d) Both (a) and (b) *(1990)*

56. In double helix of DNA, the two DNA strands are
(a) coiled around a common axis
(b) coiled around each other
(c) coiled differently
(d) coiled over protein sheath. *(1988)*

9.10 Metabolic Basis for Living

57. ATP is
(a) nucleotide (b) nucleoside
(c) nucleic acid (d) vitamin. *(2000)*

9.12 Enzymes

58. Match the following.

(A) Inhibitor of catalytic activity	(i) Ricin
(B) Possess peptide bonds	(ii) Malonate
(C) Cell wall material in fungi	(iii) Chitin
(D) Secondary metabolite	(iv) Collagen

Choose the correct option from the following:

	(A)	(B)	(C)	(D)
(a)	(ii)	(iv)	(iii)	(i)
(b)	(iii)	(i)	(iv)	(ii)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(ii)	(iii)	(i)	(iv)

(NEET 2020)

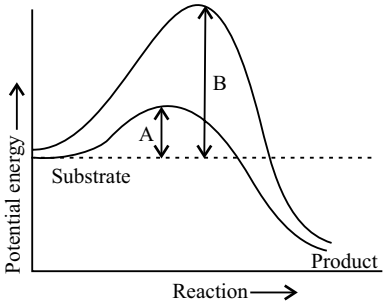
59. Consider the following statements.
(A) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
(B) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.
Select the correct option.
(a) (A) is false but (B) is true.
(b) Both (A) and (B) are true.
(c) (A) is true but (B) is false.
(d) Both (A) and (B) are false. *(NEET 2019)*

60. Prosthetic groups differ from co-enzymes in that
(a) they require metal ions for their activity
(b) they (prosthetic groups) are tightly bound to apoenzymes
(c) their association with apoenzymes is transient
(d) they can serve as co-factors in a number of enzyme-catalyzed reactions.
(Odisha NEET 2019)

61. Which of the following statements is correct with reference to enzymes?
(a) Holoenzyme = Apoenzyme + Coenzyme
(b) Coenzyme = Apoenzyme + Holoenzyme
(c) Holoenzyme = Coenzyme + Co-factor
(d) Apoenzyme = Holoenzyme + Coenzyme
(NEET 2017)

62. A non-proteinaceous enzyme is
(a) lysozyme (b) ribozyme
(c) ligase
(d) deoxyribonuclease. *(NEET-II 2016)*

63. Which of the following describes the given graph correctly?



(a) Endothermic reaction with energy A in presence of enzyme and B in absence of enzyme.
(b) Exothermic reaction with energy A in presence of enzyme and B in absence of enzyme.
(c) Endothermic reaction with energy A in absence of enzyme and B in presence of enzyme.
(d) Exothermic reaction with energy A in absence of enzyme and B in presence of enzyme.
(NEET-II 2016)

64. Which one of the following statements is incorrect?
(a) The competitive inhibitor does not affect the rate of breakdown of the enzyme-substrate complex.
(b) The presence of the competitive inhibitor decreases the K_m of the enzyme for the substrate.
(c) A competitive inhibitor reacts reversibly with the enzyme to form an enzyme-inhibitor complex.
(d) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme.
(2015 Cancelled)

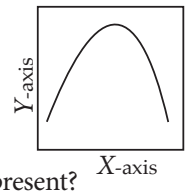
65. Select the option which is not correct with respect to enzyme action.
(a) Substrate binds with enzyme at its active site.
(b) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate.
(c) A non-competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate.
(d) Malonate is a competitive inhibitor of succinic dehydrogenase. *(2014)*

66. Transition state structure of the substrate formed during an enzymatic reaction is
(a) transient and unstable
(b) permanent and stable
(c) transient but stable
(d) permanent but unstable. *(NEET 2013)*

67. The essential chemical components of many coenzymes are
(a) carbohydrates (b) vitamins
(c) proteins (d) nucleic acids.
(NEET 2013)

68. Which of the following statements about enzymes is wrong?
(a) Enzymes are denatured at high temperatures.
(b) Enzymes are mostly proteins but some are lipids also.
(c) Enzymes are highly specific.
(d) Enzymes require optimum pH and temperature for maximum activity. *(Karnataka NEET 2013)*

69. The curve given below shows enzymatic activity in relation to three conditions (pH, temperature and substrate concentration).



