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*Please put **all** your answers in the exam booklets. There are no optional questions. The total number of marks is 160 so you can spend about 10 minutes on a 10-mark question.*
*Wherever possible **use diagrams and chemical structures** to enhance your answers.*

Marks

10 1. Draw the structure of N-formylmethionine. What role does it play in protein synthesis? Describe the mechanism by which it functions and explain the implications of this to the evolution of the genetic code.

8 2. What is an osmolyte? What structural features of proline make it a good osmolyte? Explain how proline works to protect cells under extreme conditions of temperature, pH or dehydration.

6 3. What are some of the biological advantages of cyclic peptides compared to linear peptides? Give an explanation of the advantages where they are known.

3 4. What is the main advantage of solid-phase peptide synthesis over solution-phase synthesis?

5 5. What does circular dichroism spectropolarimetry measure? Describe how it is used in the analysis of protein structure.

10 6. Describe the results of a study in which synthetic *D*- and *L*-snow flea antifreeze proteins were produced.

10 7. Describe the process by which protein structures are determined by cryoelectron microscopy.

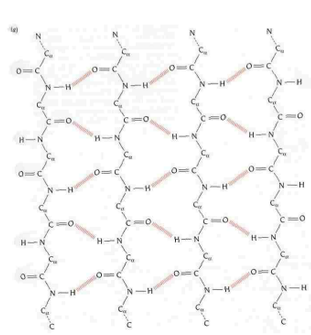
6 8. What are the forces that determine the 3D-structure and stability of proteins?

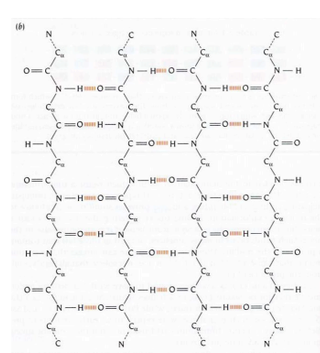
10 9. Define the pitch, rise, repeat, n and m values of a helix. What are these values for an α-helix and a 3_{10} helix?

7 10. Draw a diagram of the peptide bond and describe how the peptide dipole arises. Explain what is a helix dipole and how membrane proteins use them.

6 11. Draw a helical wheel of an amino acid sequence of your choice and use it to illustrate a structural feature of an alpha helix.

6 12. With the use of the following diagrams, describe the structures of parallel and antiparallel β-sheets.





5 13. Describe the 5 main classes in the Structural Classification of Proteins (SCOP).

5 14. Briefly describe the structure and function of a homeodomain protein.

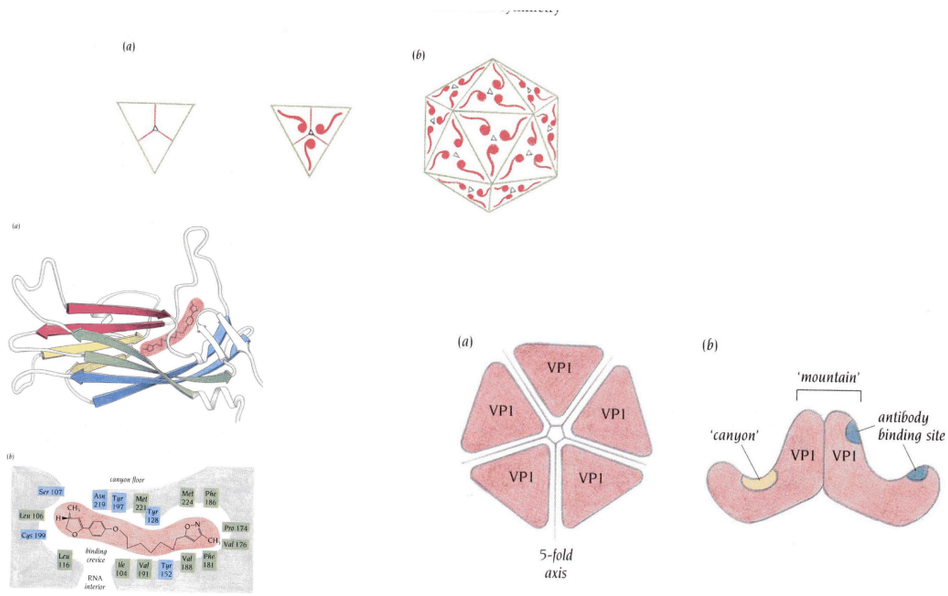
Marks

3 15. Draw a simple diagram and explain how two α-helices can pack orthogonally.

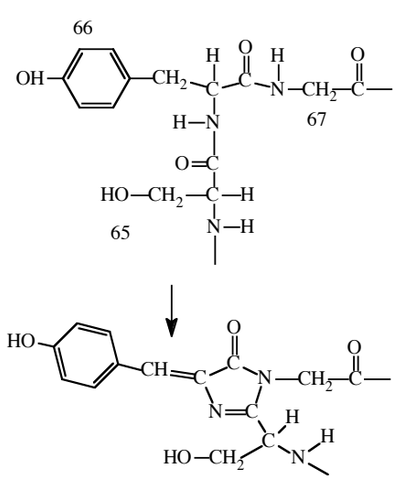
6 16. What is the hydrophobic effect and what feature of the structure of the antifreeze protein Maxi illustrates one aspect of the hydrophobic effect?

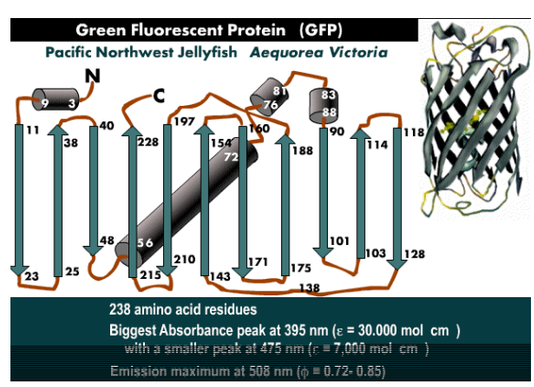
8 17. β-sheets can pack in aligned or orthogonal orientations to form flattened barrels or sandwiches. Describe each of these structures and name one protein that shows each type of packing.

8 18. With the use of the following diagrams describe the structure and function of icosahedral virus coat proteins.



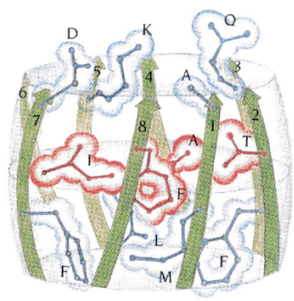
10 19. With the use of the following diagrams, describe the structure, function and uses of Green Fluorescent Protein.





Marks

5 20. Describe the hydrophobic core of glycolate oxidase using the following diagram.



5 21. Briefly describe the benefits of substrate channeling in double- and triple-barreled enzymes.

4 22. Describe 4 functions of intrinsically disordered proteins.

4 23. Describe what was learned about myoglobin function from MD simulations.

10 24. With the use of the following diagrams, describe a study, published in 2013, in which MD simulations of a G-protein coupled receptor revealed important information about the protein's function.