

(PLEASE DO NOT WRITE YOUR NAME ON THE EXAM.)

BIOS 209 - FUNDAMENTALS OF BIOLOGY II - 29 OCT. 2004

EXAM II (100 PTS)

Z-ID NUMBER: Z — _____

(56 PTS) **MULTIPLE CHOICE** (Fill in the bubble on the Scantron form with the **best** answer).

- 1) From a population genetics standpoint, a mutation is considered to be a change in DNA
 - a) that results in a recognizably different morphological phenotype;
 - b) that results in a change in the structure of the corresponding gene product;
 - c) that results in a change in the function of the corresponding gene product;
 - d) that results in a change in the expression pattern of the corresponding gene product;
 - e* that is of any magnitude, including the substitution of a single nucleotide base.

- 2) Which one of the following series is organized from the broadest category down to the narrowest category?
 - a* Anthropoid, Hominoid, Hominid, *Australopithecus*;
 - b) Hominoid, Anthropoid, Hominid, *Homo*;
 - c) Anthropoid, Hominid, Hominoid, Prosimian;
 - d) *Homo*, Hominoid, Hominid, Prosimian;
 - e) None of these is organized from the broadest to the narrowest category.

- 3) During the development of a multicellular organism, the process of cell differentiation
 - a) generally starts before cell division, but after morphogenesis;
 - b) generally starts before apoptosis, but after induction;
 - c* causes cells to take on specialized structures and functions;
 - d) causes the number of cells in the embryo to increase;
 - e) only occurs in organisms that do not have rigid cell walls.

- 4) Which of the following is an example of a PREzygotic barrier to hybridization?
 - a) Donkeys can mate with horses to produce viable, but infertile offspring called mules;
 - b) The two grass species sorghum and sugar cane commonly hybridize producing fertile offspring;
 - c) Different species of rock wallabies in Queensland are occasionally able to interbreed;
 - d* Eastern and western spotted skunks mate in different seasons and so do not interbreed;
 - e) The wolf and jackal (an African wild dog) can interbreed and produce hybrid red wolves.

- 5) Which of the following is an example of natural selection?
 - a) A mutation arises in a population of bent grasses that confers tolerance to heavy metals;
 - b* The mean beak depth in a population of Galápagos finches increases during a year of drought;
 - c) A pair of finches from Ecuador, caught in a sudden storm, is blown 600 miles to the Galápagos;
 - d) Meiotic failures during gamete production in primroses result in a polyploid zygote;
 - e) Hen pheasants are more likely to mate with cocks that have the longest spurs.

- 6) Which among the following is the oldest fossil hominid?
- "ARA-VP" (*Ardipithecus ramidus*);
 - Pan bonobo*;
 - "Turkana Boy" (*Homo erectus*);
 - "Lucy" (*Australopithecus afarensis*);
 - * The "Lukeino hominids" (*Orrorin tugenensis*).
- 7) Georges Cuvier, Jean-Baptiste Lamarck, Carolus Linnaeus and Charles Lyell were all
- proponents of the theory of "descent with modification," or what is now known as evolution;
 - * scientists who influenced Charles Darwin's views on natural selection in some way;
 - 18th or 19th century scientists who recognized that fossils were the fragments of ancient life;
 - in attendance at the public presentation of Darwin's first paper on natural selection;
 - Europeans who favored the principle of "catastrophism" over that of "uniformitarianism."
- 8) To determine the absolute age of a sample of volcanic rock using the technique of radiometric dating, the following pieces of information are needed: i.) The measurement of the amount of the parent isotope in the sample; ii.) The half life of that isotope; and iii) The
- relative age of the sample;
 - temperature of the fossil at the time the organism died;
 - * measurement of the amount of the daughter (decay) product in the sample;
 - measurement of the amount of ESCAPED decay product when the sample was initially deposited;
 - All of the above are needed for absolute dating.
- 9) Different colors and patterns can be observed in any randomly sampled group of 100 Asian lady beetles collected in Montgomery Hall this week. This observation can be generalized as
- * Asian lady beetles in the DeKalb population vary extensively in their characteristics;
 - the size of the Asian lady beetle population this year is statistically similar to that of 2003;
 - more Asian lady beetles hatched this year than the environment could support;
 - the survival of individual Asian lady beetles in this generation is nonrandom;
 - Asian lady beetles are engaged in a struggle for existence.
- 10) Paleontologists Stephen Gould and Niles Eldridge proposed what they believed was a more realistic model of evolution called "punctuated equilibrium," which
- increased age estimates for permineralized casts over that of compression fossils;
 - * was more consistent with the apparent gaps in the fossil record;
 - explained the successive deposits of volcanic material in the east african rift system;
 - altered the method of determining absolute dates of fossils;
 - suggested that speciation was a gradual process during which many transitional forms arose.
- 11) *Hox* genes
- encode transcription factors;
 - all have a homeobox sequence that specifies a DNA binding domain;
 - may have homeoboxes that are virtually identical in organisms as different as fruit flies and mice;
 - control the form of the anterior and posterior structures of the body;
 - * all of these.

