



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

MAIN CAMPUS

**UNIVERSITY EXAMINATIONS (MAIN PAPER)  
2023/2024 ACADEMIC YEAR**

**MAIN EXAMINATION**

**FOURTH YEAR FIRST SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF SCIENCE IN MEDICAL LABORATORY  
SCIENCES**

**COURSE CODE:** BML 412

**COURSE TITLE:** MEDICAL BIOTECHNOLOGY

**DATE:** 7<sup>TH</sup> DECEMBER 2023

**TIME:** 2.00-4.00PM

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**INSTRUCTIONS TO CANDIDATES**

This paper is divided into three sections, **A**, **B** and **C**, respectively: Multiple Choice Questions (**MCQs**), Short Answer Questions (**SAQs**) and Long Answer Questions (**LAQs**). Answer all questions. **DO NOT WRITE ON THE QUESTION PAPER**

**TIME:** 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

**SECTION A: Multiple Choice Questions (20 Marks)**

1. What is the central dogma of molecular biology?
  - A. DNA is transcribed to RNA, which is then translated to protein.
  - B. RNA is transcribed to DNA, which is then translated to protein.
  - C. RNA is translated to DNA, which is then transcribed to protein.
  - D. DNA is translated to RNA, which is then transcribed to protein.
2. Which of the following is not a function of the 5' cap on mRNA?
  - A. Protecting the mRNA from exonuclease degradation
  - B. Facilitating transport of mRNA to the nucleus
  - C. Enhancing recognition of mRNA by ribosomes
  - D. Initiating transcription of mRNA
3. What is the role of tRNA in translation?
  - A. It carries amino acids to the ribosome.
  - B. It serves as a template for mRNA synthesis.
  - C. It catalyzes the formation of peptide bonds.
  - D. It initiates translation by binding to the ribosome.
4. In which direction does the flow of genetic information occur in the central dogma of molecular biology?
  - A. DNA to RNA to protein
  - B. RNA to DNA to protein
  - C. Protein to DNA to RNA
  - D. RNA to protein to DNA
5. What is the function of ribosomes in translation?
  - A. They synthesize mRNA from DNA.
  - B. They catalyze the formation of peptide bonds.
  - C. They protect mRNA from degradation.
  - D. They transport amino acids to the ribosome.
6. Which enzyme is responsible for cleaving DNA segments into restriction fragments?
  - A. DNA ligase
  - B. DNA polymerase
  - C. Reverse transcriptase
  - D. Restriction endonuclease
7. What is the main advantage of using DNA produced by reverse transcriptase for cloning?
  - A. It contains introns.
  - B. It is synthesized by chemical machines.
  - C. It lacks specific sequences recognized by restriction enzymes.
  - D. It is derived from mRNA.
8. What technique uses electrical fields to separate DNA molecules based on size?
  - A. DNA sequencing
  - B. Gel electrophoresis
  - C. PCR amplification
  - D. Restriction digestion
9. Which of the following is NOT a common type of classical sequencing technique?
  - A. Sanger sequencing
  - B. Maxam and Gilbert sequencing
  - C. Pyrosequencing
  - D. Illumina sequencing
10. What is the function of a probe in molecular biology?

- B. They allow for the easy isolation of proteins.
  - C. They are derived exclusively from cDNA.
  - D. They represent the entire genome of an organism.
20. What is the main difference between genomic libraries and cDNA libraries?
- A. Genomic libraries contain only coding sequences, while cDNA libraries contain both coding and non-coding sequences.
  - B. Genomic libraries are derived from prokaryotic organisms, while cDNA libraries are derived from eukaryotic organisms.
  - C. Genomic libraries are used for gene expression studies, while cDNA libraries are used for gene mapping.
  - D. Genomic libraries are used for cloning entire genomes, while cDNA libraries are used for cloning specific genes.

**SECTION B: Short Answer Questions (40 Marks)**

1. Discuss the use of restriction enzymes in the process of gene cloning. (8 Marks).
2. Discuss the potential benefits and ethical concerns surrounding gene therapy as a medical intervention. (8 Marks).
3. Describe the properties of a good cloning host (8 Marks).
4. Distinguish between Yeast Episomal Plasmids (YEps) and Yeast Artificial Chromosomes (YACs) (8 Marks).
5. Describe the key components and mechanisms involved in the CRISPR-Cas9 system and how it enables precise modifications to the DNA. (8 Marks).

**SECTION C: Long Answer Questions (60 Marks)**

1. Discuss the fundamental principles and steps involved in the Sanger dideoxy sequencing method. (20 Marks).
2. Discuss how biotechnology can be harnessed to enhance disease diagnosis. Provide a detailed explanation of the various biotechnological techniques and tools that can be applied in the field of diagnostics. (20 Marks).
3. Explain the principles, techniques, and applications of hybridoma technology. (20 Marks).

- A. To cut DNA at specific sites
  - B. To amplify DNA sequences
  - C. To identify complementary DNA or RNA sequences
  - D. To synthesize DNA molecules
11. Which of the following vectors is commonly used for cloning genes in *E. coli*?
    - A. Lambda phage
    - B. Yeast plasmid
    - C. Bacterial artificial chromosome (BAC)
    - D. Plasmid
  12. What is the primary purpose of gene cloning?
    - A. To obtain genetically modified organisms
    - B. To obtain protein products of genes
    - C. To study variations in base sequence
    - D. To create chimeric DNA molecules
  13. Which host cell property is essential for gene cloning?
    - A. High recombination function
    - B. Hindrance to vector replication
    - C. Ease of transformation
    - D. Restriction and methylase activity
  14. What is the primary advantage of using T4 phage-encoded DNA ligase in recombinant DNA technology?
    - A. It requires no ATP for ligation
    - B. It efficiently joins blunt-ended DNA molecules
    - C. It works exclusively on cohesive ends
    - D. It is derived from bacterial plasmids
  15. In the transformation of *E. coli*, what is the purpose of incubating the bacterial cells in the presence of divalent cations and then subjecting them to a brief heat shock?
    - A. To induce the formation of recombinant DNA
    - B. To make the cells competent for DNA uptake
    - C. To destroy the bacterial cell walls
    - D. To enhance the growth of *E. coli* colonies
  16. Which of the following is NOT a selectable marker commonly used in recombinant DNA technology?
    - A. Ampicillin resistance gene
    - B. Kanamycin resistance gene
    - C. Green fluorescence protein (gfp) gene
    - D. Tetracycline resistance gene
  17. What is the function of a reporter gene in expression vectors?
    - A. It codes for a protein product used in structural studies.
    - B. It produces a signal that allows easy selection of recombinant cells.
    - C. It enhances the ligation of foreign DNA to the vector.
    - D. It inactivates non-recombinant plasmids.
  18. Which of the following techniques is used for the synthesis of many copies of a specific DNA fragment *in vitro*?
    - A. Transformation
    - B. Polymerase chain reaction (PCR)
    - C. Restriction enzyme digestion
    - D. Electroporation
  19. What is the primary advantage of genomic libraries in molecular biology research?
    - A. They contain only coding sequences of genes.