THE UNIVERSITY OF MANITOBA

April 13, 1999 FINAL EXAMINATION

PAPER NO: 182 LOCATION: Frank Kennedy Brown

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.*

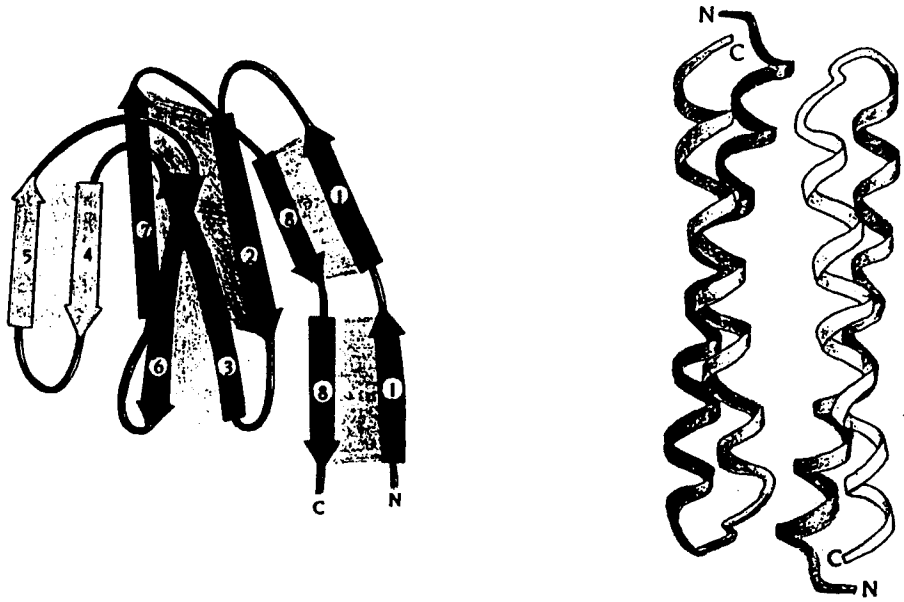
Marks		
6	1	Draw the peptide Lys-Arg and label all the dihedral angles with Greek letters or names.
12	2	Describe in detail a 3_{10}-helix and an α-helix, remarking on the differences between them.
12	3.	A π-helix can be designated 4.4_{16}. Using words and diagrams describe the properties of such a 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	4	A 14 micromolar solution of a protein comprising a single polypeptide chain has an absorbance in a 1 cm cuvette at 290 nm of 0.42 at pH 7 and an absorbance of 0.63 at pH 12. The molar extinction coefficient for tyrosinate at pH 12 is 2480 $M^{-1}cm^{-1}$. How many tyrosine residues are in this protein? What is the structure of tyrosinate?
12	5	Explain why Proline and Glycine are termed helix breakers. Does Alanine have a strong or weak helix propensity? Explain. What about Valine?
9	6.	Use a 7 residue moving window and the table below to calculate and graph a hydropathy plot for the sequence D-T-S-D-G-A-V-L-A-I-M-V-F-Q-E-K

R	15.86	D	9.66	E	7.75	N	7.58
K	6.49	Q	6.48	H	5.60	S	4.34
T	3.51	Y	1.08	G	0.00	C	-0.34
A	-0.87	W	-1.39	M	-1.41	F	-2.04
V	-3.10	I	-3.98	L	-3.98		

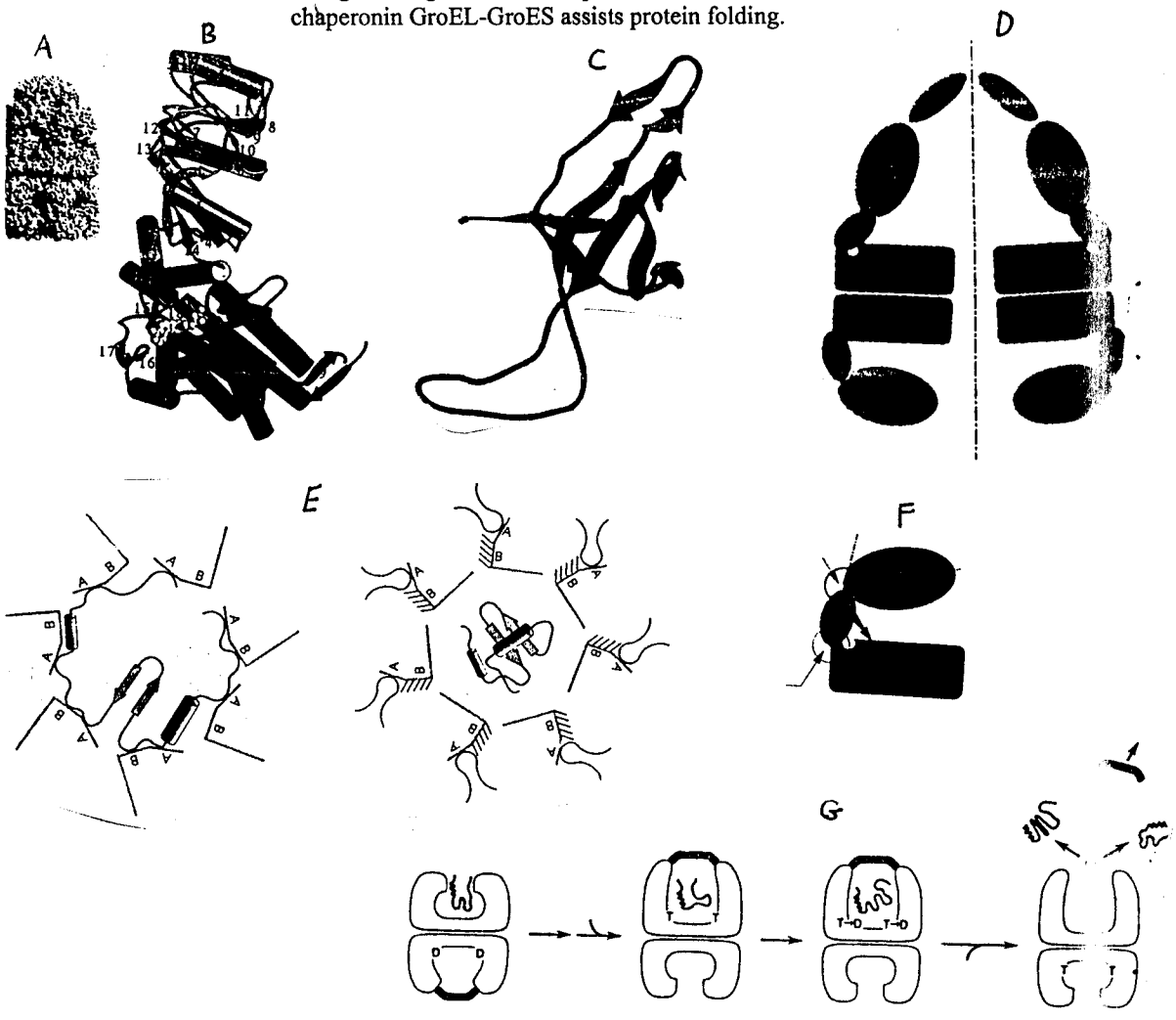
In general, what information does a hydropathy plot convey?

