

Birkbeck College

University of London

School of Crystallography

Advanced Certificate in Principles of Protein Structure

Date: Thursday 23<sup>rd</sup> September 2004

**THREE HOURS TOTAL**

Answer **FOUR** questions only (45 minutes each, total three hours).

Write your answer for each question in a separate answer book.

Record both the question number and your examination number on the cover of **EACH** question book used.

Make sure that each question number is clearly marked on each answer page in the book.

Answer **Four** questions only (45 minutes for each question):

Q1. All proteins are polymers of the 20 naturally occurring amino acids. For each amino acid indicate:

- (a) its proper name
- (b) three letter abbreviation
- (c) the one-letter code
- (d) chemical type
- (e) the R group

Answer **all** parts. All parts carry equal marks.

Q2. Describe how protein molecules are organized in a structural hierarchy. What are the main classes of structure at the domain level.

Q3. Select **four** of the following topics and give a brief description of the structure and function of each:

- (a) a monomeric enzyme
- (b) a homodimeric structural protein
- (c) a homotetrameric enzyme
- (d) a homodimer that binds DNA
- (e) a hetero-oligomer with sevenfold rotational symmetry

Q4. Describe the steps involved in finding out the likely function and structure of an unknown protein from its sequence using bioinformatics tools. Give, where possible, the names of the programs that you would use and the databases that you would search.

Q5. Answer **both** parts:

- (a) What is peer review? When and why is it used?
- (b) Describe the format of, and the type of information that might be found in, a primary research paper, a review, a piece of scientific journalism and a patent application in the area of structural molecular biology.

Q6. Compare and contrast the primary, secondary, tertiary and quaternary structural features found in membrane and cytosolic proteins?

Q7. Answer **all** parts:

- (a) What is a hydrophobicity scale, and what is it used for?
- (b) Where, on a typical hydrophobicity scale, would you expect to find the following amino acids? What does this tell you about the most likely location for each amino acid in a globular protein?
  - (i) Tryptophan
  - (ii) Aspartic acid
  - (iii) Cysteine
- (c) Explain, very briefly, how you would use a hydrophobicity scale to determine the locations of transmembrane segments in a protein sequence.

Q8. Many proteins undergo conformational changes upon binding other proteins or substrates. Using haemoglobin as an example, show how it undergoes such conformational changes. Explain how important this conformational adjustment in protein structure is for the biological function.

Q9. Our body is capable of producing a huge diversity of antibodies. Explain how such diversity is produced and how it is reflected in the structure of antibodies.