BIRKBECK COLLEGE

(University of London)

Advanced Certificate in the Principles of Protein Structure

Date: Thursday 3rd September 2009 at 2pm

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.

Each question must start on a fresh page and the question number written at the top of the sheet.

Section A: Ten Short Questions

Six questions only to be attempted from section A

(Suggested time 10 minutes on each)

A1. For the following;

a) Illustrate the CORN Law {2 marks}

b) Draw the tripeptide Pro-Ala-Gly {4 Marks}

A2. Draw a Ramachandran Plot {3 marks} and indicate the regions;

a) right handed alpha helix {1 mark}

b) beta sheet {1 mark}

c) left handed alpha helix {1 mark}

A3. Indicate six ways scientists may use to publish their research {1 mark for each}.

A4. An up-down bundle is a common architecture for proteins classified as mainly alpha-helical. Describe two proteins with this architecture, which have different topologies.

Section A: Continued

A5. a) Explain briefly, and in simple terms, how the program BLAST works and what it is used for {4 marks}

b) What is an E value? Give an estimate for an E value that would indicate that two proteins were likely to be distant homologs {2 marks}

A6. Describe the quaternary structure of the bacterial molecular chaperone GroEL-GroES.

A7. Describe how a transcription factor can recognize DNA.

A8. What is the biological role for the following;

a) Enzymes {1 mark}

b) Hormones {1 mark}

c) Receptors {1 mark}

d) Antibodies {1 mark}

e) Transport proteins {1 mark}

f) Structural proteins {1 mark}

Section A: Continued

A9. Illustrate a Greek key motif and show how this sits within the topology of gamma crystallin.

A10. Draw or describe the interaction between a MHC class I molecule, a peptide and the co-receptor that leads to the binding of a T cell to an antigen presenting cell. Indicate the positions of the cell membranes and the folds of both proteins, and name the co-receptor involved.

Section B: Eight Long Questions

Four questions only to be attempted from section B

(Suggested time 30 minutes on each)

B11. Discuss the role of the hydrogen bond in protein structure.

B12. Describe how the following are used in cell signaling;

a) protein-ligand interactions {6 marks}

b) protein modifications {6 marks}

c) protein domains that mediate protein-protein interactions {6 marks}

B13. What roles do ATP and chaperones play in ensuring that proteins are properly folded {12 marks}. What role does ubiquitin play in protein destruction {6 marks}

B14. The disease AIDS has been successfully treated using drugs that act as protease inhibitors, e.g. Ritonavir. Discuss in detail the structure and function of HIV- protease and how the features of this enzyme were used in targeted drug design.

Section B: Continued

B15. Choose any TWO of the following proteins;

an enzyme
a transport protein
a viral coat shell protein
a cytoskeletal protein

a) Describe the quaternary structure of both {10 marks}

and

b) Discuss in detail the function of one of them {8 marks}.

B16. a) Write down a simple force field equation for the total potential energy of a molecular system. Mark clearly those terms that represent the interaction energy of non-bonded atoms {3 marks}.

b) Name each term and describe briefly the form that it takes and how it arises in molecular terms. You do not need to use equations, but may find them helpful {15 marks}.

B17. Discuss the structure of vertebrate rhodopsin {9 marks}. Outline recent advances in structure determination of other examples of the G-protein coupled receptors (GPCRs) {9 marks}.

Section B: Continued

B18. The recognition step whereby the swine influenza virus gains entry into human respiratory cells is through the interaction of haemagglutinin with sialic acid. Discuss the molecular basis for this interaction {9 marks}. How would the human immune system respond and try to defend itself from this attack {9 marks}.