

**BIOPHYSICS OF MACROMOLECULES
(BTC3232)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The Henderson-Hasselbalch Equation is represented as
 - (a) $pK_a = pH + \log_{10} ([HA]/[A^-])$
 - (b) $pH = pK_a + \log_{10} ([HA]/[A^-])$
 - (c) $pK_a = pH + \log_{10} ([A^-]/[HA])$
 - (d) $pH = pK_a + \log_{10} ([A^-]/[HA])$
- (ii) The structure of a DNA-RNA hybrid is
 - (a) A form
 - (b) B form
 - (c) Between A and B form
 - (d) Z form
- (iii) What is T_m of an alpha-helix?
 - (a) It is the temperature where the denaturation of an alpha-helix starts
 - (b) It is the temperature where the denaturation of an alpha-helix is complete
 - (c) It is the temperature where 50% denaturation of an alpha-helix takes place
 - (d) It is the beyond temperature at which an alpha-helix is hydrolysed
- (iv) Which of the following statement is correct?
 - (a) Tryptophan is a nonpolar amino acid residue and usually found in the interior of a protein
 - (b) Tryptophan is a polar amino acid residue and usually found on the surface of a protein
 - (c) Tryptophan is a charged amino acid residue and usually found in the interior of a protein
 - (d) Position of Tryptophan cannot be predicted
- (v) Which of the following component combinations is NOT a part of a dual beam UV spectrophotometer?
 - (a) Sample, reference cuvette
 - (b) Beam selector
 - (c) Prism and grating
 - (d) Michelson interferometer
- (vi) In fluorescence spectroscopy, the analyte should absorb
 - (a) In the UV region
 - (b) In the UV and visible region
 - (c) In the IR region
 - (d) In the IR and visible region

- (vii) Which statement is correct for a spectro-fluorometer?
 (a) It has an excitation filter and an emission filter
 (b) It has only an emission filter
 (c) It has only an excitation filter
 (d) The detector detects the excitation ray
- (viii) Three dimensional structure of a protein can be determined by
 (a) Infra red spectroscopy (b) X ray crystallography
 (c) UV spectroscopy (d) Scanning electron microscopy
- (ix) The resolution of a microscope depends on
 (a) Light intensity (b) Lens aperture diameter
 (c) Lens thickness (d) None of these
- (x) Which of the following statements is correct?
 (a) Lysyl oxidase can induce covalent crosslinks in collagen
 (b) Scurvy is caused by deficiency of vitamin C because vitamin C is essential to make disulphide bonds in collagen
 (c) Presence of Hydroxy-proline makes collagen structure unstable
 (d) Collagen does not contain any modified amino acid

Fill in the blanks with the correct word

- (xi) The number of amino acid residues in a protein of molecular weight 58300 is _____.
- (xii) Example of non-polar amino acid is _____.
- (xiii) The number of residues per turn in an alpha helix is _____
- (xiv) _____ is considered a model enzyme for studying allosteric properties.
- (xv) Stoke's shift is related to _____ spectroscopy

Group - B

2. (a) Anti parallel β -strands are more stable than parallel β -strands-Explain. [[C01](Analyse/IOCQ)]
 (b) The ribose pucker is conformationally important in nucleic acids - Explain. [[C01](Analyse/IOCQ)]
 (c) Peptide bond is rigid and planar-explain. [[C01](Apply/IOCQ)]
4 + 4 + 4 = 12
3. (a) Explain why 3_{10} Helix and π Helix are rarely found in body. [[C01](Analyse/IOCQ)]
 (b) Name a Z-DNA binding protein. Explain it's interaction with Z-DNA. [[C03](Explain/HOCQ)]
6 + (1 + 5) = 12

Group - C

4. (a) What are intra-chain and inter-chain disulphide linkages? These linkages play important role in stabilizing the structure of antibodies. Comment on the statement. [[C03](Comment/HOCQ)]

- (b) Osteo-lathyrism is a disease related to malformation and malfunctioning of collagen tissue. It is caused by a toxic chemical beta-amino-propio-nitrile present in *Lathyrus sativus*. Explain the role of beta-amino-propio-nitrile in causing the disease. [[C03](Understand/IOCQ)]
- (c) Name three amino acid residues that are abundant in collagen. [[C04](Understand/IOCQ)]
- (3 + 3) + 4 + 2 = 12**
5. (a) Discuss the stabilizing forces of a DNA molecule. [[C03](Understand/LOCQ)]
- (b) What do you mean by melting point (T_m) of a DNA? Discuss the factors that affect the T_m. [[C03](Understand/IOCQ)]
- (c) What is Cot curve? Draw a representative Cot curve showing highly repetitive sequence, moderately repetitive sequence and unique sequence. [[C04](Understand/IOCQ)]
- 3 + (2 + 3) + (1 + 3) = 12**

Group - D

6. (a) Describe with diagram the origin of UV-Visible spectroscopy. [[C05](Understand/IOCQ)]
- (b) What are chromophores? [[C05](Remember/LOCQ)]
- (c) State and derive Lambert-Beer law for quantitative estimation of a chemical through UV-Visible spectroscopy. [[C05](Understand/IOCQ)]
- 6 + 2 + 4 = 12**
7. (a) What are the different regions of IR spectrum? Which region is most important for IR analysis? [[C05](Remember/LOCQ)]
- (b) IR spectroscopy gives degenerate vibrations. Explain. [[C05](Remember/LOCQ)]
- (c) Discuss the function of interferometer in FTIR. [[C05](Discuss/IOCQ)]
- (d) IR spectroscopy can be used for quantitative analysis of a compound. Do you agree with the statement? Justify your answer. [[C05](Justify/LOCQ)]
- (2 + 1) + 3 + 3 + 3 = 12**

Group - E

8. (a) Briefly explain how can you detect the protein structure with the help of X-ray Crystallography? [[C06](Explain/HOCQ)]
- (b) Why it is necessary to create a vacuum system in TEM or SEM? [[C06](Analyse/IOCQ)]
- (c) Discuss the applications of Mass Spectrometry. [[C06](Remember/LOCQ)]
- 6 + 3 + 3 = 12**
9. (a) Briefly explain the production of X-rays. [[C06](Describe/IOCQ)]
- (b) Explain with a diagram the working principle of Surface Plasmon Resonance. Give Example. [[C06](Describe/HOCQ)]

- (c) What are the advantages of Optical microscope over Electron microscope?
[[CO6](Remember/LOCQ)]
4 + 6 + 2 = 12
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	22.92	52.08	25

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