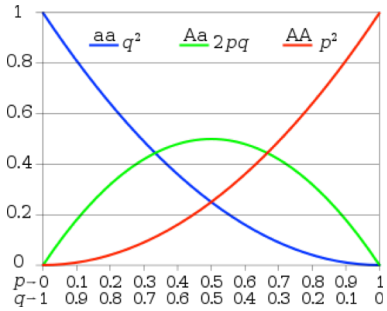

AP Biology Name:

Hardy-Weinberg Practice Problems

Directions: Use your knowledge of the Hardy-Weinberg Theorem and the Hardy-Weinberg Equation to perform the following calculations and answer the following questions. Work out the answers to these problems on a separate sheet of paper. SHOW ALL WORK and BOX your answers. Express frequencies as decimals, rather than fractions or percents.

1. You have sampled a population in which you know that the percentage of the homozygous recessive genotype (aa) is 36%. Using that 36%, calculate the following:

   A. The frequency of the "aa" genotype.
   B. The frequency of the "a" allele.
   C. The frequency of the "A" allele.
   D. The frequencies of the genotypes "AA" and "Aa."
   E. The frequencies of the two possible phenotypes if "A" is completely dominant over "a."

2. If 98 out of 200 individuals in a population express the recessive phenotype, what percent of the population would you predict would be…
   A. heterozygotes?
   B. homozygous dominant?

3. Your original population of 200 was hit by a tidal wave and 100 organisms were wiped out, leaving 36 homozygous recessive out of the 100 survivors. If we assume that all individuals were equally likely to be wiped out, how did the tidal wave affect the predicted frequencies of the alleles in the population? NOTE: assume the new population is at equilibrium -- AFTER the event - so you are comparing two populations what are at equilibrium to look for changes in allele frequencies.
   A. What is the frequency of homozygous recessive?
   B. What is the predicted frequency of heterozygotes?
   C. What is the predicted frequency of homozygous dominant?
   D. Given that the allele frequencies did change as the result of the tidal wave, we would say that microevolution has occurred. What do we call the phenomenon that caused this evolution?

4. Sickle-cell anemia is an interesting genetic disease. Normal homozygous individials (SS) have normal blood cells that are easily infected with the malarial parasite. Thus, many of these individuals become very ill from the parasite and many die. Individuals homozygous for the sickle-cell trait (ss) have red blood cells that readily collapse when deoxygenated. Although malaria cannot grow in these red blood cells, individuals often die because of the genetic defect. However, individuals with the heterozygous condition (Ss) have some sickling of red blood cells, but generally not enough to cause mortality. In addition, malaria cannot survive well within these "partially defective" red blood cells. Thus, heterozygotes tend to survive better than either of the homozygous conditions. If 9% of an African population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous (Ss) for the sickle-cell gene?

5. Within a population of butterflies, the color brown (B) is dominant over the color white (b). And, 40% of all butterflies are white. Given this simple information, calculate the following:

   A. The percentage of butterflies in the population that are heterozygous.
   B. The frequency of homozygous dominant individuals.

6. Cystic fibrosis is a recessive condition that affects about 1 in 2,500 babies in the Caucasian population of the United States. Please calculate the following.
   A. The frequency of the recessive allele in the population.
   B. The frequency of the dominant allele in the population.
   C. The percentage of heterozygous individuals (carriers) in the population.

7. This is a classic data set on wing coloration in the scarlet tiger moth (*Panaxia dominula*). Coloration in this species had been previously shown to behave as a single-locus, two-allele system with incomplete dominance. Data for 1612 individuals are given below:

   White-spotted (AA) =1469 Intermediate (Aa) = 138 Little spotting (aa) =5

   A. Calculate the allele frequencies (p and q)

8. The allele for a widow's peak (hairline) is dominant over the allele for a straight hairline. In a population of 500 indiviuals, 25% show the recessive phenotype. How many individuals would you expect to be homozyous dominant and heterozygous for the trait?

9. In purebred Holstein cattle, about on calf in 100 is spotted with red, rather than being the usual pure black color. Red spots (r) are recessive to black (R).
   A. What is the frequency of the red spotted genotype in Holsteins?
   B. What is the frequency of the recessive allele for red spots?
   C. Assume that the Holstein cow population is in Hardy-Weinberg equilibrium for this trait. What is the frequency of homozygous black cows?

10. Visualize a large, randomly mating, genetically equilibrated field of snapdragons. You see white, pink , and red flowers. Recall that snapdragon flower color is a case of incomplete dominance; WW = white, W'W' = red, and W'W = pink. Of the plants in the field, exactly 4% have white flowers. What percentage of the plants in the field have pink flowers?

11. In the USA albinism (the inability to manufacture melanin pigment) is due to a rate recessive allele. About one in 10,000 persons is an albino. The population of the USA is about 250 million. Presume that the population is in HW equilibrium with respect to albinism.
   A. How many albinos and carriers for the albinism allele live in the USA?

12. The MN blood group system is another blood group system in humans besides A, B, O). It is determined by a pari of codominant alleles, M and N. Among 278 Native Americans, the following blood types are obtained: type M = 78, type MN = 139, and type N = 61.
   A. Calculate the allele frequencies of M and N.

13. For a particular gene, assume a population has a frequency of heterozygotes of 10%. A study of the population concludes that the frequency of homozygous recessive individuals is 16%. Is this population in Hardy-Weinerg equilibrium? Why or why not?