EVOLUTION QUESTION - 1989 L. PETERSON/AP BIOLOGY

Do the following with reference to the Hardy-Weinberg model.

A. Indicate the conditions under which allelic frequencies (p and q)remain constant from one generation to the next.

B. Calculate, showing all work, the frequencies of the alleles and the frequencies of the genotypes in a population of 100,000 rabbits,of which 25,000 are white and 75,000 are agouti.(In rabbits the white color is due to a recessive allele, w, and agouti is due to a dominant allele, W.)

C. If the homozygous dominant condition were to become lethal, what would happen to the allelic and genotypic frequencies in the rabbit population after two generations?

STANDARDS: A. CONDITIONS FOR HARDY-WEINBERG:

H-W applies if:

large population size (1 pt) no genetic drift or founder effect

random mating (1 pt) no mating preference or inbreeding

no mutation (1 pt)

no selection (1 pt)

all genotypes have equal chance to reproduce no migration (1 pt) no differential migration;

no gene flow among populations; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**5 pts Max 3**

B. PROBLEM

formula (1 pt) p2 + 2pq + q 2 = 1

relationship to genotypes (1 pt) WW Ww ww or W = p, w = q

definition of all terms of equation

calculation to frequency (1pt) 25,000/100,000 = frequency ww = q2 = 0.25 or 1/4 or 25%

allele frequencies (2 pts) q = .25 = .5 = frequency of w

(1 pt if not explained)

formula (1 pt) since p + q = 1 p= 1-q = .5 p = 1 - qfrequency of W genotype frequencies p2 = (.5)2 = .25 - WW (3 pts) 2pq = 2(.5) (.5) = .5 = Ww q2 = (.5)2 = .25 = frequency of W or W w \_\_\_\_.5\_\_.5\_\_\_ W .5 .25 .25 \_\_\_\_\_\_

genotype frequencies p2 = (.5)2 = .25 - WW

2pq = 2(.5) (.5) = .5 = Ww

q2 = (.5)2 = .25 = ww

or 1 pt for freq with no explanation

**9 pts, max 6**

C. APPLICATIONS (WW genotypes die)

genotype frequency changes (1 pt)

p2 decreases (does not disappear)

or Ww decreases &/or ww increases

or 2 pq decreases &/or q2 increases

or heterozygotes decrease &/or homozygotes increase

allele frequency changes (1 pt)

p decreases (but is not eliminated because of heterozygotes)

q increases

selection (1pt) death of homozygotes due to selection (decreased fitness) Some discussion e.g.

fitness = 0 s = 1

Bonus: A rare student may know that in 2 generations p is halved i.e. p = .25, q = .75 If n = # of generations = 2 pn - po /(1 + npo) = .5/(1+2(.5)-.25 p2 = .06; 2 pq = .38; q2 = .56 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**4 pts Max 2**