

**CHEMISTRY OF BIOMOLECULES
(BIOT 2101)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which one of the following statements is not true about nucleosomal organization of core particle?
- (a) The typical structure of DNA is altered in the middle of the core particle.
 - (b) In core particle, DNA is organised as flat super helix with 1.65 turns round the histone octamer.
 - (c) While 30 nm fibres, generally 6 nucleosomes per turn organise into two start helix.
 - (d) The N-terminal histone tails in a core particle are strictly ordered and exit from the nucleosomes between turns of the DNA.
- (ii) NaCl can be hydrolyzed but not ethanol because
- (a) Ethanol is a covalent compound
 - (b) Ethanol is a polar compound
 - (c) Ethanol forms hydrogen bonding
 - (d) Ethanol contains hydrogen
- (iii) Which of the following carbohydrates is non- reducing?
- (a) Starch
 - (b) Sucrose
 - (c) Cellulose
 - (d) Glucose
- (iv) Maltose contains two molecules of
- (a) fructose
 - (b) glucose
 - (c) galactose
 - (d) xylose
- (v) Fibroin is an example of a protein
- (a) containing only beta-pleated sheet structure
 - (b) present in the tertiary structure
 - (c) having quaternary structure with four different subunits
 - (d) containing a triple helical structure

- (vi) Which of the following statements about the structure of DNA is incorrect?
(a) Hydrophobic bonding provides stability to the double helix in an aqueous cytoplasm.
(b) Once the base sequence of one strand of a DNA double helix is known, the base sequence of the second strand can be deduced.
(c) When separated, the two strands of a double helix are identical.
(d) Each nucleotide pair contains two phosphate groups, two deoxyribose molecules, and two bases.
- (vii) Which of the following is a sugar derivative?
(a) Glucose (b) Arabinose
(c) Talose (d) Glucosamine
- (viii) Consider a short linear ds-DNA molecule with 10.5 bp/turn, contains 15 complete turns. The ends of the DNA molecules are sealed together to make a relaxed circle. The linking number of that relaxed circle DNA is
(a) 105 (b) 15.0
(c) 10.5 (d) 25.5
- (ix) Which of the following compounds form micelle in water?
(a) HCl (b) CH₃COOH
(c) CH₃COO⁻Na⁺ (d) CH₃(CH₂)₁₄COO⁻Na⁺
- (x) The I in spectroscopic experiment is 0.75 and I₀ = 0.9. What is the % transmittances?
(a) 83.33% (b) 0.9%
(c) 0.83% (d) 100%

Group – B

2. (a) Describe the following terms: i) electrostatic interaction, ii) micelle
(b) Which structural features characterize starch, cellulose and glycogen?
(3 + 3) + 6 = 12
3. (a) The enzyme pectinase, which hydrolyses pectin, is used for removal of turbidity from fruit juice. Describe how pectinase works.
(b) Draw the structure of galactose and mannose. Do you think they are epimers? Justify your answer.
(c) Discuss the role of cholesterol and phospholipid in the cell membrane.
3 + (2 + 3) + 4 = 12

Group – C

4. (a) Draw the structure of the predominant form of; i) Isoleucine at pH 11, ii) Arginine at pH 7 and iii) Glutamic acid at pH 7.

- (b) What happens when
i) Alanine reacts with formaldehyde
ii) Proline is mixed with nitrous acid
- (c) Both Cysteine and Methionine are sulphur containing amino acids. However, Cysteine is classified as a polar amino acid and Methionine is classified as a non polar amino acid. Justify this classification.

$$3 + (3 \times 2) + 3 = 12$$

5. (a) Define motif and domain. Draw four motifs that are commonly found in protein structure.
- (b) Calculate the length of a short alpha helical peptide containing 80 amino acid residues.
- (c) A Valine residue in a protein was replaced by a Lys. The protein lost its activity due to this replacement. Explain the observation.

$$(2 + 4) + 3 + 3 = 12$$

Group – D

6. (a) Describe the experimental steps and explain the results of X-ray diffraction analysis of DNA crystals by R. Franklin with a labelled diagram.
- (b) What were the features of triple helix models of DNA by Linus Pauling? Why this model was rejected?
- (c) Draw the chemical structure of a RNA molecule with any three nitrogen bases.
- (d) If a virus contained ds-DNA with 30,000 base pairs, then calculate the length and the number of complete turn present in this DNA.

$$(2 + 2) + (2 + 1) + 3 + 2 = 12$$

7. (a) Discuss the role of different forces for the stability of DNA structure.
- (b) Derive the integral equation of renaturation kinetics of ssDNA to ds DNA.
- (c) Write the nature of changes and its explanation of three physical properties of DNA due to denaturation of dsDNA into ssDNA
- (d) Calculate the melting temperature of the following DNA:
"ATCCTTAAGTTATTATTGTTCAAAAATCTCTTTAA"

$$3 + 3 + 3 + 3 = 12$$

Group – E

8. (a) Show the derivation of Lambert's and Beer's law.
- (b) Show and explain the graphical pattern of the following
(i) Changes of absorbance value with the concentration of absorbing species.

(ii) Changes of transmittance value with the concentration of absorbing species.

(c) Explain the principle of NMR spectroscopy with diagram.

(d) You are working in a protein chemistry laboratory. You prepare a protein solution. You measured the concentration of the protein by adding 0.25 ml of the protein solution to 0.75 ml of water, using spectrophotometer. The absorbance (A_{280}) of the diluted protein solution was found to be 0.355. The absorption coefficient of protein is $0.45 \text{ (mg ml}^{-1}\text{) cm}^{-1}$. Calculate the original concentration of the protein that you made.

$$3 + (2 + 2) + 3 + 2 = 12$$

9. (a) Define the quantum yield and life time of fluorescence phenomena.

(b) Explain how we can differentiate three types of secondary structures of protein by CD spectroscopy with labelled diagram.

(c) Write principle of detection of radioactivity by GM counter with a labelled diagram.

(d) What is Fourier transform? Why it is used in IR spectroscopy?

$$3 + 3 + 3 + 3 = 12$$

Department & Section	Submission Link
BT	https://classroom.google.com/c/MTM4OTI3ODkzMjA5/a/MjkyNTA1NzI1ODc3/details