

PRINTED NAME _____

Print your name legibly on the line above. Work through the test as fast as possible, answering the easiest questions before returning to the more difficult ones. Read each question carefully and completely, review all of the options presented before selecting. Do not hesitate to ask me for clarification if you are unsure about the meaning of a question. Reread both the questions and your answers before turning in your test. If you are unsure of the answer to a question, cross out all incorrect answers and make a guess from among the remaining possibilities. Your test should have 9??* pages.

Midterm I material

1. p 3. Six observations (OBS) and inferences (INF) lead to the conclusion that natural selection occurs and that it results in evolution. These observations and inferences are listed below. Which one of them leads to the inference that natural selection results in evolution?
 - a. OBS: Variation among individuals is the rule in nature.
 - b. OBS: All organisms tend to have stable population sizes.
 - c. INF: There is natural selection and it produces evolution.
 - d. OBS: Some variation is inherited.
 - e. INF: Many more offspring are produced than can survive and reproduce.
 - f. OBS: All organisms have the potential for exponential increase (growth).

2. p 8. Teleological explanations for observed natural phenomena are necessarily unscientific because they:
 - a. invariably invoke intervention of a deity.
 - b. invoke a specific objective, and it is impossible to frame testable hypotheses concerning the objective.
 - c. are specific to one religion.
 - d. require that there is a cause for every observed phenomenon.
 - e. All of the above.

3. p 10. Evolution is often characterized as "just a theory," and because it is a theory, it is not necessarily correct. What is the appropriate response to this characterization?
 - a. Theory is being used here incorrectly in the sense that scientists use the term "hypothesis."
 - b. The theory of evolution may be "just a theory," but it is a highly corroborated one.
 - c. Many tests of this theory have been conducted, and none of them has falsified this theory.
 - d. Theories are models that have been tested repeatedly without falsification, and thus the theory of evolution is a reliable scientific statement.
 - e. All of the above.

4. p 13. During the Renaissance the geocentric model of the universe was replaced by the heliocentric model of the universe. Why was this change in thinking so important for the emergence of evolutionary thought?
 - a. It demonstrated the literal inaccuracy of the Bible, freeing philosophical speculation to seek answers that conflict with scripture.
 - b. It showed that the earth was very old.
 - c. It prepared the way for the application of radioisotope dating.
 - d. It was the first application of uniformitarianism to a natural phenomenon.
 - e. It stimulated global exploration that led to discovery of many unknown species and adaptive radiations on islands.

5. p 16. To whom do we attribute the development of standard names for species, binomial nomenclature, and use of a hierarchy of taxonomic categories in biological nomenclature?
 - a. Bacon

- b. Hutton
 - c. Lamarck
 - d. Linnaeus
 - e. Malthus
6. p. 18. Who was Alfred Russel Wallace?
- a. The co-proposer with Darwin of natural selection as the mechanism for evolution.
 - b. The captain of the Beagle, the ship on which Darwin sailed.
 - c. One of Darwin's most vehement critics, who advocated special creation in major debates of the 19th century.
 - d. The human demographer (student of population growth) whose book on growth of human populations and of their resources influenced Darwin.
 - e. A prominent anatomist and paleontologist of the late 18th and early 19th centuries who advocated catastrophism to explain the fossil record.
7. p. 22. What was the immediate (within a decade of publication) impact of the publication of Gregor Mendel's results on genetics of pea plants?
- a. It stimulated the development of population genetics.
 - b. It was not recognized and had no immediate impact.
 - c. It has never had a major impact on views of evolutionary theory.
 - d. It was immediately hailed as the "missing link" in evolutionary theory.
 - e. Numerous studies corroborated his findings, and its implications for evolutionary theory were appreciated.
8. p. 5. If N is the average number of offspring produced by one female during her reproductive life time, what fraction of offspring per female survive and reproduce in a typical sexually-reproducing species with a stable population size?
- a. N
 - b. $1/N$
 - c. $2/N$
 - d. $N/2$
 - e. None of the above.
9. p. 27. Which of the following geological periods came earliest (first) in the history of life on earth?
- a. Permian
 - b. Devonian
 - c. Cretaceous
 - d. Tertiary
 - e. Cambrian
10. p. 28. Why do we believe that free oxygen (O_2) was absent from the surface of the early earth on which life first originated?
- a. It is absent from volcanic emissions today.
 - b. It is never seen on other planets by astronomers.
 - c. If it had been there, there would have been ozone (O_3), which would have cut off the ultraviolet radiation (UV) needed to create the first biological monomers from gases.
 - d. The earliest rocks from that time contain unoxidized minerals.
 - e. None of the above.
11. p. 30 What are "coacervates" and why are they important?
- a. They are globules formed by macromolecules in water and may represent a means for concentration of precursors of molecules that led to the first cells.
 - b. They are fossils with hard skeletal material that signaled the beginning of the Cambrian explosion.
 - c. They are mat-like communities of procaryotes in which photosynthesis first occurred.
 - d. They are structures in the cytoplasm that consist of protein and RNA and

