1.   Evolution is often described as "the theme that ties together all aspects of biology." This
            is because the process of evolution

   A. explains how organisms become adapted to their environment.
   B. explains the diversity of organisms.
   C. explains why all organisms have characteristics in common.
   D. explains why distantly related organisms sometimes resemble one another.
   E. all of the above are appropriate answers.

2.   Which of the following is **<u>not</u>** an example of an evolutionary **adaptation**:

   A. the cryptic appearance of the moth *Abrostola trigemina*, which looks like a broken
            twig.
   B. the appearance of the leafy sea dragon (a sea horse) which looks so much like the kelp
            (seaweed) in which it lives that it lures prey into the seeming safety of the kelp
                forest and then eats them.
   C. the long, broad wings of the red-tailed hawk that allow it to sustain a gliding flight
            over open country while it searches for prey with its keen eyes.
   D. the rounded body shape of the sargassum crab which resembles the floats of the brown
            alga *Sargassum* in which it lives.
   E. all of the above are examples of adaptations.

3.   One example of coevolution is that between

   A. birds and bees.
   B. flowering plants and insects.
   C. dinosaurs and mammals.
   D. humans and other primates.
   E. worms and fishes.

4.   Which of the following is **<u>not</u>** a fact or inference of Darwin's theory of evolution by natural
            selection?

   A. there is heritable variation among individuals.
   B. there is struggle for limited resources.
   C. individuals whose inherited characteristics best fit them to the environment will
            on average leave more offspring.
   D. offspring inherit characteristics acquired by their parents during the parents
            lifetime.
   E. all of the above are correct statements.

5. The idea that attributes acquired by an individual during its lifetime (for example, increased or decreased muscular strength due to more or less physical work) were passed on to the offspring is known as _____ and is attributed to _____.

    A. adaptation, Wallace.
    B. natural selection, Darwin.
    C. inheritance of acquired characteristics, Lamarck.
    D. genetics, Mendel.
    E. none of the above is correct.

6. Natural selection can be most closely equated with

    A. assortative mating.
    B. genetic drift.
    C. differential reproductive success.
    D. bottlenecking of a population.
    E. gene flow.

7. Which of the following elements of the writings of Malthus influenced Darwin?

    A. artificial selection
    B. differential reproductive success
    C. the potential for population growth exceeds what the environment can support
    D. species become better adapted to their local environments through natural selection
    E. favorable variations accumulate in a population after many generations of being perpetuated by natural selection

8. Darwin's thinking about evolution was influenced by things that he observed on his voyage around the world in the HMS Beagle, including all of the following except

    A. fossil beds in South America.
    B. giant land tortoises on the Galapagos.
    C. birds known as finches on the Galapagos.
    D. lands with similar climates, e.g., Australia and Chile, have very different animals and plants.
    E. all of the above are correct.

9. Evidence of a **unitary origin of life** comes from:

    A. analogous traits.
    B. homologous traits.
    C. examples of sexual selection.
    D. examples of convergent evolution.
    E. none of the above give evidence of a unitary origin of life.

10. What do a mushroom, a tree, and a human have in **common**?

   A. They are all members of the same kingdom.
   B. They are all prokaryotic.
   C. They are all members of the same class.
   D. They are all members of the same phylum.
   E. They are all composed of cells with nuclei.

11. If two different species belong to the same **family**, then they also belong to the
   same _____.

   A. order
   B. class
   C. phylum
   D. all of the above are correct
   E. none of the above is correct

12. The age of the earth generally accepted during Darwin's lifetime was incorrect. The earth is
   now estimated to be about

   A. 3.5 billion years old
   B. 2 billion years old
   C. 1 million years old
   D. 4.6 billion years old
   E. 20 billion years old

13. The bones in the front leg of a lizard and in the wing of a bat, which are evolutionarily
   derived from their common ancestor, are said to be

   A. analogous
   B. functionally similar
   C. sympatric
   D. homologous
   E. convergent

14. Assuming that milk production has only arisen once, then its presence in all monotreme,
   marsupial and placental mammals, and no other groups, is an example of:

   A. a synapomorphy.
   B. convergent evolution.
   C. analogous structures.
   D. a plesiomorphy.
   E. none of the above is correct.

15. Which clade (monophyletic group), or clades, do the **birds** belong to?

clade 1: animals with backbones (vertebrates).
clade 2: animals with an amniotic egg (amniotes).
clade 3: animals with four bony limbs (tetrapods).

