Birla Institute of Technology & Science, Pilani, Rajasthan 333031
Mid Semester Test
I Semester, 2022-2023

Biophysical Chemistry, CHEM F323 **Date: 1.11.2022**
Open Book **Time: 90 minutes** **Max. Marks: 30**

Answer all the four questions, briefly and to the point

1. (a) (i) Draw the most probable structure of Asn-Glu-Lys at pH 6 following the standard convention and comment on its movement (toward anode or cathode) in electrophoresis chamber. If this system (Asn-Glu-Lys at pH 6) is titrated by dilute NaOH solution, how many pKa value(s) will be obtained. **3+1+1**

(ii) What could be the secondary structure of tripeptide Asn-Glu-Lys? Justify your answer in maximum two sentences. **2**

(b) Name the natural occuring amino acid(s) that (i) have more than one chiral centers; and (ii) exhibit UV absorption above 250 nm. **2**

(c) Calculate the length of alpha helix consisted of Met-Cys-Ala-Glu-Lys-Met-Cys-Ala-Ala-Met and maximum number of possible hydrogen bonds in it. **2**

2. Consider a hydrogen bonded system as shown below (Fig. 1). Use the electrostatic model to calculate the dependence of the molar potential energy of interaction on the angle θ. Set the partial charges on H and O to 0.5e and -0.8e respectively. **4**

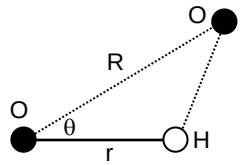

Fig. 1

3. (a) In a fully double stranded DNA, Guanine makes up 20 percent of the bases. Based on this information, calculate the percentage of adenine in bases. **1**

(b) Draw the full structure of the dinucleotide UG at physiological pH, following the usual conventions. **3**

(c) Assume the molecule given in Fig. 2 (page 2) is an A-DNA. Calculate the total number of bases present in it and also write the writhe number. **2+1**

4. (a) A finite monolayer domain is aggregated by an attractive energy component and a repulsive energy component (ideally). Consider both energy components act at interfacial plane. The attractive component is proportional to area per amphiphile in the domain and proportionality constant is 10 mJÅ^2. The repulsive component is inversely proportional to area and the proportionality constant for the energy component is 5 mJÅ^2. If area per molecule at minimum energy state is 20 Å^2, then what will be the expression for standard chemical potential? Find the chemical potential at 20 Å^2 per amphiphile area. **3**

(b) The given fatty acid (Fig. 3) will preferentially form micelle or bilayer structure? Justify your answer in brief. **1**

(c) An ideal protein solution (10 g/L) has been used for osmotic pressure measurement. The observed density of solution was 1.22 gcm^{-3} and capillary rise of separated solution at equilibrium was 11.6 cm at 25 ^{o}C. Calculate the mass of the protein. **4**

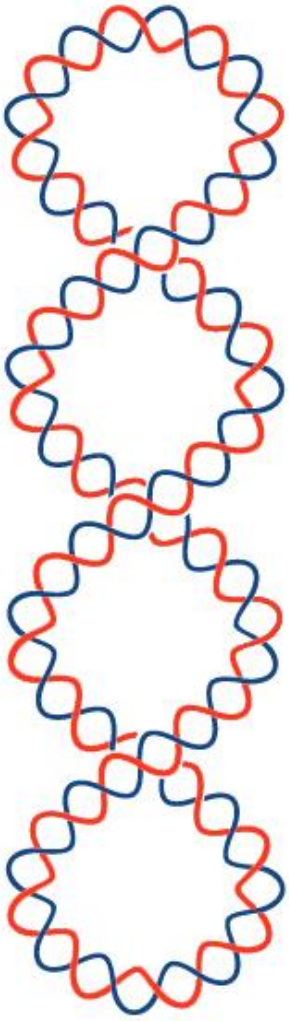

Fig. 2

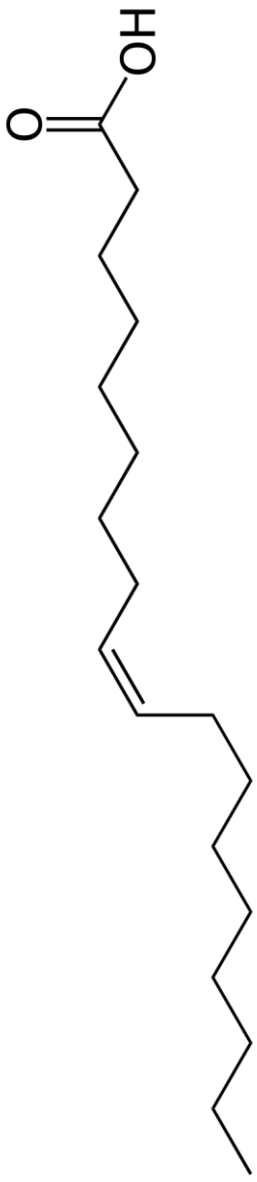

Fig. 3

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