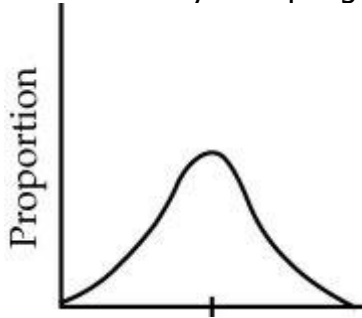


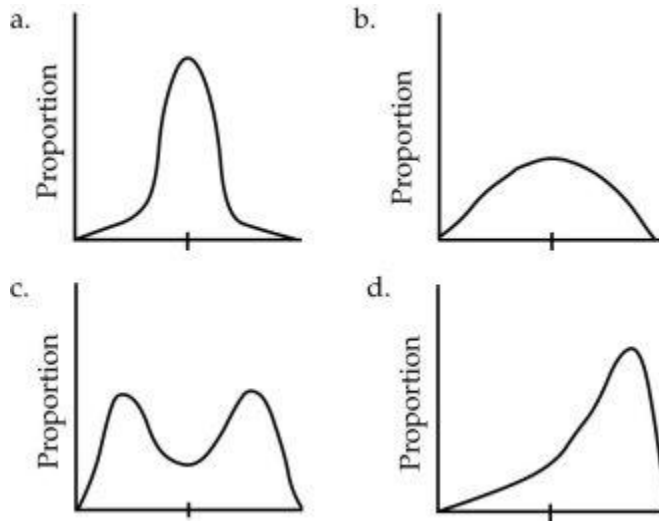
## AP Biology TEST #5 – EVOLUTION REVIEW SHEET

1. For terrestrial animals and plants, the most recent mass extinction event that occurred prior to the evolution of humans took place approximately \_\_\_\_\_ million years ago.
  - A) 10
  - B) 65
  - C) 220
  - D) 400
2. One of the main factors that distinguishes the Cambrian explosion from all others is that
  - A) evolutionarily, it was the most recent explosion.
  - B) many new major groups of animals appeared at this time, but not during other explosions.
  - C) it was the time when the dinosaurs became extinct.
  - D) there was a dramatic drop in species diversity, especially among marine organisms.
3. The sudden disappearance of the dinosaurs some 65 mya may have been the result of
  - A) Earth's collision with a large meteorite.
  - B) slow climate changes due to planetary cooling.
  - C) competition from better-adapted organisms.
  - D) the rise of birds and mammals.
4. Which of the following statements about evolution is not true?
  - A) Some species living in stable environments appear to have changed very little over many millions of years.
  - B) Species have become extinct throughout the history of life.
  - C) The fossil record of trilobites provides a good example of gradual evolutionary change within a lineage of organisms.
  - D) There is no evidence in the fossil record for periods of rapid evolutionary change.
5. Evolution occurs at the level of
  - A) the individual genotype.
  - B) the individual phenotype.
  - C) environmentally based phenotypic variation.
  - D) the population.
6. What does natural selection act on?
  - A) The gene pool of the species
  - B) The genotype
  - C) The phenotype
  - D) Multiple gene inheritance systems

7. The following graph shows the range of variation among population members for a trait determined by multiple genes.



If this population is subject to *stabilizing selection* for several generations, which of the distributions (a–d) is most likely to result?



8. Which of the following about Mendelian populations that is not true? A Mendelian population must
- A) consist of members of the same species.
  - B) have members that are capable of interbreeding.
  - C) show genetic variation.
  - D) have a gene pool.
9. In comparing several populations of the same species, the population with the greatest genetic variation would have the
- A) greatest number of genes.
  - B) greatest number of alleles per gene.
  - C) greatest number of population members.
  - D) largest gene pool.