A. 1.
B. 3.
C. 1 & 2.
D. 1 & 3.
E. 1, 2 & 3.

16. All living and extinct members of an order of birds called Passeriformes (the perching birds) have a distinctive palate, wing, and foot structure, and these are not found in any other bird species. The presence of these structures in all Passeriformes and no other birds means the structures are _____, and that the order Passeriformes is a _____ group.

A. synapomorphies, monophyletic.
B. symplesiomorphies, monophyletic.
C. synapomorphies, paraphyletic.
D. symplesiomorphies, paraphyletic.
E. none of the above is correct.

17. Despite their disjunct distribution, the living families of ratite birds, namely the ostrich of Africa, rhea of South America, emu of Australia, cassowary of Australia and New Guinea, kiwi of New Zealand and the tinamon of tropical America, comprise all the living descendants of a lineage that diverged from a common ancestral stock that inhabited Gondwanaland before it split into the southern land masses. Including their common ancestor they thus form a/an _____.

A. convergent group.
B. analogous group.
C. paraphyletic group.
D. monophyletic group.
E. none of the above is correct.

18. At the DNA level every eukaryotic genome contains nonfunctional pseudogenes: silent, nontranscribed sequences that retain some similarity to the functional genes from which they were derived. Pseudogenes can be considered to be _____ genes.

A. molecular clock
B. vestigial
C. exaptation
D. analogous
E. none of the above is correct.

19. For any given protein, molecular data shows a regularity in the rate of genetic change of the protein with time. The term applied to this phenomenon of regularity is

A. molecular clock
B. neutrality
C. adaptation
D. evolution
E. none of the above

20. Of the following, the one most different from all the others in terms of amino acid sequence in its hemoglobin α chain is the

A. human.
B. frog.
C. pigeon.
D. pig.
E. rabbit.

21. An evolutionary change in the time of appearance or rate of development of a character during ontogeny is an example of _____.

A. allometric growth.
B. heterochrony.
C. paedomorphosis.
D. punctuated equilibrium.
E. none of the above is correct.

22. If a trait called segmentation arose before arthropods and annelids (worms) branched from each other, its presence in both groups is due to

A. convergence
B. homology
C. analogy
D. divergence
E. none of the above is correct

23. Anatomical structures that show similar function but dissimilar embryonic and evolutionary relationships are:

A. homologous.
B. primitive.
C. analogous.
D. monophyletic.
E. paraphyletic.

24. In a comparison of a hawk and an eagle (both are birds, i.e., class Aves) their wings (flight structures) are _____, and the bones in their wings (they are tetrapods) are _____.

    A. analagous, analagous.
    B. analagous, homologous.
    C. homologous, analagous.
    D. homologous, homologous.
    E. none of the above is correct.

25. An adaptive radiation produces:

    A. sterile hybrids
    B. unfilled ecological niches
    C. a group of closely related but distinct evolutionary lineages
    D. unoccupied habitats
    E. a reduction in the rate of evolutionary change

26. Which of the following is **not** an example of convergent evolution:

    A. the similar body forms of the marsupial mole and the placental mole.
    B. the wings of Archaeopteryx and a bat.
    C. the body forms of the porpoise and the shark.
    D. the structure of the chimpanzee eye and the human eye.
    E. all of the above are examples of convergent evolution.

27. Almost all frogs lack teeth in the lower jaw, but frogs are descended from ancestors that did have teeth. One genus of frogs, *Amphiguathodon*, has "re-evolved" teeth in the lower-jaw.

Because the immediate ancestors of *Amphiguathodon* lacked teeth, while their more remote ancestors had teeth, the presence of teeth in the genus *Amphiguathodon* is a/an:

    A. pedomorphic trait.
    B. vestigial trait.
    C. homology.
    D. reversal.
    E. allometry.

28. Microevolution can be thought of as:

    A. changes in the frequencies of alleles in a gene pool.
    B. genes mutating in response to environmental change.
    C. creating new species where none existed before.
    D. reacting to changes in the environment.
    E. selecting the best environment in which to live.

29. An example of a macroevolutionary event is:

A. the changing frequency of light to dark moths when the Industrial revolution increased smoke in the environment.
B. the mass extinction of dinosaurs.
C. an isolated population of fruit flies grows really large.
D. a great reduction in population size of salmon due to over fishing.
E. none of the above is an example of a macroevolutionary event.

30. In the geological time scale the Cenozoic era is divided into the following epochs (from youngest to oldest):

Recent, Pleistocene, Miocene, Oligocene, Eocene, Paleocene

A. Correct.
B. Incorrect, Pliocene has been omitted.
C. Incorrect, relative positions of Paleocene and Eocene have been reversed.
D. Incorrect, relative positions of Pleistocene and Miocene have been reversed.
E. Incorrect, the oldest is Paleozoic, not the Paleocene.

