



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF AGRICULTURAL AND FOOD SCIENCES**  
**THIRD YEAR FIRST SEMESTER UNIVERSITY EXAMINATION FOR DEGREE OF**  
**BACHELOR OF SCIENCE IN NIMAL SCIENCE**  
**2019/2020 ACADEMIC YEAR**  
**SPECIAL EXAM/RESIT**

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**COURSE CODE: AAS 3317**

**COURSE TITLE: Quantitative Genetics**

**EXAM VENUE:**

**STREAM: BSc. (Animal Science)**

**DATE:**

**EXAM SESSION:**

**TIME: 2.00 Hours**

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**Instructions:**

- 1. Answer ALL question in Section A (compulsory) and ANY other TWO 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.**

- 1.1 Define the following:
- (a) Quantitative genetics. (1 mark)
  - (b) Phenotypic value. (1 mark)
  - (c) Population mean. (1 mark)
  - (d) Genotypic value. (1 mark)
  - (e) Environmental effect. (1 mark)
- 1.2 Distinguish between qualitative and quantitative traits? (1 mark)
- 1.3 For a species of your choice, list the most important traits and state which of them are repeated traits. (2 marks)
- 1.4 Define the term pleiotropy and give examples. (1 mark)
- 1.5 Differentiate between variance and covariance in the context of a quantitative trait. (1 mark)
- 1.6 Differentiate between heritability and repeatability. Give illustrations. (2 marks)
- 1.7 Explain why heritability in the broad sense sets the upper limit of heritability in the narrow sense. (3 marks)
- 1.8 Differentiate between the following:
- (a) Phenotypic variance and phenotypic standard deviation. (1 mark)
  - (b) Selection differential and selection intensity. (1 mark)
  - (c) Inbreeding coefficient and inbreeding depression. (1 mark)
  - (d) Single trait selection and multiple trait selection. (1 mark)
  - (e) Coefficient of correlation and coefficient of regression. (1 mark)
- 1.9 Using the symbol  $V$  for variance:
- (a) Give the full model of phenotypic variance of a quantitative trait. (1 marks)
  - (b) Explain each component. (6 marks)
  - (c) Explain why additive variance is the most important component. (1 marks)
- 1.10 Explain the term Most Probable Producing Ability. (2 marks)

**SECTION B [40 MARKS]**

**Answer ANY TWO questions from this Section.**

2. Discuss the following terms in the context of quantitative genetic:

- (a) Genotype by environment interaction. (5 marks)
- (b) Genotype – environment correlation. (5 marks)
- (c) Maternal effect. (5 marks)
- (d) Show that provided that both parents have equal variances, the covariance of offspring and mid-parent is the same as that of offspring and one parent, which is  $\frac{1}{2}V_A$ . (5 marks)

**3.** Assume repeatability of weaning weight as a trait of the dam is 0.40 and heritability is 0.30. If the herd average is 225,

- (a) Compute the best estimate of the next record of a cow which has had four calves with 250-day weaning weights of 220, 250, 245, and 232 kg. (5 marks)
- (b) Repeat (a) above for a cow which has had a single calf with 250-day weaning weight of 260 Kg. (3 marks)
- (c) What would be the breeding value of the cow in (a) when weaning weight is considered as a trait of the dam? (5 marks)
- (d) Repeat (c) when weaning weight is considered as a trait of the calf and the four calves in (a) are half sibs. (7 marks)

4. (a) Explain the meaning of the term additive gene variance and its importance in the improvement of a quantitative trait. (5 marks)

(b) Distinguish between selection differential and selection intensity. (5 marks)

(c) Assume that selection is carried out separately for males and females in a herd of Kenya Boran cattle in which the average daily gain is 0.22 kg/day. If the means of the selected males and females are 1.80 and 1.50 kg/day respectively,

(i) Compute the average selection differential in kg/day when both males and females are selected. (4 marks)

(ii) Repeat (i) above when only males are selected. (4 marks)

(iii) By what amount has the potential genetic gain been reduced by selecting only the males? (2 marks)

5.

(a) Write short notes on the following:

- (i) Phenotypic correlation. (2 marks)
- (ii) Genetic correlation. (2 marks)
- (iii) Environmental correlation. (2 marks)
- (iv) Repeatability. (2 marks)
- (v) Within family selection. (2 marks)

(b) Answer the following questions briefly and clearly, giving illustrations and/or Examples where necessary:

- (i) What is family selection? (2 marks)
- (ii) State two main family lines and briefly explain how each of them can arise. (3 marks)
- (iii) What are the limitations of whole family selection and within family selection? (3 marks)
- (iv) Under what conditions can family selection be recommended? (2 marks)