Candidate Number……

"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

DEPARTMENT OF BIOMEDICAL AND LABORATORY SCIENCES

NSLS 105 GENETICS AND MOLECULAR BIOLOGY

END OF SEMESTER EXAMINATIONS

NOVEMBER 2024

LECTURER: Mr Z CHIWODZA

DURATION: 3 HRS

INSTRUCTIONS

Write your Student Number on the top of every page of this question paper

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Section A: Contains (20) Multiple Choice Questions
State whether each statement is True (T) or False (F)
Answer **ALL** questions onto this question paper

Section B: Answer **ALL** questions on the separate answer sheet provided
Write your Student Number on every page that you use

Section C: Answer any **THREE (3)** out of **FIVE (5)** questions on the separate answer sheet provided
Write your Student Number on every page that you use
Credit will be given to logical and neatly presented work

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SECTION A: MULTIPLE CHOICE [40 MARKS]

- **Answer all questions by encircling the correct response T for TRUE or F for FALSE for each statement in all the questions**
- **Each correct response is allocated half a mark**

1. What properties of Nucleic Acids and Proteins enable movement on an electrophoresis gel

T F (a) Nucleic acids and Proteins have an electric charge
T F (b) Different proteins have different Molecular weight
T F (c) Nucleic acids have an overall positive charge
T F (d) proteins are have an overall negative charge

2. Regarding Nucleic Acids

T F (a) DNA is transcribed from RNA via reverse transcriptase
T F (b) RNA is less chemically stable than DNA
T F (c) RNA can be the hereditary material in some organisms like viruses
T F (d) the sense strand of a DNA molecule contains the sequence that is followed when a protein is being made

3. With regards to bioinformatics

T F (a) Basic local alignment search tool (BLAST) is an algorithm and program for comparing primary biological sequence information like proteins and DNA
T F (b) GeneBank, Ensembl, NCBI are all databases that can be used to determine the biomolecule sequences
T F (c) It can be used to detect SNPs in genetic diseases.
T F (d) phylogenetic trees are useful to represent genetic relatedness

4. With regards to genetic diseases: -

T F (a) the diseases are always inherited
T F (b) the diseases are always inherited in an autosomal recessive fashion
T F (c) laboratory diagnosis is only confirmed by PCR
T F (d) Gene therapy is not useful as a treatment option.

5. If Kasta has Turner's syndrome, how many total chromosomes does she have?

T F (a) 46
T F (b) 47
T F (c) 45
T F (d) 24

6. Which of these molecules is useful in Sanger sequencing?

T F (a) ligase
T F (b) taq polymerase
T F (c) Ferric ions
T F (d) Helicase

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7. Siqhaliso is said to be suffering from Cystic fibrosis which is an autosomal recessive related disease, which of the following could be his genotype?

T F (a) Ss
T F (b) ss
T F (c) sq
T F (d) SS

8. Which rules should be followed in a molecular biology laboratory?

T F (a) always wear closed shoes
T F (b) always wear the same lab coat in all the rooms in the molecular laboratory
T F (c) make use of powdered gloves to prevent sweating which can introduce nucleases onto samples
T F (d) In the event of a contamination with amplicons, clean the laboratory with alcohol to kill the DNA

9. Which is the order of events in production of Protropin in an *E.coli* vector system:

T F (a) cut human DNA, add gene section to plasmid, and insert plasmid to vector
T F (b) add human DNA to vector, insert plasmid to human DNA, cut the DNA
T F (c) add plasmid to vector, insert DNA, cut DNA
T F (c) cut plasmid, insert DNA, add DNA to vector

10. Match the feature of the genetic code to its use in biotechnology and molecular biology

T F (a) redundancy – limit the amount of expressed mutations that could be harmful
T F (b) universality – allows for biotechnologists to use different vectors to express a gene of interest
T F (c) punctuation – limit the amount of expressed mutation that could be beneficial to the organisms
T F (d) specificity – limit the amount of expressed mutations that could be harmful to the organisms

11. Which of the following events occur during transcription

T F (a) a section of the DNA strand is switched on
T F (b) transcription enzymes and proteins make a copy of mRNA
T F (c) a section at the end of the gene tells the transcription machinery to stop
T F (d) newly made mRNA is modified to stabilize it.

