JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF AGRICULTURAL AND FOOD SCIENCES

THIRD YEAR FIRST SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ANIMAL SCIENCE

2022/2023 ACADEMIC YEAR

REGULAR

COURSE CODE: AAB 1313

COURSE TITLE: Quantitative Genetics

EXAM VENUE: **STREAM: BSc. Animal Science**

DATE: **EXAM SESSION:**

TIME: 2 HOURS

Instructions:

1. **Answer ALL questions in section A and ANY other 2 Questions in section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

SECTION A [30 MARKS]
Answer ALL questions from this Section
1. Match COLUMN A with COLUMN B   **[10 MARKS]**

COLUMN A	COLUMN B
1. Accuracy of selection (Accuracy of breeding value prediction)	(a) The mating of dissimilar individuals.
2. Generation interval	(b) Change in gene frequencies in small populations due purely to chance.
3. Positive assortative mating	(c) The rate of change in the mean breeding values of a population is caused by selection.
4. Phenotypic value	(d) The process determines which individuals become parents, how many offspring they produce, and how long they remain in the breeding population.
5. Rate of genetic change	(e) A measure of how "choosey" breeders are in deciding which individuals are selected.
6. Selection intensity	(f) A measure of performance for a trait in an individual – a performance record
7. Selection	(g) The mating of similar individuals.
8. Random drift	(h) The amount of time required to replace one generation with the next
9. Negative assortative mating	(i) The value of an individual as a (genetic) parent
10. Breeding value	(j) A measure of the strength of the relationship between true breeding values and their predictions for a trait under selection

2. Answer all questions by indicating either TRUE or FALSE. Each question is worth 1 MARK for a total of 20 MARKS. **[20 MARKS]**

(a) Selection modifies allele frequencies so we expect to see DNA sequence for genes affecting the trait of interest to be changing to the "good" allele

(b) Genotypic value is the most appropriate quantity to use when selecting an individual as a potential parent based on their performance, which of the following quantities would be the most appropriate to use

(c) As population size increases, the level of inbreeding also increases

(d) $M_o - M_F$ is best associated with selection response

(e) The hybrid model described the molecular marker-assisted selection

(f) If a cow has one calf (baby cow) when she is 4 years old, has another calf at 5 years old and finally has her last calf at 9 years old, her generational interval = 8 years

(g) The optimum recombination rate between the marker and QTL for detecting the presence of the QTL is close to zero

(h) The finite locus model best described the response to selection which is estimated based on a change in the breeding value

(i) If you calculate *[CORRELATED RESPONSE$_X$/ DIRECT RESPONSE$_X$]* = 0.64 for trait X, it is better to select indirectly for the trait

(j) If the response to selection is calculated based on the standardized selection differential, phenotypic standard deviation and heritability, phenotypic information is assumed to be normally distributed

(k) You calculate the heritability of a trait to be 80%, the trait is expected to exhibit much heterosis

(l) Breeding value is the best value to use to predict the change in phenotype in the next generation is

(m) Epistasis is defined as one locus affecting more than one trait

(n) If the effective population size is 30, the rate of inbreeding per generation is equal to 0.0167

(o) If mutation balances selection in a large random mating population without migration, alleles could still be lost from the population.

(p) When considering individual allele effects, dominance deviations that are not zero for any genotype require dominance allele effects

(q) Pleiotropy is defined as alleles at one locus affecting the expression of alleles at another locus

(r) If a locus with two alleles of equal frequency is subject to 25% selection against the homozygous recessive genotype, the proportion of the population that survives is equal to 0.9375

(s) Environmental effect is defined as the effect that genetic factors have on animal performance

(t) Heritability (h^2) is a measure of the strength of the relationship between performance genotypic values and breeding values for a trait in a population

SECTION B (40 MARKS)

Answer ANY TWO questions in this section. Each question carries a total of 20 MARKS

3a. A breeder is studying the population of swine at the Siaya Campus of JOOUST. By careful observation, the breeder detects that 16% of the population is black, and the remainder is white. The breeder assumes the black colour is a recessive allele to the dominant black colour and assigns the coat colour locus alleles labelled W (dominant allele) and g (recessive allele). Calculate the frequency of the white phenotype for this coat colour locus **[5 MARKS]**

3b. The gene that makes goats resistant to cyanide poisoning exhibits heterozygote advantage because goats homozygous for the resistance gene suffer from vitamin K deficiency. Heterozygotes are resistant to the poison and do not suffer from vitamin K deficiency. The proportion of resistant homozygotes that die from vitamin K deficiency was estimated to be 63%. Susceptible homozygotes are not all killed when exposed to sorghum plants containing high levels of cyanogenic glycosides. A population under continuous treatment with poison came to equilibrium with the resistance gene at a frequency of 0.34. What percentage of all goats in this population will die as a consequence of the resistance gene and the poisoning? **[5 MARKS]**

3c. Explain the FIVE conditions that must be met for equilibrium to remain in effect (i.e. that no evolution is occurring): **[10 MARKS]**

4a. Animal scientists at JOOUST have identified a nonlethal dwarfism condition in the Black Angus breed of beef cattle. It is autosomal recessive and the **normal** allele is D and the dwarf allele is d. Of the 100 black Angus cattle sampled in the study, 20 had the dd genotype and 40 had the DD genotype. What was the effective number of individuals randomly mating that produced this sample of 100 cattle? **[10 MARKS]**

4b. Explain the FOUR factors that cause genetic variation in a population **[10 MARKS]**

5a. Polymorphism is the source of the variation of quantitative characters, the subject of this unit. Describe the FIVE factors causing polymorphism within a population **[15 MARKS]**

5b. A population of sheep is maintained by random mating among 20 pairs of parents in every generation. What will be the inbreeding coefficient of the population after 5 and after 10 generations? **[5 MARKS]**