THE NATIONAL UNIVERISTY OF LESOTHO

B.Sc. (Crop Science Supplementary Examination)
AGR 2501 Introduction to genetics

Date: August 2023 **Total Mark: 100** **Time allowed: 3 hours**

Answer question one and any three questions. Question one carries forty marks.

1.Which of the following is a correct definition of genetics?

A. The study of transmission of traits from parent to offspring.
B. The study of genes and traits defined by genes.
C. The study of DNA.
D. The study of variation between members of a species.

2 Which statement about nucleic acids is not correct?

A. They are macromolecules.
B. They are organic molecules.
C. They are typically long, linear molecules.
D. None; all of these statements are correct.

3 What is the main function of DNA?

A. It stores information for protein synthesis.
B. It can be mutated.
C. It directs the process of protein synthesis.
D. It provides energy for the cell.

4 Identify the correct order of organization of genetic material, from largest to smallest.

A. Genome, chromosome, gene, nucleotide
B. Gene, chromosome, nucleotide, genome
C. Chromosome, gene, genome, nucleotide
D. Chromosome, genome, nucleotide, gene

5. Which statement is correct about sex linked traits

A. They are inherited through either X or Y chromosome
B. They are determined by sex in organisms
C. They can only be expressed when inherited through the male gamete
D. None of the above

6 Which of these might be the reason for albinism

A. Presence of both recessive albinism (aa) alleles
B. Presence of one albinism allele
C. inbreeding
D. Selfing of an individual

.

7 A gene:

A. Can be described as a unit of heredity.

B. Contains information to produce a particular protein.
C. Affects traits at the cellular level.
D. Can exist in many forms.
E. All of the above.

8 Haploid cells in the human body:

A. Are a typical example of human cells.
B. Are caused by allelic variation.
C. Are gametes, which allow sexual reproduction.
D. Contain 46 chromosomes.

9 Which field of genetics is the oldest?

A. Transmission genetics.
B. Molecular genetics.
C. Population genetics.
D. Developmental genetics.

10 Which statement is true about the nuclease of the cell

A. It has many different organelles including Golgi apparatus
B. Contains ribosome's that are a site for protein synthesis nearby the nucleic acids.
C. It is enclosed in a nucleic wall.
D. It is not found in unicellular organisms

11 DNA is a polymer made of the following nucleotide combinations

A. Adenine, thiamine, guanine cytosine
B. Adenine, Uracil, guanine cytosine
C. Adenine, Uracil, Proline cytosine
D. Methionine , thiamine, guanine cytosine

12 Which is an example of a study that might be done by a quantitative geneticist?

A. A comparison between many individuals indicates that the "short" variant of a particular gene seems to increase risk for alcoholism.
B. DNA sequencing allows geneticists to determine the difference between the short and long variants of a newly discovered gene.
C. Geneticists are able to clone and express a gene to produce human insulin.
D. Study the heritability estimates of fibre texture in sheep

13 The human genome is distributed over 24 chromosomes.

A. True
B. False

14 Development of genetic technologies are often rejected at first even though they may be used to create great advances in medicine, agriculture, and many other fields.

A. True
B. False

15 Gene expression can be defined as the process of transcription and translation.

A. True
B. False

16 DNA is the most important macromolecule for correct cellular function.

A. True
B. False

17 The major difference between different cells in the same organism is that they have different DNA.

A. True
B. False

18 All sexually reproducing organisms are diploid.

A. True
B. False

19 Genetic composition of a species is stable over time.

A. True
B. False

20 Most traits are controlled by genetic variation.

A. True
B. False

Question two

A. The lubber grasshopper is a very large grasshopper, and is black with red and yellow stripes. Assume that red stripes are expressed from the homozygous RR genotype, yellow stripes from the homozygous rr genotype, and both form the heterozygous genotype.
   a. What will be the phenotypic ratio of the F_1 generation resulting from a cross of two grasshoppers, both with red and yellow stripes (red : both : yellow)? (2marks)

   b. What would be the genotypic ratio of the F_1 generation (RR : Rr : rr)? (3marks)
   c. What genotypes would be produced by crossing a grasshopper with both color stripes and one with yellow stripes (choose all that apply)? (3marks)
   d. Which phenotype is recessive and which one is dominant (2marks)

Question 2 b

1. Suppose in a strain of soybeans, high oil (H) content in the seeds is dominant to low oil content and four seeds (E) in a pod is dominant to two seeds in a pod. A farmer crosses two soybean plants, both with high oil content and four seeds per pod. The resulting F_1 offspring have a phenotypic ratio of 9:3:3:1 (High oil / four seeds : High oil / two seeds : Low oil / four seeds : Low oil / two seeds).

What genotype were the parent plants? (4 Marks)

   a. Suppose the farmer chooses two of the high oil / four seed plants and crosses them. The F_2 generation have all high oil / four seed phenotypes. What were the genotypes of the plants chosen by the farmer to cross? (6 Marks)

b. Which known genotypes might the farmer cross her high oil / four seed plants with to determine their genotype? (2 Marks)

Question three

1. Within a population of butterflies, the color brown (B) is dominant over the color white (b). And, 24% of all butterflies are white. Given this simple information, calculate the following:
    a. The percentage of butterflies in the population that are heterozygous (6 marks)
    b. The frequency of homozygous dominant individuals (4 marks)

2. State the Hardy Weinberg equation and identify each of the variables in equation. (5 Marks)
3. State five assumptions of the Hardy-Weinberg Equilibrium model and describe each. (5 marks)

Question four

a) Describe the DNA structure and the significance of a double helix nature (10 marks)
b) Discuss how DNA replicates. In your discussion, you should explain:
    a. How replication begins
    b. The roles of the main enzymes involved
    c. The source of materials for replication.
    d. Where and when will replication happen

(10 marks)

Question five

Describe the mitotic cell division in organisms (20 marks)