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

A B

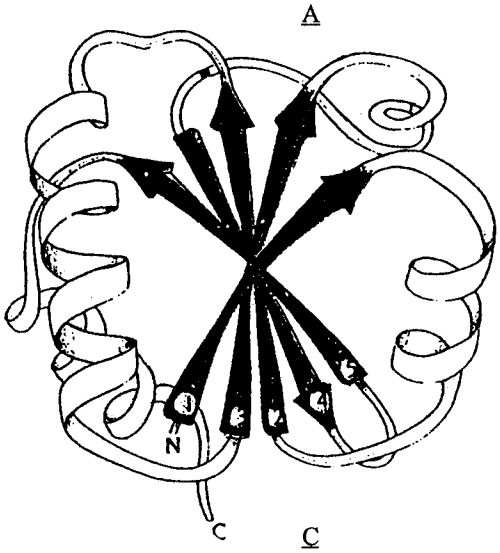


20 8. Using the diagrams below explain the mechanism by which the chaperonin GroEL-GroES assists protein folding.

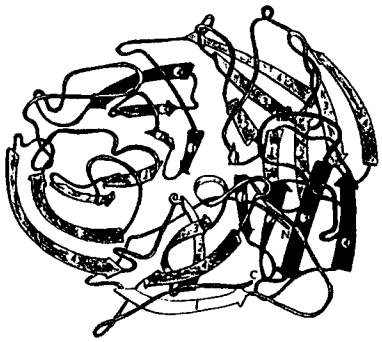


12 9. Identify the following structures. What are the main features of each?

A



B



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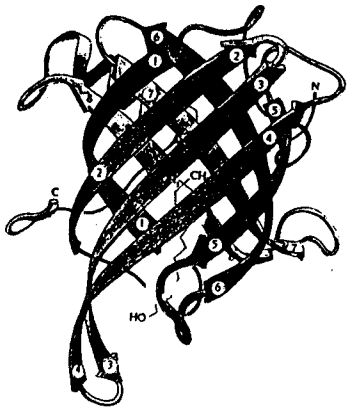
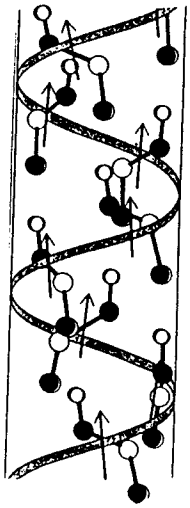


D



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

2 11. How many different conformations can a 20 amino acid peptide form if each amino acid can adopt only 9 different conformations?

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

8 13. Explain, using diagrams, what is a topological switch point.

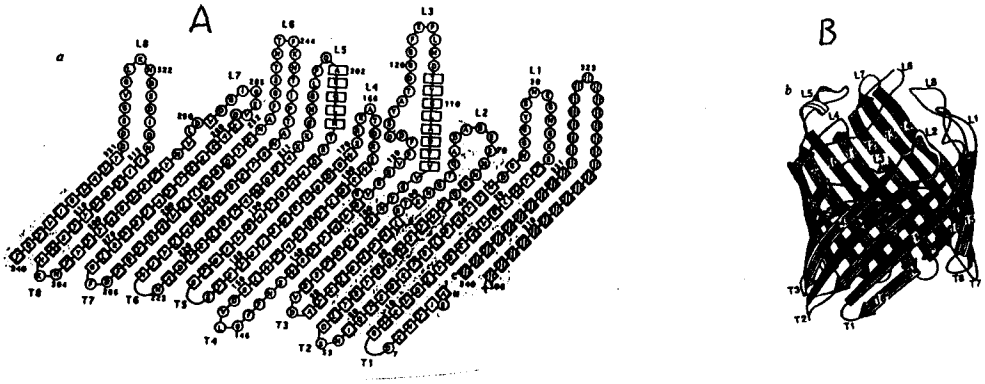
6 14. Draw the chemical structure of urea. Use a diagram and explain how urea acts to unfold proteins.

5 15. Describe the sequential framework model of protein folding.

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

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

16 16. 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.



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

16 17. 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.

16 17. With the use of the following diagrams describe the structure and function of Green Fluorescent Protein. Describe some uses for this molecule.