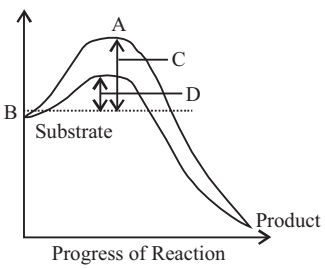
What do the two axes (*X* and *Y*) represent?

	***X*-axis**	***Y*-axis**
(a)	Enzymatic activity	pH
(b)	Temperature	Enzyme activity
(c)	Substrate concentration	Enzymatic activity
(d)	Enzymatic activity	Temperature

(2011)

70. Three of the following statements about enzymes are correct and one is wrong. Which one is wrong?
(a) Enzymes require optimum pH for maximal activity.
(b) Enzymes are denatured at high temperature but in certain exceptional organisms they are effective even at temperatures 80° - 90°C.
(c) Enzymes are highly specific.
(d) Most enzymes are proteins but some are lipids.
(Mains 2010)

71. The figure given below shows the conversion of a substrate into product by an enzyme. In which one of the four options (A-D) the components of reaction labelled as A, B, C and D are identified correctly?



	A	**B**	**C**	**D**
(a)	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
(b)	Transition state	Potential energy	Activation energy without enzyme	Activation energy with enzyme
(c)	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
(d)	Activation energy with enzyme	Transition state	Activation energy without enzyme	Potential energy

(Mains 2010)

72. A competitive inhibitor of succinic dehydrogenase is
(a) α-ketoglutarate (b) malate
(c) malonate (d) oxaloacetate. *(2008)*

73. Modern detergents contain enzyme preparations of
(a) thermoacidophiles
(b) thermophiles
(c) acidophiles
(d) alkaliphiles. *(2008)*

74. An organic substance bound to an enzyme and essential for its activity is called
(a) isoenzyme (b) coenzyme
(c) holoenzyme (d) apoenzyme. *(2006)*

75. The catalytic efficiency of two different enzymes can be compared by the
(a) formation of the product
(b) pH of optimum value
(c) K_m value
(d) molecular size of the enzyme. *(2005)*

76. Which one of the following statements regarding enzyme inhibition is correct?
(a) Competitive inhibition is seen when a substrate competes with an enzyme for binding to an inhibitor protein.
(b) Competitive inhibition is seen when the substrate and the inhibitor compete for the active site on the enzyme.
(c) Non-competitive inhibition of an enzyme can be overcome by adding large amount of substrate.
(d) Non-competitive inhibitors often bind to the enzyme irreversibly. *(2005)*

77. Enzymes, vitamins and hormones can be classified into a single category of biological chemicals, because all of these
(a) help in regulating metabolism
(b) are exclusively synthesized in the body of a living organism as at present
(c) are conjugated proteins
(d) enhance oxidative metabolism. *(2005)*

78. In which one of the following enzymes, is copper necessarily associated as an activator?
(a) Carbonic anhydrase
(b) Tryptophanase
(c) Lactic dehydrogenase
(d) Tyrosinase *(2004)*

79. Role of an enzyme in reactions is to/as
(a) decrease activation energy
(b) increase activation energy
(c) inorganic catalyst
(d) none of the above. *(2000)*

80. Which factor is responsible for inhibition of enzymatic process during feedback?
(a) Substrate (b) Enzymes
(c) End product (d) Temperature
(2000)

81. Enzymes are not found in
(a) fungi (b) algae
(c) virus (d) cyanobacteria.
(2000)

82. Co-factor (prosthetic group) is a part of holoenzyme. It is
(a) loosely attached organic part
(b) loosely attached inorganic part
(c) accessory non-protein substance attached firmly
(d) none of these. *(1997)*

83. Which is a typical example of 'feedback inhibition'?
(a) Cyanide and cytochrome reaction
(b) Sulpha drugs and folic acid synthesizer bacteria
(c) Allosteric inhibition of hexokinase by glucose 6-phosphate
(d) Reaction between succinic dehydrogenase and succinic acid *(1996)*

