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(November)

BIO-CHEMISTRY

(Honours)

(BCHEM–101)

(Biomolecules and Biophysical Techniques)

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks for the questions*

Answer **four** questions, taking at least **one** from each Part

PART—A

1. *(a)* Draw the structure of water molecule. 2

   (b) Explain why water is an effective solvent. 2

   (c) Why does the pH scale range from 0 to 14 at 25 °C? 4

   (d) Calculate the concentration of H^+ in a solution of $0.1\ M$ NaOH. 3

   (e) Which of the aqueous solutions has the lowest pH—$0.1\ M$ HCl; $0.1\ M$ acetic acid $(pK_a = 4.86)$; $0.1\ M$ formic acid $(pK_a = 3.75)$? 3

(Turn Over)

2. (a) How do epimers differ from anomers?   3

    (b) Draw the Haworth perspective formulas of the α- and β-form of D-glucose. What features distinguish the two forms?   3+1=4

    (c) How are glycosidic bonds formed? Write the structure of sucrose. Why is sucrose called a non-reducing sugar?   2+3+2=7

3. (a) Explain the difference between a hemiacetal and a glycoside.   2

    (b) How does 'chain' form of glucopyranose differ from its 'boat' form?   3

    (c) The structure of the amino acid isoleucine is

$$\begin{array}{c} COO^- \\ | \\ H_3\overset{+}{N}-C-H \\ | \\ H-C-CH_3 \\ | \\ CH_2 \\ | \\ CH_2 \end{array}$$
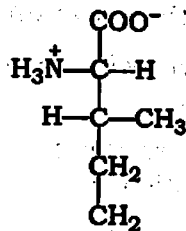
      (i) How many chiral centers does it have?

      (ii) How many possible optical isomers does isoleucine have?   1+2=3

      (Continued)

    (d) How many types of amino acids can be classified on the basis of polarity and charge (at pH 7·0) of their R-group? Name them.   1+2=3

    (e) How are peptide bonds formed? What properties do peptide bonds have?   1+2=3

4. (a) How do you define the primary, secondary, tertiary and quaternary structures of proteins?   5

    (b) Name the two most common secondary structures.   2

    (c) Define the following :   1½+1½+2+2=7

      (i) Protein motif

      (ii) Supersecondary structures

      (iii) Fibrous proteins

      (iv) Globular proteins

5. (a) What are fatty acids? How are they classified?   2+3=5

    (b) Draw the chemical structure and name the following abbreviations :   3

      (i) 16 : 0

      (ii) 16 : 1 (Δ^9)

    (c) What is Chargaff rule?   2

      (Turn Over)

(d) What is Z-DNA? How is it different from B-DNA? 1+3=4

Or

Why is RNA not a stable molecule compared to DNA? 4

Or

What is T_m? Describe the factors that influence T_m during denaturation of DNA. 1+3=4

PART—B

6. (a) What physical characteristics of a biomolecule influences its movement in an electrophoresis matrix? 5

(b) A protein has a molecular mass of 400 kDa when measured by gel filtration. When subjected to SDS-PAGE, the protein gives three bands with molecular mass of 180, 160 and 60 kDa. When electrophoresis is carried out in presence of SDS and dithiothreitol, three bands are again formed with molecular masses of 160, 90 and 60 kDa. Determine the subunit composition of the protein. 3

(c) Define sedimentation coefficient. 3

(d) An enzyme has sedimentation coefficient of 3·5 S. When substrate molecule is found into the active site of the enzyme, the sedimentation coefficient decreases to 3·0 S. Explain this change. 3

7. (a) What is the principle behind the separation of protein of different masses in gel filtration chromatography? 6

(b) State the Beer-Lambert law. 3

(c) Define molar absorption coefficient. 2

(d) The absorbance A of a $5 \times 10^{-4} M$ solution of the amino acid tyrosine at wavelength of 280 nm is 0·75. The path length of the cuvette is 1 cm. What is the molar absorption coefficient ε? 3

8. (a) What are isotopes and radioisotopes? 3

(b) State the differences between α(alpha) and β(beta) rays. 3

(c) What are the units of radioactivity? 3

(d) Define the term 'half-life'. 2

(e) C^{14} has a half-life of 5700 years. Calculate the fraction of the C^{14} atmos that decays per year. 3

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