

Biomolecular Structure, Interaction & Dynamics
QUIZ 1 - Monsoon 2020

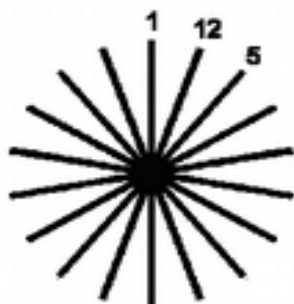
Time: 45 Minutes

Max. Marks: 40

Answer Question 1 and any Three from the rest

- Q1.** a) Describe the allowed conformational space for the backbone torsions of an alanyl-alanine dipeptide. [5]
b) As Nature's chief engineer, you have been asked to design a five turn α -helix, half of whose circumference is buried in the interior of the protein. Draw the helical wheel projection of your prototype α -helix and its amino acid sequence. [5]

Q2.



Shown above is a helical wheel diagram which shows a schematic plan projection of 'n' turns of a protein alpha helix. The positions of three of the residues are shown to provide a clue.

- a) What is the value of 'n' in the above helix? [1]
b) What is the angle between two 'spokes' corresponding to consecutive residues. Hence fill in the rest of the residue numbers. [2]
c) Use the helical wheel and state whether the sequence below (from Calmodulin) could correspond to an amphipathic helix. [7]

RALRRLRTAAERAKRTLS

- Q3.** (a) Write short notes on Hard-spheres approximation, [4]
(b) Give one advantage and one disadvantage of NMR when compared to X-ray crystallography. [4]
(c) Myoglobin and hemoglobin each bind oxygen and they have lot of similarities. However, they also have dissimilarities. One obvious difference between the two proteins is that myoglobin is a single polypeptide chain while vertebrate hemoglobins are tetrameric. The distribution of the surface residues is also different. Explain this difference. [2]

- Q4.** a) Draw a structure of a pentapeptide **Glu-Met-Arg-Thr-Gly** in its fully extended form and show one pair of donor and acceptor atoms which are involved in hydrogen bonds which lead to α - helix formation. How many atoms are there between a donor/acceptor pair in the above figure? How many residues are there? [6+1+3=10]
(b) name the carboxyl-terminal residue:
(c) give the number of charged groups at pH 7:
(d) give the net charge at pH 1:

- Q5.** What are reverse turns? What is their role in protein structures? Illustrate a typical β -turn. [2+1+7=10]

- Q6.** (a) Which of the following statements about the peptide bond are true? [2]
- i) The peptide bond is planar because of the partial double-bond character of the bond between the carboxyl carbon and the nitrogen.
 - ii) There is relative freedom of rotation of the bond between the carboxyl carbon and the nitrogen.
 - iii) The hydrogen that is bonded to the nitrogen atom is trans to the oxygen of the carboxyl.
 - iv) There is no freedom of rotation around the bond between the alpha carbon and the carboxyl carbon.
- b) Define helical parameters with the help of an illustration. [2]
- c) The pitch of a double-helical B-form DNA is 3.4 nm and its twist is 36° . Find 'n' and 'h' for this helix? [2]
- d) What is a hydrogen-bond? Elaborate with examples. [4]

**RESOLVE TO PERFORM WHAT YOU OUGHT, PERFORM WITHOUT FAIL WHAT YOU
HAVE RESOLVED**