84. Enzymes having slightly different molecular structure but performing identical activity are
(a) holoenzymes (b) isoenzymes
(c) apoenzymes (d) coenzymes. *(1991)*

ANSWER KEY

1.	(c)	**2.**	(d)	**3.**	(d)	**4.**	(a)	**5.**	(a)	**6.**	(b)	**7.**	(d)	**8.**	(a)	**9.**	(d)	**10.**	(d)
11.	(c)	**12.**	(a)	**13.**	(b)	**14.**	(d)	**15.**	(a)	**16.**	(c)	**17.**	(c)	**18.**	(d)	**19.**	(d)	**20.**	(c)
21.	(d)	**22.**	(b)	**23.**	(a)	**24.**	(c)	**25.**	(a)	**26.**	(b)	**27.**	(a)	**28.**	(b)	**29.**	(c)	**30.**	(d)
31.	(c)	**32.**	(a)	**33.**	(a)	**34.**	(b)	**35.**	(a)	**36.**	(d)	**37.**	(b)	**38.**	(c)	**39.**	(a)	**40.**	(d)
41.	(a)	**42.**	(d)	**43.**	(a)	**44.**	(c)	**45.**	(d)	**46.**	(d)	**47.**	(b)	**48.**	(b)	**49.**	(d)	**50.**	(*)
51.	(d)	**52.**	(b)	**53.**	(c)	**54.**	(d)	**55.**	(c)	**56.**	(a)	**57.**	(a)	**58.**	(a)	**59.**	(d)	**60.**	(b)
61.	(a)	**62.**	(b)	**63.**	(b)	**64.**	(b)	**65.**	(b)	**66.**	(a)	**67.**	(b)	**68.**	(b)	**69.**	(b)	**70.**	(d)
71.	(b)	**72.**	(c,d)	**73.**	(d)	**74.**	(b)	**75.**	(c)	**76.**	(b)	**77.**	(a)	**78.**	(d)	**79.**	(a)	**80.**	(c)
81.	(c)	**82.**	(c)	**83.**	(c)	**84.**	(b)												

*None of the options is correct.

Hints & Explanations

1. (c) : Glutamic aid valine and tyrosine are acidic, neutral and aromatic acid respectively.

2. (d) : Carbohydrates (commonly called sugars) are chemically defined as polyhydroxy aldehyde or ketones. All sugar molecules have one carbonyl group (–CO–) in addition to hydroxyl group (OH) on other carbon atoms.

3. (d) : Neutral or true fats are triglycerides which are formed by esterification of three molecules of fatty acids with one molecule of trihydric alcohol, glycerol (glycerine or trihydroxy propane).

4. (a) : Phosphoglycerides are the triesters of fatty acids (either saturated or unsaturated) and glycerol to which a phosphate group is also attached.

5. (a) : A nucleoside is pentose sugar and base together, without the phosphate group. Uracil is present as uridine in RNA only.

$$\text{Uracil} + \text{Ribose} \rightarrow \text{Uridine}$$

6. (b) : Basic amino acids have an additional amino group without forming amides, thus they are diamino monocarboxylic acids *e.g.*, arginine, lysine, etc.

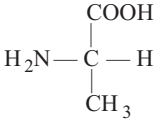
7. (d) : The given structure corresponds with the structure of ribose sugar. As it lacks a phosphoric acid hence it can be a nucleoside not a nucleotide.

8. (a) : Lecithin is a triglyceride lipid where one fatty acid is replaced by phosphoric acid which is linked to additional nitrogenous group called choline. It is a common membrane lipid. It is an amphipathic phospholipid having both hydrophilic polar and hydrophobic non-polar groups. The hydrocarbon chains of two fatty acids function as hydrophobic non-polar tails whereas the phosphate and choline behave as hydrophilic polar head group of the molecule.

Palmitic acid is a saturated fatty acid (as it does not possess double bonds in its carbon chain) and contains 16 carbon atoms with formula $C_{16}H_{32}O_2$.