10. The ability to taste the chemical PTC (phenylthio carbamide) is determined in humans by a dominant allele T, with tasters having the genotypes Tt or TT and nontasters having tt. If you discover that 36 percent of the members of a population cannot taste PTC, then according to the Hardy–Weinberg rule, the frequency of the T allele should be
- A) 0.4.
  - B) 0.6.
  - C) 0.64.
  - D) 0.8.
11. A gene in humans has two alleles, M and N, that code for different surface proteins on red blood cells. If you know that the frequency of allele M is 0.2, according to the Hardy–Weinberg rule, the frequency of the genotype MN in the population should be
- A) 0.16.
  - B) 0.32.
  - C) 0.64.
  - D) 0.8.
12. Random genetic drift would probably have its greatest effect on which of the following populations?
- A) A small, isolated population
  - B) A large population in which mating is nonrandom
  - C) A large population in which mating is random
  - D) A large population with regular immigration from a neighboring population
13. Allele frequencies for a gene locus are least likely to be significantly changed by
- A) self-fertilization.
  - B) the founder effect.
  - C) mutation.
  - D) gene flow.
14. Suppose a particular species of flowering plant that lives only one year can produce red, white, or pink blossoms, depending on its genotype. Biologists studying a population of this species count 300 red-flowering, 500 white-flowering, and 800 pink-flowering plants in a population. When the population is censused the following year, 600 red-flowering, 900 white-flowering, and 1,000 pink-flowering plants are observed. Which color has the highest fitness?
- A) Red
  - B) White
  - C) Pink
  - D) All of the above

15. In areas of Africa in which malaria is prevalent, many human populations exist in which the allele that produces sickle-cell disease and the allele for normal red blood cells occur at constant frequencies, despite the fact that sickle-cell disease frequently causes death at an early age. This is an example of
- A) the founder effect.
  - B) a stable polymorphism.
  - C) mutation.
  - D) nonrandom mating.
16. Genetic variation in a population may be maintained by
- A) frequency-dependent selection.
  - B) the accumulation of neutral alleles.
  - C) sexual recombination.
  - D) All of the above
17. Which of the following can act as a constraint on the evolutionary process?
- A) There is a trade-off between the cost and benefit of an adaptation
  - B) The occurrence of rare catastrophic events, such as meteorite impacts, can disrupt evolutionary patterns
  - C) All evolutionary innovations are modifications of previously existing structures
  - D) All of the above
18. Select all the correct answers that complete the following sentence: It is difficult to apply the biological species concept to groups of organisms that
- A) are asexual.
  - B) produce hybrids only in captivity.
  - C) show little morphological diversity.
  - D) exist only in the fossil record.
19. Which of the following statements about allopatric speciation is not true?
- A) Allopatric speciation can sometimes involve small populations.
  - B) Allopatric speciation only occurs in species that are widely distributed.
  - C) Allopatric speciation always involves a physical barrier that interrupts gene flow.
  - D) Allopatric speciation can sometimes involve chance events.
20. A long, narrow hybrid zone exists between the ranges of the fire-bellied toad and the yellow-bellied toad in Europe. Which of the following is a factor contributing to the persistence of this zone?
- A) Reinforcement strengthens the prezygotic barriers between the two species.
  - B) Hybrid offspring have the same fitness as nonhybrid offspring.
  - C) Both species travel long distances over the course of their lives.
  - D) Individuals from outside the hybrid zone regularly move into the hybrid zone.

