## Single Correct

### Q1. What does $p^2$ represent in the Hardy–Weinberg equation?

A. Heterozygous genotype
B. Homozygous dominant genotype
C. Homozygous recessive genotype
D. Allele frequency

### Q2. Which of the following is a prezygotic barrier?

A. Hybrid sterility
B. Developmental failure
C. Temporal isolation
D. Hybrid breakdown

### Q3. The Modern Synthetic Theory of Evolution combines Darwin's theory with:

A. Newton's laws
B. Inheritance of acquired traits
C. Mendel's genetics and molecular biology
D. Cell theory

### Q4. Which one of the following best explains why adaptive radiation leads to speciation?

A. Mutation rates increase significantly
B. Natural selection acts in the same way across all populations
C. Populations adapt differently to different environments
D. Gene pools become identical across regions

### Q5. The bottleneck effect is an example of:

A. Gene flow
B. Mutation
C. Genetic drift
D. Natural selection

### Q6. The founder effect is:

A. The creation of new alleles in a population
B. Selection of traits that improve survival
C. Genetic variation introduced by new species
D. Change in allele frequency when a small group starts a new population

### Q7. Which situation would likely result in high gene flow?

A. Two populations separated by a mountain
B. A small, isolated island population
C. A species with frequent interbreeding between populations
D. Asexual reproduction

## Multiple Choice

### Q1. Which of the following are assumptions of the Hardy–Weinberg equilibrium?

A. No mutation
B. Large population size
C. No migration
D. Natural selection must be strong

### Q2. Which of the following statements about the Modern Synthetic Theory are correct?

A. It incorporates Mendelian genetics
B. It excludes natural selection
C. It supports the idea of acquired traits
D. It explains evolution through population-level changes

### Q3. Which of the following would disrupt Hardy–Weinberg equilibrium?

A. Random mating
B. Mutation
C. Natural selection
D. No gene flow

### Q4. Examples of adaptive radiation include:

A. Darwin's finches in the Galápagos Islands
B. Australian marsupials
C. Human races developing across continents
D. Peppered moths during industrial revolution

### Q5. Which of the following are true about genetic drift?

A. It is more effective in small populations
B. It is caused by natural selection
C. It can lead to loss of alleles
D. It always increases genetic variation

## Short Answer

## Q1. In a population, the frequency of the recessive allele (a) is 0.3. What is the expected frequency of the heterozygous genotype (Aa) under Hardy–Weinberg equilibrium?

## Solution:

We use the **Hardy–Weinberg equation**:

p2+2pq+q2=1p^2 + 2pq + q^2 = 1p2+2pq+q2=1

Where:

- ppp = frequency of dominant allele (*A*)
- q=0.3q = 0.3q=0.3 (given)
- p=1−q=1−0.3=0.7p = 1 - q = 1 - 0.3 = 0.7p=1−q=1−0.3=0.7

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Now compute the **heterozygous genotype frequency (Aa)**:

2pq=2×0.7×0.3=0.422pq = 2 \times 0.7 \times 0.3 = 0.422pq=2×0.7×0.3=0.42

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## Answer:

The frequency of the heterozygous genotype (*Aa*) is **0.42** or **42%**.

## Q2. Differentiate between genetic drift and gene flow.

## Answer:

| Aspect | Genetic Drift | Gene Flow |
|---|---|---|
| **Definition** | Genetic drift is the random fluctuation of allele frequencies in a population due to chance events. | Gene flow is the transfer of genetic material between separate populations through migration or interbreeding. |

| | | |
|---|---|---|
| **Cause** | Occurs due to random sampling effects, especially in small populations. | Occurs due to movement of individuals or gametes between populations. |
| **Effect on Variation** | Usually reduces genetic variation within populations by randomly fixing or losing alleles. | Increases genetic variation within populations by introducing new alleles. |
| **Population Size Impact** | Stronger effect in small populations; negligible in large populations. | Can affect populations of any size if migration occurs. |
| **Role in Evolution** | Can lead to random evolutionary changes, potentially causing divergence or loss of alleles. | Promotes genetic homogenization between populations, reducing differences. |
| **Example** | Bottleneck effect or founder effect causing allele frequency changes. | Movement of pollen between plant populations or animal migration spreading genes. |