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**BIL 160 - Spring 2011**

**EXAM I**

**Krempels**

**Choose the BEST answer for each multiple choice question. Two points each.**

1. A taxonomist has received a jar containing 20 frogs, all members of a heretofore undescribed species. The taxonomist examines all the individuals, and selects one individual to be the first member of the species to be the representative on which the species full, scientific description is based. This individual is known as the \_\_\_\_\_ of the species, and the other frogs in the jar are then known as the \_\_\_\_\_.  
a. paratype; holotypes      **c. holotype; paratypes**      e. ancestor; descendants  
b. congener; conspecific      d. apomorphy; symplesiomorphies
2. The most compelling evidence that all life shares a common ancestry can be found in  
a. the commonplace use of enzymes in living systems      d. the structure of the ancestral eye  
**b. the universal nature of the genetic code**      e. the structure of chloroplasts  
c. the structure of the eukaryotic nucleus
3. Fossil evidence indicates that life on earth first arose approximately \_\_\_\_\_ years ago.  
a. 20 billion      b. 10 billion      **c. 4 billion**      d. one million      e. three

**For #4 - 8, match the scientist to the most appropriate description. You may use any answer once, more than once, or not at all. Your decision.**

- |                          |                                 |                                  |
|--------------------------|---------------------------------|----------------------------------|
| <b>a. Francesco Redi</b> | <b>c. Louis Pasteur</b>         | <b>e. Alfred Russell Wallace</b> |
| <b>b. Stanley Miller</b> | <b>d. Jean Baptiste Lamarck</b> |                                  |
4. Though his ideas were later disproven, this man provided the first testable hypothesis for a mechanism by which species could change over time. **D - Lamarck**
  5. His experimental results put the idea of spontaneous generation to rest forever. **C - Pasteur**
  6. This naturalist working in Malaysia wrote a letter to Charles Darwin, in which he proposed a mechanism for evolution by natural selection that was essentially the same as Darwin's idea. **E-Wallace**
  7. His experiments were the first to empirically address the idea of spontaneous generation. **A - Redi**
  8. His experimental apparatus mimicked the conditions of primordial terrestrial oceans, and generated organic molecules from inorganic components. **B - Miller**
  9. In the apparatus in the previous question, what highly reactive element was *missing*, making the generation of biological molecules possible?  
a. uranium      **b. oxygen**      c. carbon      d. hydrogen      e. air
  10. Various species of diatoms (microscopic algae) form the basis of the food web in most marine ecosystems. Some research suggests that as the oceans become more acidic due to increased atmospheric CO<sub>2</sub> uptake, the diatom populations could crash, profoundly affecting all other species in the ocean food web. The various species of diatoms should thus be considered  
a. indicator species      **c. keystone species**      e. native species  
b. endangered species      d. exotic species
  11. An early proponent of evolution, Jean Baptiste Lamarck, is now best known for his proposal of a mechanism for how organisms could evolve in response to "*sentiments interieurs*". This meant  
a. that a divine Creator changed living things between generations as the environment changed.  
**b. that individuals could pass characters acquired during their lifetime to their offspring.**  
c. that the strongest, fastest, smartest individuals in a population left the most offspring.  
d. "survival of the fittest" individuals in a population.  
e. that the most emotional individuals in a population would get the most mating opportunities.
  12. Evolution is never affected by random processes. It is completely explained by natural selection.  
a. true      **b. false**      c. Let me ask Glenn Beck

