



UNIVERSITY OF GHANA
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BSC. ENGINEERING

FIRST SEMESTER EXAMINATIONS: 2016/2017

DEPARTMENT OF BIOMEDICAL ENGINEERING

BMEN 403: CELL AND MOLECULAR BIOLOGY (3 CREDITS)

INSTRUCTIONS:

ANSWER ANY FOUR IN THE ANSWER BOOKLET. EACH QUESTION CARRIES 25 MARKS AND YOU CAN ANSWER IN ANY ORDER OF YOUR CHOICE.

TIME ALLOWED: TWO AND HALF (2½) HOURS

1. 2 ng of a 2500 base pairs double stranded DNA is obtained from a National Genetic Laboratory in Ghana. The purpose is to amplify the DNA using recombinant techniques.
 - a. What is a recombinant DNA? [2 marks]
 - b. In addition to the DNA provided, what other DNAs and enzymes are needed to produce a recombinant DNA. Explain their role in designing the recombinant DNA. [9 marks]
 - c. If the 2500 base pairs DNA contained 27% cytosines, calculate the percentage guanines, thymines and adenines. [6 marks]
 - d. After sequencing, you realized that 4 adenines of the 2500 double stranded DNA were mutated to cytosines, calculate the percentage adenines, thymines, cytosines and guanines. [8 marks]

2. You expressed G-protein coupled receptor T (GPCR T) and reconstituted the receptor in a synthetic phospholipid bilayer.
- a. Why will you reconstitute the receptor into a lipid bilayer? [2 marks]
 - b. What criteria will you use to select the right lipids for reconstitution? [4 marks]
 - c. The GPCR is activated by a ligand X, sketch the signaling pathway assuming all the necessary proteins are present. [8 marks]
 - d. If Ligand X is a hydrophobic ligand, design series of ligands to compete with X for the binding site in this receptor. [6 marks]
 - e. If GPCR T causes cancer would you suggest designing a ligand that completely knocks out GPCR T activation? Explain your answer. [5 marks]
3. a. What is the difference between cell division in prokaryotes and eukaryotes? [4 marks]
- b. With the aid of a diagram, explain the various stages of the cell cycle in eukaryotes. [12 marks]
 - c. What drives the progression of the cell cycle? [3 marks]
 - d. Sketch a diagram to show how two sister chromatids are produced from one chromosome. [6 marks]
4. Kinases are a class of enzymes that elicit their activities through phosphorylation of particular amino acid residues.
- a. What is the one letter symbol of these residues? [3 marks]
 - b. Draw the structures of these residues and indicate where the phosphorylation occurs. [15 marks]
 - c. Draw the structure of the molecule that is responsible for producing phosphate group? [7 marks]

5. A 1.5 mL Eppendorf tube containing a mixture of the following nucleic acids:

Plasmid DNA
Linear DNA
Circular RNA
Linear RNA
Supercoiled linear DNA

How would you separate the nucleic acids from one another assuming their molecular weights are the same? State the separation technique used and provide detailed reasons for your choice. **[25 marks]**

6. a. What is the genetic code? **[4 marks]**
- b. What is the role of ribosomes in protein synthesis? **[6 marks]**
- c. How are amino acids brought to the sites of the cell where translation takes place? **[3 marks]**
- d. There are four types of nitrogenous bases in a RNA molecule. Explain how these bases are codified to form an amino acid. **[5 marks]**
- e. The amino acid composition of a functional protein may in many instances differ from that prescribed by its mRNA. Explain. **[7 marks]**

THE END OF THE EXAMINATION