

Dr O'Ryan's Section

Question 1 (14 marks)

Define or very briefly discuss the terms or statements listed below (2 marks each):

- Over-dominance
- The effects of mutation vs. migration on allele frequencies
- Blending heredity
- The consequences of inbreeding and assortative mating are the same
- F_{ST}
- Haldane's equation to estimate selection
- Frequency-dependent fitness

Question 2 (8 marks)

You discover two geographically separate populations of *Drosophila*. How would you ascertain whether the populations are members of the same species or different species?

Question 3 (8 marks)

Individuals with cystic fibrosis generally die before they can reproduce, thus the coefficient of selection against them is $s = 1$. One can assume that the heterozygote carriers of the recessive mutant allele responsible for the disease are as fit as the wildtype homozygotes. The population frequency of the mutant allele is 0.02.

- What is the incidence of cystic fibrosis in the population one generation after selection? (hint: remember to calculate the relative contribution of each genotype to the next generation)

Question 4 (6 marks)

Briefly discuss two different molecular methods to determine the population structure and the frequency of different variants at a particular locus.

Question 5 (5 marks)

A population is composed of equal numbers of the genotypes AA , Aa , aa . The numbers of offspring produced by these genotypes are 996, 966 and 224 respectively. What is the relative fitness for each of these three genotypes?

Question 6 (7 marks)

Each of two isolated populations is in Hardy-Weinberg Equilibrium with the genotype frequencies below:

Genotype	AA	Aa	aa
Frequency in population 1	0.04	0.32	0.64
Frequency in population 2	0.64	0.32	0.04

- a) If the two populations are equal size and they merge to form a single population, predict the allele frequencies immediately after the merger
- b) If the merged population reproduces by random mating, predict the genotype frequencies in the next generation.
- c) If the merged population continues to reproduce by random mating, will these genotype frequencies remain constant?
- d) What is the phenomenon seen in (a) called?

Question 7 (7 marks)

Why is it considered important to maintain high levels of heterozygosity in natural populations?

Associate Professor Greenberg's Section

Question 1 (10 marks)

A baby is diagnosed as having Down syndrome. The couple who had the baby are in their twenties. Discuss the chromosome possibilities which could have caused this and what risks you would give the couple regarding future pregnancies.

Question 2 (5 marks)

Draw a pedigree based on the following information :

A couple have 4 children, two girls and two boys. The youngest boy is married and has 2 children, a girl and a boy. The boy is married and has one child who is a boy. All the males in this pedigree have a certain genetic condition.

Based on the pedigree you have drawn what two modes of inheritance might be involved in this family?

Question 3 (10 marks)

Write short notes on what a LOD score is and on the recombination fraction (theta) and describe how they are used in genetic linkage analysis.

Question 4 (10 marks)

Each question is worth 1 (one) mark. Please keep the answers short. **10 marks**

- a A proband is :
 - i The band at the centromere
 - ii The person who first draws your attention to a genetic condition in a family
 - iii A professional group of musicians

- b An acrocentric chromosome is :
 - i A chromosome where $p=q$
 - ii A chromosome where $q < p$
 - iii A chromosome where the centromere is near the end of the chromosome