THE UNIVERSITY OF MANITOBA

April 30, 2002 FINAL EXAMINATION

PAPER NO: 499 LOCATION: 218 Wallace PAGE NO: 1 of 4

DEPARTMENT & COURSE NO: Chemistry 2.463 TIME: 3 HOURS

EXAMINATION: Biochemistry of Proteins EXAMINER: J. O'Neil

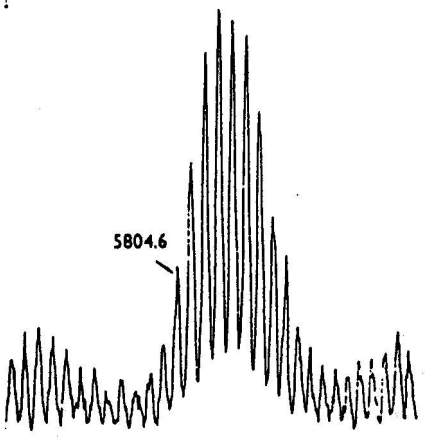
Section 1: *You must answer all of the following questions in* Section 1. *As a guide you can spend up to 2 hours and 35 minutes on this part of the exam. Wherever possible* ***use diagrams*** *to enhance your answers.*

Marks

2 1 What is meant by the term "hydrodynamic particle"?

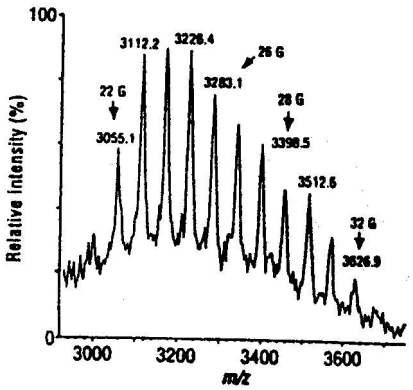
2 2 What properties of proteins determine their hydrodynamic behaviour?

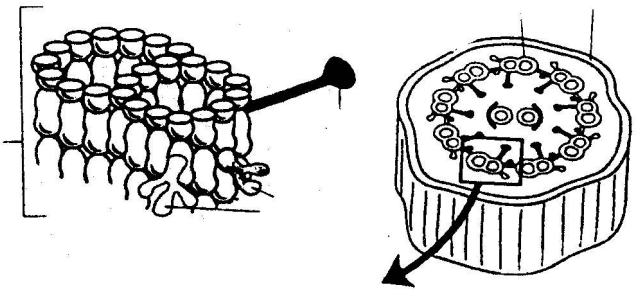
6 3 The figure below shows the mass spectrum of human insulin. What information does it convey?



2 4 What is the meaning of "racemization"?

10 5 With the use of the following diagrams explain the experiments that determined a post-translational modification of tubulin. Explain the biological function of tubulin.





9 6 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?

6 7 Explain why the peptide bond is planar. What are the structural implications of this for protein folding?

8 8 Explain in words what is a dihedral angle and give a definition of the angle ϕ. Draw the chemical structure of the peptide Arg-Ala at pH 7 and label all the side-chain and backbone dihedral angles with Greek letters or names.

12 9 Draw the structure of the amino acid proline. Comment on how the structure of this amino acid affects polypeptide conformation. Describe some examples of protein structures than contain proline and explain the biological or biochemical significance of the proteins.

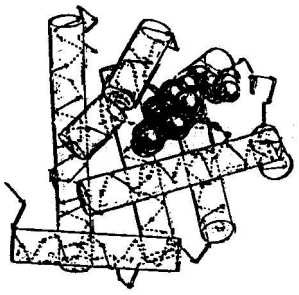
4 10 Considering that a Type III turn resembles a 3_{10} helix indicate where it would occur on a Ramachandran plot.

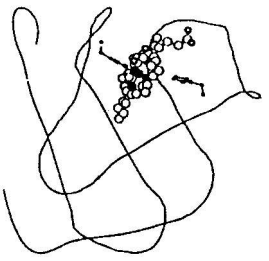
6 11 Using a diagram describe the features of the coiled-coil motif including its helix-packing interactions. Name 1 protein that adopts this structure.

8 12. Prostaglandin H2 synthase-1 is thought to reside in only 1 leaflet of the membrane bilayer. Describe the protein domain that anchors this protein in the leaflet. Name 1 drug molecule that inhibits 1 of the enzymatic activities of this enzyme. Comment on the interest in this enzyme structure for rational drug design.

6 13 With the use of the diagrams below describe the "globin fold".

A **B**





8 14 Specifically with respect to the myoglobin structure what difficulty arises in attempts to explain the biological activity of the protein based on the views of the structure shown above? How can this problem overcome?

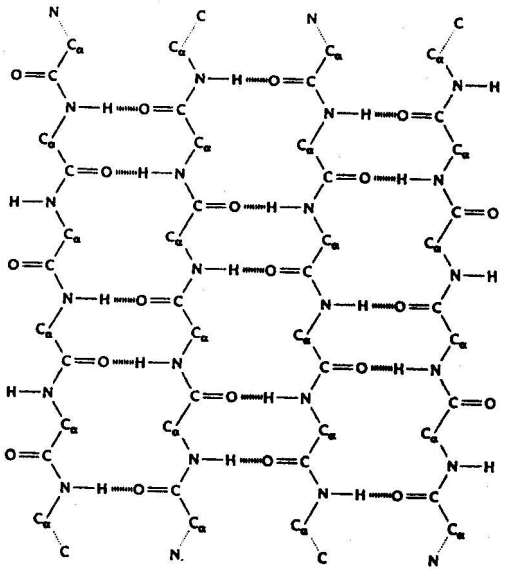
3 15 Name three techniques that can be used to extract dynamic information about proteins.

