

**PART I. Multiple choice questions – (4 points each, 36 points total). Single best answer.**

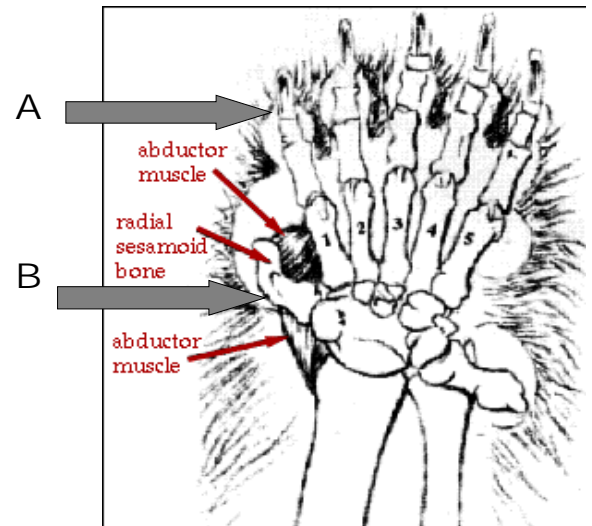
1. Over time even the most highly conserved gene sequence will fix mutations. Eventually, given sufficient time what will the probability of identical nucleotides be at any given position?
  - A. 25%
  - B. 50%
  - C. 75%
  - D. 100%
  - E. none of the above
  
2. The advent of land animals is associated with the fin bones of the lobe-finned fishes. When did these fish first crawl “out of the ooze”?
  - A. Precambrian
  - B. Devonian
  - C. Silurian
  - D. Archean
  - E. Holocene
  
3. Which of the following is a single point mutation in DNA that causes an effect in the corresponding amino acid sequence?
  - A. Transition
  - B. Translocation
  - C. Silent (or synonymous)
  - D. Replacement (or non-synonymous)
  - E. Inversion
  
4. The fossil record is great, but it has certain biases associated with it. Which of the following is NOT one of these biases?
  - A. Hard part over soft part bias (construction bias).
  - B. More rocks of recent age bias (temporal bias).
  - C. Simpler forms before complex forms (temporal bias).
  - D. Lowland and shallow marine location bias (geographic bias).
  - E. Metamorphic over sedimentary rock bias (construction bias).

5. Natural Selection is the driving force behind evolution. Which of the following is **NOT** a correct concept related to natural selection?
- A. change in the trait distribution of populations
  - B. acts at the level of the individual
  - C. forward looking process
  - D. operates on existing traits or phenotypes
  - E. has no ultimate goal
6. Charles Darwin described the theory of evolution through the process of natural selection in his book, "The Origin of Species," but what he did not yet understand (and hopefully you do) was the underlying mechanism. What was this mechanism, which is now considered under the concept of "NeoDarwinism"?
- A. extinction
  - B. adaptation
  - C. mutation
  - D. phylogeny
  - E. nonrandom mating
7. Which of the following was **NOT** a result of the Paleozoic atmospheric oxygen spike (i.e., up to 35%) that ranged from ~350 to 250 Mya?
- A. Invasion of land by plants
  - B. Gigantic insects
  - C. Origin of flight
  - D. Invasion of land by animals
  - E. Extensive wildfires
8. Of the following, which is **NOT** a lesson from the **BIG TREE** of life?
- A. Demonstrates three Domains of life forms regarding genetic diversity.
  - B. Indicates a "constant clock" among different the three different Domains.
  - C. Points to a single source or bottleneck for the origin of life.
  - D. Indicates prokaryotes had a thermophilic origin (i.e., Hot start).
  - E. Shows that each Domain is nearly as distantly related as any other.
9. 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 proteinaceous enzymes catalyzing metabolic functions.
  - E. Formation of protobionts through the aggregation of a membrane.

**PART II. Short answer questions – (Number of points in parentheses, 84 points total).**

10. (10 points) What is the primary pattern predicted by the punctuated equilibrium hypothesis in terms of the occurrence of various species in the fossil record? Why are **bryozoans** a good indicator of this hypothesis as opposed to **foraminifera**?
11. (12 points) Consider the Hardy-Weinberg Equilibrium Principle. (A) What actually goes to **equilibrium** and why is this considered a “null” hypothesis? (B) Briefly, what are four of the five assumptions that are required? (C) What cellular process accounts for the segregation of alleles allowing H-W equilibrium to even be possible?
12. (8 points) If the allele frequencies for a particular loci were  $A_1=0.5$  and  $A_2=0.5$ , then what would the predicted genotype frequencies be under H-W?

13. (8 points) Consider the concepts of “homology” and “analogy” in a comparison between your thumb and the digits shown in the paw of a panda bear. Which structure denoted below (either A or B) is homologous and which is analogous? In addition, briefly describe how you can make this conclusion for each.



14. (8 points) When it comes to developmental patterns as seen in evolution, what exactly does **heterochrony** refer to? Also can you name at least two different yet specific examples of this over-arching pattern?
15. (8 points) What is a “cline” and how does it relate to the frequency of a chromosomal inversion in the fruit flys (i.e., *Drosophila sp.*)? What is the selective advantage offered in colder, wetter climates?

16. (8 points) Why is the **molluscan eye** considered more “complex” (o.k., I’ll say it, better) than the **vertebrate eye** in terms of its overall design?
17. (10 points) What are **three different examples** that can be defined as encompassing the concept of homoplasy, and why is it necessary to minimize this in any phylogenetic analysis? Also, how does the concept of Ocham’s Razor apply to minimizing homoplasy?
18. (12 points) Currently, humans have a genome size of ~3.0 billion (Giga) nucleotides with only ~20,000 genes that are actually encoded. Shortly after the Human genome project finished, it was thought that there were as many as ~80,000 genes, which “coincidentally” marked the same time that George Bush first took office. (A) Over the last six years, what is the theoretical “dumbing-down” rate of decay of the human genome. (B) Name an organism that has a larger genome than yours. (C) Is this organism considered more complex than humans? (D) What paradoxical concept best describes this issue of complexity?

**PART III. Short Essay – (Number of points in parentheses, 30 points total).**

- 19.** (15 points) Consider what you now know about evolution along with the following case study. Recently farmers have been able to plant crops, such as cotton, with an engineered microbial pesticide gene known as “BT.” However, as a consortium farmers only plant 95% of their fields with seeds that have the BT gene. What is the purpose of setting aside 5% of their fields to get planted with wild type seeds?

20. (15 points) Briefly 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?