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13. Charles Darwin was the first scientist to propose
- a. that evolution occurs
  - b. a mechanism for evolution
  - c. that the earth was older than 6000 years
  - d. using artificial selection to domesticate animals
  - e. a mechanism for evolution that was supported by observable evidence**
14. You are studying beetles in Madagascar, and have found three types that are *physically indistinguishable*. In studying their behavior, you find that none of the three interbreed because they have different courtship behavior. If you wished to study the evolutionary relationships of these three beetle species, which of the following would give you the most relevant information?
- a. comparison of their ontogenies
  - b. comparison of their DNA sequences**
  - c. comparison of their morphologies
  - d. fossil specimens of related beetles
  - e. comparison of their analogous characters
15. Which of these statements would be considered accurate by a Darwinian evolutionary biologist?
- a. Antibiotics cause bacteria to mutate so that they become resistant to those antibiotics.
  - b. The ancestors of modern whales had hind limbs, but did not use them very much once they began to return to an aquatic existence. This caused the hind limbs to become vestigial.
  - c. The *functional* similarity of the wing of a bat and the wing of a bird is due to common ancestry.
  - d. The shark and the squirrel both have tails posterior to the anus because of common ancestry.**
  - e. More than one of the above would be considered accurate by a Darwinian biologist.
16. Which of the following represents an idea Darwin took from the writings of religious scholar Thomas Malthus?
- a. all species are fixed in the form in which they were created
  - b. populations tend to increase at a faster rate than their food supply**
  - c. earth changed over time due to a series of catastrophic geological events
  - d. evolution proceeds by means of random changes in genes
  - e. earth is more than 10,000 years old.
17. The naturalist who synthesized a concept of natural selection independently of Darwin was
- a. George Cuvier
  - b. Reverend John Henslow
  - c. Thomas Malthus
  - d. Abraham Lincoln
  - e. Alfred Wallace**
18. Which of the following statements about natural selection is most accurate?
- a. A characteristic that is adaptive in one habitat is almost always also adaptive in other habitats.
  - b. Different species in the same habitat adapt to changes by undergoing the same genetic mutations.
  - c. Natural selection is the only means by which populations can evolve.
  - d. Individuals with adaptive traits leave more offspring than those lacking those adaptive traits.**
  - e. Individuals evolve adaptive traits in response to environmental challenges.
19. When Darwin published *On the Origin of Species*, he was unaware that
- a. related individuals in the same species have variable physical characteristics.
  - b. physical variation was due to differences in individuals' DNA.**
  - c. members of a population often had to compete for limited resources.
  - d. the fossil record showed that some species once found on earth had become extinct.
  - e. Darwin was aware of all of the above.
20. According to philosopher Karl Popper, an hypothesis or theory is most powerful when it
- a. is confirmed by a great deal of observable evidence over many years.
  - b. is one that can be proven to be true with many experiments.
  - c. is potentially falsifiable with rigorous, repeatable experiments.**
  - d. is irrefutable.
  - e. is one that he made up himself.

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21. Tay-Sachs disease is a lethal genetic condition. Children who inherit two copies of the rare, recessive allele that causes Tay Sachs usually die before the age of three. Thus, the majority of recessive alleles for Tay Sachs in the current human population are found in individuals who are
- a. haploid
  - b. polymorphic
  - c. homozygous recessive
  - d. homozygous dominant
  - e. heterozygous**
22. In terms of global population genetics, which of these human traits should be considered mutant?
- a. brown hair
  - b. vestigial tail
  - c. blue eyes**
  - d. opposable thumb
  - e. none of the above
23. Biodiversity is the end result of millennia of gradually accumulated genetic diversity. Which of these is NOT likely to *directly* contribute to genetic diversity in living things?
- a. errors in DNA replication
  - b. translocations and other meiotic errors
  - c. recombination of genes during gametogenesis
  - d. errors in structural protein translation**
  - e. heritable changes in DNA "packaging" affecting gene expression
24. Which of the following statements about natural selection is the most accurate?
- a. Adaptations beneficial in one habitat are usually beneficial in other habitats.
  - b. Different species that occupy the same habitat will adapt to that habitat via the same mutations.
  - c. Once a trait is adaptive, it is always adaptive, even in a changing environment.
  - d. Natural selection is the only means by which populations can evolve.
  - e. Well adapted individuals contribute more genes to the gene pool than less well adapted individuals.**
25. Instead of teeth, adult Blue Whales have **baleen**, a filtering structure the whales use to sieve small food organisms from the water. Blue Whale embryos develop teeth, which are shed and replaced by baleen before birth. The Blue Whale's embryonic teeth provide evidence that
- a. all whales are descended from terrestrial carnivores.
  - b. baleen whale embryos pass through a stage when they resemble adult toothed whales.
  - c. baleen whales and toothed whales share a common ancestor that had teeth.**
  - d. ontogeny recapitulates phylogeny.
  - e. baleen evolved before teeth.
26. A gene locus in a small population of Leprechauns has just mutated. The dominant allele codes for River Dancing, and the recessive allele codes for Square Dancing. Because dancing is an important part of Leprechaun mating behavior, the population immediately starts to exhibit *positive* assortative mating with respect to this locus. Over several generations, you should expect to see
- a. An increase in the proportion of Square Dancing individuals
  - b. An increase in the proportion of homozygous River Dancing individuals
  - c. A decrease in the proportion of River Dancing heterozygous individuals
  - d. two of the above (increase in both types of homozygotes due to positive assortative mating)**
  - e. all of the above
27. It is now understood that environmental factors can, in some cases, result in a "repackaging" of DNA in an individual organism's germline cells, and these permanent changes—sometimes resulting in a changed phenotype—can be inherited and expressed by that individual's offspring and future generations. This phenomenon
- a. proves that Lamarck was completely correct hypothesizing that "use vs. disuse" drives evolution.
  - b. is known as epigenetic inheritance.**
  - c. demonstrates that natural selection is only a minor factor in driving evolution.
  - d. proves, once again, that inheritance follows Mendel's Laws.
  - e. provides support for both uniformitarianism and catastrophism
28. The fossil record provides strong evidence that humans evolved from Old World monkeys.
- a. true
  - b. false**
  - c. But we believe we're not as stinky.

