

**Multiple Choice Questions (worth 2 points each)**

1. Which are actual evidence supporting the endosymbiotic theory for the origin of eukaryotes?
  - A) fossil evidence suggest early eukaryotes ate proteobacteria
  - B) free-living mitochondria still exist in some environments
  - C) mitochondria and chloroplasts have their own DNA
  - D) all of the above are true
  - E) none of the above are true
2. Which is true about the Miller-Urey experiment?
  - A. Miller and Urey were almost certainly correct about the mixture of gasses present on the early Earth.
  - B. it resulted in the formation of simple amino acids and proteins
  - C. it was the first time living things were produced in a test tube
  - D. A and B are true.
  - E. All of the above are true.
3. Which of the following designs would be the best nature reserve or set of reserves from the point of view of minimizing local extinctions and maximizing species diversity. Assume that each reserve or set of reserves has the same types and amounts of habitats present and draw from the same species pools.
  - A. 1000 small reserves that are each 1 km<sup>2</sup> in area and round in shape
  - B. 1000 small reserves that are each 1 km<sup>2</sup> in area and rectangular in shape
  - C. One single large reserve that is 1000 km<sup>2</sup> in area and round in shape
  - D. One single large reserve that is 1000 km long and 1 km wide
4. Why do scientists think RNA, rather than DNA, may have been the original genetic material?
  - A) Most organisms on Earth use RNA as their genetic material
  - B) The simplest life forms, viruses, use RNA
  - C) RNA is more stable than DNA
  - D) RNA has the ability to catalyze a few simple, chemical reactions
  - E) A and D are correct

**Questions 5-7 refer to the following list of mass-extinction events.**

- A) The Current mass extinction
- B) The Oxygen Crisis
- C) The Permian-Triassic mass extinction
- D) The Cretaceous-Tertiary mass extinction
- E) More than one of the above

5. Which mass extinction(s) happened early in the proterozoic eon?
6. Which extinction was responsible for the extinction of more than 90% of species at the end of the paleozoic era?
7. The destruction of habitats by agriculture and human engineering is relevant to which mass extinction?

For questions 8-11, match the description of the event with one of the following types of mutation.

- A) substitution
- B) insertion
- C) deletion
- D) duplication
- E) transposition

8. An A-T base pair is spontaneously replaced with a G-C base pair
9. A retrovirus incorporates itself into the host's genome, adding a 1,400 base pair sequence to the G6PDH gene of the target tissue.
10. Because of an error in DNA replication, a worm produces gametes that have two copies of the hemocyanin gene rather than one.

Questions 11-15 apply to the following mechanisms of evolution. Select the one which is the best answer.

- A. Selection
- B. Allele Flow
- C. Mutation
- D. Nonrandom Mating
- E. Genetic drift

11. Which mechanism is responsible for the origin of new alleles?

12. Which is the only mechanism capable of producing adaptation?
13. Inbreeding is an example of which mechanism?
14. Which mechanism results from the stochastic process of sampling error in small populations
15. Which mechanism cannot cause allele frequency change in a panmictic species?

Questions 16-21 refer to the following scenario. A species of seagulls exists as a large number of different populations on separate islands of the Azores archipelago. Each population contains 100 individuals.

Every generation, 5 individuals from each population disperse to other islands in the archipelago. In the following months, 5 seagulls migrate into each population from other islands in the archipelago.

16. Which of the following is true?
  - A) Allele flow is sufficient to negate the effects of genetic drift in this species.
  - B) Allele flow is insufficient to negate the effects of genetic drift in this species.
  - C) Genetic drift could lead to the extinction of some island populations due to the fixation of deleterious alleles.
  - D) This species is panmictic, therefore allele flow can have no effect.
  - E) A and B are true

In the population above, the melanic, black-colored seagull, is due to a dominant allele. Mm and MM individuals are black, and mm individuals are white.

In each population, 81 individuals are white-colored, with 19 black-colored individuals.

17. Assuming Hardy-Weinberg equilibrium, what is the approximate frequency of the melanic (M) allele in each population?
  - A) .81
  - B) .19
  - C) .90
  - D) .10
  - E) .044

Questions 18-19. During a storm, two males and two females are blown 300 miles due West, to an isolated island uninhabited by seagulls (Survivor Island). They reproduce and found a new population. They cannot disperse back to the original habitat, nor can any new seagulls cross to the new island.

By chance, all four original colonists were white-colored gulls.

