

**MULTIPLE-CHOICE QUESTIONS****Questions 1–5**

Questions 1–5 refer to the fields of study listed below. Choose the one that has provided each of the following pieces of evidence that biological evolution has occurred.

- (A) Comparative biochemistry
- (B) Comparative anatomy
- (C) Comparative embryology
- (D) Geographic distribution

1. Giraffes have the same number of vertebrae in the neck as do humans.
2. Kangaroos are found only in Australia.
3. Human embryos have tails.
4. Humans and sea stars both have radial cleavage in early embryonic development.
5. Humans can be made temporarily immune to various human diseases by receiving antibodies against those diseases from horses.

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6. The condition in which there are barriers to successful interbreeding between individuals of different species in the same community is referred to as

- (A) sexual dependency
- (B) reproductive isolation
- (C) geographic isolation
- (D) adaptive radiation

7. The wing of the bat and a human's arm have different functions and appear very different. Yet, the underlying anatomy is basically the same. Therefore, these structures are examples of

- (A) geographic isolation
- (B) analogous structures
- (C) homology
- (D) reproductive isolation

8. In a population that is in Hardy-Weinberg equilibrium, the frequency of a particular recessive allele  $a$  is 0.4. What is the percentage of the population heterozygous for this allele?

- (A) 4%
- (B) 16%
- (C) 32%
- (D) 48%

9. According to the Hardy-Weinberg equation, the dominant trait is represented by

- (A)  $p$
- (B)  $q$
- (C)  $q^2$
- (D)  $p^2$

**Questions 10-13**

**Matching Column**

- (A) Stabilizing selection
- (B) Disruptive selection
- (C) Directional selection
- (D) Sexual selection

10. The population of peppered moths in England changed from white to black in fifty years.

11. Human newborns usually weigh between 6-8 pounds (2.7-3.6 kg).

12. In one region of New Jersey there exist two distinct types of one species of snake.

13. Large horns and giant antlers are characteristic of the male.

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14. Miller's classic experiment demonstrated that a discharge of sparks through a mixture of gases could result in the formation of a large variety of organic compounds. Miller used all of the following gases in his experiment EXCEPT

- (A) methane
- (B) ammonia
- (C) water
- (D) oxygen

15. Which is an example of a cline?

- (A) Males of a species have long antlers to fight other males of that species.
- (B) In many species of birds, males have bright plumage to attract the female.
- (C) In one species of rabbit, the ones that evolved in the cold, snowy north are white, while the ones that evolved in the south are brown.
- (D) The hybrid tomato plant is stronger and produces better fruit than the pure genotype.

16. Who synthesized proteinoid microspheres in the laboratory using an apparatus that mimicked the early earth?

- (A) Haldane
- (B) Fox
- (C) Urey
- (D) Miller

17. The differences in sparrow songs among sympatric species of sparrows are examples of
- (A) geographic isolation
  - (B) convergent evolution
  - (C) behavioral isolation
  - (D) physiological isolation
18. Which part of the theory of evolution did Darwin develop after reading Thomas Malthus?
- (A) Evolution occurs as advantageous traits accumulate in a population.
  - (B) In any population, there is variation and an unequal ability of individuals to survive and reproduce.
  - (C) Only the best-fit individuals survive and get to pass on their traits to offspring.
  - (D) Populations tend to grow exponentially, overpopulate, and exceed their resources.
19. In a population of 1,000 people, 90 have blue eyes. What percent of the population has hybrid brown eyes?
- (A) 3%
  - (B) 9%
  - (C) 21%
  - (D) 42%
20. The average length of a rabbit's ears decreases the farther north the rabbits live. This variation is an example of a
- (A) genetic drift
  - (B) a cline
  - (C) geographic isolation
  - (D) founder effect

**Questions 21–24**

**Matching Column**

- (A) Founder effect
  - (B) Parallel evolution
  - (C) Adaptive radiation
  - (D) Convergent evolution
21. Darwin's finches
22. The establishment of a genetically unique population through genetic drift
23. The independent development of similarities between unrelated groups resulting from adaptation to similar environments
24. The Tasmanian wolf in Australia is a marsupial but looks very similar to the gray wolf, a placental mammal of North America

