

THE UNIVERSITY OF MANITOBA

April 16, 2005

FINAL EXAMINATION

PAPER NO: 219

LOCATION: Frank Kennedy Gold Gym

PAGE NO: 1 of 4

DEPARTMENT & COURSE NO: Chemistry 2.463

TIME: 3 HOURS

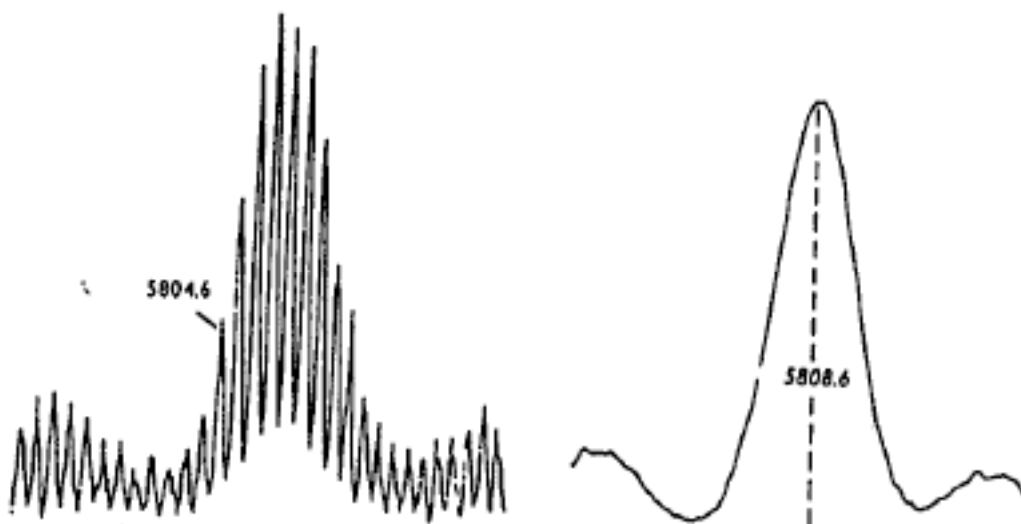
EXAMINATION: Biochemistry of Proteins

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

- 10 1. Describe the determination of disulphide pairs in a protein using a chemical method and using mass spectrometry.
- 10 3. Describe the sequence or draw the structure of glutathione. Explain how glutathione is involved in controlling protein folding in cells. For full marks use molecular structures. In which organelle does this reaction normally take place? What enzyme is involved?
- 8 4. 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?



- 3 5. Define proteomics.
- 8 6. Outline a proteomic strategy for the identification of all the proteins in a human epithelial cell.
- 6 7. Draw the chemical structure of the tripeptide Phe-Lys-Leu at pH 7 and label all the dihedral angles with Greek letters or names.

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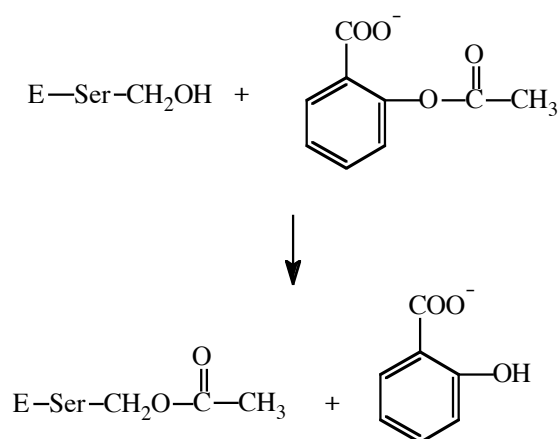
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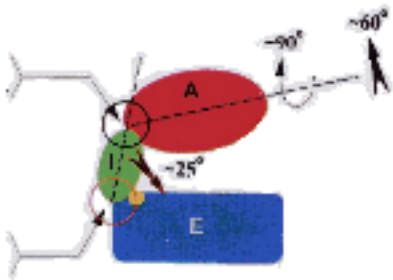
- 12 8. A π -helix can be designated 4.4₁₆. In words and pictures describe the properties of such a structure. How many turns of helix are there in one repeat of such a helix? How many residues per repeat? If the rise of the helix is 1.2 Å what is the repeat of the helix? What is the pitch?
- 6 9. Draw the following sequence on a helical wheel:
Val-Gln-Lys-Gly-Phe-Arg-Ile-Leu-Arg-Ser-Gly What does your diagram indicate about the helix?
- 3 10. Describe the “globin fold”.
- 6 11. Name 3 examples of protein function in which a conformational change is required. Name and give a brief description of the type of dynamics that is the foundation for all protein conformational changes.
- 1 12. Is it possible for a β -strand to occur as an isolated ribbon or must it always occur paired with another β -strand?
- 9 13. Use a 5 residue moving window and the table below to calculate and graph a hydropathy plot for the sequence D-T-S-E-G-A-V-L-A-V-M-V-F-Q-D-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 14. Discuss the significance of the following reaction:



