



National Open University of Nigeria
Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi - Abuja
Faculty of Science
Department of Pure and Applied Sciences
2021 EXAMINATION_2

COURSE CODE: BIO403

COURSE TITLE: POPULATION CYTOGENETICS

CREDIT: 2 Units

TIME ALLOWED: 2 Hours

INSTRUCTION: ANSWER QUESTION ONE (1) AND ANY OTHER THREE (3) QUESTIONS

- 1a. Explain fitness and coefficient of selection in population genetics (4 marks)
- b. The M and N antigens are encoded by alleles of a gene on chromosome;
- i. How many possible genotypes are expected from above? (1 mark)
 - ii. List the expected genotypes (3 marks)
 - iii. Which of the listed genotypes represents the heterozygous genotype? (1 mark)
- c. A locus has three alleles with each allele coding for different proteins. A study carried out in a random mating large population gave the following numbers of genotypes:

S/N	Genotype	Frequency
1.	AA	10
2.	AB	25
3.	BB	97
4.	AC	34
5.	BC	93
6.	CC	36
	TOTAL	295

From the information given, what are the:

frequencies of all the genotypes (7 marks)

frequencies of all the alleles involved? (9 marks)

- 2a. Explain absence of natural selection as an assumption needed to attain Hardy-Weinberg equilibrium (5 marks)
- b. In Abuja Municipal Council of Nigeria, cystic fibrosis (a recessive condition) affects about 1 in 2,500 babies. Use this information to calculate:
- i. The frequency of the recessive allele in the population (4 marks)
 - ii. The frequency of the dominant allele in the population (3 marks)
 - iii. The percentage of heterozygous genotypes in the population (3 marks)

- 3a. Why is complete dominance not Suitable for the determination of genotypic Frequency by Actual Counts? (4 marks)
- b. Describe how gel electrophoretic technique can be used to detect variant forms of a protein (11 marks)
- 4a. Why are carriers of sickle cell traits more immune to malaria parasites compared to the two homozygote genotypes? (4 marks)
- b. A population of 1000 people living in a town in Nigeria was tested for their genotype at the phenylketonuria gene locus using gel electrophoresis. The trait was observed to be controlled by two alleles S and K. The result gave 660 SS, 200 SK and 140 KK. Calculate:
- the genotypic frequencies in the population (7 marks)
 - the allelic frequencies in the population (4 marks)
- 5a. Outline five factors that can change gene frequencies. (5 marks)
- b. If A^1A^1 produces an average of 10 offspring, A^1A^2 produces an average of 6 offspring and A^2A^2 produces an average of 4 offspring.
- Which of the three genotypes will have the highest reproductive output? (1 mark)
 - Determine the fitness of each of the three genotypes (5 marks)
 - Calculate the selection coefficients of each genotype. (4 marks)