
Section 1: *You must answer all of the following questions in* Section 1. *As a guide you can spend up to 2 hours and 30 minutes on this part of the exam. Wherever possible* ***use diagrams and structures*** *to enhance your answers.*

Marks

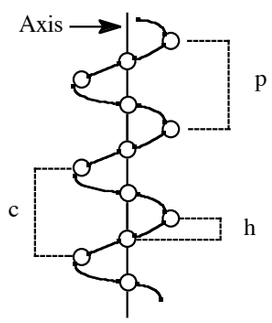
8 1. What does the abbreviation SILAC stand for? Describe the SIALC proteomics approach, what it attempts to measure, and how it is carried out.

6 2. Explain how X-ray diffraction and molecular dynamics simulations revealed how O_2 can gain access to the heme iron that is buried in the hydrophobic core of myoglobin.

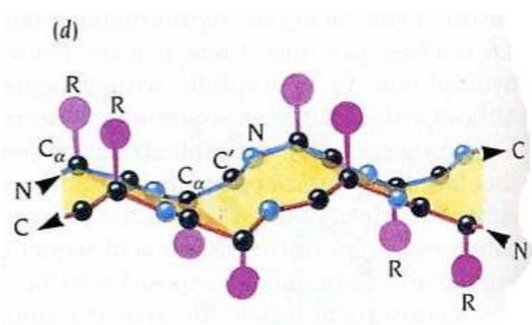
4 3. Draw a helical wheel for the following sequence. What does the diagram reveal?
Ile-Asn-Glu-Ala-Phe-Asp-Leu-Leu-Arg-Ser-Ala.

8 4. Draw the chemical structure of the tripeptide Ile-Trp-Val at pH 7. Label the backbone dihedral angles that describe the conformation of the peptide.
Such a short peptide will exist in dynamic equilibrium between many different conformations. What conformation do you think the backbone of this peptide samples most frequently? Explain your reasoning.

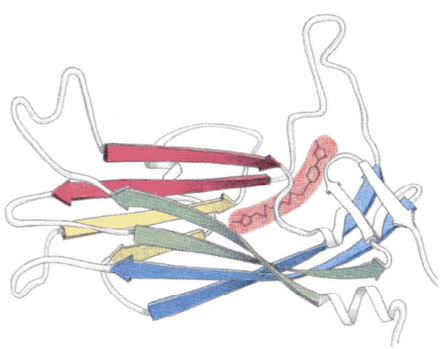
8 5. With the use of the following diagram define and explain the parameters that are used to distinguish different types of helices in proteins.



4 6. What type of structure is represented in the following diagram? Briefly describe the features of the structure.



6 7. With the aid of the diagram below describe the relationship between the structure of the rhinovirus VP2 coat protein and its interactions with antibodies.



Marks

4 8. Draw the structure of an amino acid that is isosteric with Cys. What is the value of such a molecule?

6 9. Use your knowledge of protein structure to explain how an α-helix could be used to stabilize the binding of a metal cation. Do the same for an anion.

10 10. Describe in detail the two types of helical packing in the RNA binding protein Rop.

8 11. Explain the concept of fluorescence and how fluorescence spectra are acquired. How can fluorescence be used to monitor protein folding?

6 12. Describe the structure of Green fluorescent protein. What property of the structure makes its quantum yield very high?

6 13. Explain the meanings of the symbols in the following equation. Explain how the equation is used with respect to protein structures.

$$R = \Sigma||F_{obs}|-|F_{calc}|| \,/\, \Sigma|F_{obs}|$$

6 14. The following table gives the identity of each of the amino acids in the chicken muscle triosephosphate isomerase parallel β-barrel. Describe the structure of the barrel and the significance of the amino acid types at each position in the β-strands.

		Positions				
Strand No.	Residue No.	1	2	3	4	5
1	6-10	Phe	Val	Gly	Gly	Asn
2	37-41	Glu	Val	Val	Cys	Gly
3	59-63	Gly	Val	Ala	Ala	Gln
4	89-93	Trp	Val	Ile	Leu	Gly
5	121-125	Gly	Val	Ile	Ala	Cys
6	158-162	Lys	Val	Val	Leu	Ala
7	204-208	Arg	Ile	Ile	Tyr	Gly
8	227-231	Gly	Phe	Leu	Val	Gly

2 15. What structural feature is shared by the water-soluble RNA-binding protein Rop and the integral membrane photosynthetic reaction centre?

6 16. Comment on the difficulty of predicting the 3-dimensional structure of a protein from its amino acid sequence.

9 17. Discuss the role of entropy in determining the conformation of a protein.

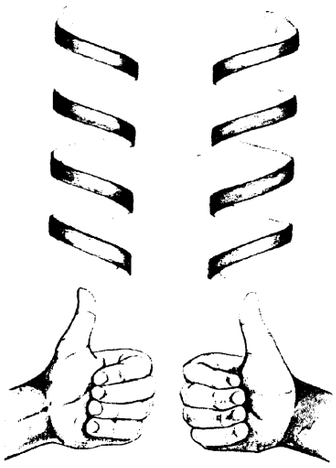
3 18. Membrane proteins constitute about 25% of all eukaryotic and prokaryotic proteins yet they constitute only a small fraction of the proteins in the protein data bank. Give three reasons.

16 19. How many classes of membrane proteins are there? Name and describe the key features of one example of a protein from each class.

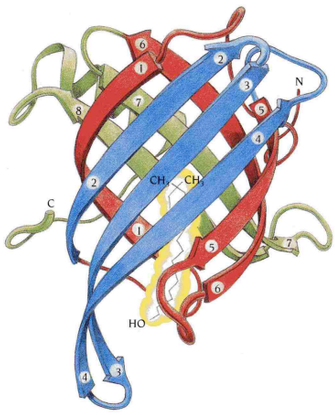
Marks

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

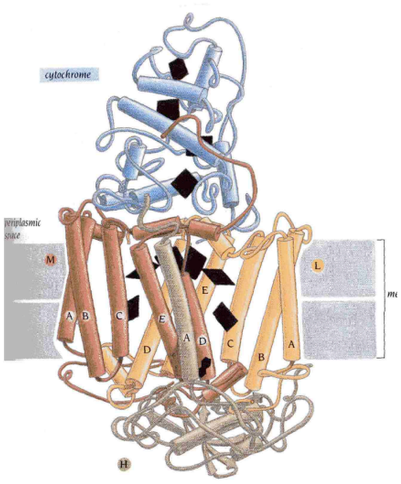
A



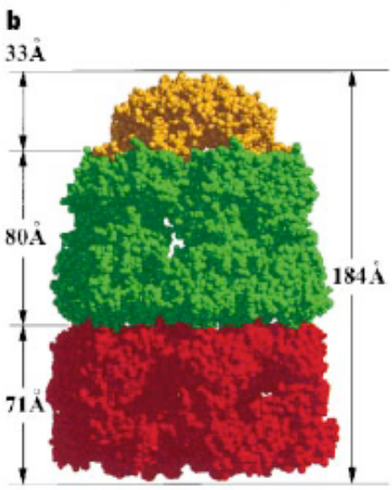
B



C



D



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

20 21. Describe the role of the protein disulphide isomerase (PDI) in ensuring the proper folding of proteins in cells. In your answer describe the structure of glutathione and explain the chemical mechanism by which it or PDI can catalyze disulphide bond formation.

OR

20 22. Describe the role of the peptidyl-prolyl *cis-trans* isomerase in protein folding in cells. In addition, explain the structural basis of the conformational preferences of Pro and of protein segments containing proline.

158