THE UNIVERSITY OF MANITOBA

April 15, 1996 FINAL EXAMINATION

PAPER NO: 80 LOCATION: University Centre 210-22 PAGE NO: 1 of 3

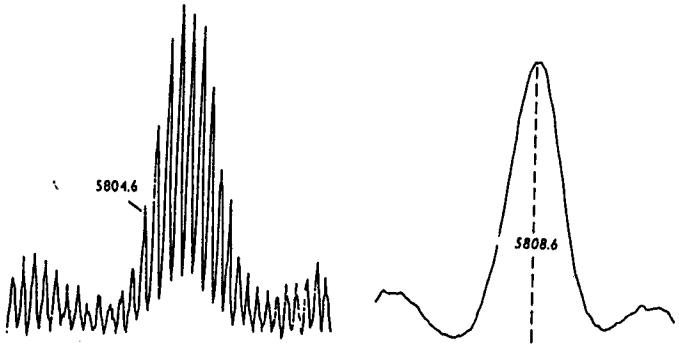
DEPARTMENT & COURSE NO: CHEMISTRY 2.463 TIME: 3 HOURS

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

Section 1: *You must answer all of the following questions in* Section 1. *You can spend up to 2.5 hours on this part of the exam. Wherever possible* ***use diagrams*** *to enhance your answers.*

Marks

8 1. In the figures below are shown 2 mass spectra of human insulin. What instrumentation was used to produce each of the spectra?
Explain the origin of the many peaks in the spectrum at the left.
What is the source of the labelled peak on the left?
What is the meaning of the number on the spectrum on the right?



4 2. Draw the peptide Pro-Leu and label all the dihedral angles ϕ, ψ, ω, χ.

6 3. Explain the origin of the peptide dipole and its relationship to the helical macrodipole.

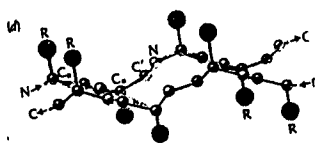
6 4. Explain the contribution of the peptide dipole to the cooperativity of α-helix formation.

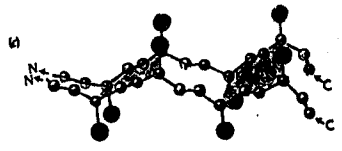
12 5. A π-helix can be designated 4.4_{16}. In words and pictures describe the properties of such a structure.
How many turns of helix are there in one repeat of such a helix? How many residues per repeat?
If the rise of the helix is 1.2 Å what is the repeat of the helix? What is the pitch?

6 6. Draw your own diagram and explain the common ways in which α-helices pack together.

2 7. Give a reason why it might be misleading to describe *loop structures* as secondary structure.

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





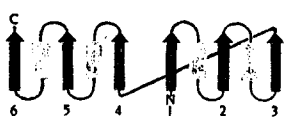
7 9. The globin fold occurs in nearly all living cells with amino acid sequence homologies ranging from 16% to 99%. The 3D structures of these molecules are virtually identical. Discuss.

8 10. Using words and a diagram suggest a folding pathway for the formation of a Greek Key motif.

4 11. Draw a diagram to illustrate the first intermediate in the folding of a Jelly-Roll Barrel.

6 12. Below are 2 topology diagrams. Explain why one forms a closed barrel and the other an open, twisted sheet. Where is the topological switch point in one of the diagrams and what generally is its function?

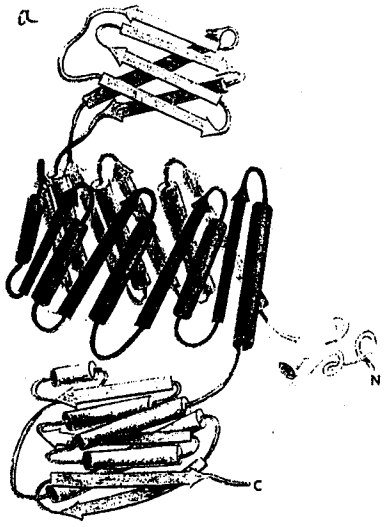
a



b

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

a



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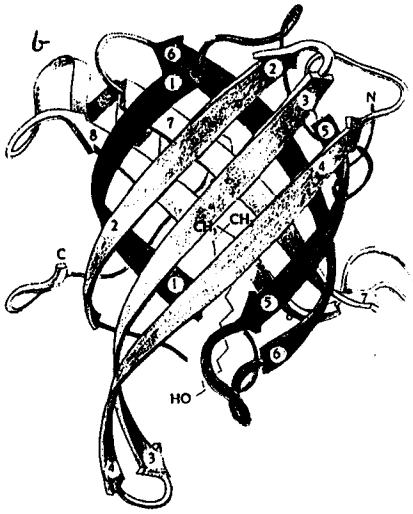

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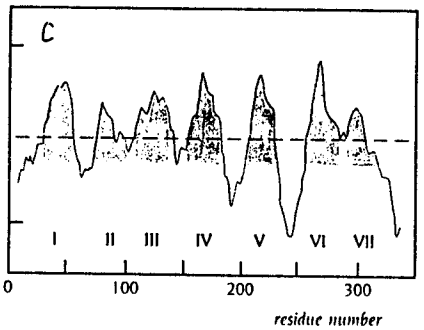

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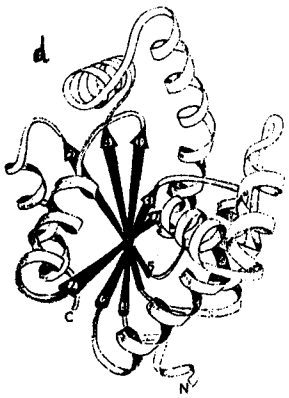

8 14. The influenza virus contains two major membrane proteins in its outer lipid envelope. Name the proteins and very briefly describe the main features of each. What structural feature do they both have in common?

4 15. Explain the advantage of using molecules such as CH_3 CH_2 CH_3 as analogues of amino acids in measurements of side chain hydrophobicity.

3 16. How many different conformations can a 27 amino acid protein form if each amino acid can adopt only 3 different conformations?

6 17. Describe the molten globule state of a protein.

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

15 18. Describe the "protein folding problem". Explain the concept of *cooperativity* and indicate its relevance to protein folding. Describe the hydrophobic zipper model of protein folding.

OR

15 19. With the use of the diagrams below discuss the structure of the *E. coli* porin complex and indicate how knowledge of the structure improves our understanding of the function of the molecule.

123