21. Which of the following would not be considered an example of a prezygotic reproductive isolating mechanism?
- A) One bird species forages in the tops of trees for flying insects, whereas another forages on the ground for worms and grubs.
  - B) The males of one species of moth cannot detect and respond to the sex attractant chemicals produced by the females of another species.
  - C) Sperm of one species of sea urchin are unable to penetrate the egg plasma membrane of another species.
  - D) Mosquitoes of one species are active in foraging and searching for mates at dusk, whereas those of another species are active at dawn.
22. Which of the following factors would not be expected to increase the rate of speciation in a group of organisms?
- A) Fragmentation of populations
  - B) Poor dispersal ability
  - C) High birthrates
  - D) Dietary specialization
23. More than 800 species of *Drosophila* occur in the Hawaiian Islands, representing 30 to 40 percent of all the species in this genus. The occurrence of so many *Drosophila* species in this island chain is
- A) the result of many founder events followed by genetic divergence.
  - B) an example of an evolutionary radiation.
  - C) largely the result of sympatric speciation.
  - D) Both a and b are correct
24. Which of the following observations constitutes conclusive evidence that two overlapping populations that had been geographically separated have not diverged into distinct species?
- A) Matings between members of the two populations produce viable hybrids.
  - B) A stable hybrid zone exists where their ranges overlap.
  - C) Interbreeding is common between members of the two populations.
  - D) None of the above
25. A field contains two related species of flowering plants. Species A has a diploid chromosome number of 16, and species B has a diploid number of 18. If a third species arises as a result of hybridization between A and B, how many chromosomes will it have?
- A) 17
  - B) 32
  - C) 34
  - D) 36

26. The following answer choices describe four hypothetical families of birds, each endemic either to a single large island or to an island group (archipelago) far from the nearest continental land mass. In which of the four would you predict the highest rate of speciation?
- A) Family A is endemic to a large island. The species in this family have promiscuous mating systems.
  - B) Family B is endemic to an archipelago. The species in this family have monogamous mating systems.
  - C) Family C is endemic to a large island. The species in this family have monogamous mating systems.
  - D) Family D is endemic to an archipelago. The species in this family have promiscuous mating systems.
27. The *genome* of a eukaryotic organism is best defined as
- A) all of the organism's protein-coding genes.
  - B) all of the organism's DNA contained in its nucleus.
  - C) all of the organism's genetic material.
  - D) a haploid set of all the organism's chromosomes.
28. The sequence alignment technique
- A) permits comparison of sequences of amino acids in proteins or sequences of nucleotides in DNA.
  - B) enables the detection of deletions and insertions in sequences that are being compared.
  - C) enables the detection of back substitutions and parallel substitutions in sequences that are being compared.
  - D) Both a and b
29. Experimental molecular evolutionary studies have shown that
- A) a heterogeneous environment favors adaptive radiation.
  - B) a heterogeneous environment induces an increase in the mutation rate.
  - C) it requires more than a year to demonstrate substantial molecular evolution even in bacteria.
  - D) Both a and b
30. Which of the following is not a valid conclusion based on studies of the structure of proteins, such as cytochrome c and lysozyme, in different species?
- A) The rate of evolution of particular proteins is often relatively constant over time.
  - B) Many nucleotide substitutions result either in no change in the amino acid sequence of the protein or in a change to a functionally equivalent amino acid.
  - C) Fewer differences were observed in the amino acid sequences of a protein if the organismal sources of the proteins were closely related.
  - D) Functionally important regions of a protein can be discovered by identifying the regions with the most amino acid substitutions.

31. Which of the following statements about gene families is false?
- A) Gene families evolve via gene duplication.
  - B) Pseudogenes are quickly removed from gene families by deletion.
  - C) Members of a gene family can include several functional genes.
  - D) Examples of gene families include the *engrailed* and globin gene families in vertebrates.
32. A group that consists of all the evolutionary descendants of a common ancestor is called a(n)
- A) clade.
  - B) taxon.
  - C) homology.
  - D) ingroup.
33. A synapomorphy is
- A) the product of convergent evolution.
  - B) the result of an evolutionary reversal.
  - C) a shared derived characteristic.
  - D) a trait that was present in the ancestor of a group.
34. Members of genus X, a hypothetical taxon of invertebrates, have antennae with a variable number of segments. Species A and B have 10 segments; species C and D have 9 segments; species E has 8 segments. In all other genera in this family (including genus Y), all species have antennae with 10 segments. Which of the following character states is a synapomorphy useful for determining evolutionary relationships within genus X?
- A) 10-segment antennae in species A and B
  - B) 10-segment antennae in genus Y and in two species of genus X
  - C) Antennae with fewer than 10 segments in species C, D, and E
  - D) 8-segment antennae in species E
35. A derived trait is one that
- A) differs from its ancestral form.
  - B) is homologous with another trait found in a related species.
  - C) is the product of an evolutionary reversal.
  - D) has the same function, but not the same evolutionary origin, as a trait found in another species.
36. The most important limitation of fossils as a source of information about evolutionary history is that
- A) it is sometimes impossible to determine when a fossil organism lived.
  - B) the fossil record for many groups is fragmentary or even nonexistent.
  - C) most fossils contain no nucleic acids or proteins and therefore are worthless for studies of molecular evolution.
  - D) it is impossible to determine if morphologically similar fossils belong to the same species because one cannot know if the fossil species could have interbred.

