

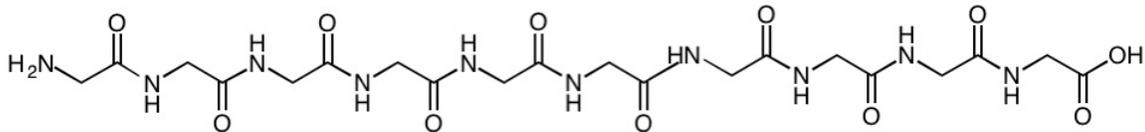
Biochemistry CUME October 2017

Topic: Protein Structure Analysis

Protein structures can be described and characterized at four different levels - primary structure (1°), secondary structure (2°), tertiary structure (3°) and quaternary structure (4°).

1. Primary Structure (25 points):

(a) (10 points) The primary structure of a protein refers to its amino acid sequence. Given the sequence (MQVGIEHNWK) of a polypeptide, please draw the chemical structure of this peptide by adding proper side chains to the protein backbone structure from the amino-terminus to the carboxyl terminus.



(b) (5 points) Which of the following group does each of the 10 amino acids in **1(a)** belong to? Please use 3-letter code to identify the amino acids.

- Charged:
- Polar:
- Non-polar:

c) (10 points) Name one experimental technique (biophysical or biochemical, but not bioinformatics) that can be used for protein sequencing. What is the principle behind this sequencing method?

2. Secondary Structure (25 points):

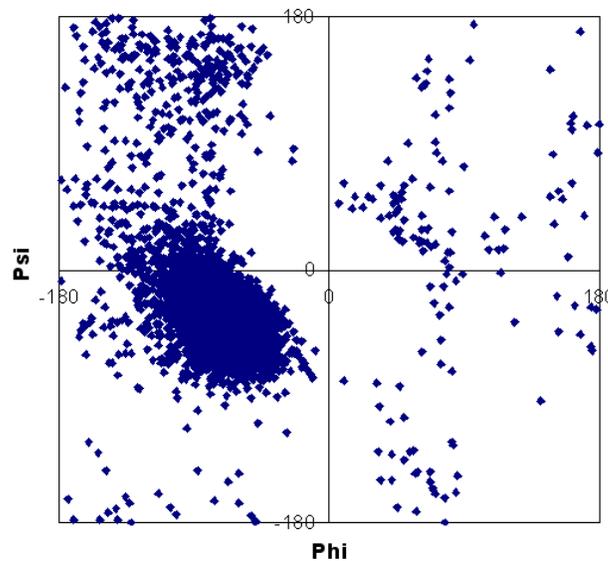
(a) (15 points) Alpha-helix and beta-sheet are two major types of protein secondary structures. Please describe the main features of the hydrogen bonding pattern and the backbone geometry characteristic for each type. Use illustration if necessary.

(b) (10 points) What spectroscopic method is often used for protein secondary structure analysis?

3. Tertiary Structure (25 points):

(a) (5 points) What are the four major interactions that govern protein folding?

(b) (10 points) The Ramachandran diagram shows the distribution of the backbone dihedral angles (ϕ , ψ) of a protein structure. Please **circle** and **label** those region(s) in the ϕ - ψ plot where you expect to find residues from alpha-helix and beta-strand, respectively.



(c) (10 points) Tertiary protein structures can be determined by several biophysical methods. Please describe two widely used experimental approaches, and discuss their strengths and limitations in protein structure determination.

4. Quaternary Structure (25 points)

(a) (15 points) What is the definition of protein quaternary structure? Provide 1-2 examples to explain how the quaternary structure of a protein plays an important role in its function.

(b) (10 points) What chromatography-based method is commonly used for analyzing the quaternary structure? And how?