

Mid-Term Test

Answer all questions in the Exam Booklets. Put your name and student number on all exam booklets. You may use a calculator and diagrams where appropriate.

The total number of marks is 70 and you have 75 minutes so spend about 1 min. per mark i.e. 20 min. for a 20 mark question etc.

Answer questions 1. It is worth 15 marks.

1. Explain in words what is a dihedral angle. Give a definition of the dihedral angle ϕ . Draw the peptide Tyr-Asp and label all the dihedral angles with Greek letters or names. Draw and label a Ramachandran Diagram. What information does it convey?

Answer question 2. It is worth 12 marks.

2. Explain the chemical reactivity of the amino acid Cys, give some examples, and describe the role of this chemistry in the folding of proteins.

Answer question 3 OR question 4. Each is worth 15 marks.

3. Describe in chemical detail the main steps of an Edman degradation indicating the role and importance of pH, buffers, and organic solvents.
4. Outline a protocol for amino acid analysis of a protein and describe in chemical detail peptide hydrolysis by strong acid or base. Explain the problem that arises in amino acid analysis when a protein contains β -branched dipeptides and present a solution to the problem.

Answer question 5 OR question 6. Each is worth 15 marks.

5. Name 3 methods for the determination of the M_r of a protein. Of the methods you have named which gives the most accurate measure of protein mass? Explain the physical meaning of the symbols in the following equation:

$$\frac{dr}{dt} = \frac{M_r(1 - \bar{v}\rho)\omega^2 r}{N \cdot f}$$

Explain how the f of a protein is deduced using the above equation and include a simple description of the experiment. Why would determination of f be useful? What is the hydrodynamic particle?

6. Explain how electrospray ionization AND matrix-assisted laser desorption ionization methods insert proteins into the vacuum of the mass spectrometer. Explain how mass spectrometry can be used to sequence proteins OR describe the use of mass spectrometry to measure changes in non-covalent associations of proteins and other molecules.

Answer question 7. It is worth 10 marks.

7. Explain why there is such great interest in the HIV-1 protease. Synthetic *D*- and *L*-HIV-1 protease rotate plane-polarized light in equal but opposite directions in the region between 240 nm and 170 nm. What are the structural implications of this observation?

Answer question 8. It is worth 3 marks.

8. Explain the meaning of the term “racemization”.

Bonus Question: It is worth 3 marks.

9. Human hair is made of α -keratin and grows at the rate of about 20 cm / year. If we assume that the biosynthesis of the protein is the rate-limiting factor in hair growth what is the rate (per second) at which peptide bonds are assembled? For full marks, show your calculations and assumptions.