Test Bank for Evolutionary Analysis 5th Edition by Herron and Freeman

Chapter 6 Mendelian Genetics in Populations I: Selection and Mutation

1) A hypothetical population has two alleles for a gene: A and a. In a random sample of 100 individuals, 20 are homozygous for a, 20 are homozygous for A, and 60 are heterozygous. What is the frequency of A?

1. A) 20%
2. B) 25%
3. C) 50%
4. D) 60%
5. E) 80%

Answer: C

Section: 6.1

Skill: Application/Analysis

2) In the mating of an Aa female and an Aa male, the genotypic outcome predicted by a Punnett square is _____.

1. A) three-quarters Aa and one-quarter AA
2. B) one-half AA and one-half aa
3. C) three-quarters Aa and one-quarter aa
4. D) one-quarter AA, one-quarter aa, and one-half Aa
5. E) All offspring will have the genotype Aa

Answer: D

Section: 6.1
Skill: Application/Analysis

3) The probability that two mutually exclusive events will occur is calculated by _____.

1. A) multiplying the probability of each individual event
2. B) adding the probability of each individual event

3. C) adding the probability of each individual event and subtracting 1
4. D) adding the probability of each individual event and multiplying by 2

Answer: B

Section: 6.1

Skill: Knowledge/Comprehension

4) If a population is in Hardy-Weinberg equilibrium, which of the following statements is correct?

1. A) Each allele will be present at a 50% frequency.
2. B) Allele frequencies can vary from generation to generation, but the average frequency must remain constant.
3. C) The size of the population must remain constant from generation to generation.
4. D) Allele frequencies must remain the same from generation to generation.
5. E) The rate of change of allele frequencies must be greater than 1 percent from generation to generation.

Answer: D

Section: 6.1

Skill: Application/Analysis

5) The null hypothesis, which demonstrates that evolution is not occurring from generation to generation, is known as the _____ model.
1. A) Bateman
2. B) Hardy-Weinberg
3. C) Fisher stability
4. D) Mendelian stability

Answer: B

Section: 6.1

Skill: Knowledge/Comprehension

6) In large populations, the Hardy-Weinberg equilibrium principle can be used to determine whether evolution is occurring. For instances where allelic frequencies are indicated by p and q, the resultant genotype frequencies are indicated by which of the following equations?

1. A) $p^2 + q^2$
2. B) $p^2 + pq + q^2$
3. C) $p^2 + 2pq + q^2$
4. D) $p^2 + (pq)^2 + q^2$

Answer: C

Section: 6.1

Skill: Knowledge/Comprehension

7) Cavener and Clegg (1981) demonstrated natural selection by observing the cumulative change in allele frequencies in populations of *Drosophila melanogaster* that were subjected to high levels of _____.

1. A) mercury
2. B) carbon dioxide
3. C) alcohol
4. D) sugar
5. E) nitrous oxide

Answer: C

Section: 6.2

8) If there were a high allele frequency for the CCR5-32 coreceptor, and the rate of infection with HIV was high as well, one would expect the frequency of the CCR5-32 coreceptor allele to _____.

1. A) remain the same due to the lethality of AIDS
2. B) remain the same due to the population maintaining Hardy-Weinberg equilibrium
3. C) fall quickly due to heterozygote selection
4. D) rise quickly and confer resistance on a large part of the population

Answer: D

Section: 6.2

Skill: Application/Analysis

9) In experiments with laboratory populations of *Drosophila melanogaster,* Mukai and Burdick (1959) observed that a lethal allele maintained a higher than expected frequency. The explanation for this observation is that, at equilibrium, the selective advantage of the lethal allele when it occurs in heterozygotes balances the disadvantage of the allele in homozygotes, and is termed _____.

1. A) equilibrium distribution
2. B) underdominance
3. C) allelic frequency dependence
4. D) overdominance
5. E) terminal dominance

Answer: D

Section: 6.3

Skill: Knowledge/Comprehension

10) In the study of Gigord and colleagues using Elderflower orchids, the allele frequencies of yellow and purple flowers varied such that when the yellow allele started to become rare, the reproductive success of purple flowers decreased and the reproductive success of yellow-flowered individuals increased in a process known as _____.

1. A) overdominance
2. B) frequency-dependent selection
3. C) underdominance
4. D) Hardy-Weinberg stabilization
5. E) frequency depression

Answer: B

Section: 6.3

11) The point at which the rate that a deleterious allele is being eliminated from a population by natural selection is in equilibrium with the rate at which the deleterious allele is being replaced by a new mutation is termed _____.

1. A) mutation-dependent selection
2. B) frequency-dependent selection
3. C) mutation-dependent equilibrium
4. D) mutation-selection balance

Answer: D

Section: 6.4

Skill: Knowledge/Comprehension

12) Cystic fibrosis is one of the most common genetic diseases among individuals of European ancestry, and affects one newborn in approximately how many?

1. A) 10
2. B) 100
4. D) 2,500
5. E) 10,000

Answer: D

Section: 6.4

Skill: Knowledge/Comprehension

13) Cystic fibrosis is caused by a recessive loss-of-function mutation that encodes a protein called the _____.

1. A) cystic fibrosis transmembrane ion channel
2. B) chloride ion transmembrane conductance regulator

3. C) cystic fibrosis transmembrane conductance regulator
4. D) cystic fibrosis ion channel regulator

Answer: C

Section: 6.4

Skill: Application/Analysis

14)   An analysis showing the heterozygote superiority
CFTR demonstrates increased resistance to infections with the bacteria that cause _____.

