

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE
IN AGRICULTURE

AGRI 223/BOTA 212: POPULATION GENETICS

STREAMS: BSC. AGRIC

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 16/04/2025

8.30 A.M. – 10.30 A.M.

INSTRUCTIONS:

- Answer all the questions in section I and TWO questions in section II.
- Use of calculators is allowed.
- Do not write anything on the question paper.

SECTION I (30 MARKS): ANSWER ALL THE QUESTIONS (COMPULSORY)

1. Explain the following terms as used in population genetics:
 - (a) Gene pool. (1 marks)
 - (b) Panamictic population. (1 marks)
2. Draw a state-space graph of a prey-predator Lotka-Volterra model, showing a scenario where both species populations are below their respective isoclines. (4 marks)
 - (b) Write down the model equations. (3 marks)
3. An open pollinated maize population had an average of 6 leaves per plant. After 10 breeding cycles of selection for only plants with high leaf numbers, the mean was raised to 10 leaves per plant. Selection was stopped for several generations and the mean leaf number was reduced to 8, which was maintained for the next 11 generations during which time selection was not practised.
 - (a) Explain these observations. (5 marks)
 - (b) Explain why the mean number of leaves per plant did not drop to the original value of 6. (2 marks)
4. (a) If the selective disadvantage of genotype HbA/HbA is 0.1 and that of hbs/hbs is 0.7, what will be the equilibrium frequency of the Hbs and HbA allele? (4 marks)
 - (b) What is the expected percentage of Hbs/Hbs infants born each year in the equilibrium population where $S_1 = 0.1$ and $S_2 = 0.7$? (2 marks)

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5. A sheep rancher in Kenya finds that the recessive allele y causing yellow fat had become established in his flock of 1000 sheep, and that 1 in 25 sheep express this trait. Assume that the population is randomly mating and that all genotypes have the same reproductive fitness.
- (a) How many sheep express the normal trait of white fat? (4 marks)
 - (b) How many normal sheep carry the recessive allele? (3 marks)
 - (c) Since only animals with white fat are selected for breeding, why is it that the recessive allele has not been eliminated from the population? (1 marks)

SECTION II (40 MARKS): ANSWER ANY TWO QUESTIONS

6. In a given population the following individuals were observed: $AA = 1800$, $Aa = 2000$ and $aa = 200$. Calculate relevant population genetic indices. (20 marks)
7. (a) Discuss factors that influence genetic equilibrium in a population. (10 marks)
- (b) A certain population with the following allelic frequency $p(A) = 0.4$, received emigrants from a different population whose allelic frequency are $p_m(A) = 0.6$. The proportion of emigrants is 30%. What would be the allelic change after this migration? (6 marks)
- (c) Calculate the inbreeding coefficient for a mating offspring of full-sibs to its great-grandparent. (4 marks)
8. In Chuka University, 70% of the population are tasters, who can detect the bitter taste of arrowroots, and 30% are non-tasters. A single autosomal gene is involved, and taster is dominant over non-taster.
- (a) What population of all marriages between tasters and non-tasters have chance (except by mutation) of producing a non-taster child? (12 marks)
 - (b) If mating is random, what is the probability of a non-taster finding a non-taster partner? (4 marks)
 - (c) If the frequency of non-taster fruit is 9 in 100. Calculate the gene (allelic) frequencies at equilibrium. (4 marks)
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