

1. A. A wide variety of answers are acceptable here. Some students gave very good answers with genetic drift scenarios (and isolation between Hawthorn flies and apple flies, followed by random fixation of different alleles that affect pupation time). Selection scenarios had to make clear that selection was affecting pupation time AND that pupation time was heritable, so that there is a difference in the genetic composition of the population for genes affecting pupation time between Hawthorn and apple flies.

B. Like A, a wide variety of answers are acceptable. Key is that the scenario makes clear the phenotypic difference in pupation time results directly from a change in the environment (e.g., because larvae mature more slowly on apple because it is a poorer food source) without any change in the genetic composition of the population for genes affecting pupation time.

2. Random mating
No chance events/infinite population size
No new genetic input (no mutation or migration)
No difference in survival or reproduction/ no differences in fitness

3. A. observed genotype frequencies

$$RR = 72/200 = 0.36$$

$$RW = 96/200 = 0.48$$

$$WW = 32/200 = 0.16$$

B. frequency of R allele

$$R = 0.36 + 0.48/2 = 0.6$$

C. expected genotype frequencies

$$\text{freq } W = 0.16 + 0.48/2 = 0.4$$

$$RR = 0.6^2 = 0.36$$

$$RW = 2 \times 0.6 \times 0.4 = 0.48$$

$$WW = 0.4^2 = 0.16$$

D. Yes, the expected and observed genotype frequencies are the same, so they are **consistent** with being in HWE

E. observed phenotype frequencies

$$RR = 0.25$$

$$RW = 0.50$$

$$WW = 0.25$$

$$\text{Freq of } R = 0.25 + 0.5/2 = 0.5$$

$$\text{Freq of } W = 0.25 + 0.5/2 = 0.5$$

expected genotype frequencies

$$RR = 0.5^2 = 0.25$$

$$RW = 2 \times 0.5 \times 0.5 = 0.5$$

$$WW = 0.5^2 = 0.25$$

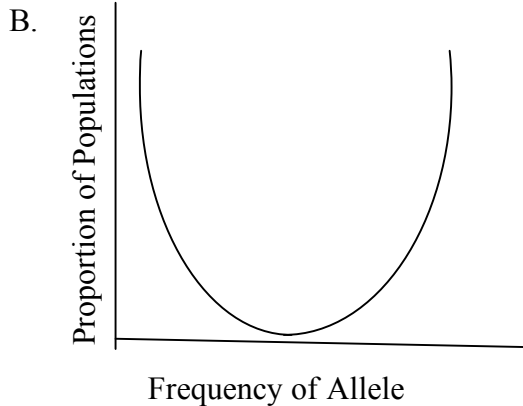
F. NO

(note that YES is essentially never a justified answer to this question)

G. the allele frequencies of R and W changed from 2009 to 2010, and allele frequencies do NOT change under Hardy-Weinberg equilibrium (even between the first and second generations).

4. A. The populations will diverge

$2Nm = 2 \times 100 \times .001 = 0.2$ which is less than 1, so genetic drift, rather than migration, dominates. Because genetic drift dominates, these populations will tend to diverge, leading to what we called a U-shaped distribution.



5. Equal Sex Ratio, Constant population size, No overlap in generations

6. A.	Salwatty	0.05
	Waigiou	0.05
	New Guinea	0.05

B. Salwatty. The rate of change in allele frequencies from generation to generation is:
 $m^*(p_c - p(t))$

Since p_c and $p(t)$ are the same for the two small islands, differences in m determine differences in rate of change. The migration rate to Salwatty is higher, so equilibrium will be achieved there faster.

7. A. genetic drift

B. population 2

C. Smaller populations are more sensitive to genetic drift which leads to larger variations in allele frequency. Population 2 has more variation every generation and its line is more jagged which shows it is a smaller population.

D. Population 2 at generation 0 = 0.5 or ca. 50%

Population 2 at generation 85 = 0.2 (between 0.1 to 0.3 was accepted)

Extra Credit

$$p(t+1) = (1-m)p(t) + mp_c$$

$$p(t+1) = (1-0.1)0.7 + 0.1 \times 0.05 = 0.9 \times 0.7 + 0.005 = 0.63 + 0.005 = 0.635$$

OR

$$p(t+1) = p(t) + m(p_c - p(t))$$

$$p(t+1) = 0.7 + 0.1(0.05 - 0.7) = 0.7 + 0.1 \times -0.65 = 0.7 - 0.065 = 0.635$$