8 16 Explain how molecular dynamics simulations of protein motion are carried out. What are the two major conclusions about protein dynamics that have been reached using this method?

2 17 What did you observe and learn from viewing the protein dynamics movies that were available on the course web site?

12 18 Identify the following structures. What are the main features of each?

A



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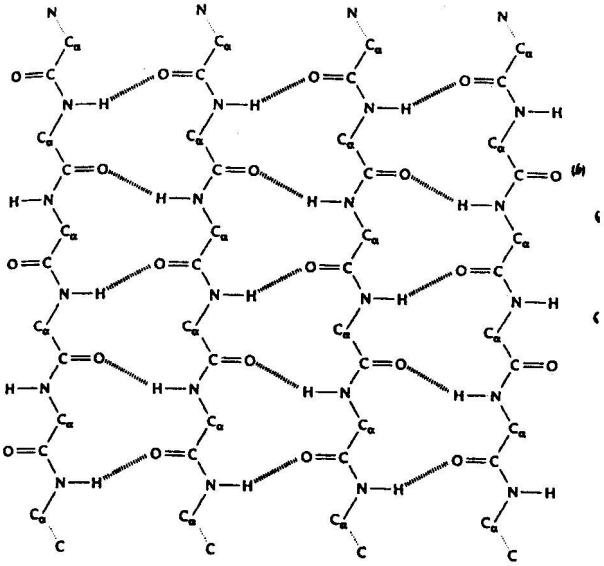

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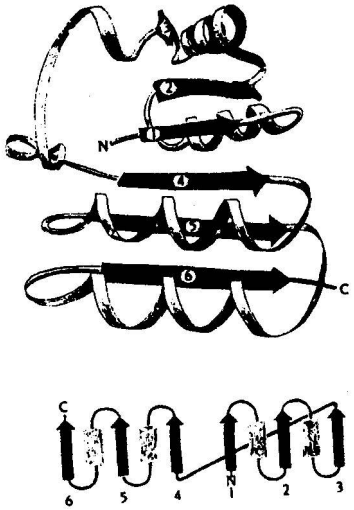

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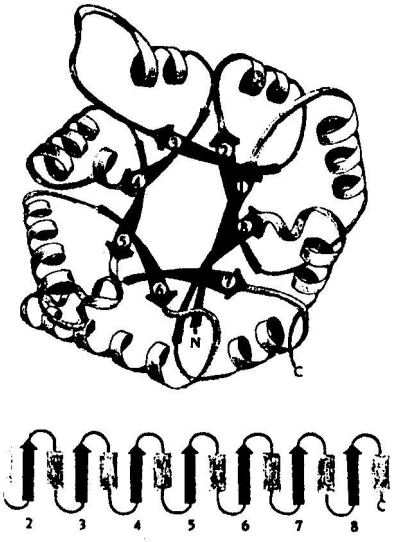
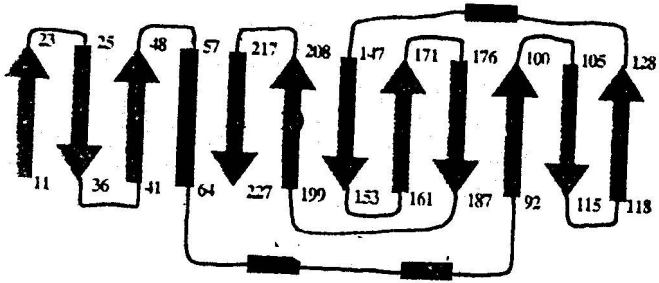
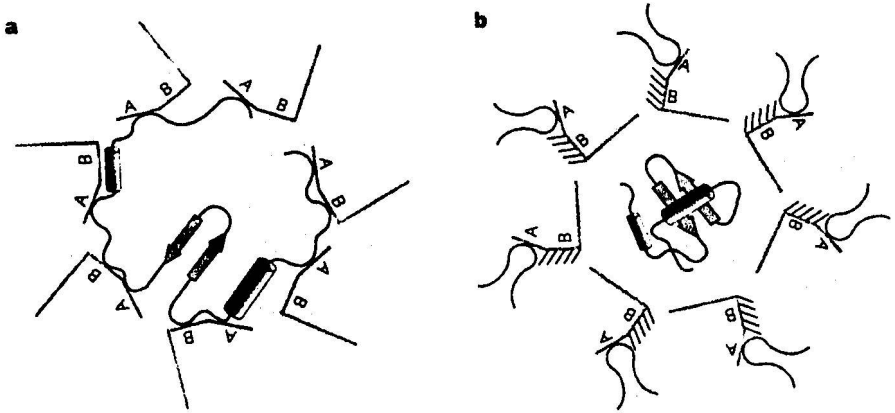


8 19 With reference to the topology diagram shown below describe the structure of the Green Fluorescent Protein. How is this protein used in molecular and cell biology research?



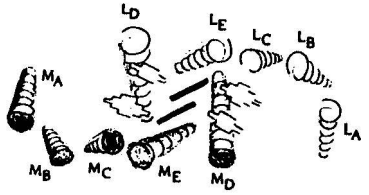
6 20 With the use of the diagram below give a brief explanation of how the Chaperonin GroEL assists in the folding of proteins.



2 21 How many different conformations can a 3 amino acid peptide adopt if each amino acid can adopt 6 different conformations?

Section 2: *Answer 1 of the following questions in* Section 2. *You can spend about 25 min. on this question.*

20 22. Explain different mechanisms by which helices pack in proteins. Be sure to explain the example given in the diagram below.



20 23. Describe the variety of structures adopted by membrane proteins. Be sure to use diagrams where appropriate and to describe the relationship between structure and function in the examples you choose.

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