- play a crucial role in transcription of proteins.
- e. They are small populations in which new species are thought to evolve.
- 12 p. 33. The best evidence for the first appearance of aerobic (oxygen-generating) photosynthesis is
- a. occurrence of eucaryotes in the fossil record
 - b. a mass mortality of anaerobic bacteria to which free oxygen was poison.
 - c. appearance of fossil cells containing organelles that resemble chloroplasts.
 - d. development of an ozone layer that cut down penetration of ultraviolet (UV) radiation to the surface of the earth.
 - e. formation of massive layers of oxidized iron.
13. p. 35. The evolution of sex is considered a very important development in the history of life because:
- a. it caused more rapid reproduction and shorter generation time.
 - b. it allows new mutant alleles to be recombined in diverse combinations.
 - c. it increased the cell size.
 - d. it was necessary before the multicellularity could evolve.
 - e. it was responsible for the evolution of chromosomes.
14. p. 37. What is a disadvantage of increased body size associated with the evolution of multicellularity?
- a. More predators can eat you.
 - b. Conditions inside the body tend to be more unstable; i.e., homeostasis is harder to achieve.
 - c. Fewer species and individuals represent suitable prey items.
 - d. There is less surface for materials to enter and leave the body compared to the volume of the body.
 - e. Larger species cannot move as efficiently as smaller ones.
15. p. 39. Which of the following is the highest taxonomic category?
- a. Species
 - b. Phylum
 - c. Genus
 - d. Order
 - e. Class
16. p. 41. Cladistics groups species (or higher taxa) using:
- a. only morphology.
 - b. shared, advanced (derived) character states.
 - c. all features of the phenotype.
 - d. shared, primitive (ancestral) character states.
 - e. all character states.
17. p. 42. Assume that this is the true cladogram for the five species shown below. Assuming parsimony, label where the derived (primed) character states evolved from the primitive states (unprimed), and circle any homoplasies.
- A'B'C'DE AB'CD'E AB'CD'E' A'B'CD'E'

ABCDE

18. p. 42. A matrix of character states for five species and their inferred common ancestor are shown. Assume that primed states are derived from the primitive state. Draw the most parsimonious cladogram at the right and label the species at the top.

Species

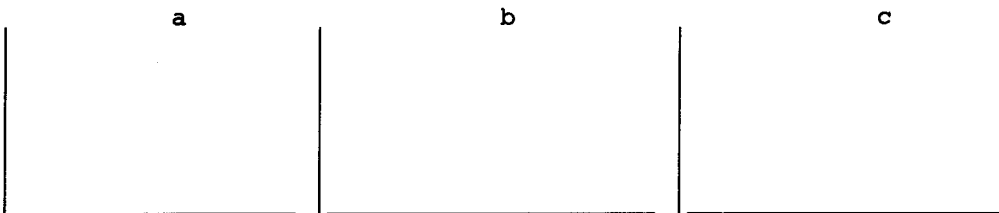
Species	Character States					
1	A'	B'	C	D	E'	F'
2	A'	B	C	D'	E	F
3	A'	B'	C'	D	E'	F
4	A'	B	C	D'	E	F
5	A'	B'	C'	D	E'	F
Ancestor	A	B	C	D	E	F