- 12) Which of the following is an example of a type of genetic drift called a founding event?
- a) A mutation arises in a population of bent grasses that confers tolerance to heavy metals;
 - b) The mean beak depth in a population of Galápagos finches increases during a year of drought;
 - c* A pair of finches from Ecuador, caught in a sudden storm, is blown 600 miles to the Galápagos;
 - d) Meiotic failures during gamete production in primroses result in a polyploid zygote;
 - e) Hen pheasants are more likely to mate with cocks that have the longest spurs.
- 13) During what is called a bottleneck effect
- a) gene flow during the immigration of individuals or gametes causes a change in allele frequencies;
 - b) a change in DNA is propagated throughout a population eventually achieving "fixation;"
 - c* stochastic events, which reduce the size of a population, cause a change in allele frequencies;
 - d) the population experiences an adaptive shift in response to environmental stresses;
 - e) numerous, relatively rapid speciation events originate from a single ancestral lineage.
- 14) According to our class consensus definition, a new heritable trait that increases fitness is called a(n)
- a* adaptation;
 - b) allometry;
 - c) exaptation;
 - d) polyploidization;
 - e) paedomorphosis.
- 15) Who, among the following, studied beak evolution in Galápagos finches for about 30 years?
- a) Bertram Boltwood;
 - b* Rosemary Grant and Peter Grant;
 - c) Godfrey Hardy and Wilhelm Weinberg;
 - d) Walter Alvarez and Luis Alvarez;
 - e) Georges Cuvier.
- 16) According to our current understanding of evolution, which of the following is true?
- a) Founding events and bottlenecks both immediately increase the variability within a population;
 - b) Natural selection only occurs when some feature of the environment changes;
 - c) A bottleneck refers to any environmental change that increases the size of a population;
 - d* A mutation can be neutral, having no measurable effect on fitness;
 - e) Hominid evolution followed an anagenetic pattern.
- 17) Fruit flies, zebrafish, nematodes, wall cresses and mice were chosen as model organisms for developmental studies largely because these:
- a) are the only known animals with homeotic genes that function sequentially;
 - b) organisms are the most similar to humans in terms of adult morphology and physiology;
 - c) animals all develop from single-celled zygotes into multicellular adults;
 - d* organisms reproduce rapidly, represent a broad taxonomic spectrum, and are easily reared;
 - e) animals are the only ones known to undergo morphogenesis after the onset of cell division.

18) EMBRYONIC stem cell research poses a moral dilemma for some people because the embryonic stem cells are harvested from

- a) human umbilical cords in cord banks WITHOUT the permission of the parents;
- b) human placentas obtained from hospitals WITHOUT the permission of the parents;
- c) aborted human fetuses obtained from abortion clinics WITH the consent of the mother;
- d) aborted human fetuses obtained from abortion clinics WITHOUT the knowledge of the mother;
- e* human embryos of a few days old that were conceived by in vitro methods in fertility clinics.

19) Paleontologists digging in Egypt and Pakistan have found extinct fossil whales, now classified as *Basilosaurus*, that had hind limbs. *Basilosaurus* is an example of a(n)

- a) hominid fossil;
- b) hoax;
- c* transitional form;
- d) hopeful monster;
- e) extant amphibian.

20) According to population geneticists, a balanced polymorphism occurs when natural selection

- a) causes a mean phenotype to progressively INCREASE with each passing generation;
- b) causes a mean phenotype to progressively DECREASE with each passing generation;
- c) reduces the phenotypic variation in the population in favor of the mean phenotype;
- d* maintains stable frequencies of two or more phenotypic forms in a population;
- e) all of these.

21) During the embryonic development of a multicellular animal from a zygote, the onset of the process of

- a) cell differentiation precedes that of mitotic cell division, which precedes morphogenesis;
- b) mitotic cell division precedes that of morphogenesis, which precedes cell differentiation;
- c) morphogenesis precedes that of cell differentiation, which precedes mitotic cell division ;
- d) cell differentiation precedes that of morphogenesis, which precedes mitotic cell division;
- e* mitotic cell division precedes that of cell differentiation, which precedes morphogenesis.

22) Starch gel electrophoresis of allozymes is a technique used by population geneticists to estimate

- a) the number of descendant lineages that will be produced in future adaptive radiations;
- b* the frequencies of polymorphic loci and heterozygote genotypes in natural populations;
- c) the age of a permineralized fossil that is embedded in a layer of volcanic sediment;
- d) the number of RECENT mutations in the homeotic gene clusters of model organisms;
- e) the number of ANCIENT mutations in the homeotic gene clusters of model organisms.

23) After the elapse of TWO half-lives, the proportion of the original (parent) isotope in a sample is expected to be what fraction of its original value?

- a) One-half;
- b* One-quarter;
- c) One-eighth;
- d) One-sixteenth;
- e) This answer can not be determined without knowing the length of the half life.

