

**Birla Institute of Technology & Science, Pilani; Pilani Campus, Rajasthan 333031**  
**COMPREHENSIVE EXAMINATION**  
**I Semester, 2022-2023**

**Biophysical Chemistry, CHEM F323**

**Date: 20.12.2022**

**CLOSED BOOK**

**Time: 180 Min**

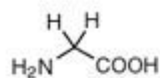
**Max. Marks: 40**

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

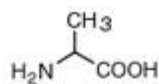
1. (a) Which secondary structure can be predicted for polyproline and polyisoleucine? Justify your answer. 2
- (b) In which case do you expect a higher value of  $pK_1$  (for acidic group), gly or gly-gly? Provide a qualitative suitable reason. 1
- (c) Write the structures of L-Tyr following the standard convention with equilibrium among them that it will acquire with increasing pH values (1 – 12) of the solution and derive an expression for its isoelectric point. 3
- (d) How the protein folding landscape looks like? Write a couple of conditions that will facilitate the smooth protein folding process. 1
- (e) Write short notes on the best scale of hydrophobicity. 1
2. (a) Why Chargaff's law is applicable to DNA molecules but not to the RNA? 1
- (b) Write the comparison between Watson Crick and Hoogsteen base pairing model in nucleic acids. 2
- (c) Generally, cell contains DNA but diameter of cell is very small in comparison to the length of DNA molecules. How it is possible and what is the nature (cyclic/acyclic) of DNA? 1
3. (a) What will be the preferred 3-D structure of  $CH_3-(CH_2)_{12}-COONa$  in water? Justify your answer. 1
- (b) Write an application of Donnan ratio in details. 2
- (c) A membrane protein is newly synthesized inside the cell. Write all the energy parameters that need to be considered to evaluate that the protein will be stable in the membrane. 1
- (d) Describe a non-destructive method for finding the weight average molecular weight of polymers. 3
4. (a) In the structural elucidation of biomolecules, which one is more informative IR or Raman Spectroscopy? Justify your answer. 1
- (b) UV-Visible studies will be more suited to explore the unfolding process of protein or DNA molecules? Justify your answer in brief. 1
- (c) Calculate the approximate dielectric constant of 3M aqueous solution of Gly-Gly-Gly. Consider the dielectric constant of pure water as 78 under the given condition. 2
- (d) Describe the dielectric relaxation of pure water in the range of  $100 - 800 \text{ cm}^{-1}$ . 2
- (e) What is Rayleigh scattering and how it is connected/related with the wavelength of incident radiation? 1
5. (a) Which one is better, results of molecular electron microscopy with  $2 \text{ \AA}$  resolution or single crystal data with  $3 \text{ \AA}$  resolution for structural elucidation of a known protein? Justify your answer in brief. 2
- (b) Write the problems associated with Critical point drying and Freeze-drying methods of biomolecules for microscopic analysis. 2
- (c) What should be the features of a good man made receptors? Write in brief. 1
- (d) Write the details of any templet cyclization reaction. 1
- (e) Draw the scattering geometry and find the magnitude of the scattering vector in single crystal X-ray scattering. 2
- (f) What is the role of Fourier Transform in single crystal X-ray crystallography? 1

6. (a) Can we ascertain the positions of all the hydrogen atom of the hemoglobin accurately by single crystal X-ray scattering studies? Justify your answer. 1
- (b) What do you understand by point group and Space group in single crystal X-ray crystallography? 1
- (c) What should be the criteria, that a receptor can form metal organic framework. Explain in brief with rough sketch. 2
- (d) Write short note on Catecholase enzyme. 1
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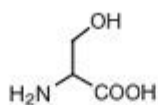
**Small**