18. What is the new frequency of the recessive (m) allele?  
A) 1.0 B) .19 C) 0.0 D) .81 E) can't tell from this data
19. The difference in color between the new population and the old populations is due to which evolutionary phenomenon?  
A) Stabilizing selection  
B) Mutation  
C) Founder Effect  
D) Allopatric speciation  
E) None of the Above

Questions 20-21. Over the course of the next 200 years, these Survivor Island gulls evolved mating displays that differ from those of the parent population.

When television producers introduce the original Azores archipelago gulls to the island, the two kinds of gulls find each other's mating behavior objectionable, and do not interbreed.

20. What type of isolation mechanism keeps the two species of gulls from interbreeding?  
A) Mechanical Isolation  
B) Temporal Isolation  
C) Ecological Isolation  
D) Behavioral Isolation  
E) None of the above
21. In the seagull problem above. What type of evolutionary event has occurred?  
A) allopatric speciation  
B) cladogenesis  
C) sympatric speciation  
D) artificial selection  
E) A and B

22. Humans exhibit which of the following with respect to height?
- A) positive assortative mating
  - B) disruptive selection
  - C) negative assortative mating
  - D) none of the above
  - E) A and B are true
23. The original evidence for evolution included which of the following?
- A) embryology
  - B) the fossil record
  - C) biogeography
  - D) homologous structures
  - E) all of the above

For Questions 24-26, match the name of the scientist or philosopher with their contribution to the theory of Evolution.

- A) Plato
- B) Carolus Linneus
- C) Thomas Malthus
- D) Charles Lyell
- E) Georges Cuvier

24. Which scientist developed the idea that the geological processes in operation now are the same processes that occurred long ago?
25. Which scientist advanced the notion that each animal and plant contained a perfect “essence” that is unchangeable?
26. Which scientist proposed the theory of catastrophism?

For Questions 27-30 match the scientific contribution to the scientist or philosopher that most applies.

- A) Developed a theory of Evolution by Natural Selection
- B) Developed a theory of Evolution based on the inheritance of acquired characteristics.
- C) Originated the now-discredited notion that all organisms can be ranked on a *scala naturae*, a great chain of being.
- D) Is known for his experiments on *Drosophila*, demonstrating the role of mutation in evolution
- E) Is known for describing the pattern of punctuated equilibrium in the fossil record.

27. Alfred Russell Wallace

28. Charles Darwin

29. Georges Cuvier

30. Jean Lamark

31. Which of the following is true about inbreeding?

- A) It leads to the gradual loss of the homozygous genotype
- B) It leads to the gradual loss of the heterozygous genotype
- C) Species that inbreed regularly, such as parasitic wasps, do not suffer inbreeding depression.
- D) It leads to inbreeding depression in mammals, resulting from the loss of the homozygous genotype(s).
- E) B and C are true

32. Which is FALSE about conditions on the Earth 3.8 billion years ago.

- A) The atmosphere contained more CO<sup>2</sup> than is present today
- B) The atmosphere contained more O<sup>2</sup> than is present today
- C) Impacts with asteroids and comets were more common than today
- D) Biochemical evidence suggests there may have been life.
- E) All of the above are false.

33. Which of the following are characteristics possessed by vertebrates at some point in their life cycle

- A) A dorsal, hollow, nerve chord
- B) Pharyngeal gill slits
- C) Neural crest tissue
- D) A postanal tail
- E) All of the above

Questions 34-37. Match each scenario with the pattern of selection that fits best.

- A. Directional Selection
- B. Stabilizing Selection
- C. Disruptive Selection
- D. Kin Selection
- E. Frequency-Dependent Selection

34. A population of Madagascar hissing cockroaches lives in a woodpile. It suffers heavy predation from lizards. Because their heads are small, the lizards are unable to eat the very largest adult cockroaches, and instead prey upon small and medium sized adults. What type of selection do the lizards impose on the roaches?
35. Tropical paper wasps *Polybia sp.* nests are composed of thousands of sisters. When the old queen dies, they fight to be queen. Those that lose the contest stay with the nest to help the queen raise many more offspring than she would be able to raise herself.
36. Indian paintbrush flowers vary greatly in color. Bumblebees form a search image for the most common color, and preferentially pollinate those flowers.
37. For birds and parasitoids, females that lay close to the Lack optimum number of eggs have the most surviving offspring. Those that lay fewer or more eggs have lower relative fitness.
38. Which of the following is true about mass extinctions?
- A) One of the earliest mass extinctions may have been caused by oxygen in the atmosphere
  - B) Humans are currently causing a mass extinction
  - C) Generally, mass extinctions weed out the unfit species
  - D) A and B are true
  - E) None of the above are true

Questions 39-42 apply to the following scenarios

**Scenario 1:** Two species of tree crickets live in a Costa Rican dry forest. Their habitats and ranges overlap. The two species never interbreed because the calls of the males are different and do not attract females of the other species.