Adenylic acid or adenosine monophosphate is a nucleotide formed by union of adenine (nitrogenous base), ribose (pentose sugar) and phosphate. It is formed through phosphorylation of nucleoside as phosphate combines with sugar molecule at its 5′ carbon atom.

Amino acids are organic acids with carboxylic group (–COOH) having amino group ($-NH_2$) generally attached to α-carbon or carbon next to carboxylic group. Alanine is a nonpolar and neutral amino acid having one methyl group and having amino group attached to carbon next to carboxylic group.

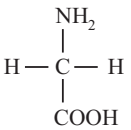


Alanine

9. (d) : 'A' is a structural formula of lecithin. It is probably the most common phospholipid. Phospholipids are major components in the lipid bilayers of cell membrane.

10. (d) : Living organisms requires 6 elements in relatively large amounts. C, H, O, N, P, S. These elements contribute to the structural organization of living organisms.

11. (c) : Glycine is considered as the simplest amino acid as it has one amino group, one carboxylic group and no substituent functional group.



12. (a) : Minor elements are those which are required in quantity of less than milligram/gram of dry matter but they are essential for proper growth and development of an organism *e.g.*, Cl, Mn, B, Zn, Cu, Mo, etc. These elements work as non-protein cofactor in enzymes *e.g.*, Zn, Cu etc. They also take part in oxidation reduction reactions *e.g.*, Cu, with variable valency. Chloride ion enhances activity of salivary amylase. Zinc is required for activity of carbonic anhydrase and alcohol dehydrogenase, etc.

13. (b) : Lipid molecules are insoluble or sparingly soluble in water but are freely soluble in organic solvents like ether, alcohol and benzene. Insolubility of lipids in water is due to the fact that the polar groups they contain are much smaller than their nonpolar portions. The nonpolar chains are long complex hydrophobic hydrocarbon chains. If shaken in water lipids often form small droplets or micelles. The complex formed is called emulsions. These non polar proteins give them water repellent or hydrophobic property.

14. (d) : Erucic acid is an unsaturated fatty acid belonging to the oleic acid series, occurring as glycerides in rapeseed oil and other vegetable oils. It is the *cis*-isomer, the *trans*-isomer is known as brassidic acid. Erucic acid is used as a binder for oil paints. It is useful in manufacture of emulsions to coat photographic films and papers. Spoilage of oil can be detected by erucic acid. Oleic acid is found in various animal and vegetable sources. It is widely used in industries including textile, chemical, medicine, leather, stationary, paper making, etc. Linolenic acid is used in making soaps, emulsifiers and quick-drying oils, in beauty products. It helps in acne reduction, moisture retention, etc. Linoleic acid is an important fatty acid especially for growth and development of infants. Commercially it is used in margarine, animal feeds, soaps and drugs.

15. (a) : Essential amino acids are those amino acids that must be ingested in food for survival as they are not synthesized in the body. There are 7 essential amino

acids. Glycine, aspartic acid and serine are non-essential amino acids as they can be synthesized in the body.

16. (c) : Proteins show enormous diversity because of different proportions and sequences of twenty amino acid within the protein molecule. A large number of permutations and combinations of these amino acids are responsible for the unlimited variety of proteins. Proteins are the most abundant and most varied of the macromolecules having one or more polypeptides (chains of amino acids). The proteins constitute almost 50% of the total dry weight of the cell. Proteins may be simple or conjugated. Among conjugated, proteins may be phosphoprotein, glycoprotein, nucleoprotein, chromoprotein, lipoprotein, flavoprotein, metallo protein, etc. Functionally, proteins may be structural protein, enzymes, hormones, respiratory pigment, etc.

17. (c) : Carbon, hydrogen, oxygen and nitrogen are called four big elements of living body. They make up about 99% of the mass of most cells. As C, H, O and N are lightest elements so the bonds they form are the strongest covalent bonds. So that the compounds formed are stable, varied in size and shapes. Carbon constitutes more than 50% of the dry matter. It has been observed that human body contains 0.5% hydrogen, 18.5% carbon, 65% oxygen and 3.3% nitrogen. Other elements are present in very lesser amount.

