



UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

**FOURTH YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF EDUCATION (SCIENCE) AND BACHELOR
OF SCIENCE (GENERAL)**

BOTA 421: MOLECULAR AND MICROBIAL GENETICS

STREAM: Bsc (General) & Bed (Science)

TIME: 2 HRS

DAY: TUESDAY [2.30P.M – 4.30P.M]

DATE: 16/04/2024

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.



INSTRUCTIONS: Answer All Questions in Section A and ONE from Section B.

SECTION A: 40 MARKS) – Answer ALL questions in this section

QUESTION ONE

- a) Describe what bacterial transformation is and explain why it is relevant to the chemical nature of the genes **(2 Marks)**
- b) Hershey and Chase showed that when phage were labelled with ^{32}P and ^{35}S , the ^{35}S remained outside the cell and could be removed without affecting the course of infection; whereas the ^{32}P entered the cell and could be recovered in progeny phages. What distribution of isotopes would you expect to see if parental phages were labelled with the isotopes of:
- N
 - H; Explain **(2 Marks)**
- c) To what extent is the statement “Genes are made of DNA” consistent with the results of Avery’s work and with the results of the Hershey-Chase experiment **(3 Marks)**

QUESTION TWO

- a) Outline the two major types of experimental analysis that laid the foundations for the deduction of the structure of DNA by Watson and Crick **(2 Marks)**
- b) A double stranded DNA molecule is 100,000 bps (100Kbps) long.
- How many nucleotides does it contain?
 - How many complete turns are there in a molecule?
 - How long is the DNA molecule? **(3 Marks)**

QUESTION THREE

- a) Describe the important features of the double helix structure? **(3 Marks)**
- b) Thirty percent of the nucleotides in DNA from the locust are As. What are the percentage values for: T, G and G+C **(3 Marks)**
- c) Explain what is meant by Central Dogma. How has the original concept of the central dogma been changed to account for more recent discoveries **(4 Marks)**

QUESTION FOUR

Outline the events involved in the initiation and termination of transcription by RNA polymerase II

(3 Marks)

QUESTION FIVE

Draw and annotate the cloverleaf structure of tRNA. To what extent is the cloverleaf a true representation of the actual structure of the tRNA

(5 Marks)

QUESTION SIX

Plasmid R100 carries a gene for resistance to streptomycin. You have an F^+ strain of *E. coli* that contains R100. Design an experiment to test if R 100 is mobilizable?

(10 Marks)

SECTION B (30 MARKS)

Answer any **two** questions.

QUESTION SEVEN

A. Hershey and M. Chase finally affirmed DNA as a molecule of heredity. Give an outline of their study giving the procedure, results obtained and inference(s) made.

(15 Marks)

QUESTION EIGHT

Deduce and explain the effects of the following mutations on expression of the lac operon

- Mutation in the operator, so that the repressor is no longer able to bind
- A mutation, location unknown, which prevents the *lac* mRNA from being degraded
- A mutation in the *lacI*, so that the repressor is no longer synthesized
- A mutation in *lac Y* that causes transcription to terminate in the middle of the gene
- A mutation in the promoter, so that RNA polymerase no longer binds
- A mutation in the *lac I*, so that the repressor no longer binds lactose.

(15 Marks)

QUESTION NINE

- Explain how transduction mapping can be used to determine the gene order
- Explain what transformation is and how it can be used in gene mapping experiments
- Describe and deduce the methods used by Jacob and Wolman to test for transfer of each of the gene markers they studied in the first interrupted mating experiments

(15 Marks)

