1. (13 points) Suppose a recessive mutation \( a \) exists in a (diploid, infinite, random-mating) population. It has fitness 0.7 in homozygotes, with the selection being due to inviability a few years after birth, and it has fitness 1.0 in all other genotypes. Suppose that one individual per 100,000 out of the whole population dies of this genetic disorder.

   (a) What is the gene frequency of the \( a \) allele?

   (b) If the population is at equilibrium between mutation and selection, what would the mutation rate be?

   (c) What fraction of all copies of the \( a \) allele are eliminated each generation?

   (d) Given that, how many generations ago was the mutation that led to an average copy of the \( a \) allele?

   (e) If mutation to the \( a \) allele were to cease entirely, how much would it decrease in frequency in the next 10 generations? Probably the easiest way to do this is just to set up the formula for the gene frequency in the next generation in terms of the current gene frequency, and use it 10 times.

2. (12 points) Suppose that a stream has a large resident population of rainbow trout (that remain there and do not run to the sea). They are fixed for a locally-favored allele \( A \) that has fitnesses of \( AA \), \( Aa \), and \( aa \) of 1 : 0.9 : 0.81 in that stream. A hatchery is suddenly set up next door and each generation trout that are all \( aa \) enter the stream and breed with the locals, the newly-arrived hatchery fish arriving adults and constituting 5% of all parents in each generation.

   (a) What will be the ultimate fate of allele \( A \)?

   (b) Make some calculation that gives us a good sense for how rapidly this ultimate state is approached, and describe why the calculation conveys that.