18. (d) : Amino acids are mostly synthesised from α-ketoglutaric acid. These are the precursors of amino acids. A five carbon compound formed during Krebs' cycle is α-ketoglutaric acid which is the first dicarboxylic acid formed. Pyruvic acid converted into alanine, α-ketoglutaric acid into glutamic acid, OAA into aspartic acid, polymerization of such amino acids results into formation of proteins.

19. (d) : Water is the most abundant substance of living beings. The water content of actively living cells varies between 60–95%. In human beings, maximum water content found in the embryo is 90–95%. Water content decreases thereafter in adult and the aged where it is 65-70%.

20. (c) : Nicotine, strychnine and caffeine are the examples of alkaloids. These are produced by plants and are used by them in their defense against herbivores and pathogens.

21. (d) : Concanvalin A, a lectin is a secondary metabolite, which has no direct function in growth and development of plants, rather are found at particular stages of development.

22. (b) : Collagen is the most abundant protein in animal world. RuBisCO is the most abundant protein in the world of the bisphere.

23. (a) : GLUT stands for glucose transport protein channel. They are of different types. Glucose transporter type 4 (GLUT IV) is a protein encoded in humans by the SLC2A4 gene. It is insulin regulated glucose transporter found primarily in adipose tissues and striated muscles.

24. (c) : Collagen is an insoluble fibrous protein found extensively in the connective tissue of skin, tendons and bone. Collagen accounts for over 30% of the total body proteins of mammals and it is the most abundant animal protein.

25. (a) : Glycoproteins are proteins that contain sugars like carbohydrates as prosthetic group. In most glycoproteins, the linkage is between asparagine and N-acetyl-D-glucosamine. Some glycoproteins are immunoglobulins, membrane proteins and muscle proteins. Lipoproteins are protein complexed with lipids like triglycerides, phospholipids etc. Nucleoproteins are proteins associated with nucleic acids and chromoproteins are proteins associated with pigments *e.g.*, cytochrome, phytochrome.

26. (b) : Glycine is a neutral amino acid. Cysteine and methionine are sulphur containing amino acid.

27. (a) : Chitin is a structural polysaccharide that constitutes the exoskeleton of arthropods. It is a complex carbohydrate in which N-acetyl glucosamine monomers are joined together by (1, 4) β-linkages. Chitinous exoskeleton provides strength and elasticity to arthropods.

28. (b) : In non-reducing sugars, a free aldehyde or ketonic group is absent. Sucrose is a non-reducing sugar formed by condensation of one molecule each of glucose and fructose with release of a water molecule. A glycosidic bond is established between carbon atom 1 of glucose and carbon atom 2 of fructose.

29. (c) : *Refer to answer 27.*

30. (d) : Starch is the major storage carbohydrate of plants. In most plant species, it is accumulated in the chloroplast of leaves, whereas in storage organ it accumulates in amyloplast as reserve starch. It is the osmotically inactive form of photosynthetic product and is a hexosan polysaccharide made of large number of glucose unit so, chemically non-reactive.

31. (c) : The cell wall of most fungi consist of chitin or cellulose. In *Pythium,* the hyphal wall contains cellulose whereas, in yeast the cell wall is thin and is composed of chitin in combination with other compounds (carbohydrates, glucan and mannan). The bacterial cell wall contains N-acetyl glucosamine and N-acetyl muramic acid.

32. (a) : Carbohydrates are organic compounds synthesized in the chlorophyll containing cells of some bacteria, algae and green plant cells, during photosynthesis. Certain photoautotrophic bacteria *e.g.*, Green sulphur bacteria and purple sulphur bacteria contain pigments like chlorobium chlorophyll and

bacteriochlorophyll respectively that helps them in photosynthesis.

33. (a) : All those sugars which have free aldehyde or ketone group are called reducing sugars. These are able to reduce cupric ions (Cu^{+2}) into cuprous ions (Cu^{+}). Sucrose, starch are non-reducing sugars.

34. (b) : Cellulose is the most abundant carbohydrate. Cellulose molecule is composed of 1600 to 6000 glucose molecules joined together. Those polymers form long twisting macromolecules of cellulose. The chains are unbranched and linear. The successive glucose residues are joined together by β-1-4, linkages.