31. The oldest known **eukaryote** fossils occur in the:

A. Cambrian.
A. Cenozoic.
B. Paleozoic.
C. Mesozoic.
D. Precambrian.
E. none of the above is correct.

32. When fossils are found, the actual parts of the organisms are usually replaced by

A. bones and shells
B. gas bubbles
C. minerals
D. proteins
E. water

33. Which of the following is **not** a fossil?

A. coal.
B. a burrow of an extinct animal.
C. an impression of a skeleton of the dinosaur stegosaurus.
D. a set of footprints.
E. all of the above are fossils.

34. Before the Cretaceous, the west coast of Africa was directly connected to

   A. Europe
   B. Eurasia
   C. the North coast of Australia
   D. Antarctica
   E. South America

35. When two major plates of the earth's crust collide, all of the following are possible except

   A. changes in the shape of continents
   B. earthquakes
   C. mountain building
   D. sunspots
   E. volcanic eruptions

36. A major evolutionary episode that corresponded most closely in time with the formation of Pangaea was the

   A. origin of humans
   B. Cambrian explosion
   C. Permian extinctions
   D. Pleistocene ice ages
   E. Cretaceous extinctions

37. Which of the following pairs is incorrectly associated.

   A. Silurian Period - invasion of land
   B. Cambrian Period - oldest known stromatolites
   C. Pleistocene Epoch - ice ages
   D. Cretaceous Period - extinction of dinosaurs
   E. Cenozoic Era - adaptive radiation of mammals

38. Jellyfish **first** appeared in the fossil record in the

   A. Paleozoicn
   B. Mesozoic
   C. Precambrian
   D. Cambrian
   E. Cenozoic

39. Which list is correct in order of appearance in the fossil record.

    A. amphibians, fish, mammals, reptiles
    B. fish, amphibians, reptiles, mammals
    C. fish, amphibians, birds, reptiles
    D. amphibians, reptiles, birds, dinosaurs
    E. none of the above is correct

40. The first organisms to colonize the land were the

    A. amphibians
    B. annelid worms
    C. insects
    D. plants
    E. trilobites

41. What characterizes a **prokaryotic** cell?

    A. the presence of mitochondria.
    B. the presence of chloroplasts.
    C. the presence of a nucleus.
    D. multicellular level of organization.
    E. none of the above is correct.

42. Which of the following is **incorrect**.

    A. all protists are eukaryotes.
    B. microevolution refers to changes in a gene pool over generations.
    C. Darwin was unaware of Mendel's laws of genetic inheritance at the time he wrote his
         book entitled Origin of Species, describing evolution by natural selection.
    D. the endosymbiotic theory states that present day eukaryote cells arose from a
         symbiotic consortium of prokaryote and early protoeukaryote cells.
    E. all of the above are correct statements.

43. The group of primates that includes the monkeys, apes, and humans is known as the

    A. anthropoids
    B. australopithecines
    C. hominids
    D. hominoids
    E. humanoids

44. When single-stranded DNA from a human is mixed with single-stranded DNA from a
    chimpanzee, we find that about 99% of the DNA is homologous. This can be taken as
    evidence that:

A. humans and chimpanzees originated in similar environments.
B. humans evolved from chimpanzees.
C. chimpanzees evolved from humans.
D. humans and chimpanzees are closely related.
E.   all organisms have similar DNA.

45. When humans (*Homo Sapiens*) appeared.

A. Cretaceous.
B. Precambrian.
C. Pleistocene.
D. Paleocene
E. Permian.

46. If a gene is described as polymorphic, how many alleles does it have?

A. one.
B. more than three.
C. two or more.
D. two.
E. none of the above.

47. If one gene with two codominant alleles (denoted A and B) controls flower color in pansies, and AA individuals have red flowers, AB individuals pink flowers, and BB individuals white flowers, then in matings of pink with pink individuals, on average how many of the offspring will have red, pink, and white flowers, assuming Mendelian segregation:

A. 25%, 50%, 25%
B. 0%, 100%, 0%
C. 33.3%, 33.3%, 33.3%
D. none of the above is correct
E. insufficient information is given to calculate this quantity

48. A population of Amerindians living in Brazil was surveyed and 10 individuals were found with type M blood (genotype = MM), 180 had type MN blood (genotype = MN), and 810 had type N blood (genotype = NN). What is the frequency of the M allele in this population?

