ANSWERS TO CALCULATIONS AND ESSAY QUESTION

Suppose you have a population of frogs with 500 individuals. Normally the frogs are a purple color; however, this population is polymorphic for a mutant body color, black, designated by *pp*. Purple is dominant to black and there are no other alleles for color in the population. Assume the population is in Hardy-Weinberg equilibrium, with the frequency of P = 0.3 (purple allele).

1. What are the expected frequencies of the purple and black phenotypes? (4 points)

Dominant allele = 0.3 – P
Recessive allele = 0.7 – p

p2 = PP = 0.09
2pq = Pp = 0.42
q2 = pp = 0.49

PP + Pp = freq of Purple phenotypes = 0.09 + 0.42 = 0.051
Pp = freq of Black phenotypes = 0.49

2. What would be the expected frequencies of the homozygous dominant, heterozygous, and homozygous recessive (in that order) after 500 generations if the population continued to be under the conditions of Hardy-Weinberg? (6 points)

From question above

p^2 = PP = 0.09
2pq = Pp = 0.42
q^2 = pp = 0.49

3. If 500 black individuals migrated into the population, what would be the expected purple and black phenotypic frequencies after 100 more generations if, after the immigration event, Hardy-Weinberg conditions were continually met? (3 points)

0.3 *1000 alleles = 300 P alleles in population
0.7*1000 alleles = 700 p alleles in population
Total = 1000 alleles (500*2)

Add 1000 "p" alleles (500 black individuals – pp immigrate into population)

Then you have 300 P + 1700 p = 2000 total alleles
Allelic frequencies then become:
P = 300/2000 = 0.15 = "p"
p = 1700/2000 = 0.85 = "q"

new genotypic frequencies are
PP = p^2 = 0.0225
Pp = 2pq = 0.255
pp = q^2 = 0.7225

purple phenotypic frequency is 0.0225 + 0.255 = 0.2775
black phenotypic frequency is 0.7225

because HW conditions are maintained after immigration event, these remain in effect after 100 generations.

In a sample of flowers from a forest floor, three genotypes controlled by 2 alleles (A and B) at one locus showed the following numbers in the population; AA = 15, AB = 80, BB = 5.

5. Are these numbers what you would expect if this population was in Hardy-Weinberg equilibrium? (3 points)

100 individuals, 200 alleles in population
Existing genotypic frequencies are:
AA = 15/100 = 0.15
AB = 80/100 = 0.80
BB = 5/100 = 0.05

A = 30+80 = 110/200 = 0.55
B = 80+10 = 90/200 = 0.45

Expected genotypic frequencies are:
AA = p^2 = 30.25
AB = 2pq = 49.5
BB = q^2 = 20.25

These are considerably different than the existing genotypic frequencies and thus the answer is NO.

Multiple Choice
2. There is a gene that causes people to have crumbly earwax. This gene is expressed as a complete dominant over the gooey earwax gene. On Paradise Island there are 100 people, of which 75 have crumbly earwax. Assuming Hardy-Weinberg conditions, what is the frequency of the crumbly earwax allele on Paradise Island?

A. 0.25
B.0.50
C. 0.87
D. 0.75
E. None of the above is correct
F. Not enough information to make a determination

G = crumbly
g = gooey

100 people on Paradise Island
75 are GG or Gg
25 then must be gg
Thus, $q^2 = 0.25$
Thus, q = 0.5
Thus, 1-q = 0.5

Essay:

You needed to provide two well-labeled graphs one which would appear as a normal distribution and other indicating diversifying (disruptive) selection. You could have discussed any number of plausible scenarios, many of which would result in eventual speciation. In your discussion, you had to describe and name diversifying selection (disruptive selection).