



Name :

Roll No. :

Invigilator's Signature :

CS/B. TECH (BT)/SEM-3/BT-303/2010-11

2010-11

STRUCTURAL CHEMISTRY OF BIOMOLECULES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following :

10 × 1 = 10

- i) The complementary of DNA sequence 5' ATTGGCA3' is
- a) 5'TAACCGT3' b) 3'TAACCGT5'
- c) 3'ATACCTG5' d) 5'ATACCTG3'.
- ii) The chemical bond present in all proteins is
- a) Phosphodiester bond
- b) Peptide bond
- c) Glycosidic bond
- d) N₂ bond.



- iii) Molecular weight of an unknown protein can be found out by
- a) SDS Polyacrylamide Gel Electrophoresis
 - b) Ion Exchange Chromatography
 - c) Affinity Chromatography
 - d) None of these techniques.
- iv) Cleavage of the following peptide with Chymotrypsin
H₂N-Gly-Arg-Ala-Ser-Phe-Gly-Asn-Lys-Trp-Glu-Val-COOH
results in
- a) 2 fragments
 - b) 3 fragments
 - c) 4 fragments
 - d) no cleavage.
- v) Which of the following amino acids is unable to form proper peptide bond ?
- a) Valine
 - b) Cysteine
 - c) Arginine
 - d) Proline.
- vi) The length of α -helical section of a polypeptide chain of 20 residues would be
- a) 30 Å
 - b) 20 Å
 - c) 5.4 Å
 - d) 3.6 Å.



vii) Which pair of the amino acid residues can interact in the interior of a protein only through van der Waals forces ?

- a) Arg, Thr
- b) Ser, Thr
- c) Glu, His
- d) Val, Leu.

viii) RNA is very much susceptible to hydrolysis in alkali because

- a) it contains uracil residues in its structure
- b) its 2'-OH group participates in intramolecular cleavage of phosphodiester backbone.
- c) cleavage occurs in the glycosidic bonds of purine bases
- d) cleavage occurs in the glycosidic bonds of pyrimidine bases.

ix) For a double stranded DNA, which of the following statements is wrong ?

- a) A/T ratio is constant
- b) G is always equal to C
- c) $A+T = G+C$
- d) $(A + G) / (C + T)$ ratio is constant.

x) Which of the following amino acids does not contribute to fluorescence of a protein ?

- a) Tyrosine
- b) Phenyl alanine
- c) Cysteine
- d) Tryptophan.



- xi) N-terminal amino acids are usually determined by Sanger's method using
- a) Ninhydrin reagent
 - b) 2, 4 dinitrofluorobenzene
 - c) Hydrazine
 - d) Concentrated Nitric Acid.
- xii) The Michaelis-Menten constant K_m is a measure of
- a) the rate of the reaction
 - b) the affinity of the enzyme for the substrate
 - c) the concentration of the enzyme-substrate (ES) intermediate
 - d) none of these.

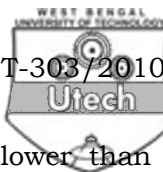
GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following.

3 × 5 = 15

2. Define amphipathic molecule with an example. Briefly describe the structures of wax and glycogen. 2 + 3



3. The latent heat of melting of ice is much lower than the latent heat of vaporization of liquid water, Explain why. Calculate the pH where valine will have no electrophoretic mobility, given that $pK_1 = 2.3$, $pK_2 = 9.6$. 3 + 2
4. What is a prosthetic group ? Define the value of K_m in enzyme catalysis. What is 'induced fit' model ? 1 + 2 + 2
5. State the types of DNA super coiling and mention their handedness. What is the significance of C_0t curve of DNA ?
6. Define fluorophore with a biomolecular example. Draw a peptide bond with two amino acids (general structure) indicating the ϕ and Ψ angles. 2 + 3

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. What are the fat soluble vitamins ? Which amino acid acts as a buffer in normal physiological pH and why ? How many stereoisomers can be obtained for an aldohexose and why ? Draw the general structure of a pyran ring and state the significance of formation of such a ring in case of D-glucose. Explain why butter is a soft solid and sunflower oil is a liquid at 22°C. 1 + 3 + 3 + 5 + 3



8. State the properties of a naturally occurring α -helix. An octapeptide has the primary structure as NH_3^+ -val-lys-arg-met-arg-phe-asp-leu- COO^- . Treating the peptide with both trypsin and cyanogen bromide will free two different types of amino acids. Name them. What are the other fragments. How can you sequence them? Differentiate between tertiary and quaternary structures of proteins. Draw a schematic figure for a hypothetical protein and indicate different types of secondary structures. 3 + 1 + 5 + 2 + 4
9. Which phosphate groups of ATP are generally broken down to give energy and why? RNA can act as an enzyme but DNA cannot do so. Explain. What are the conditions for formation of A-DNA and Z-DNA? Define directionality of DNA strands with respect to Watson-Crick model. If a 22bp long DNA molecule contains 13 adenine bases, what will be its melting point? 3 + 2 + 4 + 2 + 4
10. What is the basic difference between absorption and emission spectroscopy? Draw the absorption spectra for phenyl alanine, tyrosine and tryptophan. Define bathochromic, hypsochromic, hypochromic and hyperchromic shifts. 3 + 4 + (4 \times 2)



11. Draw the light path of TEM. How does it differ from SEM ?
What are the constraints of use of electron beams in electron microscopy ? Electron microscopes have a much higher resolution than the light microscopes. Explain in brief.
Describe the principle of NMR. 4 + 2 + 3 + 3 + 3

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