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OF SCIENCE AND TECHNOLOGY**

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<b>QUALIFICATION : BACHELOR OF SCIENCE</b>	
<b>QUALIFICATION CODE: 07BOSC</b>	<b>LEVEL: 6</b>
<b>COURSE: GENETICS</b>	<b>COURSE CODE: GEN602S</b>
<b>DATE: NOVEMBER 2023</b>	<b>SESSION: 1</b>
<b>DURATION: 3 HOURS</b>	<b>MARKS: 100</b>

**FIRST OPPORTUNITY: 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 5 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 or 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. Division of the cytoplasm of a eukaryotic cell during mitosis is called?
  - A. karyokinesis
  - B. plamsokinesis
  - C. diakinesis
  - D. cytokinesis
  
- 1.2. Synapsis of the homologous chromosomes in the eukaryotic cell occurs during which of the following division phases?
  - A. anaphase I
  - B. telophase I
  - C. prophase I
  - D. prophase II
  
- 1.3. In a cross between two black Labrador dogs, the phenotype ratio of the offspring is 9 black puppies to 3 chocolate puppies to 4 yellow puppies; this is an example of?
  - A. partial recessiveness
  - B. incomplete penetrance
  - C. incomplete dominance
  - D. epistasis
  
- 1.4. Mitotic cell division results in two cells that have:
  - A.  $n$  chromosomes that are genetically identical
  - B.  $n$  chromosomes that are genetically different
  - C.  $2n$  chromosomes that are genetically identical
  - D.  $2n$  chromosomes that are genetically different
  
- 1.5. Which of the following is an autosomal recessive trait?
  - A. Duchenne muscular dystrophy
  - B. Lesch-Nyhan syndrome
  - C. Marfan syndrome
  - D. Cystic Fibrosis
  
- 1.6. Which of the following terms best describes the replication of DNA?
  - A. constitutive
  - B. conservative
  - C. semi-conservative
  - D. semi-constitutive

- 1.7. In DNA molecule, which of the following bonds is true?
- the  $[G] = [C]$
  - the  $[G+C] = [A+T]$
  - the  $[G] = [A]$
  - none of the above are true
- 1.8. During DNA synthesis, the addition of a new nucleotide to a newly formed DNA strand always proceeds in which direction?
- from the promoter
  - in either direction
  - in the 3' to 5' direction
  - in the 5' to 3' direction
- 1.9. Which of the following statements is true on the role of the enzyme ligase during the replication of a DNA molecule?
- remove the RNA primer
  - to stabilise the single-stranded structure
  - to link Okazaki fragments together
  - to unwind the original DNA molecule
- 1.10. Which of the following statements about transposons during gene recombination is not true?
- during transposition a short sequence of target DNA is duplicated, and the transposon is inserted between the directly repeated target sequences
  - some transposons insert into almost any target DNA sequence
  - the actions of transposases go on indefinitely without interruption
  - transposons are important genetic elements because they cause mediate genomic rearrangement
- 1.11. In transcription, RNA polymerase binds at?
- a promoter
  - an operator
  - the centromere
  - an enhancer
- 1.12. Which of the following statements best describes the Central Dogma theory in genetics?
- the pattern of genetic information flow in the cell
  - the pattern of chromosomal inheritance in populations
  - the role of mutations in disease
  - the role of promoters
- 1.13. Which statements below best describe the role of the enzyme resolvases in genetic recombination?
- catalyses transposon movement to another part of the genome
  - catalyses transposon formation in gene recombination
  - represses the action of transposase
  - speeds up the action of transposase

- 1.14. Which of the following blood genotypes belongs to an individual who is regarded as a universal blood recipient?
- $I^A I^A$
  - $I^A I^O$
  - $I^A I^B$
  - $I^O I^O$
- 1.15. Which of the following autosomal chromosome conditions is for an individual suffering from Down Syndrome?
- Trisomy 18
  - Trisomy 21
  - X monosomy
  - Trisomy 15
- 1.16. Which of the following is the optimum temperature for thermostable DNA polymerase of Taq polymerase during the PCR experimental step of DNA denaturation?
- 94 – 98°C
  - 100 – 105°C
  - 45 – 50°C
  - 75 – 80°C
- 1.17. Which of the following is an assumption for Hardy-Weinberg equilibrium?
- no epistasis
  - no dominance
  - no crossing-over
  - no mutation
- 1.18. Which of the following chromosome number is a pentasomy?
- $2n - 2$
  - $2n + 2$
  - $2n - 1$
  - $2n + 3$
- 1.19. A human with Patau's syndrome would represent which of the following chromosomal conditions?
- diploid condition
  - euploid condition
  - aneuploid condition
  - haploid condition
- 1.20. Which factors alter allele frequencies that bring about the most evolutionary change?
- Indiscriminating intraspecific mating
  - Inbreeding
  - DNA replication
  - Genetic drift



**SECTION B: ESSAY QUESTIONS****[80 MARKS]**

Please answer ANY FOUR of the questions in this section.

**QUESTION 2**

- 2.1. Using suitable molecular diagrams, discuss the structure of the DNA double helix, including its subunits and how they are bonded together, indicating the antiparallel arrangements of the polynucleotide strands. (15)
- 2.2. Explain the concept of epistasis in genetics. Give an example of a genetic disease resulting from this concept. (5)

**QUESTION 3**

- 3.1. With suitable diagrams, briefly describe the process of mitotic division in a eukaryotic cell, emphasising the changes on the chromosome. (12)
- 3.2. Briefly differentiate gene mutation from chromosomal mutation. (2)
- 3.3. With the aid of illustrations, discuss the substitution, insertion, and deletion process in gene mutation. (6)

**QUESTION 4**

- 4.1. 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)
- 4.2. Briefly explain the molecular structure of transfer RNA and highlight the main structural differences between RNA and DNA molecules. (8)
- 4.3. Briefly explain the primary function of ribosomal RNA. (2)

**QUESTION 5**

With schematic diagrams, briefly explain the process of gene expression in eukaryotes and the role of the enzymes involved in the process. (20)

**QUESTION 6**

- 6.1. Explain the process of nonreplicative transposition and how it differs from replicative transposition. Use illustrations to show the differences. (10)
- 6.2. Discuss the consequences of transposition events within a given population. (6)
- 6.3. Explain the term microevolution based on genetic principles. (4)

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**END OF QUESTION PAPER**