X

19. p. 44. The biological species concept emphasizes:
- reproduction among individuals of the species and genetic isolation from members of other species.
 - use of molecular character states (e.g., DNA sequence, protein variation) to distinguish species.
 - use of morphological character states to distinguish species.
 - positive assortative mating as an isolating mechanism.
 - None of the above.
20. p. 47. Which of the following speciation mechanisms is considered to be most likely to occur in nature?
- Sympatric speciation.
 - Parapatric speciation.
 - Allopatric speciation.
 - They are all equally likely.
 - We have no way of inferring which is most likely.
21. p. 48. Genetic drift is:
- the result of sampling error in gene frequencies in finite populations.
 - is a form of directional natural selection.
 - is a consequence of mutation.
 - results from the dispersal of individuals between populations.
 - results from disruptive selection.
22. p. 46. The following are all isolating mechanisms. Identify the one that can never result from natural selection against hybridization and for reproductive isolation?
- Habitat isolation.
 - Hybrid inviability.
 - Mechanical isolation.
 - Seasonal isolation.
 - Ethological or sexual isolation.
23. p. 51. In all samples of DNA, the amount of guanine (G) and cytosine (C) are always equal, and the amount of Adenine (A) and Thymine (T) are always equal. Why is this true?
- On average, the same number of each type of nucleotide occurs in any DNA sequence by chance.
 - The four types of nucleotides are equally abundant in the cell, so natural selection has favored equal use of them in all genes.
 - All codons include one of each kind of nucleotide.
 - All 64 codons are equally abundant in genes.
 - G and C, and A and T nucleotides pair up to form opposite strands of the double-stranded DNA molecule.
24. p. 53. What does RNA polymerase do?
- It catalyzes replication of genes during cell division.
 - It catalyzes the formation of polypeptide bonds.
 - It positions amino acids in the correct position for the formation of

- polypeptide bonds.
- d. It catalyzes the bonding of adjacent nucleotides during transcription of of DNA sequences to RNA sequences.
 - e. It positions nucleotides before RNA forms.
25. p. 55. Why are frame shift mutations so damaging to the function of a gene's product (i.e., a protein for which it codes)?
- a. They change every amino acid in the protein "downstream" of the frame shift mutation.
 - b. They cause a change in an amino acid without causing compensatory changes in adjacent amino acids.
 - c. They transfer a gene from one chromosome to another.
 - d. They rearrange many genes on a chromosome.
 - e. None of the above.
26. p 57. Mendel's Law of Segregation states that:
- a. members of different species normally do not interbreed in nature.
 - b. certain alleles cannot occur together in the same genotype.
 - c. fossils from different time intervals never occur together in the same stratigraphic layers.
 - d. reproductively isolated populations that are not ecologically divergent cannot coexist for long in the same habitat.
 - e. alleles do not lose their separate identities when they occur in the same heterozygous genotype and are passed on separately in the gametes.
27. p. 60. Suppose that A and B are dominant to a and b respectively. If a cross is made between two parents with genotypes AaBb and AaBb, and there are 32 offspring, how many would be expected to exhibit both dominant characteristics?
- a. 32
 - b. 18
 - c. 16
 - d. 9
 - e. 8
28. p. 58. A monohybrid testcross of ?? X aa gives half dominant and half recessive phenotypes. What is the unknown genotype?
- a. aa
 - b. Aa
 - c. AA
 - d. More information is needed.
29. Human blood groups are determined by multiple alleles for the ABO blood group gene. The alleles A and B are codominant to each other, and both are dominant to the allele I, which when homozygous codes for blood type O. Suppose a woman of blood group A marries a man of blood group B, and they have a child of blood group O. What are the genotypes of the parents?
- a. woman AB, man II
 - b. woman AI, man BI
 - c. woman AA, man II
 - d. woman AA, man BB
 - e. woman II, man II
30. Suppose flower color is controlled by a gene with two alleles, C and c and two heterozygotes are crossed. What genotypes will be produced and in which proportions?
- a. 2 CC : 1 Cc : 2 cc
 - b. 1 CC : 1 cc
 - c. 1 CC : 1 Cc : 1 cc
 - d. 1 CC : 2 Cc : 1 cc
 - e. None of the above.
31. p. 61. Linked genes:

- a. violate the Law of Independent Assortment.
 - b. are located close together on the same chromosome.
 - c. will be inherited as if they were a single gene.
 - d. violate the Second Law of Thermodynamics.
 - e. All of the above.
32. p. 62. Polygenic inheritance:
- a. is responsible for a genetic law established by Mendel.
 - b. determines traits controlled by many genes of roughly equal effect that interact additively.
 - c. usually produces a few distinctively different phenotypes, e.g., red versus white flowers in plants.
 - d. common in nature but not the kind of trait that Darwin envisioned to be acted upon by natural selection.
 - e. All of the above.
33. p. 64. What is the Hardy-Weinberg Equilibrium frequency for a population in which the genotypic (zygotic) frequencies start at $AA = 0.30$, $Aa = 0.40$, and $aa = 0.30$?
- a. $AA = 0.30$, $Aa = 0.40$, $aa = 0.30$.
 - b. $AA = 0.50$, $Aa = 0.00$, $aa = 0.50$.
 - c. $AA = 0.33$, $Aa = 0.33$, $aa = 0.33$.
 - d. $AA = 0.25$, $Aa = 0.50$, $aa = 0.25$.
 - e. None of the above.
34. p. 64. Which of the following departures from Hardy-Weinberg equilibrium will not cause major changes in the frequencies of alleles in a population from one generation to the next?
- a. Gene flow.
 - b. Genetic drift.
 - c. Mutation.
 - d. Natural selection.
 - e. All of the above.
35. p. 65. How would you expect a population to change over several generations during which it experienced truncating directional selection on body size, such that the smallest 25% of individuals failed to reproduce?
- a. The mean value of the trait should be stable, but variation for the trait should decrease.
 - b. The mean value of the trait should decrease, but variation should not change much.
 - c. The mean value of the trait should remain about the same, but variation should increase.
 - d. The mean value of the trait should increase.
 - e. The mean value of the trait should decrease, and variation for the trait should increase with time.
36. p. 66. Which of the following diagrams represents directional selection?



