

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

FACULTY OF APPLIED SCIENCES

BACHELOR OF SCIENCE HONOURS DEGREE EXAMINATIONS

DEPARTMENT OF APPLIED BIOLOGY AND BIOCHEMISTRY

**THEORY: MOLECULAR GENETICS AND BIOTECHNOLOGY SBB 4105**

DECEMBER 2004

3 HOURS (100 marks)

**INSTRUCTIONS**

Answer Four (4) Questions. Each question carries 25 marks. Where a question contains subdivisions, the mark value for each subdivision is given in brackets. Illustrate your answer where appropriate with large, clearly labelled diagrams.

- 1.(a) What are the advantages of using bacteriophage M13 in molecular biology? (4 marks)  
(b) Describe the structure of a Ti plasmid giving the functions of the associated regions. (12 marks)  
(c) *Bam*HI recognizes the following sequence:  
NNGGATCCNN  
NNCCTAGGNN  
where N represents any base (A,T,G,C)
- (i) How many theoretical recognition sites does it have in  $\lambda$ DNA which is 49kb long? (3 marks)  
(ii) What assumptions are made in calculating the number of recognition sites? (2 marks)  
(iii) Recognition sites have been experimentally determined to be 5 for *Bam*HI in  $\lambda$ DNA (49kb), explain the difference between the actual and theoretical numbers. (4 marks)
- 2.(a) List 5 important features of plasmids that are relevant to cloning. (5 marks)  
(b) What are the advantages and disadvantages of the following cloning methods:  
(i) Short gun method (3 marks)  
(ii) cDNA cloning (4 marks)  
(iii) Gene synthesis (3 marks)  
(c) Discuss how a named hereditary disease can be directly diagnosed using the concept of Southern blot analysis. (10 marks)
3. A gene for insulin in eukaryotic cells is flanked by restriction sites for *Hpa*I and *Hae*III, both of which produce blunt ends. Discuss in detail an experiment to clone this gene using the plasmid pBR322, including how cells with the insulin gene can be identified.
4. Discuss how humans can synthesize more than 10 million distinct antibodies.
5. Write an essay on the environmental and social implications of modern biotechnology as discussed during your course.

- 6.(a) The enzymes *EcoRI*, *Hind III*, and *PstI* are used to digest a small DNA molecule, single or in combination. The results obtained are as follows:

<b>Enzyme</b>	<b>Fragment size (kb)</b>
<i>EcoRI</i>	20
<i>Hind III</i>	20
<i>PstI</i>	3; 17
<i>EcoRI</i> + <i>Pst I</i>	10; 7; 3
<i>Hind III</i> + <i>Pst I</i>	10; 4.5; 3; 2.5

- (i) Is the original molecule linear or circular? (3 marks)
- (ii) Construct possible restriction maps showing distances between sites and highlight the one that is consistent with all the data. Give reasons. (12 marks)
- (b) What are the general problems associated with production of recombinant protein in *E. coli*. (6 marks)
- (c) Define gene therapy and give two examples where it can be used. (4 marks)

END OF EXAMINATION PAPER

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