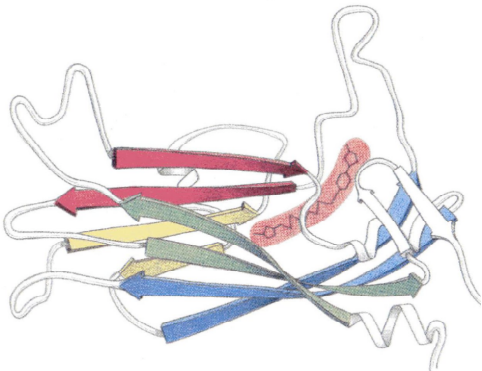
Marks

- 12 15. Identify the following structures. Describe the main features of each using examples wherever possible.

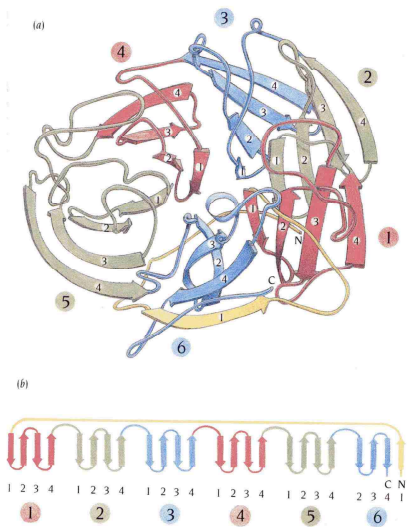
A



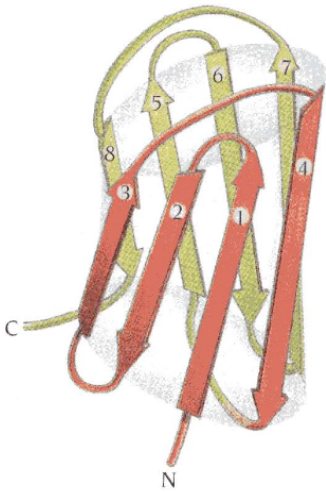
B



C



D



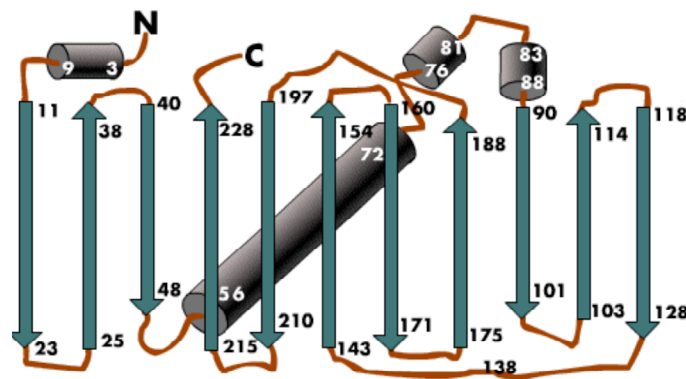
- 2 16. How many different conformations can a 7 amino acid peptide form if each amino acid can adopt 3 different conformations?
- 10 17. Draw and label a 3-dimensional folding funnel. Outline the main features of protein folding that are illustrated in folding funnels. What is the experimental basis of the funnel?

Marks

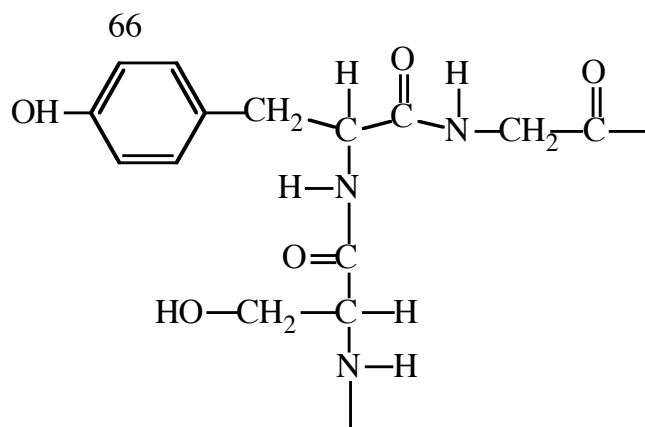
Section 2: Answer 1 of the following questions in Section 2. You can spend about 25 min. on this question.

- 20 18. With the use of the following diagrams describe the structure and function and cell biology uses of Green Fluorescent Protein.

A



B



- 20 19. Explain different mechanisms by which helices pack in proteins. Give examples of each.
- 20 20. 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.