THE UNIVERSITY OF MANITOBA

April 17, 1998 FINAL EXAMINATION

PAPER NO: 551 LOCATION: Engineering Room 346 PAGE NO: 1 of 3

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 20 minutes on this part of the exam. Wherever possible* ***use diagrams*** *to enhance your answers.*

Marks

10 1. What information did V. N. Ramachandran use to construct his Ramachandran Plot? Draw a Ramachandran Plot and label the locations of the right and left-hand α-helices, parallel and antiparallel β-sheets, the right-hand 3_{10} helix, and the collagen triple helix.

6 2. Explain the origin of the peptide dipole and its relationship to the helical macrodipol

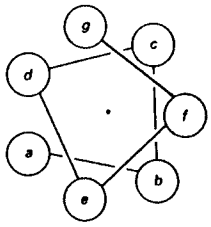
4 3. Explain why Proline is termed a helix breaker.

10 4. Describe an ideal α-helix using structural parameters such as the rise, pitch, repeat *etc.*

6 5. Draw the following sequence on a helical wheel: I-N-E-G-F-D-L-L-R-S-G What does your diagram indicate about the helix?

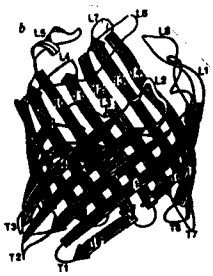
6 6. What is a Chameleon sequence? What do such sequences indicate about protein structures?

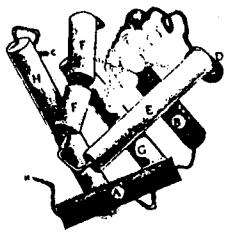
6 7. Using the diagram below describe the features of the coiled-coil motif including its helix-packing interactions. Name 1 protein which adopts this structure.



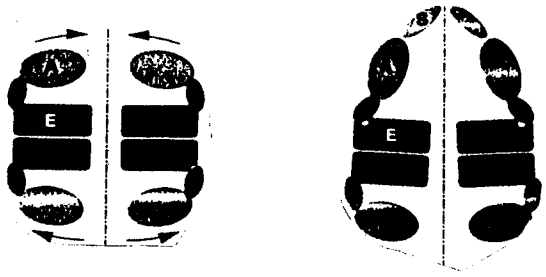
6 8. Identify the following structures. What are the main features of each?

A B





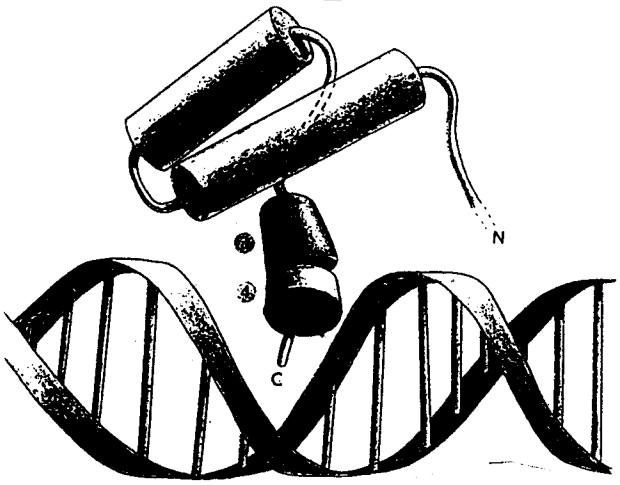
7 9. Label 7 components in the diagram on the right.
5 Explain the conformational event which the two diagrams of the chaperonin complex illustrate.



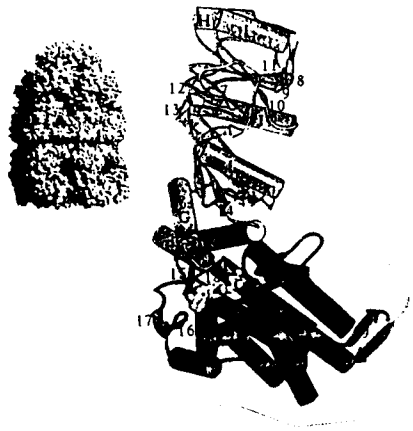
4 10. What is a Schellman motif?

12 11. Identify the following figures. What are the main features of each?

A



B



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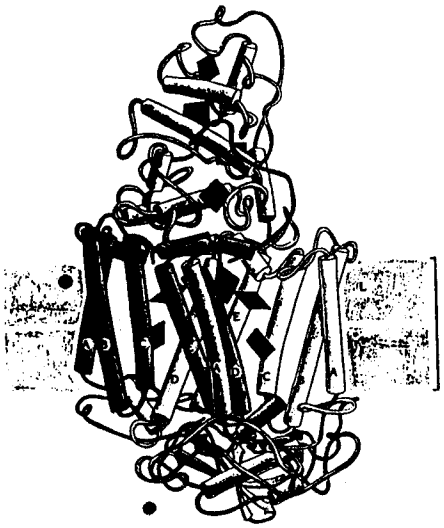

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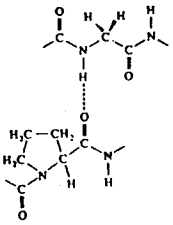

8 12. Discuss the covalent attachment of membrane proteins to lipid.

2 13. How many different conformations can a 4 amino acid peptide form if each amino acid can adopt only 6 different conformations?

6 14. Describe how the Hydrophobic Zipper Hypothesis helps explain some aspects of the cooperativity of protein folding.

8 15. Prostaglandin H2 synthase-1 is thought to reside in only 1 leaflet of the membrane bilayer. Describe the protein domain which anchors this protein in the leaflet. Name 1 drug molecule which inhibits 1 of the enzymatic activities of this enzyme. Explain why this molecule is a target for the design of new drugs for cancer prevention.

6 16. Draw the chemical structure of urea. Use a diagram and explain how urea acts to unfold proteins.

15 17. Describe 6 experimental approaches to the protein folding problem.

6 18. Explain the role and importance of entropy in determining the folded state of a protein.

Section 2: *Answer 1 of the following questions in* Section 2. *You can spend about 20 min. on this question.*

15 19. Cells have evolved a number of mechanisms to assist protein folding. Describe 4 such mechanisms and name the factors involved in the process.

5 19. How does the GroEL / GroES complex aid the folding of proteins?

10 Describe, in as much detail as you can, the mechanism by which the GroEL / GroES complex assists proteins to fold.

Section 3: *Answer 1 of the following questions in* Section 3. *You can spend about 20 min. on this question.*

15 20. The structures of the proteins found on the outer surfaces of viruses are of interest from the point of view of drug design. Give one example of an influenza virus protein and one example of a rhinovirus protein found on the outer surfaces of the respective viruses. Describe the structures of both of these proteins pointing out features relevant to drug design and using diagrams where appropriate.

15 20 Describe thermodynamic and structural features of proteins which discourage short helix formation. Describe the thermodynamic and structural features of proteins which might permit the formation of short helices in proteins in contrast to those formed by homopolymers which are quite long?

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