

CHUKA



UNIVERSITY

Knowledge is Wealth (*Sapientia divitia est*) Akili ni Mali
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FIRST YEAR EXAMINATION 2024/2025
EXAMINATION FOR BACHELOR OF SCIENCE IN AGRICULTURE, BACHELOR OF
SCIENCE IN AGRICULTURAL EDUCATION, BACHELOR OF SCIENCE IN
ANIMAL SCIENCE AND, BACHELOR OF SCIENCE IN FOOD SCIENCE AND
TECHNOLOGY

BOTA 111: GENERAL GENETICS

Stream: BSc AGRI (Y1S2), BSc AGED (Y1S2), BSc ANSC (Y1S2), BSc FOST (Y1S2)

INSTRUCTIONS

Answer **ALL** the questions in section A and any **TWO** question in section B.

Use of calculators and statistical tables is allowed.

Do not write anything on the question paper.

SECTION A (30 MARKS): ANSWER ALL QUESTIONS

- Two plants used as the male and female parent have the genotypes AABb and aaBB, respectively. List the genotypes for the following stages of a cross between these two plants.
 - Sperm nucleus. (1 mark)
 - Ovum. (1 mark)
 - Polar nuclei. (2 mark)
 - Endosperm nuclei. (2 mark)
- A normal woman marries a man who has vitamin-D resistant rickets, a dominant X-linked gene. What kind of children and in what proportions can these parents expect with regard to both sex and the disease? (4 marks)
 - An X-linked recessive gene produces ocular albinism in humans. A woman with normal vision whose father has ocular albinism marries a man who also has ocular albinism. Calculate the probability that the first child from this mating will be male with ocular albinism. (2 marks)
- The following interrupted length of DNA constitutes a gene in a eukaryotic organism:
3'-TACCGACCC.....TGCATT-5'
5'-ATGGCTGGC.....ACGTAA-3'

Giving reasons, indicate which side of the DNA duplex (top or bottom) is transcribed? (3 marks)

- (ii) State the functions of the following enzymes in DNA replication:
- (a) DNA polymerase I. (1 mark)
 - (b) DNA Ligase. (1 mark)
 - (c) DNA gyrase. (1 mark)

4. In a genetic laboratory, DNA samples arrive for sequencing at a random of 6 samples per hour.

- i. Find the probability that at least 10 samples arrive within 90 minute period. (3 marks)
- ii. If a DNA sample is received at 11:30 am, find the probability that the next sample arrives exactly at 11.45 am. (3 marks)

5. In a cross $+r+/w+s \times wrs/wrs$, the following offspring were obtained.

$+r+/wrs$ 360	$w++/wrs$ 90
$wr+/wrs$ 50	$w+s/wrs$ 350
wrs/wrs 4	$+++/wrs$ 6
$+rs/wrs$ 100	$++s/wrs$ 40
	1000

- (i) Calculate the map distance between the genes. (4 marks)
- (ii) Calculate interference. (2 marks)

SECTION B (40 MARKS): ANSWER ANY TWO QUESTIONS

7. (a) A sample of 1000 students in Chuka University showed the following distribution of blood groups: A = 450, B = 130, AB = 60 and O = 360 individuals. Calculate the allelic frequencies. (10 marks)

(b) Analyse the Hardy-Weinberg equilibrium. (10 marks)

8.(a) Discuss Down syndrome. (16 marks)

(b) Outline the structural mutations. (4 marks)

9. In a crossing experiment using garden peas (*Pisum sativum*), the F_1 was advanced to F_2 and the following F_2 phenotypic classes were observed:

- 130 plants bearing round/yellow seeds
- 410 plants bearing round/green seeds
- 400 plants bearing wrinkled/yellow seeds
- 125 plants bearing wrinkled/green seeds

- (a) Formulate the null hypothesis for the above cross. (2 marks)
- (b) Test the given data to determine whether it supports your suggested hypothesis using chi-square test at significant $\alpha = 0.05$. Clearly show your working. (18 marks)

