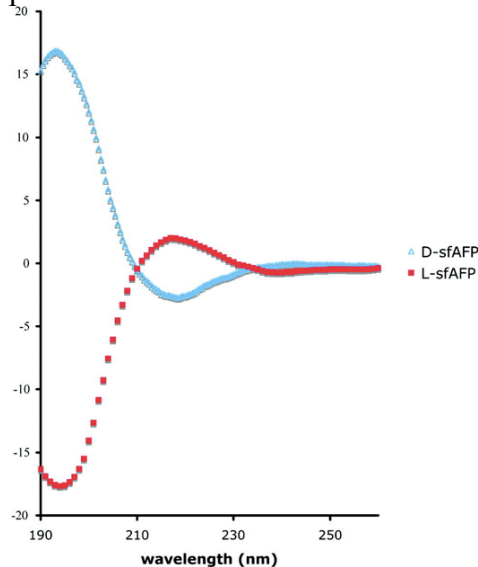


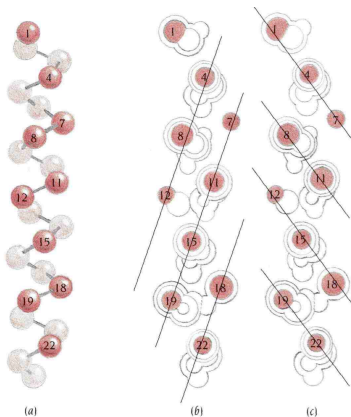
Section 1: You must answer all of the following questions in Section 1. As a guide you can spend up to 2 hours and 20 minutes on this part of the exam.
Wherever possible **use diagrams and structures** to enhance your answers.

Marks

- 12 1. With the use of the following figure discuss the structure and function of the snow-flea antifreeze protein.

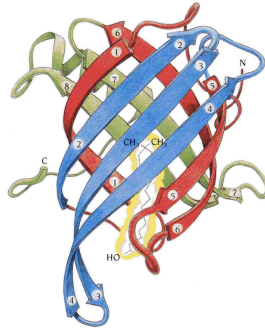


- 6 2. Predict the secondary structure of a protein polymerized from a random mixture of *D*- and *L*- amino acids. Explain your answer.
- 12 3. Draw the chemical structure of the tetrapeptide Glu-Gly-Asp-Glu at pH 9. Label the backbone and side-chain dihedral angles that describe the conformation of the Aspartic acid. Give a definition of the ω dihedral angle.
Such a short peptide will exist in dynamic equilibrium between many different conformations. What do you think is the most stable conformation for the backbone of this peptide at pH 9? Explain your reasoning.
- 2 4. With the use of the following equation explain the R-factor in X-ray diffraction.
$$R = \frac{\sum ||F_{\text{obs}}| - |F_{\text{calc}}||}{\sum |F_{\text{obs}}|}$$
- 1 5. Which NMR parameter contains information about dihedral angles?
- 12 6. 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 7. With the use of the following diagram describe two forms of α -helix packing.



Marks

- 2 8. Draw a β -hairpin motif.
- 10 9. With the use of the following diagram describe the structure and function of the plasma retinol-binding protein.

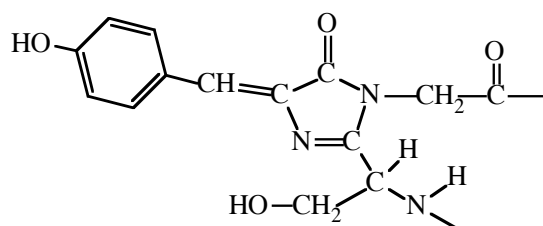


- 2 10. Draw a β - α - β motif.
- 8 11. Describe the following protein structure and briefly relate the structure of the protein to its function:

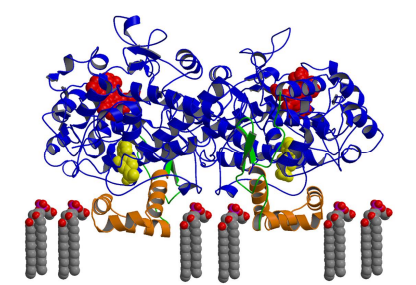


- 12 12. Identify the following structures. Describe the main features of each using examples wherever possible.

