

THE NATIONAL UNIVERSITY OF LESOTHO

Faculty of Agriculture

DEPARTMENT OF CROP SCIENCE

B.Sc. Crop Science

AGR 2501 Introduction to Genetics

Date: January 2023

Total Mark: 100

Time allowed: 3 hours

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

Question One

Write the short notes on the following terms as applied in genetics:

1. Genetics
 - A. The study of DNA.
 - A. Chromosome
 - B. Genome
 - C. Gene
 - D. Albinism
- A. Selfing of an individual
 - B. Haploid cells in the body:
- A. Molecular genetics.
 - B. Quantitative genetics?

(marks 40)

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 F₁ 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 F₁ 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)

B.

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 F₁ 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).

- a. What genotype were the parent plants? **(4 marks)**
- b. Suppose the farmer chooses two of the high oil / four seed plants and crosses them. The F₂ generation have all high oil / four seed phenotypes. What were the genotypes of the plants chosen by the farmer to cross? **(6 marks)**
- c. 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

1. Describe the DNA structure and the significance of a double helix nature **(10 marks)**
2. 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)**