

Anekant Education Society's
Tuljaram Chaturchand College, Baramati.
Department of Microbiology

M.Sc. I (Microbiology)

Semester : I

Paper: III

Subject Code: MICRO4103

Subject: Biochemistry

2 Marks Question

1. Define Inductive effect.
2. Define hydrogen bond.
3. What is covalent catalysis?
4. Write two examples of oxidation reaction.
5. Difference between conformation and configuration.
6. Define Cot curve.
7. What is Ramachandran plot.
8. What is the global charge of the trinucleotide ApGpUpC at pH 7.
9. Difference between weak acid and weak base.
10. What is the pH of 0.1M acetic acid? (pKa= 4.76).
11. Give two example of substitution reaction.
12. Define concept of buffer, strength of buffer and buffer value.
13. Define host-guest interaction.
14. Enlist method used in estimation of nucleic acid.
15. What is reducing sugar and give its two examples.
16. Give examples of fibrous and globular proteins.

17. Define secondary structures of proteins .
18. What are enantiomers.
19. Giving suitable examples for following terms with respect to monosaccharide
 - i) Enantiomers
 - ii) Epimer
 - iii) Anomer
 - iv) Aldose
20. What are phosphoglyceride?
21. What are steroids?
22. What are epimer?
23. Give two epimers of glucose with structure.
24. Give two examples of terpenes.
25. Give two examples of sugar acids.

4 Marks Questions: Short note on

1. Biochemical significance of Inductive effect.
2. Biochemical buffers.
3. Significance of resonance in biomolecules.
4. N-terminal labeling
5. Host - guest interaction.
6. Henderson Hasselbalch equation
7. Elimination reaction
8. Weak acids and weak bases.
9. Bicarbonate buffer system.
10. t-RNA.
11. Ninhydrin reaction.
12. C terminal labeling.
13. Partial double bond nature of peptide bond.
14. Describe the classification of amino acids.
15. Prostaglandin.

16. Enantiomers.
17. Derivatives of sugars.
18. Terpenes
19. Epimers.
20. Anomers.
21. Edman degradation.
22. Sugar acid
23. Explain 5' → 3' polarity of nucleic acids.
24. What is mutarotation? Explain with examples.
25. Explain biochemical significance of tautomerism
26. Explain the term cot curves and give their significance.
27. Describe the methods for estimation of nucleic acid.
28. Explain the term cot curves and give their significance.
29. Describe the methods for estimation of nucleic acid.
30. Describe the structure and functions of phospholipids.
31. Diagrammatically illustrate the D-series of ketoses.
32. Giving suitable examples explain the terms enantiomers and epimers.
33. What are reducing sugars? Describe any one method for estimation of reducing sugars.
34. What are epimer? Give two epimers of glucose with structure.
35. How are lipids classified on the basis of their chemical structure?
36. Diagrammatically illustrate the D-series of aldoses.
37. Enlist various types of isomerism observed in sugars and explain any one type with example.
38. What are steroids? Explain their structure and function with suitable examples.
39. Differentiate between pyranose and furanose form of glucose.
40. Elaborate on structure and functions of triglycerides.

6Marks Questions: Long answer questions

1. Describe the preparation of 100ml of 0.1M phosphate buffer pH 6.7, starting with 1M H₃PO₄ and 1M NaOH. The pK_a's for H₃PO₄ are pK_{a1} = 2.1 pK_{a2} = 7.2 pK_{a3} = 12.7.
2. Justify that amino acids and proteins act as buffers.

