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TECHNOLOGY**

UNIVERSITY EXAMINATIONS 2015/2016
SPECIAL EXAMINATION FOR THE DEGREE OF BACHELOR OF
EDUCATION SCIENCE

SBT 408 : POPULATION GENETICS

Time: 2 Hrs

INSTRUCTIONS:

1. Answer ALL questions in section A (3 Marks each)
 2. Answer any TWO questions in section B (20 Marks each)
 3. Use illustrations where appropriate
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SECTION A (30 Marks):

INSTRUCTIONS: ANSWER ALL QUESTIONS IN THIS SECTION

1. Explain the subtle distinction between the terms heterozygous and homozygous
2. State the factors that influence effective population size in natural population
3. Describe the Wright-Fisher model of random genetic drift
4. One of the assumptions of Hardy-Weinberg equilibrium is that genotypes mate at random with to their respective genotypes at that particular locus. State three ways in which this assumption may be violated.
5. Giving specific examples, describe three types of natural selection
6. Explain why selection on rare dominant allele in a population is efficient
7. Early doubters of Mendelian genetics pointed to the general lack of 3:1 phenotypic ratios in natural populations as evidence that Mendel's results on peas were not generally applicable. Why is this argument flawed?
8. If the frequency of albinism (homozygous for aa) in a given population is 1 in 20000. Calculate the frequency among offspring of first cousin marriages.
9. A population geneticist finds that a rare recessive genetic disorder occurs in 1 out of 1800 newborns. Calculate the frequency of heterozygous carriers in this population.
10. Achondroplasia is a kind of dwarfism is a kind of dwarfism determined by dominant allele (D). Therefore, in a bout 4 births out of 100000 a mutation occurs. Calculate the frequency of alternate allele(d) after one generation mutation.

SECTION B (ANSWER ANY TWO QUESTIONS , 20 MARKS EACH)

11. Suppose that a gene has a dominant allele (A) and a recessive allele (a) and that survival during early life stages for individuals homozygous for the recessive allele is only 80% as high as for individuals with the dominant phenotype.
 - a) If the population allele frequency is 0.7 A and 0.3 a in generation 1 adults, what are the expected proportions of the three genotypes in generation 2 zygotes?
 - b) What are the allele frequencies and expected proportions of the three genotypes in generation 2 adults? (Assume that a very large number of offspring is produced and that 20% of aa individuals dies immediately, before a random sample of the remaining individuals is selected to form the adult population for the next generation.) 20% mortality reduces aa from 0.09 to 0.072, so new frequencies are:

c) Would a sample size of 1000 adults be enough to detect a significant deviation from Hardy-Weinberg equilibrium in the generation 2 adults?

12 Describe the Hardy-Weinberg theory (20 marks)

13

- a) The dry type of ear cerumen ("wax") is due to homozygosity for a simple Mendelian recessive allele. Among American Indians the frequency of dry-cerumen individual is 40 percent.
 - i) What is the frequency of the recessive allele? (3 marks)
 - ii) What is the overall frequency of heterozygotes? (4 marks)
 - iii) Among individuals with the wet type of cerumen, what is the frequency of homozygotes? (3 marks)
- b) A population of water snakes is found on an island in Lake Victoria. Some of the snakes are banded and some are unbanded. Banding is caused by an autosomal allele that is recessive to an allele for no bands. The frequency of banded snakes on the island is 0.2, whereas the frequency of banded snakes on the mainland is 0.61. A large number of snakes migrate from the mainland to the island and after the migration 20% of the island population consists of snakes that came from the mainland.
 - i) Assuming that both the mainland population and the island population are in Hardy-Weinberg equilibrium for the alleles that affect banding, what is the frequency of the allele for bands on the island and on the mainland before migration? (5 marks)

14.

- a) Giving examples, describe the theory of genetic drift Genetic drift will eventually lead to loss of all alleles in the population except one.
- b) Describe the general properties of genetic drift