



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;
- How many possible genotypes are expected from above? (1 mark)
 - List the expected genotypes (3 marks)
 - 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:
- The frequency of the recessive allele in the population (4 marks)
 - The frequency of the dominant allele in the population (3 marks)
 - 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:

i. the genotypic frequencies in the population (7 marks)

ii. 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.

i. Which of the three genotypes will have the highest reproductive output? (1 mark)

ii. Determine the fitness of each of the three genotypes (5 marks)

iii. Calculate the selection coefficients of each genotype. (4 marks)