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University Examinations 2023/2024

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MEDICAL MICROBIOLOGY

HMM 3123: FUNDAMENTALS OF GENETICS

DATE: APRIL 2024 **TIME: 2 HOURS**

INSTRUCTIONS:

(i) The paper consists of **Three** Sections
(ii) Section A: Multiple Choice Questions
(iii) Section B: Short Answer Questions
(iv) Section C: Long Answer Questions

SECTION A: MULTIPLE CHOICE QUESTIONS (Answer all questions in this section)

1. Which of the following types of mutations is characterized by changes in chromosome number?

a) Gene mutations
b) Chromosome mutations
c) Genome mutations
d) Point mutations

2. Which DNA polymerase is primarily involved in proofreading and gap filling during DNA replication in E. coli?

a) DNA polymerase I
b) DNA polymerase Il
c) DNA polymerase Ill
d) DNA polymerase IV

3. Which enzyme is responsible for sealing the nicks between Okazaki fragments during DNA replication?

a) DNA polymerase I
b) DNA polymerase Ill
c) DNA ligase
d) DNA helicase

4. Which nitrogen bases are pyrimidines?

a) Adenine and guanine
b) Guanine and thymine
c) Cytosine and thymine
d) Adenine and cytosine

5 What are the phenotypic ratios expected in the Fl generation of the monohybrid cross between a pea plant with round seeds (RR) and one with wrinkled seeds (rr)?

a) 1 round: 1 wrinkled
b) 3 round: 1 wrinkled
c) 2 round: 1 wrinkled
d) 4 round: 0 wrinkled

6. What are nucleic acids primarily composed of?

a) Amino acids
b) Nucleotides
c) Monosaccharides
d) Lipids

7. How is DNA oriented?

a) 3' to 5' direction
b) 5 ^{t} to 3' direction
c) Random direction
d) Bidirectional

8. Which of the following base pairs are complementary in DNA?

a) Adenine-Thymine and Guanine-Cytosine
b) Adenine-Uracil and Guanine-Cytosine
c) Adenine-Cytosine and Guanine-Thymine
d) Adenine-Guanine and Thymine-Cytosine

9. What did Okazaki and Okazaki discover in 1968 regarding DNA replication?

a) The structure of DNA

b) The mechanism of DNA repair

c) The role of RNA in DNA replication

d) The presence of small DNA fragments during replication

10. How are the two strands of the parent DNA helix copied during replication?

a) Both strands are copied simultaneously
b) The replication apparatus moves in the same direction on both strands
c) One strand is copied continuously, while the other is copied discontinuously in short fragments
d) The lagging strand is copied continuously, while the leading strand is copied discontinuously in short fragments

11. Which of the following is an example of a trait?

a. Learning to ride a bike
b. Eye color
c. Reading a book
d. Listening to music

12. In a heterozygous genotype, how many different alleles are present?

a) None

b) One

c) Two

d) Three

13. What is a clone?

a) A group of genetically identical organisms

b) An organism with unique genetic makeup

c) A sample of diverse genes within a cell

d) A type of genetic mutation

14. What is genetic recombination?

a) The replication of DNA within a single organism

b) The exchange of information between two DNA segments

c) The process of genetic mutation

d) The alteration of genetic material using artificial means

15. What is another term for recombinant DNA technology?

a) Genetic mutation

b) Genetic recombination

c) Genetic engineering

d) Genetic selection

16. According to Hardy & Weinberg, under what conditions would there be NO change in the genetics of a population?

a) Small population, non-random mating, migration, mutations, selection

b) Large population, random mating, migration, mutations, selection

c) Large population, non-random mating, no migration, mutations, selection

d) Small population, random mating, migration, mutations, no selection

17. Which of the following is NOT a condition for NO change in the genetics of a population according to Hardy & Weinberg?

a) Large population

b) Non-random mating

c) No mutations

d) Migration

18. What is the primary component of a chromosome?

a) DNA

b) RNA

c) Protein

d) Lipid

19. According to Mendel's law of dominance:

a) Alleles segregate independently during gamete formation.

b) The dominant allele masks the expression of the recessive allele.

c) Alleles for different traits assort independently of each other.

d) Each parent contributes one allele for each trait to the offspring.

20. What is the direction of DNA synthesis on the leading strand during replication?

a) 3' to 5'
b) 5 ' to 3'
c) Bidirectional
d) Random direction

SECTION B: ANSWER ALL QUESTIONS (40 MARKS)

l. Define the following terms (5 marks)

a) Heredity
b) Monohybrid cross
c) gene cloning
d) Alleles

2. State and explain the mendelian law of inheritance (6 marks)
3. Compare and contrast between purines and pyrimidines (5 marks)
4. Describe central dogma (5 marks)
5. Describe the structure of DNA (5 marks)
6. A scientist crosses two pea plants, one with round seeds (RR) and the other with wrinkled seeds (IT). They perform a monohybrid cross to study the inheritance pattern of seed shape. Utilizing a Punnett square, determine the genotypic and phenotypic ratios expected in the Fl generation. Additionally, discuss how this experiment exemplifies Mendel's principle of dominance. (5 marks)
7. Explain formation of replication fork in prokaryotes DNA replication (5 marks)
8. State techniques and procedures recombinant DNA technology (5 marks)

SECTION C: ANSWER ANY TWO QUESTIONS

QUESTION 2

Describe differences in DNA replication between Eukaryote and Prokaryotes (20 marks)

QUESTION 3

Describe and illustrate steps involved in gene cloning (20 marks)

QUESTION 4

Discuss the applications of genetic engineering (20 marks)