

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE(AGED), BACHELOR OF
EDUCATION (SCIENCE), BACHELOR OF SCIENCE
(GENERAL)

BOTA 113: GENERAL GENETICS

STREAM: R

TIME: 2 HRS

DAY: MONDAY [8.30AM – 12.30PM]

DATE: 19/12/2022

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS: - Answer all questions in Section A and any TWO questions in Section B

SECTION A: 40 MARKS

QUESTION ONE

- (a) List the three traditional sub disciplines of genetics and summarize what each covers. (3 Marks)
- (b) Outline the notion of pangenesis and how it differs from the germ-plasm theory (2 marks)

QUESTION TWO

- (a) A certain mRNA codon is determined to be AUG
- (i) What is the tRNA anticodon if no unusual bases are involved? (1 mark)
- (ii) What is the DNA sequence that is responsible for this mRNA? (1 mark)
- (b) Differentiate between transcription and translation (2 marks)

QUESTION THREE

In Cats, black coat colour is dominant over grey. A female black cat whose mother is grey mates with a grey male. If this female has a litter of six kitten. Using binomial expression, determine the probability of obtaining three black and three grey kittens (6 marks)

QUESTION FOUR

In the California poppy, an allele for the yellow flowers (C) is dominant over an allele for white flowers (c) at an independently assorting locus, an allele for entire petals (F) is dominant over an allele for fringed petals (f). A plant that is homozygous for yellow and entire petals is crossed with a plant that is white and fringed. A resulting F1 plant is then crossed with a plant that is white and fringed, and the following progeny are produced: 54 yellow and entire, 58 yellow and fringed, 53 white and entire and 10 white and fringed.

- (a) Using chi-square test, compare the observed numbers with those expected for the cross
- (b) What conclusion can you make from the results of the chi-square test? (5 marks)

QUESTION FIVE

In poultry, the gene **R** gives Rose comb, gene **P** gives Pea comb. When both are present, the result is Walnut comb. Individuals homozygous recessive for both loci (ie **rrpp**) have single comb. However the two pairs of genes are inherited independently. Determine the proportions of phenotypes in a cross: **RRPp** (Walnut) × **rrPp** (Pea) (5 marks)

QUESTION SIX

Why was Mendel's approach to the study of heredity so successful?

(5 marks)

QUESTION SEVEN

Which types of chromosome mutations

- i. Increase the amount of genetic material in a particular chromosome
- ii. Increase the amount of genetic material in all chromosomes
- iii. Decrease the amount of genetic material in a particular chromosome
- iv. Change the position of DNA sequences in a single chromosome without changing the amount of genetic material
- v. Move DNA from one chromosome to a non-homologous chromosome. (5 marks)

QUESTION EIGHT

Briefly describe the *lac* operon and how it controls the metabolism of lactose.

(5 marks)

SECTION B: 30 MARKS**QUESTION NINE**

(a) Perform a dihybrid cross from the P to the F₂ generations in which the two traits show complete dominance. Show gametes types where necessary and in the F₂ summarize your results under columns: Genotypes, genotype ratios, phenotype and phenotype ratios. Use your own example with appropriate symbols which must be defined at the start. (9 marks)

(b) A plant heterozygous for the independent assorting genes (Aa Bb Cc Dd) is self-pollinated. Determine the expected frequency of the following genotype in the progeny:

- i. aabbccdd
- ii. aabbCcDd
- iii. AaBbCcDd

(6 marks)

QUESTION TEN

A corn plant known to be heterozygous at three loci is test crossed. The progeny phenotypes and numbers are as follows:

+++	455
abc	470
+bc	35
a++	33
++c	37
ab+	35
+b+	460
a+c	475

(a) what are the genotypes of the parents?

(b) Make a map of these genes, showing their order and the distances between them

(c) Derive the coefficient of coincidence for interference between the given genes.

(15 marks)

QUESTION ELEVEN

(a) Define the “Hardy-Weinberg Principle (law of Equilibrium)”. What is its five assumptions? (7 marks)

(b) In a certain population, the genotype frequency of aa was reported at 20%. What are the frequencies of i) genotype AA and Aa; ii). Alleles A and a. (4 marks)

(c) A population begins with the following frequencies, 0.44AA; 0.32Aa; 0.24aa. If random mating occurs, what will be the genotypic frequencies in the next generation. (4 marks)

Table 1: Chi-Square Table

Degrees of Freedom	Probability (P)									
(df)	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	---	---	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750