35. (a) : Lactose is popularly known as milk sugar. It is a disaccharide composed of one molecule of glucose and one molecule of galactose. The covalent bond that joins these two monosaccharide units is called glycosidic bond or glycosidic linkage. It is a reducing sugar.

36. (d) : Polysaccharides are complex long chain carbohydrates which are formed by dehydrate synthesis or polymerisation of more than 10 but generally very large number of units called monosaccharides. Starch, glycogen and cellulose are all polysaccharides. Starch is a glucosan homopolysaccharide which is the main reserve food of plants. Glycogen is also a glucosan homopoly-saccharide which is the major reserve food of fungi, animals and some bacteria. It is also called animal starch. Cellulose is the structural polysaccharide of plant cell walls, some fungi, protists. It is a fibrous glucosan homopolysaccharide of high tensile strength.

37. (b) : Glycogen (animal starch) is a polysaccharide consisting of a highly branched polymer of glucose occurring in animal tissues, especially in liver and muscle cells. It is the major store of carbohydrate energy in animal cells.

38. (c) : Lipids are fatty acids esters of alcohols and related substances. Polysaccharides are polymers of monosaccharides. Proteins are polymers of amino acids and nucleic acids are polymer of nucleotides.

39. (a) : Each nucleotide consists of three distinct units - a phosphate group derived from phosphoric acid, a pentose sugar and a ring shaped nitrogenous base.

Nucleoside + Phosphoric acid → Nucleotide + H_2O

40. (d) : The bases are of two types-purines and pyrimidines. The purine derivatives adenine (A) and guanine (G) are double ring structures whereas pyrimidine derivatives thymine, cytosine and uracil are single ring structures. Thymine (T) and cytosine (C) are found in DNA and cytosine (C) and uracil (U) is found in RNA.

41. (a) : In the given question there are 4 pyrimidines as 2 cytosine and 2 thymine in option '*a*'.

42. (d) : *Refer to answer 40.*

43. (a) : *Refer to answer 40.*

44. (c) : Nucleotide is an organic compound consisting of a nitrogen-containing purine or pyrimidine base linked to a sugar (ribose or deoxyribose) and a phosphate group.

45. (d) : DNA is the largest macromolecule in the organisms. It is a long, double chain of deoxy-ribonucleotide or deoxyribotide units. The two deoxyribonucleotide chains are twisted around a common axis to form a right-handed double helix (spiral) that encloses a cylindrical space in it. Each deoxyribonucleotide unit, in turn, consists of three different molecules : phosphate, ($PO^3{}_4^-$), a 5-carbon deoxyribose sugar ($C_5H_{10}O_4$) and a nitrogenous base.

46. (d) : The nucleic acids (DNA and RNA) are the molecules having complex structure and very high molecular weights. The nucleic acid is composed of a large number of nucleotide molecules joined into a linear, unbranched chain. Nucleotide is an organic compound consisting of a nitrogen-containing purine or pyrimidine base linked to a sugar (ribose or deoxyribose) and a phosphate group.

47. (b)

48. (b)

49. (d) : Tertiary structure or three dimensional structure of protein is stabilised by several types of bonds—hydrogen bonds, ionic bonds, van der Waal's interactions, covalent bonds and hydrophobic bonds.

50. None of the options is correct.

A - Serine	(Neutral - Polar)
B - Cysteine	(Neutral - Polar)
C - Tyrosine	(Neutral - Polar)
D - Not an amino acid	

51. (d) : Inulin is a polymer of fructose (polysaccharide). In a polysaccharide the individual monosaccharides are linked by a glycosidic bond. While insulin is a polymer of amino acids linked by a peptide bond.

52. (b)

53. (c) : One complete turn of a DNA double helix is 34Å long and has 10 base pairs.

54. (d) : According to Chargaff's rules, the amount of adenine is always equal to that of thymine and the amount of guanine is always equal to that of cytosine *i.e.*, A = T (120) and G = C (120), therefore, the total number of nucleotides would be 120 × 4 = 480.

