Hardy Weinberg Practice Problems

For the Hardy Weinberg law, the five conditions that must be met for this law to hold true are:

1. *Populations must be large (no genetic drift)*
2. *No migration*
3. *No mutations*
4. *Random mating*
5. *No natural selection*

Once the law fails, evolution is occurring.

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| **Formula** |
| *p + q = 1*  | *p2 + 2pq + q2 = 1*  |
| Refers to alleles | Refers to populations |
|  |  |
| p is the dominant allele frequencyq is the recessive allele frequency | p2  is the homozygous dominant genotype2pq is the heterozygous genotypeq2 is the homozygous recessive genotype |
|  |  |
|  | *p2 + 2pq refers to the dominant phenotype**q2refers to the recessive phenotype* |
|  |  |
| The total frequencies add up to 1 to represent 100% |

**HINT**\*: Most times you always start solving from q2 to find q and then use p + q = 1 to find p.

**Practice Problems**:

1. Two alleles (brown, B and white, b) exist for mouse coat colour. In a population of mice whose gene pool consists of 500 alleles, 301 of these alleles are brown. Calculate the allele frequencies for:

a. the brown allele \_\_\_\_\_\_\_\_\_\_\_ b. the white allele \_\_\_\_\_\_\_\_\_\_\_

1. In the American Caucasian population approximately 70% of people can taste the chemical phenylthiocarbamide (PTC) (the dominant phenotype), while 30% are non-tasters (the recessive phenotype). Determine the expected frequency of:

a) homozygous recessive phenotype (q2) \_\_\_\_\_\_\_\_\_\_\_\_\_

b) the recessive allele (q) \_\_\_\_\_\_\_\_\_\_\_\_\_

c) the dominant allele (p) \_\_\_\_\_\_\_\_\_\_\_\_\_

d) homozygous tasters (p2) \_\_\_\_\_\_\_\_\_\_\_\_\_

e) heterozygous tasters (2pq) \_\_\_\_\_\_\_\_\_\_\_\_\_

1. In humans, attached ear lobes are caused by the inheritance of two recessive alleles. Free ear lobes are the result of inheriting at least one dominant allele for free ear lobes. The frequency of the recessive allele is 70% (0.7). What would the frequencies of the following be, assuming H-W equilibrium?

Alleles: R \_\_\_\_\_\_\_\_ r \_\_\_\_\_\_\_\_\_\_\_

Genotypes: RR \_\_\_\_\_\_\_ rr \_\_\_\_\_\_\_\_\_\_\_ Rr \_\_\_\_\_\_\_\_\_

How many people in a population of 7000 would carry the allele for free ear lobes? \_\_\_\_\_\_\_\_\_

1. On an isolated Pacific Ocean Island, there exists a recessive allele for psychic ability which enabled the lucky natives to complete witch doctor school. This recessive allele was found in the population of 2000 natives at a frequency of 10%.

a. How many witch doctors are there on the island? \_\_\_\_\_\_\_\_\_\_\_

b. What proportion of the population would be hybrid? \_\_\_\_\_\_\_\_\_\_\_

1. If 18 out of 50 lizards sampled has the recessive phenotype for short tails (tt),

a. What would be the proportion of t alleles in the lizard population? \_\_\_\_\_\_\_\_\_\_\_\_\_

b. What would be the allele frequency for the dominant allele? \_\_\_\_\_\_\_\_\_\_\_\_\_

c. What percent of the population would be heterozygous? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Assume that in sheep, white wool colour is dominant to black wool colour. If 25% of the sheep in a large population have black wool, calculate:

a. the allele frequencies of the two types of wool colour.\_\_\_\_\_\_\_\_\_\_\_\_

b. the expected proportion of homozygous white sheep. \_\_\_\_\_\_\_\_\_\_\_\_

c. the expected proportion of hybrid sheep. \_\_\_\_\_\_\_\_\_\_\_\_

d. the expected number of white sheep in a population of 750? \_\_\_\_\_\_\_\_\_\_\_\_

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."  \_\_\_\_\_ and \_\_\_\_\_
E. The frequencies of the two possible phenotypes if "A" is completely dominant over "a." \_\_\_\_\_

1. 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.
2. The frequency of the recessive allele in the population.   \_\_\_\_\_
3. The frequency of the dominant allele in the population. \_\_\_\_\_
4. The percentage of heterozygous individuals (carriers) in the population. \_\_\_\_\_
5. 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?

**PUBLIC EXAM QUESTIONS**

1. In a population, 9% of individuals are homozygous dominant for tongue rolling. What percentage of individuals are heterozygous for tongue rolling?

(A) 30%

(B) 42%

(C) 70%

(D) 91%

1. In a population of squirrels that is in Hardy-Weinberg equilibrium, 91% are grey and 9% are black. If black colour is a recessive phenotype, what percentage of the population is homozygous dominant for this trait?

(A) 21 %

(B) 42 %

(C) 49 %

(D) 70 %

1. A recessive trait appears in 81% of a population that is in Hardy-Weinberg equilibrium. What percentage of the population in the next generation will be heterozygous?

(A) 1 %

(B) 9 %

(C) 18 %

(D) 81 %

1. The frequency of a recessive allele for a certain trait is 0.20 in a population at Hardy Weinberg equilibrium. What percentage of the individuals in the next generation would be expected to show the dominant trait?

(A) 16

(B) 32

(C) 64

(D) 96

1. If the frequency of a recessive allele in a Hardy-Weinberg population is 0.01, what frequency of the population would you expect to express the recessive trait?

(A) 0.0001

(B) 0.0010

(C) 0.0100

(D) 0.1000

1. A teacher observed that the frequency of students able to roll their tongues has decreased over thirty years. Is this population in Hardy-Weinberg Equilibrium? Give three reasons to support your answer.