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29. Which of the following statements about evolution is the most accurate?
- a. It is goal-directed, with superior species evolving from less well-adapted species.
  - b. It represents the result of selection for acquired characteristics.
  - c. It is reflected in the evolution of humans directly from extant species of apes.
  - d. It results from the differential survival and reproduction of selected phenotypes.**
  - e. It is driven by the "survival of the fittest."
30. Dog breeds such as Cocker Spaniels and Beagles have high foreheads, large eyes, and short muzzles compared to their wolf ancestors. What can you confidently say about the dogs' facial morphology?
- a. It is due to neoteny
  - c. It is an example of paedomorphy**
  - e. all of the above
  - b. It is due to progenesis
  - d. all of the above
31. The morphology of the beagles and spaniels in the previous question is a product of
- a. sexual selection
  - c. inbreeding
  - e. more than one of the above**
  - b. artificial selection
  - d. natural selection
32. The existence of the Red Wolf ("*Canis rufus*"), which is most likely a hybrid between the timber wolf ("*Canis lupus*") and the coyote ("*Canis latrans*"), is evidence
- a. that *Canis lupus* and *Canis latrans* are reproductively isolated
  - b. of introgression between *Canis lupus* and *Canis latrans***
  - c. that *Canis lupus* and *Canis latrans* share a relatively recent common ancestor
  - d. two of the above**
  - e. that Timber wolves and Coyotes sometimes suffer from "beer goggles"
33. Speciation
- a. occurs so slowly that no one has ever observed the emergence of new species
  - b. occurs only via accumulation of genetic change over vast expanses of geologic time
  - c. occurs only when a small population is isolated from its original source population
  - d. proceeds at the same rate, no matter which type of organism is being considered.
  - e. has been known to occur when two closely related species hybridize**
34. The concept of "irreducible complexity"—that some structures have interacting parts that work too closely together to have evolved gradually—is a major stumbling block for evolutionary biologists, who have so far been unable to show otherwise.
- a. true
  - b. false**
  - c. what time is it?
35. During the course of evolution, certain genes in snakes were duplicated and mutated, eventually giving rise to genes encoding a snake venom now known as crotamine. The original, source genes encoded enzymes that
- a. prevented blood clotting
  - c. digested food
  - e. kept teeth clean
  - b. fought bacteria and other pathogens**
  - d. paralyzed the heart muscle
36. When an evolutionary biologist says that an individual organism has greater fitness than other members of its species, it means that the individual organism
- a. lives longer than other members of its species
  - b. competes for resources more effectively than other members of its species
  - c. mates more frequently than other members of its species
  - d. leaves more fertile, viable offspring than other members of its species**
  - e. all of the above
37. Some species of *Anopheles* mosquito lay their eggs in brackish water, others in running fresh water, and others in stagnant water. What type of reproductive isolating mechanism is most likely to be separating these species?
- a. geographic isolation
  - c. temporal isolation
  - e. hybrid breakdown
  - b. ecological isolation**
  - d. behavioral isolation