3. What is Hydrogen bonding ? Discuss the role of H- Bonding in Bimolecular.
4. What is the pH of 0.1M acetic acid? (pKa= 4.76).
5. What are non-covalent interactions? Explain the role of non-covalent interactions in biology.
6. Calculate the ratio of acetate and acetic acid required to prepare buffer of pH 5.3 ? Ka for acetic acid is 1.76×10^{-5} .
7. Derive Henderson and Hassel bach equation. Give its significance in buffer formulation.
8. Write a note on tautomeric form of bases and their implication in pairing of bases.
9. Describe the preparation of 200ml of 0.5M KH_2PO_4 - K_2HPO_4 buffer, pH7.5 using acid pka = 6.86 (Given - MW - KH_2PO_4 = 136, K_2HPO_4 = 174)
10. Explain the mechanism of elimination reactions giving suitable examples.
11. How does stereochemistry affects the interactions of organic molecules?
12. Explain the role of hydrophobic and hydrophilic interactions in biomolecules
13. Calculate the pH of the final solution when 100ml of 0.1M NaOH is added to 150ml of 0.2 M CH_3COOH ($k_a = 1.8 \times 10^{-5}$).
14. Describe the preparation of 100ml of 0.1M buffer of pH 5.0 using sodium acetate and Acetic acid. (pka of Acetic acid = 4.76).
(Given - MW - Sodium acetate = 82.03, Acetic acid = 60.05).
15. Explain charge transfer complex and host-guest interactions with suitable examples.
16. Compare between B and Z form of DNA.
17. Describe the Watson and Crick model of DNA structure with the help of diagram.
18. Explain denaturation of DNA and its relationship with T_m value.
19. Compare structure of mRNA of bacteria and eukaryotes
20. Justify: 'Although RNA is single stranded it can possess extensive secondary structure'.
21. Diagrammatically illustrate double helix of DNA showing Watson and Crick basepairing.
22. Explain why, RNA, and not DNA, is hydrolyzed under basic pH conditions? What is the global charge of the trinucleotide ApGpUpC at neutral

pH?

23. Give a comparative account of A, B and Z forms of DNA.
24. Explain N-terminal and C-terminal sequencing by giving at least two methods for it.
25. Explain with the help of suitable example the structure and function of Fibrous protein.
26. What is quaternary structure of proteins? Explain with suitable example.
27. Describe method each for qualitative and quantitative estimation of proteins.
28. A mixture of following amino acids is subjected to electrophoresis at pH 3.9: Ala, Leu, Arg, Asp, His.
 - i) Which ones will go toward anode(-)? toward cathode(+)? Why?
 - ii) Is it possible to separate amino acids by the above mentioned method?
Given: $pK_{\alpha} \text{ COOH} = 2.3$, $pK_{\alpha} \text{ -NH}_2 = 9.7$, $pK_{\text{R}} \text{ Asp} = 3.65$, $pK_{\text{R}} \text{ His} = 6.0$, $pK_{\text{R}} \text{ Arg} = 12.48$
29. What is Ramachandran plot? Explain its significance
30. Explain in brief the secondary structures encountered in proteins.
31. Explain with the help of suitable example the structure and function of fibrous proteins.
32. Describe structure and function of globular proteins
33. Describe the preparation of 100 ml of 0.5M KH_2PO_4 - K_2HPO_4 buffer, $\text{pH} 7.5$ using acid $pK_a = 6.86$. (Given - MW. $\text{KH}_2\text{PO}_4 = 136$, $\text{K}_2\text{HPO}_4 = 174$)
34. How will you classify lipids? Illustrate with example.
35. Discuss the nomenclature and properties of fatty acids.
36. What are the steroids? Explain their structure and function with suitable examples.
37. Describe the classification of phospholipids with suitable examples.
38. Explain the nomenclature of fatty acids.
39. What is the difference between configuration and conformation of biomolecule. explain with example
40. What are phosphoglyceride? Give major classes of phosphoglycerides with their functions.
41. What is mutarotation? Explain with examples.
42. Draw the structure of triglyceride and enlist the functions.
43. What are steroids? Explain their structure and function with suitable examples.

12 Marks Questions

1. What is the intracellular and extracellular buffering system occurring in animals with lungs?
2. Explain why the absorption of UV light by double-stranded DNA increases (the hyperchromic effect) when the DNA is denatured. What is its application?
3. The flat faces of the bases of DNA are hydrophobic. What is the effect of this fact on 3-D structure of double stranded DNA?
4. Draw the structure of a dinucleotide that might be obtained by the partial hydrolysis of DNA and RNA. Indicate the following:
 - i. The 5' end
 - ii. The 3' end
5. When double stranded DNA is dissolved in formamide the T_m value decreases. When it is dissolved in alkali again its T_m value decreases. Explain.
6. If placed in water and adjusted to pH 3, will the following molecules migrate toward anode or cathode if placed in electric field? [8 Marks]
 - i. Aspartic acid
 - ii. Alanine
 - iii. Tyrosine
 - iv. Lysine
 - v. Arginine
 - vi. GlutamateJustify your answer.
7. An amino acid analyzer containing polystyrene cation exchanger column at pH 3.2 was loaded with mixture of amino acid containing Ala (pI=6.02), Arg (pI=10.76), Glu (pI=3.22), Cys (pI=5) and Try (pI=5.88). Give the order of elution of these amino acids using buffer of successively higher pH with explanation.
8. A group of peptides that influence nerve transmission in certain parts of the brain has been isolated from normal brain tissue. These peptides are known as opioids, because they bind to specific receptors that also bind opiate drugs, such as morphine and naloxone. Some researchers consider these peptides to be the brain's own painkillers.