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12. The following are needed for control of gene expression

T F (a) Promoter
T F (b) repressor
T F (c) inducer
T F (d) pyrophosphate

13. Match the molecular biology technologies to their use in the different fields of molecular biology

T F (a) Short Tandem Repeats testing – Paternity testing
T F (b) Transcriptomics – Studying gene expression
T F (c) Proteomics – detection of abnormal proteins produced in a state of disease.
T F (d) Single Nucleotide Polymorphism – detection of mutations that can cause disease

14. Regarding DNA as a nucleic acid

T F (a) it contains Adenine that is always paired to Guanine
T F (b) it contains ribonucleic acid as a sugar that stabilizes the strands
T F (c) the double strand is stabilized by covalent bonds between the base pairs
T F (d) the 3' end of the strand contains the phosphate group which allows for the easier joining of 5' hydroxyl group

15. Restriction Fragment Length Polymorphism depends on the following principles

T F (a) DNA contains palindromic sites
T F (b) DNA is negatively charged and thus can in a matrix with electric charge
T F (c) some enzymes like *Eco*R1 have Exonuclease activity which help cut the DNA
T F (d) some enzymes like HIND111 have Endonuclease activity which help cut the DNA

16. Which RNA is correctly match to its use in the cell

T F (a) mRNA – contains information directly transcribed from the DNA
T F (b) rRNA – is contained in the ribosome
T F (c) tRNA – carries amino acids to the ribosome
T F (d) miRNA – can bind to untranslated regions of mRNA to suppress translation

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17. Which technique is correctly matched to its use in the molecular biology laboratory?

T F (a) Southern Blotting – detection of proteins
T F (b) Northern Blotting – detection of DNA
T F (c) Eastern Blotting – detection of RNA
T F (d) Western Blotting – detection of post translation modification

18. With regards to DNA PCR

T F (a) An initial sample with 2 strands will yield 48 strands after 4 amplification cycles
T F (b) A DNA strand with more GC pairs requires more energy (heat) to separate
T F (c) It can be done in a thermocycler
T F (d) It needs polymerase enzymes to analyze the amplicon

19. Which of the following components are necessary for extraction of Nucleic acids from human blood

T F (a) proteinase K
T F (b) Sodium dodecyl-sulfate
T F (c) Ethanol
T F (d) Chloroform

20. Applications of molecular biology include

T F (a) Disease diagnosis
T F (b) Production of therapeutic drugs
T F (c) Crime and Forensics
T F (d) Paternity Testing

SECTION B: [20 Marks]

Answer ALL questions on the separate answer sheet provided.

1. Write short notes on the following
   a) DNA Replication [5]
   b) Translation [5]

2. State 5 components needed in each of the following processes
   a) (reverse transcriptase) rtPCR [5]
   b) Electrophoresis [5]

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SECTION C: [75 marks]

Answer any THREE (3) questions on the separate answer sheet provided. Each Question carries 25 marks

1. **Skuza** has just been diagnosed with HIV. It can be treated using Antiretroviral therapy. Describe a molecular test you can do in the lab to monitor treatment effectiveness. **[25].**
2. Describe the process of DNA replication in a eukaryotic cell **[25].**
3. The bacteria *Escherichia coli* is known to be a lactose fermenting bacterium. Explain at molecular level how it regulates metabolism of lactose in its environment. **[25]**
4. The qPCR kits for the Human Papilloma Virus have just run out in your lab. However, the laboratory is well stocked on Nitrocellulose membranes and some probes for the virus. Describe the alternative test you can perform with the available reagents to produce the same outcome. **[25].**
5. Discuss the process of Mitosis and Meosis in eukaryotic cells and describe how errors in these processes can lead to diseases. **[25].**