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38. If you were to follow the embryonic development of a camel, a horse, and a pig, you would note that the camel and pig have the most persistent ontogenetic similarities. This means...
- a. **Camels are more closely related to pigs than they are to horses**
  - b. Pigs are more closely related to horses than they are to camels
  - c. Camels are more closely related to horses than they are to pigs
  - d. Adults camels and horses are more similar to each other than they are to pigs, so they share a more recent common ancestor with each other than either does with pigs.
  - e. Who cares? Let's make sausage!

**Use the following information to answer #39 - 43**

By the year 2099, earth was declared officially uninhabitable, and small groups of human colonists traveled into space to start new populations on planets made habitable with tax dollars diverted from the war between the U.S and Canada.

One hundred randomly selected individuals were sent to Ganymede to be fruitful and multiply. Of these, 25 had type A blood (all had genotype AA), 50 had type AB blood (genotype AB), and 25 had type B blood (all had genotype BB). All were healthy, and proceeded to reproduce.

In a few decades, the Ganymede population had grown to 10,000. A blood type survey was done, revealing that 8100 people had blood type A, and 1900 had blood type AB. (Quick review: A and B alleles are codominant. Both A and B alleles are dominant to the type O allele. People with genotype AA or Aa have type A blood. People with genotype BB or Bb have type B blood. People with genotype AB have type AB blood, and people with genotype oo have type O blood.)

39. What is the frequency of the A allele in the most recent (10,000 member) population of Ganymede? (You may round fractions, if you think it's necessary.)
- a. 0.14
  - b. 0.5
  - c. 0.81
  - d. 0.86
  - e. **0.91**

**8100 x 2 = 16200 alleles in the AA individuals**

**1900 x 1 = 1900 alleles in the AB individuals**

**(16200 + 1900)/20,000 = 0.905 (round up to 0.91)**

40. With respect to the blood type locus, if the Ganymede population has been in Hardy-Weinberg equilibrium since its founding and was *still* not evolving at the time of the 10,000-population blood survey, how many individuals with blood type B would you *expect* to find?
- a. 1900
  - b. **2500**
  - c. 5000
  - d. 10,000
  - e. need more information to determine

**Initial allele frequencies:**

**50 A alleles (in the 25 homozygous individuals)**

**50 A alleles (in the 50 AB individuals)**

**50 B alleles (in the 50 AB individuals)**

**50 B alleles (in the 25 BB individuals)**

**Initial frequency of A allele = 0.5; Initial frequency of B allele = 0.5**

**Plugging into the HW equation:**

**$(0.5)^2 + 2(0.5)(0.5) + (0.5)^2 = 0.25 AA + 0.50 AB + 0.25 BB$**

**Multiply the expected BB frequency by population size:  $10,000 \times 0.25 = 2500$**

41. Which of the following hypotheses is most reasonable, with respect to the *newly determined* blood type proportions in the 10,000-member Ganymede population?
- a. Type o blood is not well adapted for the Ganymede environment.
  - b. **Blood type B may be maladaptive on Ganymede, compared to A or AB blood types.**
  - c. Type AB blood appears to be the most adaptive blood type on Ganymede.
  - d. Founder Effect has resulted in a higher proportion of type B individuals than expected.
  - e. Type A blood is most attractive to Ganymedian vampires.
42. What is the most probable reason for the lack of people with Type O blood on Ganymede?
- a. bottleneck effect
  - b. **founder effect**
  - c. **founder effect**
  - d. **founder effect**
  - e. reversion mutations

