

Birla Institute of Technology & Science, Pilani; Pilani Campus, Rajasthan 333031
COMPREHENSIVE EXAMINATION
I Semester, 2023-2024

Biophysical Chemistry, CHEM F323

Date: 13.12.2023

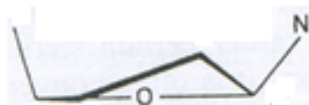
PART II (CLOSED BOOK)

Time: 135 Min

Max. Marks: 30

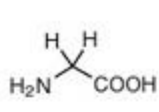
Answer all the five questions, briefly and to the point. Don't use pencil.

1. (a) Write the name of amino acids that behave ambiguously while categorizing them in polar and non-polar sets of natural occurring amino acids in context of predicting their environmental preferences. Briefly justify their ambiguous behavior. 2.5
- (b) How many configuration(s) is/are possible in hairpin turn of beta sheet. Draw all the configuration(s) showing hydrogen bonding, using any amino acid sequence of your choice. 2.5
- (c) If one molar aqueous solution of alanine at pH 7 is placed into the electrophoresis chamber and potential is applied. The molecules will move towards anode or cathode? Justify your answer. 1
2. (a) Suppose energies for hydrogen bonded base pairs as $G-G = X$ and $C-C = Y$ kcal/mol. Find the interaction energy of G-C base pair (in terms of X and Y) from the approximation that the hydrogen bond energies are dependent on donor and acceptor atoms only (neglect the neighboring group effects). Provide logical steps for the calculations. 3
- (b) How one can prepare a monolayer structure of lipid? Explain in brief. 1
- (c) Which phase of monolayer structure looks brighter under fluorescence microscope and why? 1
- (d) Ring puckering mode of a sugar present in nucleic acid is given below. Redraw the sugar molecule in your answer sheet and write (I) the carbon numbering following the standard conventions and (II) name/notation of puckering mode. 1

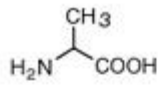


3. (a) If 2.5 moles of Gly-Gly-Gly is dissolved in 1 liter of water, calculate the approximate increment in dielectric constant of water at low frequency region. 2
- (b) Describe the characteristics of a suitable receptor that can stabilize the organic cation during catalytic reaction. 1
- (c) Write short notes on correlation factor (g_c) explaining the nature of solvent if its g_c value is 0.2. 1
- (d) Most of the research papers are devoted towards the synthesis of functional mimic of catecholase rather than structural mimic. Suggest suitable reason for this fact. 1
- (e) Write short note on any photosensitive receptor. 1
4. (a) Write the advantages of light scattering method of finding the molecular weight in comparison to the osmometry. 1
- (b) Define polarizability and polarizability volume. 1
- (c) Derive the relationship between polarizability and refractive index of the solution. 2
- (d) The shape and size of a bilayer membrane is determined by electronic microscope. Will it differ if the sample is prepared by (i) vacuum drying and (ii) Freeze etching drying method. Justify your answer. 2
5. (a) How electron density map is generated in X-ray crystallography. 1
- (b) Comment on the authenticity of position of hydrogen in the crystal structure of biopolymers. 1
- (c) Which parameter in X-ray crystallography data indicates about the precision of the crystal structure. 1
- (d) Why $\phi = 0, \psi = 0$ and $\phi = 0, \psi = 180^\circ$ is not observed in the polypeptide's conformation? 1
- (e) Which secondary structure may be predicted for polymethionine and will that structure be more stable in water or in a hydrophobic medium? Justify your answer for both the cases. 2

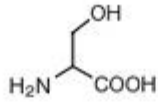
Data for reference



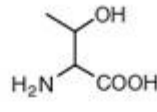
Glycine (Gly, G)
MW: 57.05



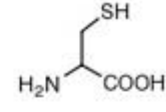
Alanine (Ala, A)
MW: 71.09



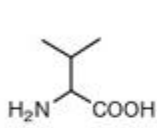
Serine (Ser, S)
MW: 87.08, pK_a ~ 16



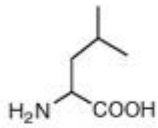
Threonine (Thr, T)
MW: 101.11, pK_a ~ 16



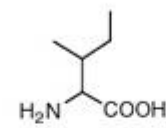
Cysteine (Cys, C)
MW: 103.15, pK_a = 8.35



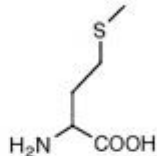
Valine (Val, V)
MW: 99.14



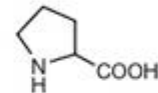
Leucine (Leu, L)
MW: 113.16



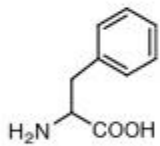
Isoleucine (Ile, I)
MW: 113.16



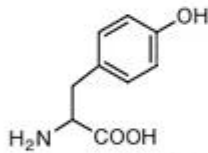
Methionine (Met, M)
MW: 131.19



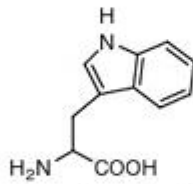
Proline (Pro, P)
MW: 97.12



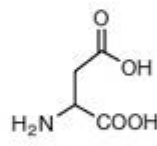
Phenylalanine (Phe, F)
MW: 147.18



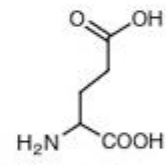
Tyrosine (Tyr, Y)
MW: 163.18



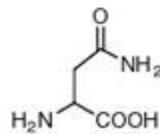
Tryptophan (Trp, W)
MW: 186.21



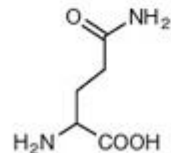
Aspartic Acid (Asp, D)
MW: 115.09, pK_a = 3.9



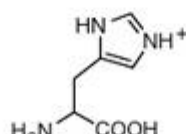
Glutamic Acid (Glu, E)
MW: 129.12, pK_a = 4.07



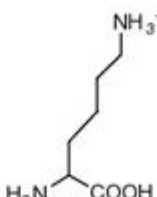
Asparagine (Asn, N)
MW: 114.11



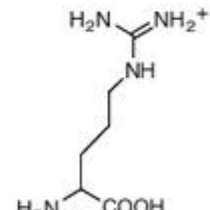
Glutamine (Gln, Q)
MW: 128.14



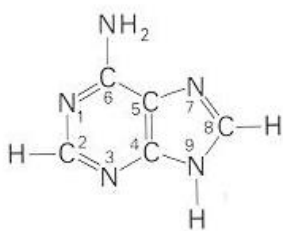
Histidine (His, H)
MW: 137.14, pK_a = 6.04



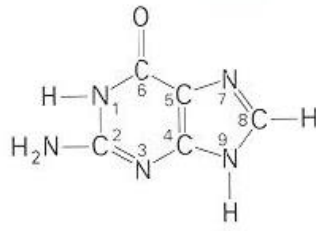
Lysine (Lys, K)
MW: 128.17, pK_a = 10.79



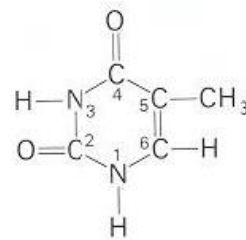
Arginine (Arg, R)
MW: 156.19, pK_a = 12.48



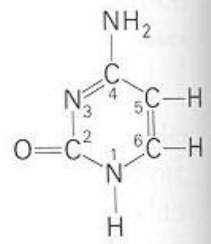
Adenine
(A)



Guanine
(G)



Thymine
(T)



Cytosine
(C)

The EndGood Luck***