37. Which of the following statements describes a purpose for which biologists use phylogenetic trees?
- A) For human diseases once found only in other animals, phylogenetic trees are helpful in determining when and where the infectious organisms first entered human populations.
  - B) Phylogenetic trees are useful for determining how many times a particular trait may have independently evolved within a lineage.
  - C) Phylogenetic trees can sometimes be used to make predictions about future evolution.
  - D) All of the above
38. The most important attribute of a biological classification scheme is that it
- A) avoids the ambiguity created by using common names.
  - B) reflects the evolutionary relationships among organisms.
  - C) helps us remember organisms and their traits.
  - D) improves our ability to make predictions about the morphology and behavior of organisms.
39. The organisms that make up a class are \_\_\_\_\_ diverse and \_\_\_\_\_ numerous than those in a family within that class. The organisms that make up a phylum all diverged from a common ancestor \_\_\_\_\_ recently than did the organisms in an order within that phylum.
- A) more; more; less
  - B) more; more; more
  - C) more; less; less
  - D) less; less; more
40. Which of the following incomplete lists of taxonomic categories ranks them properly from most inclusive to least inclusive?
- A) Phylum, order, family, genus
  - B) Class, phylum, order, species
  - C) Order, class, family, genus
  - D) Family, order, class, kingdom
41. In what way was the evolution of eukaryotic cells linked to the increase in the oxygen concentration in the atmosphere that occurred during the Precambrian?



42. In the absence of controls on the emission of CO<sub>2</sub> by the burning of fossil fuels, scientists believe that the concentration of this gas could double by the end of the current century, leading to a significant rise in the average temperature of Earth. What might be the evolutionary effects of this climatic change?
44. Discuss the main use of the Hardy–Weinberg rule in evolutionary biology.
45. The Hardy–Weinberg expression is an expansion of a binomial or  $(p + q)^2 = p^2 + 2pq + q^2$ . In this equation, the left-hand side represents \_\_\_\_\_ frequencies, and the right-hand side represents \_\_\_\_\_ frequencies.
46. The following data were collected in a study in which dark and light moths of the peppered moth (*Biston betularia*) were released and recaptured a few days later in several different areas (a, b, c, and d). Based on these data, in which area is the light phenotype most advantageous? (Assume that recapture rates reflect the relative survival of the moths, not the ability of the investigators to find and recapture the moths.) What does this tell us about the fitness of light moths in this area?
- | Area | Moth type | Released | Recaptured |
|------|-----------|----------|------------|
| a    | dark      | 100      | 25         |
|      | light     | 200      | 50         |
| b    | dark      | 100      | 25         |
|      | light     | 200      | 100        |
| c    | dark      | 200      | 50         |
|      | light     | 400      | 100        |
| d    | dark      | 200      | 100        |
|      | light     | 300      | 75         |

47. As peppered moths rest on bark surfaces during the day, they are subject to predation by birds. Assuming that moths that are more camouflaged will be preyed on less, what can you say about the color of bark surfaces in area d?
48. Discuss the conditions on the Galápagos Islands that led to the evolution of the birds known as Darwin's finches.
49. Suppose that members of two populations are separated by a geographic barrier and begin to diverge genetically. Many generations later, when the barrier is removed, the two populations can interbreed, but the hybrid offspring do not survive and reproduce well. Explain how natural selection might lead to the evolution of more effective prezygotic barriers in these species.
50. Discuss the implications the following statement has for systematics: "DNA is the genetic material for all prokaryotes and eukaryotes."