- 24) In the Hardy-Weinberg equation, the variables “p” and “q” represent
- a* the overall frequencies of the dominant and recessive alleles in a population, respectively;
 - b) the proportions of homozygous and heterozygous genotypes in a population, respectively;
 - c) the frequencies of homozygous dominant and homozygous recessive individuals, respectively;
 - d) conventional names for the dominant and recessive alleles, respectively;
 - e) the relative proportions of carriers and noncarriers in a population, respectively.
- 25) Which of the following is an example of sexual selection?
- a) A mutation arises in a population of bent grasses that confers tolerance to heavy metals;
 - b) The mean beak depth in a population of Galápagos finches increases during a year of drought;
 - c) A pair of finches from Ecuador, caught in a sudden storm, is blown 600 miles to the Galápagos;
 - d) Meiotic failures during gamete production in primroses result in a polyploid zygote;
 - e* Hen pheasants are more likely to mate with cocks that have the longest spurs.
- 26) Extensive research supports the principle of “genomic equivalence,” which is the idea that
- a) all polyploid and diploid genomes are comprised of two or more haploid genomes;
 - b) the genomes of all organisms have equivalent overall numbers of protein coding genes;
 - c* nearly all of the nucleated cells of a multicellular organism have exactly the same genes;
 - d) embryonic cells retain the nearly infinite capacity for division and differentiation;
 - e) the genomes of most adult cell types are NOT sufficiently complete to permit successful “cloning” (nuclear transplantation).
- 27) Phylogenetic trees are inferred from comparison of what kinds of characters?
- a) Shared ancestral characters;
 - b) Homologous, shared ancestral characters;
 - c* Homologous, shared derived characters;
 - d) Analogous, shared ancestral characters;
 - e) All of these types of characters are equally useful for phylogenetic inference.
- 28) The geologic time scale, initiated in the 1800’s, was first constructed based on the principle of
- a* relative dating of fossils;
 - b) absolute dating of fossils;
 - c) radiometric dating of fossils;
 - d) paleomagnetic dating of fossils;
 - e) carbon-14 dating of fossils.

(20 PTS) **CORRECTED TRUE OR FALSE** (WRITE “T” OR “F” ON THE BLANK; IF FALSE, CORRECT THE STATEMENT).

29* _____ Genetic drift is considered to be one of the adaptive causes of evolution.

30) _____ Adaptations are often compromises to conflicting effects on fitness by different aspects of an organism’s environment.

TRUE OR FALSE (CONTINUED).

31)_____ In many animals (insects, worms, vertebrates, etc.), cells and tissues move to new positions in the embryo during morphogenesis.

32*_____ Older fossil-bearing sediments are typically found deposited above younger fossil-bearing sediments.

33)_____ Speciation can occur in as little as a single generation.

34*_____ Sympatric speciation occurs when a new species arises in subpopulations that are separated by a geographic barrier.

35*_____ Mutations come about in response to the adaptive needs of an organism.

36*_____ DNA studies of mammals, insects, yeast and prokaryotes suggest that the homeobox DNA sequence evolved recently among extant animals.

37)_____ The fossil record reveals that the history of life on earth includes repeated mass extinctions followed by the extensive radiation of surviving groups.

38)_____ Many of the genes found in the four *Hox* clusters of jawed vertebrates are identical to those found in the single *Hox* cluster of invertebrates.

(24 PTS) SHORT ANSWER (READ EACH QUESTION CAREFULLY AND FILL IN THE BLANK).

39) Increasing resistance to insecticides by populations of insect pests is an example of what kind of natural selection?

_____ .

40) The feet of tree-dwelling salamanders have shorter digits and extensive webbing that are adaptations for vertical climbing. Foot growth ends sooner in tree salamanders than in closely related ground-dwelling salamanders, which is an example of

_____ .

41) The only person who attempted to develop a comprehensive model to explain how life evolves BEFORE Charles Darwin and Alfred Wallace proposed their model of natural selection was

_____ .

42) In 1924, Raymond Dart discovered and named the first fossil of which species?

_____ .

43) In a population at Hardy-Weinberg equilibrium, for a gene with two contrasting alleles ("A" and "a"), if the frequency of "A" is 0.8, the frequency of heterozygotes ("Aa") in the next generation will be

_____ .

(Please show your calculation and circle your answer.)

44) Which mass extinction occurred about 250 million years ago and claimed about 90% of the species of marine animals and many terrestrial species as well?

_____ .

45) A biological species is defined as

_____ .

46) One specific line of evidence that convinced Darwin of the fact of evolution was

_____ .

47) Paleoanthropology is defined as

48) The contribution that an individual makes to the gene pool of the next generation relative to the contributions of other individuals is called

49) Coincidental resemblance between species from different evolutionary branches due to similar selective pressures and/or ecological roles is called

50) "Circular reasoning" occurs when the conclusion of an argument is contained in one of its assumptions. An brief example of circular reasoning in evolutionary biology follows:

The similarity in forelimb anatomy between bats and whales is assumed to be evidence of common ancestry. Bats are known to share a common ancestor with whales because of the fact that they both share similar anatomical organization of forelimbs.

The circularity can be avoided here by finding what other specific kinds of evidence?
