IMPERIAL COLLEGE LONDON

MEng and ACGI Examinations 2016-2017

Part 1

Biomedical Engineering
BE1-HMCP
MOLECULES, CELLS AND PROCESSES, Main Exam

11/05/2017, 14.00-15.30
Duration: 90 minutes

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The paper has 10 COMPULSORY questions.
Answer 10 question(s).
Each question is worth 10 marks.

Marks for questions and parts of questions are shown next to the question. The marks for questions (and parts thereof) are indicative, and they may be slightly moderated at the discretion of the examiner.

Question 1.

a) Sketch a simple phospholipid molecule indicating typical dimensions. Estimate the phospholipid volume in femtolitres explaining any approximations you have made.

4 marks

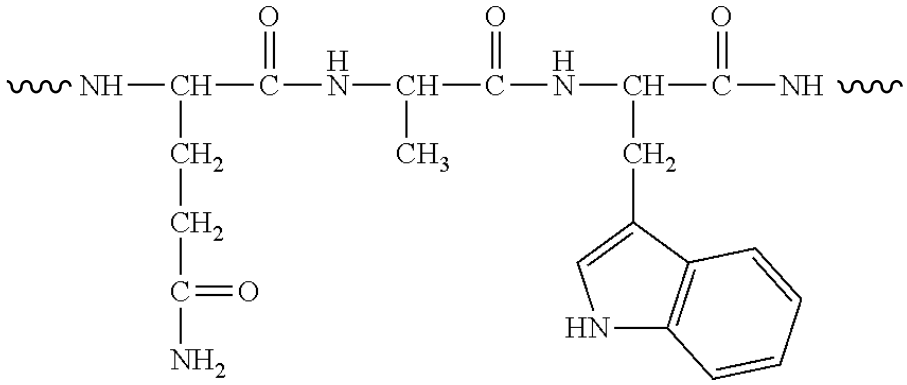
b) Calculate how long it would take a GFP molecule to diffuse a 2 μm length in an E.coli cell membrane.(take D (GPF in E.coli membrane) = 8 μm2 s–1).

3 marks

c) Sketch the hydrogen bonding between water molecules.

3 marks

Question 2. The diagram below is a three amino-acid sequence taken from the middle of a longer protein sequence. The amino acids are (from left to right) glutamine, alanine, tryptophan.



a) By marking on the above diagram, identify on the molecule the three peptide bonds.

3 marks

b) The whole protein is a transmembrane protein. Explain where in the protein this peptide is likely to occur, with reference to the peptide structure/charge properties.

4 marks

c) State the most abundant component of a cell membrane by mass. Give an example of a role this component could perform in the membrane.

3 marks

Question 3.

a) Explain what is meant by primary and secondary protein structures.

4 marks

b) Explain with the aid of a diagram how an alpha helix is stabilised.

3 marks

c) Explain how an alpha helix structure could be used to make an ion channel

3 marks

Question 4.
Explain with the aid of diagrams how ATP-synthase makes ATP. In your answer consider the energy source that drives ATP synthase and how this is used to produce new ATP molecules.

10 marks

Section B: 'Cells and processes'
Please use a new answer book for questions 5-10

Question 5

a) There are 4 bases of RNA. Name them. **3 marks**
b) Describe the differences between RNA and DNA. **7 marks**

Question 6

a) What is the form and function of tRNA? **5 marks**
b) Describe the difference in definition between a codon and a triplet? **5 marks**

Question 7

a) Describe the structure of DNA. In your answer explain the meaning of the terms: nucleotide bases, and backbone? **5 marks**
b) What are the differences between a histone and a nucleosome? **5 marks**

Question 8

Describe the difference between:
a) DNA transcription and DNA translation. **5 marks**
b) A peptide and a protein **5 marks**

Question 9

a) There are different RNA's in the cell. What are they? **4 marks**
b) In DNA replication Okazaki fragments arise in the lagging strand. What are these Okazaki fragments? **6 marks**

Question 10

a) What is the function of the nucleus in a standard cell? **4 marks**
b) Explain the function of the cytoskeleton **6 marks**