55. (c) : The density of DNA decreases on heating as hydrogen bonds breakdown. According to Chargaff's rules, the amount of adenine is always equal to that of thymine and the amount of guanine is always equal to that of cytosine *i.e* A = T and G = C. The base ratio A + T/ G + C may vary form species to species, but is constant for a given species.

56. (a) : According to Watson-Crick model, the DNA molecule consists of two long, parallel chains which are

joined together by short crossbars at regular intervals. The two chains are spirally coiled around a common axis in a regular manner to form a right handed double helix.

57. (a) : ATP is a nucleotide as it is composed of adenine, ribose sugar and phosphoric acid. There are two additional phosphate groups attached to the phosphate group of AMP. The last two phosphate molecules are connected by high energy bonds.

58. (a)

59. (d) : Enzymes could be simple or conjugated (holoenzyme). Conjugated enzymes are formed of two parts - a protein part called apoenzyme and a non-protein part named co-factor. Co-factors are bound to the enzyme to make it catalytically active. There are three types of cofactors : prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and are distinguished from other cofactors in which they are tightly bound to the apoenzyme. Co-enzymes are organic compounds but their association with the apoenzyme is only transient, occurring during the course of catalysis. A number of enzymes require metal ions for their activity which form coordination one or more coordination bonds with the substrate.

60. (b)

61. (a) : Holoenzyme is the complete conjugate enzyme consisting of an apoenzyme and a cofactor. Cofactor may be organic or inorganic in nature. Organic cofactors are of two types-coenzyme and prosthetic group.

62. (b) : A ribozyme is a ribonucleic acid (RNA) enzyme that catalyses a chemical reaction in a similar way to that of a protein enzyme. These are found in ribosomes and are also called catalytic RNAs.

63. (b)

64. (b) : Competitive inhibition is a reversible inhibition where inhibitor competes with the normal substrate for the active site of enzyme. A competitive inhibitor is usually chemically similar to the normal substrate and therefore, fits into the active site of an enzyme and binds with it. The inhibition is thus due to substrate analogue. The enzyme, now cannot act upon the substrate and reaction products are not formed. *E.g.*, the activity of succinate dehydrogenase is inhibited by malonate. K_m value or Michaelis constant is defined as the substrate concentration at which half of the enzyme molecules are forming enzyme substrate (ES) complex or concentration of the substrate when the velocity of the enzyme reaction is half the maximal possible. A smaller K_m value indicates greater affinity of the enzyme for its substrate, hence, shows a quicker reaction. The competitive inhibitor decreases the affinity of enzyme for substrate, thus increases the K_m value.

65. (b) : The reduction of activity of succinate dehydrogenase by malonate is an example of competitive inhibition. Competitive inhibition is a reversible inhibition where inhibitor competes with the normal substrate for the active site of enzyme. A competitive inhibitor is usually similar to the normal substrate and therefore, fits into the active site of an enzyme and binds with it. The enzyme, now cannot act upon the substrate and reaction products are not formed. Hence, action of an enzyme may be reduced or inhibited. Since a competitive inhibitor occupies the site only temporarily, the enzyme action is not permanently affected. Thus, addition of a lot of succinate can reverse the inhibition of succinate dehydrogenase by malonate.

66. (a) : Transition state is formation of unstable intermediate structural state. During this, substrate bonds are broken and new bonds are established that transform the substrate molecules into products. This state is transient and highly unstable.

67. (b) : Coenzyme is the non protein organic group which gets attached to the apoenzyme to form holoenzyme or conjugate enzyme. It helps in removing a product of chemical reaction besides bringing contact between the substrate and the enzyme. Most of the coenzymes are made of water soluble vitamins B and C, *e.g.*, thiamine, riboflavin, nicotinamide, pyridoxine.

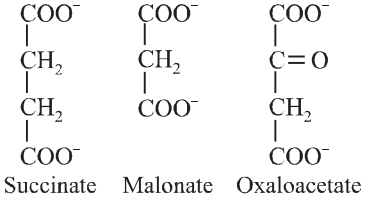
68. (b) : Enzymes are mostly proteins but some are RNA (ribozymes). No lipid working as enzymes are known.