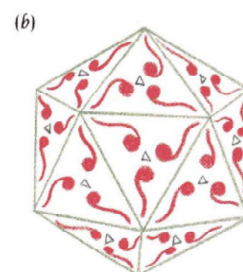
A



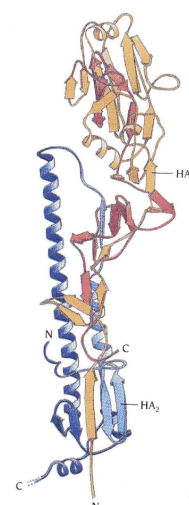
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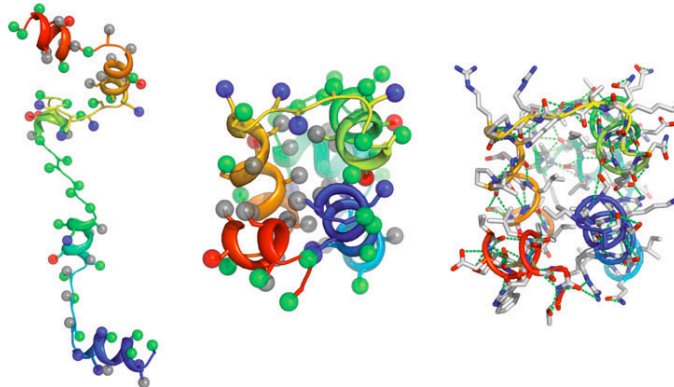


D



Marks

- 3 13. What is “*Simulated Annealing*”?
- 10 14. With the use of the following diagram briefly outline protein structure prediction using ROSETTA.



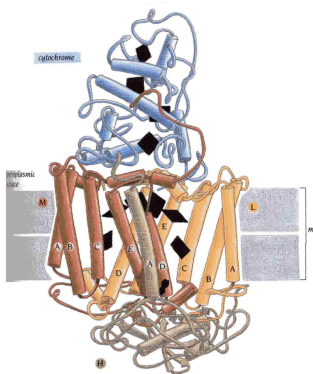
- 2 15. Briefly describe the protein structure prediction method called “*threading*”.
- 9 16. Which ionization state of the Cys side-chain is chemically reactive? Show the reaction between oxidized glutathione OR oxidized dithiothreitol and a reduced protein. Explain how these reactions could be involved in the protein folding process. Outline how cells maintain cytoplasmic proteins in a reduced state.
- 10 17. Describe the domain structure of HSP90. What function is associated with each domain? Describe the ATPase cycle of HSP90.
- 8 18. Explain what aspects of detergent micelle formation resemble protein folding.

Section 2: Answer Question 19 OR Question 20. You can spend about 20 min. on this question.

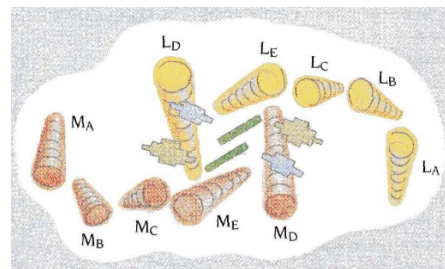
Marks

- 20 19. With the use of the following diagrams discuss the structure and function of the photosynthetic reaction centre from *Rhodospseudomonas viridis*.

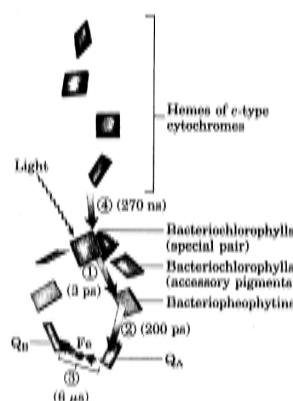
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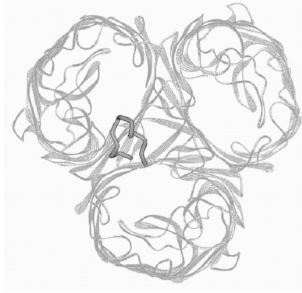


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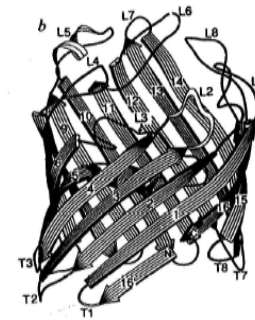


20. With the use of the following diagrams discuss the structure and function of the *E. coli* OmpF porin.

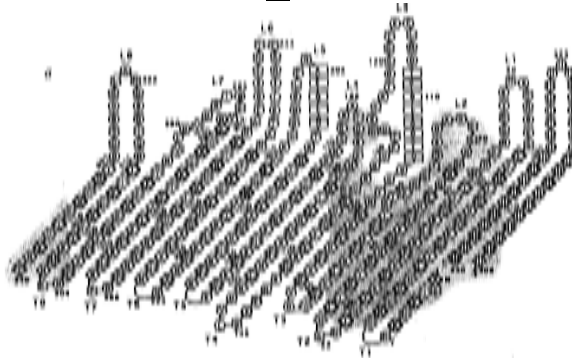
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C



Section 3: Answer Question 21 OR Question 22. You can spend about 20 min. on this question.

21. Describe the role of the Protein Disulphide Isomerase OR the GroE Chaperonin complex in protein folding.

OR

22. Describe the results of the molecular dynamics simulations of David Shaw and co-workers published in 2011.