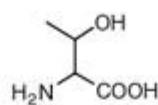
Glycine (Gly, G)  
MW: 57.05



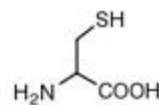
Alanine (Ala, A)  
MW: 71.09



Serine (Ser, S)  
MW: 87.08, pK<sub>a</sub> ~ 16

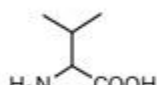


Threonine (Thr, T)  
MW: 101.11, pK<sub>a</sub> ~ 16

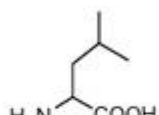


Cysteine (Cys, C)  
MW: 103.15, pK<sub>a</sub> = 8.35

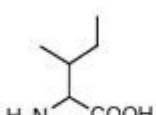
**Hydrophobic**



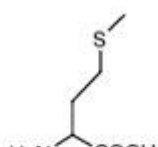
Valine (Val, V)  
MW: 99.14



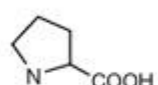
Leucine (Leu, L)  
MW: 113.16



Isoleucine (Ile, I)  
MW: 113.16

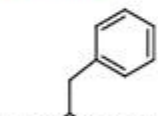


Methionine (Met, M)  
MW: 131.19

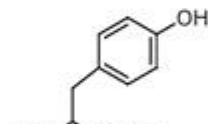


Proline (Pro, P)  
MW: 97.12

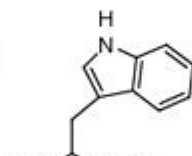
**Aromatic**



Phenylalanine (Phe, F)  
MW: 147.18

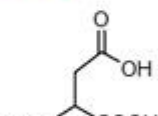


Tyrosine (Tyr, Y)  
MW: 163.18

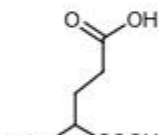


Tryptophan (Trp, W)  
MW: 186.21

**Acidic**

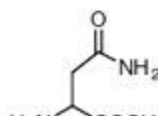


Aspartic Acid (Asp, D)  
MW: 115.09, pK<sub>a</sub> = 3.9

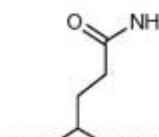


Glutamic Acid (Glu, E)  
MW: 129.12, pK<sub>a</sub> = 4.07

**Amide**

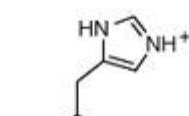


Asparagine (Asn, N)  
MW: 114.11

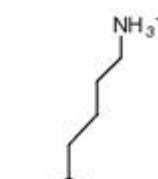


Glutamine (Gln, Q)  
MW: 128.14

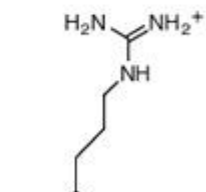
**Basic**



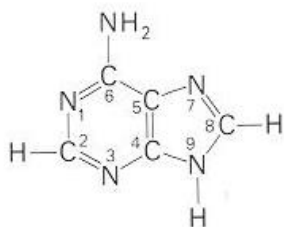
Histidine (His, H)  
MW: 137.14, pK<sub>a</sub> = 6.04



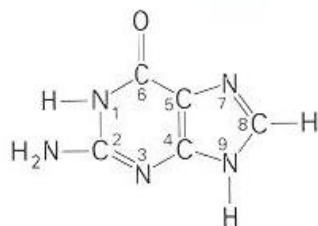
Lysine (Lys, K)  
MW: 128.17, pK<sub>a</sub> = 10.79



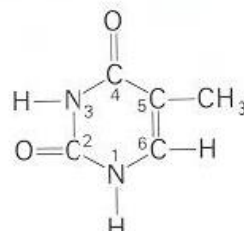
Arginine (Arg, R)  
MW: 156.19, pK<sub>a</sub> = 12.48



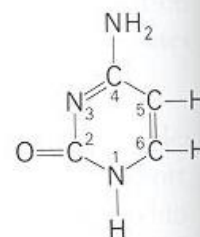
Adenine  
(A)



Guanine  
(G)



Thymine  
(T)



Cytosine  
(C)

\*\*\*\*The End\*\*\*\*Good Luck\*\*\*\*