Using the information below, determine the amino acid sequence of the opioid leucine enkephalin. Explain how your structure is consistent with each piece of information.

i) Complete hydrolysis by 6 M HCl at 110 °C followed by amino acid analysis indicated the presence of Gly, Leu, Phe, and Tyr, in a 2:1:1:1 molar ratio.

ii) Treatment of the peptide with 1-fluoro-2,4-dinitrobenzene followed by complete hydrolysis and chromatography indicated the presence of the 2,4-dinitrophenyl derivative of tyrosine.

No free tyrosine could be found.

iii) Complete digestion of the peptide with chymotrypsin followed by chromatography yielded free tyrosine and leucine, plus a tripeptide containing phe and Gly in a 1:2 ratio.

9. Indicate whether and where the following peptides are cleaved by the indicated treatments. Justify your answer.

	Peptide	Treatment
a.	Phe-Arg-Pro	Trypsin
b.	Phe-Met-Leu	Carboxypeptidase B
c.	Ala-Gly-Phe	Chymotrypsin
d.	Gly-Met-Pro	CNBr

10. A peptide has the sequence

Glu-His-Trp-Ser-Gly-Leu-Arg-Pro-Gly

- i) What is net charge of the molecule at pH-3, 8, 11
 ii) Estimate pI of this peptide

Considering the following data

Amino acid	pKa	pKb	pK _R
Glu	2.19	9.67	4.25
His	1.81	9.17	6
Trp	2.38	9.39	-
Ser	2.21	9.15	-

Gly	2.34	9.6	-
Leu	2.36	9.6	-
Arg	2.17	9.04	12.48
Pro	1.99	10.96	-

11. What would be net charge on following hexapeptide at pH 1, 7 and 13?



Given:

$$pK_{\alpha} \text{-COOH}=2.3, pK_{\alpha} \text{-NH}_2 =9.7, pK_{\text{R}} \text{ Asp}=3.65,$$

$$pK_{\text{R}} \text{ Glu}=4.25, pK_{\text{R}} \text{ Lys}=10.53, pK_{\text{R}} \text{ Arg}=12.48$$

12. A disaccharide, which you know to be either maltose or sucrose, is treated with Fehling's Solution, and a red color is formed. Which sugar is it, and how do you know?

13. Explain mechanism of inhibition of cell wall synthesis by penicillin.

14. Determine the sequence of polypeptide based on the following data.

i. Acid hydrolysis: (Ala₂, Arg, Lys₂, Met, Phe, Ser₂),

ii. Carboxypeptidase A digestion: (Ala)

Trypsin digestion: (Ala, Arg) (Lys)

(Lys, Phe, Ser,) (Ala, Met, Ser)

iii. CNBr treatment: (Ala, Arg, Lys₂, Met, Phe, Ser) (Ala, Ser)

iv. Thermolysin digestion: (Ala) (Ala, Arg, Ser)

15. Determine the sequence of peptide from following information:

i. Composition of peptide : lys + ser + met + tyr + gly + ala + phe.

ii. Reaction with FDNB : DNP- ser.

iii. Glycine was released rapidly upon treatment with carboxypeptidase A

iv. Chymotrypsin released two peptides : one containing tyr+lys+ser and second containing met + ala + phe and free glycine

v. CNBr treatment released two peptides, one containing tyr +lys + ser + met and second with phe + ala + gly.

16. **I.** Tropomyosin, a 70kd muscle protein, is a two- stranded α helical coiled coil. Estimate the length of the molecule.
- II.** Suppose that a 40 residue segment of protein fold into a two stranded antiparallel β structure with a 4 residue hairpin turn. What is the longest dimension of this motif?

