BIRKBECK COLLEGE

*(University of London)*

Advanced Certificate in the Principles of Protein Structure

Date: Wednesday 20th September 2006

Time: 3 hours

Start time as per instructions to local exam centre

*Students will be expected to answer 6 of the 10 short questions in section A, and 4 of the 8 long questions in section B. They will be advised to spend 1 hour on section A and 2 hours on section B.*

*Short questions are worth 6 marks.*

*Long questions are worth 18 marks*.

# Section A: Short Questions

**Six** questions only to be attempted from section A

(Suggested time 10 minutes on each)

A1. Draw the dipeptide Ala-Gly {3 Marks}. What is the CORN Law {2 marks} and why does it not apply to Gly {1 mark}.

A2. Describe briefly the interatomic interactions below and give an example of a pair of amino acids that could form these interactions together;

i) Van der Waals interactions {3 marks}

ii) Ion pair interactions {3 marks}.

A3. Illustrate the following;

i) The ridges and groves model for packing of helices {2 marks}

ii) A beta hairpin {2 marks}

iii) The organisation of the LRR protein inhibitor of ribonuclease {2 marks}.

A4. For the following;

i) Draw a Ramachandran plot and show the region for a right handed alpha helix {3 marks}

ii) Describe the hydrogen-bonding pattern for an alpha helix {3 marks}.

A5. Describe the helix-turn-helix motif and give an example of a protein that has this motif.

# Section A: Continued

A6. Show schematically the characteristic geometric features of

i) Either a parallel or anti-parallel beta-sheet {2 Marks}.

ii) A beta-barrel {2 Marks}

iii) A beta-alpha-beta motif {2 Marks}.

A7. What is a small G-protein?

A8. Discuss the following;

i) What is peer review and when is it used {2 marks}?

ii) What is an impact factor {2 marks}?

iii) Under what circumstances might the impact factor of a journal be a poor indicator of the journal's quality {2 marks}?

A9. Illustrate the structure of a porin protein. What is this protein's function and where, and in what type of organism, is it found?

A10. Give a brief description of the program BLAST. What is the main output of this program and what criteria are used to decide whether two similar sequences are homologous?

# Section B: Long Questions

**Four** questions only to be attempted from section B
(Suggested time 30 minutes on each)

B11. Describe how symmetry contributes to protein quaternary structure.

B12. What kinds of eukaryotic quality control systems are in place for ensuring the fidelity of information transfer from RNA to the folded protein?

B13. Describe a simple force field equation for the total energy of a molecule or molecular complex using at least five terms. Describe each term in full, what energy values it depends on and how it is calculated. Give an example of an advantage and disadvantage of the use of molecular mechanics over quantum mechanics in simulating a protein molecule.

B14. Discuss the structure and function of the F1 rotary protein motor.

B15. Define allostery and illustrate how it works using hemoglobin as a model system.

B16. Answer **all** parts.

For each of the classic twenty amino acids give:

i) The full name, the three letter abbreviation and the single letter code

ii) Draw the complete side chain group for each amino acid and indicate the chemical properties for each one.

## Section B: Continued

B17. Compare and contrast the roles, functions and structures for MHC Class I and II proteins.

B18. Describe and draw in detail the structure of three different membrane proteins from the all-alpha class. Sketch the position of the membrane on each diagram. Briefly describe the function of each of these proteins.