NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Faculty of Health, Natural Resources and Applied Sciences

School of Natural and Applied Sciences

Department of Biology, Chemistry and Physics

13 Jackson Kaujeua Street
Private Bag 13388
Windhoek
NAMIBIA

T: +264 61 207 2012
F: +264 61 207 9012
E: dbcp@nust.na
W: www.nust.na

QUALIFICATION: **BACHELOR OF SCIENCE**	
QUALIFICATION CODE: **07BOSC**	LEVEL: **6**
COURSE: **GENETICS**	COURSE CODE: **GEN602S**
DATE: **JANUARY 2025**	SESSION: **1**
DURATION: **3 HOURS**	MARKS: **100**

SECOND OPPORTUNITY / SUPPLEMENTARY: QUESTION PAPER

EXAMINER: *Prof Edosa Omoregie*

MODERATOR: *Dr Jeya Kennedy*

INSTRUCTIONS

1. Answer all questions on the separate answer sheet.
2. Please write neatly and legibly.
3. Do not use the left-side margin of the exam paper. This must be allowed for the examiner.
4. No books, notes and other additional aids are allowed.
5. Mark all answers clearly with their respective question numbers.

PERMISSIBLE MATERIALS:

1. Non-Programmable Calculator

ATTACHMENTS

None

This paper consists of 6 pages, including this front page

SECTION A: MULTIPLE CHOICE [20 MARKS]

QUESTION 1: MULTIPLE CHOICE QUESTIONS [20 MARKS]

Evaluate the statements in each numbered section and select the most appropriate answer from the given possibilities. Fill in the appropriate letter next to the number of the correct statement/phrase on your ANSWER SHEET. [20]

1.1. Which of the following statements best describes the term "homologous chromosomes"?
a) Chromosomes that code for the same traits but are identical in form
b) Chromosomes inherited from the same parent
c) Chromosomes with the same gene sequence but different alleles
d) Chromosomes that have undergone mutation
e) Chromosomes that are involved in DNA replication

1.2. Which phase of the cell cycle is most critical for checking DNA integrity before cell division?
a) G1 phase
b) S phase
c) G2 phase
d) Prophase
e) Metaphase

1.3. Which of the following is an example of codominance?
a) Blood type AB in humans
b) Pink flowers from red and white parent plants
c) Sickle cell trait
d) Freckles in humans
e) Pea plant height

1.4. What is the main role of helicase in DNA replication?
a) Proofreading the newly synthesized DNA
b) Joining Okazaki fragments
c) Unwinding the double helix
d) Synthesizing RNA primers
e) Sealing the sugar-phosphate backbone

1.5. What is the function of Okazaki fragments in DNA replication?
a) They are synthesized in the leading strand
b) They join the two daughter DNA molecules
c) They form the continuous strand of DNA
d) They are short sequences synthesized on the lagging strand
e) They prevent mutations from occurring

1.6. Which type of chromosomal mutation involves the complete loss of a chromosome?
a) Duplication
b) Inversion

c) Translocation
d) Deletion
e) Nondisjunction

1.7. Inversions and translocations differ in that:
a) Inversions involve gene loss
b) Translocations do not alter genetic content
c) Inversions reverse the direction of a segment within the same chromosome
d) Translocations happen only between non-homologous chromosomes
e) Inversions always result in a lethal phenotype

1.8. What is the purpose of gene splicing in eukaryotic cells?
a) To remove exons and join introns
b) To produce different proteins from the same gene
c) To prevent the transcription of defective genes
d) To control the initiation of DNA replication
e) To synthesize ribosomal RNA

1.9. Post-translational modification of proteins occurs to:
a) Enhance mRNA stability
b) Facilitate transcription factor binding
c) Regulate protein activity and function
d) Modify the DNA sequence of genes
e) Prevent mRNA degradation

1.10 What is the primary purpose of homologous recombination?
a) To correct errors in DNA replication
b) To exchange genetic material between homologous chromosomes
c) To prevent chromosomal translocations
d) To ensure accurate DNA replication
e) To repair damaged RNA molecules

