

**Birla Institute of Technology and Science, Pilani, Rajasthan 333031**  
**Mid Semester Test**  
**I Semester, 2023-2024**

**Biophysical Chemistry, CHEM F323**  
**Open Book**

**Time: 90 minutes**

**Date: 12.10.2023**  
**Max. Marks: 30**

**Answer all the three questions, briefly and to the point**

1. (a) If aqueous acidic solution (at pH 2) of Asn-Lys-Ala is titrated with dilute NaOH solution; write the structure of different ionic forms of this peptide that will exist under different equilibrium conditions with course of increasing pH. Assign the equilibrium constants as  $K_1$ ,  $K_2$ ,  $K_3$  etc. for each step and deduce the expression for isoelectric point of this tripeptide. **4**
- (b) Consider a polypeptide of 20 residues containing Ala, Gly, Val only and answer the following-
- (i) What will be the maximum number of hydrogen bonds and full turns about its axis, if it folds into  $\alpha$ -helix. **1**
- (ii) What will be the maximum number of hydrogen bonds if it forms  $\beta$ -sheet structure via hairpin turn. **1**
- (c) Draw the stereospecific structure(s) about the  $\alpha$ -carbon of natural occurring amino acid(s) that has/have more than one chiral centers. **2**
- (d) An aqueous solution of one mole of Asp-Lys-Arg-Asn-Glu at pH 7 is titrated with 0.5 mM solution of NaOH. Based on this information, calculate the amount (number of moles) of NaOH required to complete the titration. **2**
2. (a) Comment on the strength (weak/strong) of N-H $\cdots$ N hydrogen bonding present in A-T base pair of nucleic acid with justification. **1**
- (b) For insertion of a polypeptide fragment into a bilayer membrane, the magnitude of solvation energy for polar and non-polar components are 13 kcal/mole and 45 kcal/mole respectively. The elastic deformation energy component has magnitude 10 kcal/mole and immobilization energy component is 7 kcal/mole. How much energy will be released/absorbed during transfer of this peptide fragment from bilayer to aqueous media? **3**
- (c) Osmosis is the process responsible for carrying the nutrients and water from groundwater supplies to the upper parts of trees. The osmotic pressures required for this process can be as high as 20 atm. What would be the molar concentration of the tree sap to achieve this pressure on a day when the temperature is 27 °C? [Given  $R = 0.0821 \text{ L atm / mol K}$ ] **2**
- (d) Draw the complementary strand of a nucleic acid denoted by standard symbol GUC. **4**
- 3 (a) Calculate the energy of interaction between two 1 unit elementary charges located inside a protein (dielectric medium of  $\epsilon = 10$ ) and separated by 2 nm distance. **2**
- (b) Which secondary structure(s) can be proposed for (i) polyglycine, (ii) polyglutamic acid and (iii) prolyline. Write your answer with justification. **6**
- (c) Which type of molecular interaction(s) will be applicable among 2-methylpropane molecules. Justify your answer. **1**
- (d) Write the number of the nucleic acid given in Figure 1. **1**

**PTO**

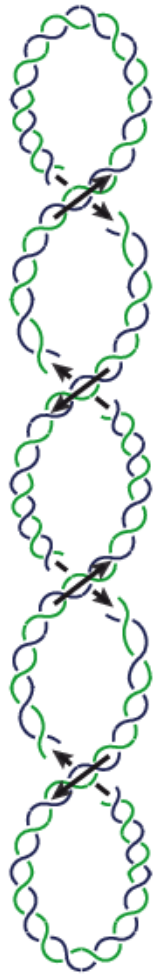


Figure 1

\*\*\*The End\*\*\*