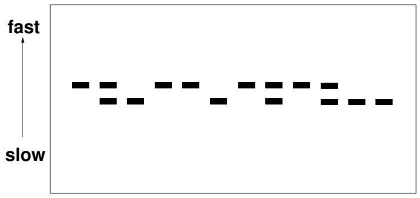
Genetics 453 Name: ______________________________

1996 Midterm exam

The test is closed book. You may use a calculator, but you can also leave computations in fractional form, such as $2 \times 3.67/19$. You can work in the space provided and also on the back of the sheet (in which case make it very clear which problem is being worked on). The questions total 100 points.



1. (25 points) The figure shows an electrophoretic gel on which we have examined a population for a locus which has two alleles. For this locus:

   (i) What are the numbers of each of the three genotypes that we see in this sample?

   (ii) What are the genotype frequencies?

   (iii) What are the gene frequencies?

   (iv) What genotype frequencies do we expect to see if the assumptions of the Hardy-Weinberg calculation apply?

   (v) What are some possible explanations for any discrepancies you see between the observed and expected genotype frequencies?

2. (20 points) How would Lamarck have explained the fact that farmers are able to breed from the highest-scoring parts of their herds and get an offspring generation with an improved mean?

3. (30 points) Suppose that there are several populations of 1000 animals each, all exchanging migrants with each other at a moderately high rate (say 5% of the individuals in each generation are new migrants from the other population). Suppose that a locus with three genotypes (2 alleles), AA, Aa, and aa has their fitnesses $1 : 1 : 0.9$ in one population, but $1 : 1 : 1$ in all the others. If we start with a 50% frequency of the A allele in all populations,

(i) What do we expect to happen to the gene frequencies of the populations in the next 100 or so generations?

(ii) What would we expect to happen if, instead, the migration rate between populations were zero?

(iii) How would the results of these two questions differ if instead the populations had each been of size 10 individuals?

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4. (25 points) A widespread fossil, found in many parts of a continent, is observed in the fossil record to change suddenly in the size of a character (everywhere, at the same point in the fossil record).

   (i) Is this an example of punctuational change? Explain why or why not.

   (ii) Could it be due to species selection? Explain why or why not.

   (iii) How should your answers to the above two questions be affected if the length of time between closest consecutive observations in the fossil record is 20,000 years? 200 years?