## Answers to Multiple-Choice Questions

1. **(B)**
2. **(D)**
3. **(C)**
4. **(C)**
5. **(A)**
6. **(B)** Any barrier that isolates organisms fosters evolution. Barriers to interbreeding are caused by reproductive isolation. Geographic isolation refers to organisms being isolated by geography, such as mountains or rivers. Balanced polymorphism refers to two different versions of the same species living in one area, such as a speckled snail and a plain snail. Both are camouflaged in different environments. Sexual dependency is not related to the topic in any way.
7. **(C)** Homologous structures demonstrate a common ancestry. They may not look alike, but they have an underlying common structure. Analogous structures may have the same function and look alike, but they do not have a common structure, nor do they have a common ancestry.
8. **(D)** The question provides you with the frequency of the allele. It provides you with  $q$ . Since the frequency of the recessive allele is 0.4, the frequency of the dominant allele is 0.6. The formula for the hybrid =  $2pq$ . Therefore, substituting,  $2 \times 0.4 \times 0.6 = 48\%$ .
9. **(A)** According to Hardy-Weinberg equilibrium,  $p$  is the dominant allele and  $q$  is the recessive allele.
10. **(C)** The black peppered moths replaced the white peppered moths. Since one characteristic replaced another, this is directional selection.
11. **(A)** Stabilizing selection tends to eliminate the extremes in a population.
12. **(B)** Disruptive selection tends to select for the extremes. Originally, there was probably a range of coloration of snakes in the area in question. Over time, pressure from the environment selected against different colorations until only two remained.
13. **(D)** Sexual selection has to do with the selection for traits that attract a mate.
14. **(D)** Free oxygen was not available in the early earth's atmosphere. Scientists believe that since oxygen is very reactive, had it been present in the ancient atmosphere, it would have reacted with and degraded all the other chemicals in the atmosphere. The consequence would be that evolution of the early earth would not have occurred as it did.
15. **(C)** A cline is a change in some trait along some geographic axis, such as a north-south cline. In this example, the animal is camouflaged by its colorings.
16. **(B)** Sidney Fox was able to produce these cell-like structures, which he called proteinoid microspheres, when he began with amino acids in his experiment.
17. **(C)** A bird's song is a behavior; therefore, this is an example of behavioral isolation.

18. **(D)** Malthus was a mathematician studying populations. He stated that populations tend to overpopulation and exceed their resources. This leads to starvation, disease, and death.
19. **(D)** Of the total population, 9% have blue eyes (90 out of 1000), so  $q^2 = 0.09$  and  $q = 0.3$ . Therefore,  $p = 0.7$  and the frequency of hybrid brown =  $2pq = 42\%$ .
20. **(B)** The rabbit's ears get shorter and grow closer to the head to retain heat. This is an example of a north-south cline.
21. **(C)** Adaptive radiation is the emergence of numerous species from one common ancestor introduced into a new environment. Today, 13 different species of finches are on the Galapagos Islands where originally there was only 1 species. Each species fills a different niche.
22. **(A)** Genetic drift is evolution through chance. The founder effect is one example of genetic drift. Another is the bottleneck effect.
23. **(D)** The classic example of this can be seen in the whale and the shark. The two animals are unrelated; the whale is a mammal and the shark is a fish. However, they look alike because they experience the same environmental pressures. They both have a streamlined appearance with fins because that design is best for living in the ocean, not because they are related or have a recent common ancestor.
24. **(B)** Eutherians (placental mammals) and marsupials are closely related although they diverged several million years ago. Although they live thousands of miles apart, these two animals live in similar environments and are under the same selective pressures from their respective environments. As a result, they have evolved along similar parallel lines.

### FREE-RESPONSE QUESTIONS

**Directions:** Answer all questions. You must answer the question in essay—not outline—form. You may use labeled diagrams to supplement your essay, but diagrams alone are *not* sufficient. Before you start to write, read each question carefully so that you understand what the question is asking.

1. Explain Charles Darwin's theory of evolution by natural selection.
2. Each of the following refers to one aspect of evolution. Explain each in terms of natural selection.
  - a. Convergent evolution and the similarities among species in a particular biome.
  - b. Insecticide resistance
  - c. Speciation and isolation
  - d. Heterozygote advantage