69. (b) : Enzymes generally function in a narrow range of temperature and pH. Each enzyme shows its highest activity at a particular temperature and pH called the optimum temperature and optimum pH. Activity declines both below and above the optimum values. X-axis always represents temperature or pH and Y axis represents enzyme activity.

70. (d) : *Refer to answer 68.*

71. (b)

72. (c, d) : Malonate or oxaloacetate, which resemble succinate in structure and inhibit the activity of succinate dehydrogenase. Such competitive inhibitors are often used in control of bacterial pathogen.



73. (d) : Modern detergents contain enzyme preparation of alkaline protease which are called alkaliphiles, for removing protein stain.

74. (b) : Enzymes are simple if they are made of only proteins (*e.g.*, pepsin, amylase, etc.) while conjugate enzymes have an additional non-protein cofactor which may be organic or inorganic. Loosely attached organic

cofactor is coenzyme. It plays an accessory role in enzyme catalyzed processes often by acting as a donor or acceptor of a substance involved in the reaction. ATP and NAD are common coenzymes.

75. (c) : K_m value or Michaelis constant is defined as the substrate concentration at which half of the enzyme molecules are forming (ES) complex or concentration of the substrate when the velocity of the enzyme reaction is half the maximal possible. The K_m varies from enzyme to enzyme and is used in characterizing the different enzymes. A smaller K_m value indicates greater affinity of the enzyme for its substrate, hence, shows a quicker reaction. K_m value is a constant characteristic of an enzyme for its conversion of a substrate.

76. (b)

77. (a) : Enzymes control all the life processes. They increase the rate of a biological reaction. The magnitude of increase may be greater than those affected by other catalysts.

Vitamins are accessory indispensable food factor, organic in nature (organic acid, amino acid, esters, alcohols, steroids, etc.) required by an organism in small amounts to maintain normal growth and regulate the metabolic processes.

Hormones are biologically active organic substance that are produced in minute quantities by some specialized organs and exert physiological effects at sites far from their origin.

78. (d) : Copper is associated as an activator with tyrosinase. It is widely distributed in plants, animals and man. It is also known as polyphenol oxidase or catecholase. It oxidizes tyrosine to melanin in mammals and causes the cut surfaces of many fruits and vegetable to darken.

79. (a) : All molecules require certain amount of energy for activation (to overcome energy barrier) before they can react. This energy is called activation energy. This energy is recovered when products are formed. The essence of an enzyme is its ability to speed up (catalyze) a reaction by making or breaking specific covalent bonds (bonds in which atoms are held together by sharing of electrons). Enzymes act by somehow lowering the temperature at which a given bond is unstable *i.e.*, they speed up a reaction by lowering the activation energy. It is the magnitude of the activation energy which determines how fast the reaction will proceed.

80. (c) : Feedback inhibition or end product inhibition is the inhibition of the activity of an enzyme catalysing some early reactions of the series by the end product of the metabolic pathway.

For example, a substrate A is converted into a product F through B, C, D and E intermediate products. As the concentration of end product F increases, it diffuses to allosteric enzyme (E_1) causing a reduced synthesis of the product B which in turn lowers the rate of enzymatic reactions in rest of the pathway.

81. (c) : Viruses do not have enzymes so they cannot synthesize proteins. They multiply only inside the living host cell and for multiplication and metabolism they take over the machinery of the host cell. They lack their own cellular machinery and enzymes.

82. (c)

83. (c) : Feedback inhibition or end product inhibition occurs when the end product of a metabolic pathway inhibits the activity of an enzyme catalysing some early reactions of the series. The end product is the inhibitor and the enzyme inactivated is called allosteric enzyme. The enzyme is regulated by modulators that bind non-covalently at site other than the active site. An example of feedback inhibition is the inhibition of the activity of the enzyme hexokinase by glucose 6-phosphate in glycolysis. This enzyme catalyses conversion of glucose into glucose 6-phosphate but as the reaction proceeds, increase in concentration of glucose 6-phosphate inhibits the activity of hexokinase.

84. (b) : Enzymes having slightly different molecular structures but performing identical activities are called isoenzymes. Over 100 enzymes are known to have isoenzymes.

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