Biomolecules

Standard difficulty · 20 questions · 40 marks · Time: 36 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer 8 × 1 = 8 marks

1. The bond that joins two amino acids is a:
   (a) phosphodiester bond **(b)** ester bond
   (c) glycosidic bond **(d)** peptide bond

2. In a sample of double-stranded DNA, 38% of the bases are adenine. The percentage of guanine is:
   (a) 12% **(b)** 62% **(c)** 38% **(d)** 76%

3. A protein made of 3 polypeptide chains has 153 amino acids in all. How many peptide bonds does it have?
   (a) 153 **(b)** 154 **(c)** 152 **(d)** 150

4. Sucrose is:
   (a) a phospholipid **(b)** a polysaccharide of fructose
   (c) a monosaccharide (pentose) **(d)** a disaccharide

5. Enzymes that catalyse joining two compounds, such as by C–O, C–S, C–N or P–O bonds are:
   (a) transferases **(b)** ligases **(c)** lyases **(d)** hydrolases

6. Aspartic acid is a:
   (a) acidic amino acid **(b)** aromatic amino acid
   (c) basic amino acid **(d)** neutral amino acid

7. A double-stranded DNA molecule has 1,000 base pairs. Its length is about: (distance between base pairs 0.34 nm)
   (a) 34,000 nm **(b)** 680 nm **(c)** 340 nm **(d)** 34 nm

8. Assertion (A): If 23% of the bases in double-stranded DNA are adenine, 23% are guanine.
   Reason (R): In double-stranded DNA, A pairs with T and G with C, so A = T and G = C.
   (a) Both A and R are true, and R is the correct explanation of A.
   (b) Both A and R are true, but R is not the correct explanation of A.
   (c) A is true, but R is false.
   (d) A is false, but R is true.

Section B — Short answer 8 × 2 = 16 marks

9. What is the difference between a nucleoside and a nucleotide?

10. A double-stranded DNA segment has 500 base pairs, and 15% of its bases are adenine. How many of each base does it have?

11. A DNA segment has 112 A–T base pairs and 159 G–C base pairs. How many hydrogen bonds hold its two strands together?

12. Find the molecular mass of a tripeptide made of lysine, aspartic acid, alanine (masses 146, 133, 89 Da). (Water = 18 Da)

13. What kind of biomolecule is adenine?

14. Name the class of enzymes that catalyse interconversion of optical, geometric or positional isomers.

15. A DNA molecule has 46,000 base pairs. Find its length in nm and its number of turns of the helix. (0.34 nm per base pair; 10 base pairs per turn)

16. Is tyrosine an acidic, basic, neutral or aromatic amino acid?

Section C — Word problems — 4 × 4 = 16 marks

17. Describe the levels of structure of a protein.

18. A double-stranded DNA molecule has 5,000 base pairs, and 28% of its bases are adenine. Find (a) the number of each base, (b) the number of hydrogen bonds, (c) its length in nm and (d) its number of turns.

19. A tetrapeptide is made of leucine, threonine, aspartic acid, phenylalanine (masses 131, 119, 133, 165 Da). (a) How many peptide bonds does it have? (b) How many water molecules are released when it forms? (c) Find its molecular mass. (d) Which level of protein structure does the order of these amino acids describe?

20. Classify these biomolecules: uracil, glucose, chitin, starch, adenine.

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Answer key

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Q	Answer	Working
1	**(d) peptide bond**	—
2	**(a) 12%**	A = T = 38%; G = C = (100 − 76) ÷ 2 = 12%
3	**(d) 150**	each chain of k amino acids has k − 1 peptide bonds
4	**(d) a disaccharide**	—
5	**(b) ligases**	—
6	**(a) acidic amino acid**	—
7	**(c) 340 nm**	1,000 × 0.34 nm
8	**(d) A is false, but R is true.**	A is false: G = (100 − 2 × 23) ÷ 2 = 27%. R is true.
9	**A nucleoside is a nitrogenous base joined to a sugar (adenosine). A nucleotide also has a phosphate group (adenylic acid).**	—
10	**A 150, T 150, G 350, C 350**	1,000 bases; A = T = 15%; G = C = 35%
11	**701**	112 × 2 + 159 × 3
12	**332 Da**	368 − 2 × 18 (two water molecules leave as two peptide bonds form)
13	**A purine base**	—
14	**Isomerases**	—
15	**15,640 nm; 4,600 turns**	46,000 × 0.34 nm; 46,000 ÷ 10
16	**Aromatic**	—
17	**Primary: the sequence of amino acids, from the N-terminal to the C-terminal. Secondary: the chain folds into a helix (mostly right-handed) or a sheet, held by hydrogen bonds. Tertiary: the helix folds on itself into a 3-D shape, which gives the protein its biological activity. Quaternary: several folded chains (subunits) arranged together, as in haemoglobin with two alpha and two beta subunits.**	—
18	**(a) A = T = 2,800, G = C = 2,200; (b) 12,200; (c) 1,700 nm; (d) 500**	A–T pairs 2,800 (2 hydrogen bonds each), G–C pairs 2,200 (3 each); 0.34 nm and 10 base pairs per turn
19	**(a) 3; (b) 3; (c) 494 Da; (d) the primary structure**	548 − 3 × 18
20	**uracil: a pyrimidine base found in RNA; glucose: a monosaccharide; chitin: a complex polysaccharide (heteropolymer); starch: a**	—

Q	Answer	Working
	polysaccharide (homopolymer); **adenine: a purine base**	

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