

PART I. Multiple choice questions – (5 points each, 50 points total). Remember, single best answer only.

1. Of the multiple micro-evolutionary processes listed below, which of the following acts to **inhibit divergence** in populations and thereby block speciation?
 - A. Natural Selection
 - B. Genetic Drift
 - C. Migration
 - D. Mutation
 - E. Non-random mating

2. According to our text, the term "hominins" currently refers to African great apes and humans. Which of the following would NOT be considered as a **hominin**?
 - A. Gorillas
 - B. Neanderthals
 - C. Orangutans
 - D. Australopithecines
 - E. Bonobos

3. Which of the following dates is erroneous (just plain wrong!) as described by the **fossil record**?
 - A. The end of the ammonites @ 65 Mya
 - B. The end of the trilobites @ 250 Mya
 - C. The first fossils of living organisms @ 5.5 Bya
 - D. The end of the Ediacara biota @ 550 Mya
 - E. The first Eucarya algae @ 2.1 Bya

4. Consider the **C-value paradox**, which of the following organisms has the largest haploid genome size?
 - A. *Drosophila melanogaster* (fruitfly)
 - B. *Escherichia coli* (bacterium)
 - C. *Homo sapiens* (humans)
 - D. *Allium cepa* (onion)
 - E. *Amoeba dubia* (amoeba)

5. **Mass extinction events** are thought to be associated with a number of possible catastrophes. In addition to the ever-popular asteroid impact scenario, which of the following are also possible extinction causing catastrophes?
- A. Human population explosion
 - B. Extreme acid rain
 - C. Extreme volcanic activity
 - D. Drop in sea level (regression) followed by a rise in sea level (transgression)
 - E. All of the above
6. During sexual selection rapid divergence between populations can occur due to leks. Which of the following best describes the concept of a **lek**?
- A. Males usually have exaggerated morphological features like long tail feathers
 - B. Male breeding colors are usually brighter to help attract a female
 - C. Males and females court and copulate in aggregate groups
 - D. Females choose males based on their inherent behavior
 - E. Females choose males based on morphological characteristic cues
7. In order to make the leap from abiotic chemicals to cellular life, four major **theoretical hurdles** must be overcome. Which of the following is NOT one of these hurdles?
- A. Abiotic synthesis of monomers such as amino and nucleic acids.
 - B. Polymerization of monomers into polymers such as proteins and DNA.
 - C. Transference of heredity information from one generation to the next.
 - D. Development of ribozymes catalyzing metabolic functions.
 - E. Formation of protobionts through the aggregation of a membrane.
8. Which of the following was NOT a result of the Paleozoic atmospheric **oxygen spike** (up to 35%) that ranged from ~350 to 250 Mya?
- A. Snowball Earth Effect
 - B. Gigantic insects
 - C. Origin of flight
 - D. Invasion of land by animals
 - E. Extensive wildfires

9. Over time even the most highly conserved gene sequence will fix mutations. Eventually, given sufficient time what will be the **probability** for a single nucleotide (e.g., A) to be at any given homologous position?
- A. 25%
 - B. 50%
 - C. 75%
 - D. 100%
 - E. None of the above
10. Consider the **reinforcement** model that happens during the completion of speciation. Which of the following types of selection are *best* associated with this model?
- A. Directional Selection
 - B. Sexual Selection
 - C. Stabilizing Selection
 - D. Disruptive Selection
 - E. Natural Selection

PART II. Short answer questions – (Number of points in parentheses, 100 points total).

11. (10 points) Briefly, what is meant by the concept of **heterozygote superiority**?
12. (10 points) Compare and contrast the concepts of **migration** and **the founder effect**.

13. (10 points) What is **codon bias**? Why is the observation of nonrandom codon use evidence that certain codons might be favored by natural selection? If you were given a series of gene sequences, how would you determine whether codon usage is random or nonrandom?
14. (10 points) Describe the concept of **impact frustration** and how this may have affected the initial development of the life on Earth as opposed to more recent evolutionary developments. How might **hydrothermal vents** have factored into this scenario?

15. (10 points) Consider the process of speciation. The **reinforcement hypothesis** makes what “predictions” regarding divergent populations coming back into contact with one another? Are these predictions easily testable through observational studies?
16. (10 points) Describe the **primary observation** witnessed regarding the size of the habitat range of multicellular organisms regardless of the type of extinction affecting them (i.e., either mass or background extinction). What percent of all extinctions did the “big five” mass extinctions account for?

- 17.** (20 points) It was recently announced that there has been a new hominin fossil found in a South African cave. It was described as having a small brain case and a prehensile foot indicating it could hang from tree branches. Based on what you already know about human evolution, (A) predict this fossil's age, (B) this hominin's overall size, and (C) what type of habitat conditions (including food items) might this hominin have enjoyed.
- 18.** (20 points) Examine the graph provided which shows F_{st} , a measure of genetic variability between populations as a function of geographic distance. These data are from human populations in Europe. F_{st} has been calculated from autosomes (from both parents), mtDNA (only from the mother), and Y chromosome (only from the father) loci. Consider these data and develop a hypothesis using an evolutionary force/mechanism to explain why these alleles are more homogenized across populations of autosomal and mtDNA loci rather than for Y-chromosome loci.

PART III. Short Essay – (Number of points in parentheses, 50 points total).

- 19.** (25 points) Consider the three main models of evolution in terms of explaining the fossil record. What are the three models and how does each deal with speciation in terms of what pattern does each hypothesis predict will happen over time? How does the concept of **cryptic species** pose a potential problem for each of these hypotheses? Which phylum (or group) is considered to best represent each of the two “punctuated” models (i.e., two different answers)?

20. (25 points) What are the (at least) four major events (as discussed in class) that occurred during the evolution of life on Earth that were critical in shaping extant biology, **and** why was each so important for this present day outcome? (You may also choose another event, if you can convince me it was critical to shaping today's biology). What umbrella concept do these occurrences fall under?

21. Extra Credit, Short answer (10 points): What does the term **anagenesis** refer to when considering the gradualism model for evolution?