1.11. In which phase of meiosis does crossing over occur?
a) Prophase I
b) Anaphase II
c) Metaphase I
d) Telophase I
e) Prophase II

1.12. Which of the following blood genotypes belongs to an individual who is regarded as a universal blood recipient?
a) I^AI^A
b) I^AI^O
c) I^AI^B
d) I^OI^O
e) None

1.13. Which of the following autosomal chromosome conditions is for an individual suffering from Down Syndrome?

a) Trisomy 18
b) Trisomy 21
c) X monosomy
d) Trisomy 15
e) None of these

1.14. Which of the following is an assumption for Hardy-Weinberg equilibrium?

a) no epistasis
b) no dominance
c) no crossing-over
d) no mutation
e) spontaneous mutation

1.15. Which of the following chromosome number is a pentasomy?

a) $2n - 2$
b $2n + 2$
c) $2n - 1$
d) $2n + 3$
e) $2n + 1$

1.16. A human with Patau's syndrome would represent which of the following chromosomal conditions?

a) Diploid condition
b) Euploid condition
c) Aneuploid condition
d) Haploid condition
e) Triploid condition

1.17. What is the significance of gene recombination in evolution?

a) It leads to genetic uniformity within a population
b) It increases genetic diversity and evolutionary potential
c) It eliminates harmful mutations from the genome
d) It regulates the expression of genes in response to environmental changes
e) It causes genetic disorders by introducing mutations

1.18. Which of the following describes gene flow?

a) The transfer of alleles from one population to another
b) The random loss of alleles due to small population size
c) The non-random mating of individuals within a population
d) The formation of new alleles through mutation
e) The gradual elimination of deleterious alleles

1.19. What is a significant ethical concern associated with the cloning of humans?

a) The high cost of cloning procedures
b) The inability to replicate personality traits through cloning

c) The question of whether a cloned human possesses the same rights as a naturally-born human
d) The technical difficulty of isolating the correct gene for cloning
e) The inability to control the size and shape of cloned organs

1.20. Which of the following is NOT a potential application of gene therapy as discussed in genetic engineering?
a) Treating inherited genetic disorders by inserting functional copies of genes
b) Enhancing human physical traits like strength and intelligence
c) Introducing new genes to fight diseases such as cancer
d) Replacing defective genes responsible for causing disease
e) Modifying viruses to serve as vectors to deliver therapeutic genes into cells

SECTION B: ESSAY QUESTIONS [80 MARKS]

Please answer ANY FOUR of the questions in this section.

QUESTION 2
2.1. In tabular form, highlight the main differences between genetic mutation and genetic variations. (5)
2.2. Briefly differentiate gene mutation from chromosomal mutation. (5)
2.3. Compare and contrast mitosis and meiosis, focusing on their roles in reproduction and inheritance. (10)

QUESTION 3
3.1. In a tabular form, briefly differentiate the main differences between nucleosome and chromatid. (5)
3.2. Describe the synthesis of new DNA and explain the roles of the various enzymes involved in synthesising new DNA strands from the parent DNA strand. (10)
3.3. Discuss the significance of proofreading and DNA repair mechanisms in maintaining genetic fidelity and preventing diseases. (5)

QUESTION 4
4.1. List the three main functional gene products that control structure and function in organisms. (3)
4.2. With schematic diagrams, briefly explain the process of gene expression in eukaryotes and the role of the enzymes involved in the process. (12)
4.3. Explain the process of non-replicative transposition and how it differs from replicative transposition. Use illustrations to show the differences. (5)

QUESTION 5
Discuss the effects of genetic drift, gene flow, and mutation on population allele frequencies. Use relevant examples and illustrations to explain how these mechanisms influence evolutionary change. (20)

QUESTION 6

Explain the process of creating genetically modified organisms (GMOs), from identifying a gene of interest to expressing that gene in the target organism. Discuss the benefits and potential risks associated with GMOs in agriculture and medicine. (20)

END OF QUESTION PAPER