- a.
- b.
- c.
- d. None of the above.

- c. is an application of Mayr's allopatric speciation model to account for patterns of change in the fossil record.
 - d. represents a serious challenge to evolutionary theory and favors creationist arguments.
 - e. None of the above.
43. p. 86. Adaptive radiations seem to be triggered by:
- a. colonization of an island archipelago.
 - b. extinction of a dominant group.
 - c. formation of new habitats.
 - d. drastic changes in the environment.
 - e. All of the above.
44. p. 91. What event seems to have triggered the adaptive radiation of the Semionotid fish from the Triassic and Jurassic of eastern North America and adjacent areas of Europe and Africa?
- a. Extinction of the cichlid fishes.
 - b. Withdrawal of glaciers from the region.
 - c. Cyclical filling and drying of rift lakes, creating and eliminating new lake habitat.
 - d. Formation of the Appalachian mountains in response to collision of North America and Europe.
 - e. None of the above.
45. p. 95. *Archaeopteryx lithographica* is considered to be a missing link because it:
- a. is intermediate for many character states that differ between reptiles and mammals.
 - b. is intermediate for many character states that differ between reptiles and birds.
 - c. has mostly reptilian characters plus feathers and a few other advanced avian character states.
 - d. has mostly amphibian character states plus a few advanced character states of reptiles.
 - e. has feet on its limbs and clearly is an amphibian, but also has a tail fin and scales like fishes.
46. p. 103. The slogan, "survival of the fittest," was originally coined by:
- a. Darwin to encapsulate his view of natural selection.
 - b. Karl Marx to support his thesis that there is a natural progression from feudalism to socialism.
 - c. Herbert Spencer to justify "Social Darwinism," in which unconstrained competition would inevitably lead to social progress.
 - d. Malthus to describe the consequences of human population growth.
 - e. creationist opponents of evolutionary theory to discredit it as an immoral theory.
47. p. 104. What is wrong with the creationist argument that evolutionary biology is not a science but a religion because it describes past events, making it impossible to test predictions.
- a. Construction of cladograms shows that there were common ancestors.
 - b. Geographical distribution of related species requires an evolutionary explanation.
 - c. It is possible to make predictions about what will be observed when we study past events or existing patterns of variation that have not been investigated previously.
 - d. Creationists make no testable predictions about biological phenomena to test creation as an explanation because they are teleologists.
 - e. None of the above.
48. p. 104. Which of the following statements about creationists is correct?
- a. Repeated defeats in the courts have blunted their attacks on the teaching of biology.

- b. They have failed because evolution is widely taught U.S. public schools.
- c. They have collected large quantities of data that are inconsistent with evolutionary theory.
- d. They represent a small fringe of extremists with no significant following.
- e. They are correct in believing that evolutionary theory represents an intrusion of materialistic mechanistic thinking into previously religious issues.

49. p. 104. What is wrong with Gish's claim that evolutionists were embarrassed by the discovery of living lobefin fish (coelocanths) off the coast of Africa in the middle of this century?

- a. Lobefins were discovered long before this century living in African waters.
- b. Lobefins are not really related to the ancestors of land vertebrates.
- c. Lobefins may be close to the ancestry of land vertebrates, but there is no reason to expect groups that are close to the ancestry of other larger groups to have become extinct.
- d. Lobefins had been known from the fossil record for many years.
- e. None of the above.

50. p. 106. The engagement of individuals in altruism or sacrifice of their potential to reproduce:

- a. must be pathological.
- b. often can be explained by their realization of increased fitness through the reproduction of relatives that benefit from the altruism or sacrificed reproduction.
- c. must be inconsistent with natural selection and is a serious failure of the theory.
- d. is illusory, and claimed observations of such behaviors invariably prove to be erroneous.
- e. really occurs only in groups of insects in which all members are very closely related.