## Answer Key

1. B
2. B
3. A
4. D
5. D
6. C
7. a
8. C
9. B
10. A
11. B
12. A
13. A
14. A
15. B
16. D
17. D
18. A
19. B
20. D
21. A
22. C
23. D
24. D
25. C
26. D
27. C
28. D
29. A
30. D
31. B
32. A
33. C
34. C
35. A
36. B
37. D
38. B
39. A
40. A
41. Small prokaryotic cells can obtain enough oxygen by diffusion even when oxygen concentrations are very low. Eukaryotic cells, being larger, have a lower surface area-to-volume ratio and hence need a higher concentration of oxygen in their environment for diffusion to meet their requirement for this gas.

42. The fossil record indicates that rapid evolution often occurs in lineages exposed to a period of environmental instability. The record also shows that major environmental changes occurring over a short time interval, sometimes lead to large-scale, rapid extinctions that appear "instantaneous" in the fossil record. The possible effects of global warming on biodiversity are discussed in more detail in Chapter 57 of the textbook.
43. ~~By dramatically altering Earth's vegetation from forests and grasslands to crops and pastures, humans are causing the extinction of many species, both large and small. By transporting species around the world, humans are reversing the independent evolution of Earth's biota on separate continents. Lastly, by artificial selection and biotechnology (including gene transfer between species), humans are directly determining how certain species are evolving.~~
44. No population meets the Hardy–Weinberg conditions for genetic equilibrium. However, by determining how a population deviates from the expectations of Hardy–Weinberg equilibrium, evolutionary biologists can identify what evolutionary agents are affecting the population.
45. allele; genotype
46. Area *b*. In areas *a* and *c*, recaptures were 25% of releases for all moths, but in area *b*, 50% of the light moths were recaptured, indicating that moths with this phenotype survived best in this area. This suggests that fitness will be higher for light moths in this area, but it won't be possible to determine this for certain until the moths reproduce because fitness, by definition, depends on the relative contribution to subsequent generations (it is possible, for example, that light moths will have a harder time finding mates in this area).
47. Dark moths seem to survive best in area *d*. If the increased survival of the moths is due to cryptic coloration, then the bark surfaces in that area should also be dark.
48. The relatively great distance between the Galápagos Islands and the South American mainland and also between each of the islands in the archipelago ensured that once immigrants had arrived on an island, they would be genetically isolated for a substantial period of time. Also, because the islands differ greatly in climate and vegetation, the resident birds were subject to different selection pressures. This, in combination with reduced gene flow between the islands, led to a rapid evolutionary radiation of finches.
49. Recall that natural selection tends to remove from a population traits that reduce survival or reproductive success. Individuals that interbreed between populations will have lower fitness (they will contribute fewer offspring to future generations) than those who breed within their own population. If the tendency to avoid interbreeding is heritable (and not just the result of chance), the frequency of alleles that prevent interbreeding will increase in each population. How might such a trait be heritable? Any of the prezygotic barriers to interbreeding might be heritable traits. For example, if the species in question are frogs, and if their mating calls started to diverge while the populations were separated, the following traits might be heritable: a tendency to make a call that is more distinct from that of the other population, or the ability to distinguish between the existing calls of the two populations (coupled with a preference for the call of one's own population). As alleles for these traits increased in frequency, they would contribute to the behavioral isolation of the two populations and perhaps eventually to more complete speciation.
50. Some of the implications of this statement are that DNA evolved as the genetic material before eukaryotes had diverged from prokaryotes, that DNA is an ancestral and general homologous trait, and that all surviving eukaryotes use DNA as the genetic material.