1. A) pneumonia
2. B) typhoid fever
3. C) scarlet fever
4. D) bubonic plague
5. E) tuberculosis

Answer: B

Section: 6.4

Skill: Knowledge/Comprehension
15) Chun-Hong Chen and colleagues (2007) designed a new gene that would carry a strong selective advantage and confer the resistance to malaria on free-living mosquitoes. The gene was termed *Medea*, and this acronym stands for which of the following?

1. A) Maternal-effect depleted embryonic activation
2. B) Maternal-effect dominant embryonic activation
3. C) Maternal-effect deleterious embryonic arrest
4. D) Maternal-effect dominant embryonic arrest

Answer: D

Section: 6.5

Skill: Knowledge/Comprehension

16) A group of interbreeding individuals and their offspring is known as a(n) _____.

Answer: population

Section: 6.1

Skill: Knowledge/Comprehension

17) The Hardy-Weinberg equilibrium principle is known as the null hypothesis. List the five assumptions that are required for a population to be in Hardy-Weinberg equilibrium.

Answer: no selection, no mutation, no chance events, no migration, and mating occurs randomly

Section: 6.1

Skill: Knowledge/Comprehension

18) In biallelic populations, where allelic frequencies are indicated by p and q, the resultant genotype frequencies are indicated by what algebraic formula?

Answer: $p^2 + 2pq + q^2$

Section: 6.1

Skill: Knowledge/Comprehension

19) The Hardy-Weinberg equilibrium principle is often referred to as the _____, [two words] which indicates that if a population is in Hardy-Weinberg equilibrium, that population is not evolving.

Answer: null model

Section: 6.1

Skill: Knowledge/Comprehension

20) The statistical test used to determine whether the quantitative allele frequency results of an experiment fall within reasonable limits, or whether the null hypothesis is violated and the measured outcomes are significantly different than those expected is called the _____. [three words]

Answer: chi-square test (χ^2)

Section: 6.2

Skill: Knowledge/Comprehension, Application/Analysis

21) Two processes that can maintain rare or deleterious alleles in populations are _____ [four words] and _____. [two words]

Answer: negative frequency-dependent selection; heterozygote superiority

Section: 6.3

Skill: Application/Analysis
22) Although selection tends to eliminate deleterious alleles from populations, these mutations often persist because they are frequently created again. The rate at which deleterious alleles are being eliminated by selection is exactly equal to the rate at which new copies are being created by creation is termed _____. [three words]

Answer: mutation-selection balance

Section: 6.4

Skill: Knowledge/Comprehension

23) Cystic fibrosis in humans is caused by a recessive loss-of-function mutation in a locus on chromosome 7 that encodes for a protein called _____. [five words]

Answer: cystic fibrosis transmembrane conductance regulator (CFTR)

24) Chun-Hong Chen and colleagues (2007) designed a new gene that would carry a strong selective advantage and confer the resistance to malaria on free-living mosquitoes. What was the acronym given this gene, and what does the acronym stand for?

Answer: The gene was termed *Medea*, and this acronym stands for maternal-effect dominant embryonic arrest.

Section: 6.5

Skill: Knowledge/Comprehension

25) Explain the consequence of overdominance in maintaining a deleterious allele in a population as it relates to genetic diversity.
Answer: Overdominance, or heterozygote superiority, helps prevent potentially deleterious alleles from being lost in a population. Because the selective advantage of the deleterious allele in heterozygotes is balanced by the disadvantage of maintaining the allele in the homozygous state, allelic diversity within the population is maintained. This diversity enables more favorable responses to changing selective pressures of the environment.

Section: 6.3

Skill: Application/Analysis

26) Briefly describe the structure of compound chromosomes, and explain how their behavior during meiosis can be used to study underdominance.

Answer: Compound chromosomes are homologous chromosomes that have exchanged entire arms; one homolog therefore contains two copies of one arm, whereas the other homolog contains two copies of the other arm. During meiosis, four types of gametes are produced in equal numbers; gametes with both homologous chromosomes, gametes with just one member of the pair, gametes with the other member of the pair, or gametes containing no members of the homologous pair. Heterozygotes produced are therefore not viable, so the resultant populations consist of only homozygotes.

Section: 6.3

Skill: Application/Analysis

27) List the five assumptions made by the Hardy-Weinberg equilibrium principle that are necessary to illustrate that evolution is NOT occurring from generation to generation, and provide a one- or two- sentence explanation of the importance of each assumption.

Section: 6.1

Skill: Knowledge/Comprehension

28) Discuss the experiments Cavener and Clegg (1981) performed in order to demonstrate that natural selection occurred by observing the cumulative change in allele frequencies in populations of *Drosophila melanogaster* that were subjected to high levels of alcohol. Be sure to discuss the methodology employed, and the significance of the *AdhS* and *AdhF* alleles in reproductive success.

Section: 6.2

Skill: Synthesis/Evaluation

29) Explain the significance of the experiments of Mukai and Burdick (1959) with laboratory populations of *Drosophila melanogaster* using the *V* (viable) and *L* (lethal) alleles. Be sure to explain their observation that a lethal allele was maintained at a higher than expected frequency, and the evolutionary significance of overdominance in these populations.

Section: 6.3

Skill: Synthesis/Evaluation