"Investing in Africa's Future"

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

DEPARTMENT OF BIOMEDICAL AND LABORATORY SCIENCES

BACHELOR OF MEDICAL LABORATORY SCIENCES HONOURS

NSLS105: GENETICS AND MOLECULAR BIOLOGY

END OF SEMESTER FINAL EXAMINATIONS

APRIL 2025

LECTURER: DR S L MUTAMBU

DURATION: 3 HOURS

INSTRUCTIONS

1. Write your candidate number on the space provided on top of each page.
2. Answer **all** questions in sections A on the question paper.
3. Answer **all** questions in section B on separate answer sheets provided.
4. Answer any **3** questions in section C on separate answer sheets provided
5. Mark allocation for each question is indicated at the end of the question
6. Credit will be given for logical, systematic and neat presentations in sections B and C

SECTION A: MULTIPLE CHOICE [40MARKS]

- **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. Genetic traits

T F a) can be part of an organism's physical appearance
T F b) may not be easily seen *e.g.* blood types
T F c) inherited through our genes
T F d) can come from interactions between our genes and the environment

2. Concerning genes:

T F a) they are pieces of RNA containing information for the synthesis of DNA.
T F b) they are made from a large molecule called Ribonucleic Acid
T F c) each unique form of a single gene is called an allele
T F d) random changes in genes that can create new alleles are called mutations

3. Concerning genes and proteins:

T F a) genes are expressed by being transcribed into RNA
T F b) RNA is then translated into protein
T F c) transcription is controlled by other DNA sequences such as promoters
T F d) proteins are made of a chain of 24 different types of amino acid molecules

4. The Human Genome

T F a) is arranged on 23 pairs of chromosomes
T F b) has twenty-two pairs called autosomes
T F c) also has one pair called the sex chromosome
T F d) humans have 23 pairs of chromosomes in every cell except for mature white blood cells

5. Archaea:

T F a) lack interior membranes and organelles
T F b) cell walls lack peptidoglycan
T F c) most exist in extreme living conditions
T F d) have found good use in industry

6. Concerning DNA:

T F a) consists of two long polymers of simple units called nucleotides
T F b) nucleotides are made of a base, sugar and phosphate group
T F c) the types of bases in DNA are adenine, guanine, cytosine and

thymine

T F d) uracil takes the place of cytosine in RNA

7. Below are types of non-coding RNAs:

T F a) small nuclear RNA
T F b) macro-RNA
T F c) transfer RNA
T F d) ribosomal RNA

8. The ribosome has these sites that are needed for binding tRNA:

T F a) I
T F b) P
T F c) A
T F d) E

9. Below are tools needed for mRNA translation into protein:

T F a) ribosomes
T F b) mRNA
T F c) tRNA
T F d) amino acids

10. Gene expression is a

T F a) process by which a gene gets turned on in a cell to transcript RNA and produce proteins.
T F b) process by which the instructions in our DNA are converted into a functional protein
T F c) process called induced expression where some genes are expressed at lower levels
T F d) process by which information from a gene is used in the synthesis of a functional gene product.

11. Genetic disorders can be due to a

T F a) defect in Chromosomal number
T F b) single-gene mutation
T F c) complex mutations and environment
T F d) all of the above

12. Single Gene Mutations:

T F a) occur due to environmental factors like radiation or chemicals
T F b) can also occur during DNA replication
T F c) some mutations can be passed on to offspring
T F d) a diseased state occurs if the mutation leads to a malfunctioning protein

13. Regarding biotechnology:

T F a) it is the use of living organisms, or substances/systems obtained from living organisms, to produce products or processes of value to humankind

T F b) it can be applied in different sectors of the productive economy
T F c) principles of ethics also apply to biotechnology
T F d) stem cell therapy is an emerging trend of biotechnology

14. The following are tools used in Biotechnology:
T F a) Recombinant Nucleic Acid Technology
T F b) Microarrays and Nucleic Acid Probes
T F c) Gene banking
T F d) Gene sluicing

15. The following are different types of PCR techniques:
T F a) Triplex PCR
T F b) Real-Time PCR
T F c) Reverse Synthetase PCR
T F d) Nested PCR

16. DNA and Protein Analysis Methods include:
T F a) Adsorbance of different materials to detect molecules
T F b) Mass spectrometry to detect proteins/nucleic acid using mass to charge ratio of a molecule
T F c) Chromatography which separates different molecules based on size and solubility in a solvent
T F d) Flow cytometry which detects cells based mainly on size using gated channels

17. 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

18. Gene expression is much more complex in eukaryotes than in prokaryotes because eukaryotes have:
T F a) larger genome size
T F b) cell and tissue specific gene expression
T F c) compartmentalization which allows each compartment to perform specific functions without interference from other cell functions
T F d) gene concentration in one part of the genome

19. Tools and terms used in rDNA include:
T F a) vectors
T F b) host cells
T F c) cloning
T F d) transformation

20. Chromosomal disorders usually have no cure, but managing symptoms can improve quality of life and examples are:
T F a) Down Syndrome
T F b) Turner Syndrome
T F c) Cre-de-Chit Syndrome

T F d) Klinefelter Syndrome

SECTION B [20 MARKS]

Answer all questions on separate answer sheets provided

1. State the differences between RNA and DNA. [5]

2. List any 5 blotting techniques and what they are used to detect or analyse in Biotechnology. [5]

3. **Akosua** and **Kwaku** got married a year ago and are now ready to start a family. They have both decided to have a few tests, including those for HIV and sickle cell done before starting a family. All the tests done are negative for Kwaku. However, Akosua, has been found to be a carrier of the sickle cell trait.

Using a Punnet Square, describe the different genotypes and phenotypes that they can potentially have amongst their children. [5]

4. State the steps in the process of Polymerase Chain Reaction. [5]

SECTION C [60 marks]

Answer any 3 questions from this section on separate answer sheets provided

1. Discuss the classification of proteins. [20]

2. Illustrate and discuss in detail the structure of a typical eukaryotic gene with its core elements. [20]

3. Illustrate and discuss in detail the *trp* operon as a model for gene regulation. [20]

4. Give a detailed account of the Southern blotting technique. [20]

5. Discuss in detail a genomic library and how it is constructed. [20]

THE END