**Scenario 2:** A species of wren arrives on a chain of volcanic islands off the coast of New Zealand that previously had no wrens. After several thousand years, wrens from these islands are able to interbreed with occasional migrants from the mainland, but the resulting offspring are poorly adapted to compete with the local wrens and produce no offspring.

**Scenario 3:** Syrphid flies have black and yellow markings nearly identical to those of yellowjacket wasps, yet the flies cannot sting or bite. Avian predators generally avoid both types of insects.

**Scenario 4:** Sickle cell anemia is a genetic disease in humans. Individuals homozygous for the sickle cell allele ( $Hb^sHb^s$ ) generally do not survive to adulthood. In areas where malaria is present, individuals heterozygous for the sickle cell ( $Hb^+Hb^s$ ) allele have higher fitness than individuals with normal hemoglobin ( $Hb^+Hb^+$ ).

39. Which is an example of Batesian mimicry?

- A) scenario 1                      B) scenario 2                      C) scenario 3  
D) scenarios 1 and 3                      E) none of the above

40. Which is an example of a behavioral isolation mechanism?

- A) scenario 1                      B) scenario 2                      C) scenario 3  
D) scenario 4                      E) none of the above

41. Which is an example of a postzygotic isolation mechanism?

- A) scenario 1                      B) scenario 2                      C) scenario 3  
D) scenario 4                      E) none of the above

42. Which is an example of balancing selection?

- A) scenario 1                      B) scenario 2                      C) scenario 3  
D) scenario 4                      E) none of the above

Questions 43-46 apply to the following scenario.

A species of snake has two forms, brown and green. They are determined by a single locus with two alleles, such that

**GG**= brown **Gg**=brown **gg**=green

The brown form, being cryptic, has a 90% chance of surviving to adulthood

The green form has a 60% chance of surviving to adulthood.

If the brown form lives to adulthood, it produces an average of 20 offspring.

The green form is less fecund, surviving adults produce an average of 15 offspring.

Initially, the population is in Hardy-Weinberg Equilibrium, and 90 out of 1000 individuals in the population are green.

43. What is the absolute fitness of the (gg) genotype?

- A) .09
- B) .50
- C) 18 offspring
- D) 1.0
- E) 9 offspring

44. What is the relative fitness of the (gg) genotype?

- A) .09
- B) .50
- C) 18 offspring
- D) 1.0
- E) 9 offspring

45. What is the selection differential against the (gg) genotype?

- A) .09
- B) .50
- C) -9 offspring
- D) -30% chance of survivorship
- E) -5 offspring

46. What would be the frequency of the (G) allele after one round of selection?
- A) .033
  - B) .733
  - C) .700
  - D) .300
  - E) .667
47. The mutation rate from a normal allele to one causing a lethal, recessive genetic disease is  $1 \times 10^{-8}$ . Under mutation-selection balance what is the equilibrium frequency of this allele?
- A) .09
  - B)  $1 \times 10^{-16}$
  - C)  $1 \times 10^{-4}$
  - D) 1.0
  - E) 0.0
48. The Cambrian explosion was...
- A) The exothermic reaction that precipitated the oxygen in the ocean
  - B) The impact that is thought to have given rise to the moon
  - C) The origin of eukaryotes from a prokaryote ancestor
  - D) The evolution and diversification of animal body plans that occurred approximately 540 million years ago
  - F) none of the above
49. Which of the following is true of homologous structures?
- A) They are characteristics present in two species that were not present in their common ancestor
  - B) They are characteristics present in two species that were present in a common ancestor
  - C) They are important in the process of kurtosis.
  - D) They generally result from convergent evolution
  - E) B and C are true
50. Which of the following is true of cladogenesis?
- A) It is ultimately responsible for the origin of every group of organisms
  - B) It results from the gradual change of a single lineage over time
  - C) It is a more subjective phenomenon than anagenesis
  - D) A and B are true
  - E) all of the above are true.