A. 0.01
B. 0.09
C. 0.10
D. 0.20
E. insufficient information is given to calculate.

49. One condition specified for Hardy-Weinberg equilibrium is

    A. dominant alleles replace recessive alleles
    B. lack of genetic polymorphism
    C. migration
    D. natural selection
    E. random mating

50. Which of the following is **not** a condition that must be met for Hardy-Weinberg equilibrium?

    A. large population
    B. no mutations
    C. no migration
    D. dominant alleles more frequent than recessive alleles
    E. no natural selection

51. Which of the following populations is **not** in Hardy-Weinberg proportions?

    A. 25% AA, 50% AB, 25% BB
    B. 64% AA, 32% AB, 4% BB
    C. 81% AA, 18% AB, 1% BB
    D. 20% AA, 60% AB, 20% BB
    E. all of the above are in Hardy-Weinberg proportions.

52. In the ABO blood group system, allele A is dominant to O, allele B is dominant to O, while alleles A and B are codominant. Assuming Hardy Weinberg proportions, what is the frequency of blood type A if the allele frequencies are 50% for A, 20% for B and 30% for O.

    A. 40%
    B. 50%
    C. 55%
    D. 45%
    E. none of the above is correct

53. In a gorilla population in Zaire we consider a single gene locus with two alleles G and g, with G dominant to g. If the frequency of the genotype gg is 0.01, then, assuming Hardy-Weinberg proportions, the frequency of the genotype Gg is

    A. 0.02
    B. 0.09
    C. 0.18
    D. 0.36
    E. None of the above is correct

54. In a large randomly breeding population of lizards, 75% of the individuals at birth have white stripes; 25% do not have white stripes. If this is a genetic trait governed by a single pair of alleles with the allele for white stripes dominant, assuming Hardy Weinberg proportions, the frequency of the allele for **no** white stripes is

   A. 0.25
   B. 0.50
   C. 0.75
   D. 1.00
   E. There is no way to estimate.

55. The frequency of a rare recessive trait in a population is 1/10,000. What is the frequency of heterozygous carriers of the recessive allele, assuming Hardy Weinberg proportions?

   A. 1%
   B. approximately 2%
   C. 10%
   D. approximately 98%
   E. none of the above is correct

56. In a population, most copies of the recessive allele for a deleterious trait are found in individuals who are:

   A. afflicted with the disorder caused by the allele.
   B. polymorphic.
   C. homozygous for the allele.
   D. heterozygous for the allele.
   E. none of the above is correct.

57. Compared with other factors that can alter allele frequencies, mutation rates

   A. are low, but mutations are the source of genetic variability.
   B. are so low that they make no difference in nature.
   C. are so low that they cannot be detected in most populations.
   D. are less important than genetic drift, but more important than migration.
   E. are the most significant factor in microevolution.

58. The gene pool of a population (i.e., allele frequencies in a population) may change due to

   A. migration.
   B. a bottleneck.
   C. genetic drift.
   D. disruptive selection.
   E. all of the above are correct.

59. An epidemic killed a large proportion of a population of deer in California thereby reducing the gene pool. This is an example of

   A. directional selection.
   B. genetic isolation.
   C. the bottleneck effect.
   D. the founder principle.
   E. all of the above are correct.

60. Which of the following is an example of an evolutionary **adaptation**?

   A. a change in frequency of a neutral allele by genetic drift.
   B. constancy in the rate of accumulation of genetic changes in a molecule over time.
   C. the loss of an allele in a population due to a population bottleneck.
   D. fixation in a population of a selectively advantageous allele.
   E. none of the above is an example of an evolutionary adaptation.

61. In the early 1800's, peppered moths living in England rested on tree trunks that were covered with whitish lichens. The moths were also whitish in color and so matched the color of the background on which they rested. This made the moths less visible to the birds that preyed on them.

In the late 1840's, an increasing number of very dark moths began to appear in moth populations near cities where pollution had killed most of the lichens, leaving the tree trunks sooty and black. Over the past 100 years, the frequency of dark moths has increased to as much as 98% in populations near polluted cities.

What type of selection has operated on moths in the polluted areas since 1840?

   A. directional selection
   B. stabilizing selection
   C. disruptive selection
   D. sexual selection
   E. artificial selection

62. Which of these factors always produces adaptive evolutionary change in a given environment?

   A. genetic drift.
   B. founder effect.
   C. mutation.
   D. non-random mating.
   E. none of the above is correct.

63. In the guppy (*Poecilia reticulata*), a South American fish, males have a pattern of colorful and very variable spots. Guppies from streams inhabited by their major fish predator (*Crenicichla*) have smaller, less variable and less contrasting spots than guppies inhabiting streams that lack this predator.

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A scientist, John Endler, mixed a sample of zoo guppies from a *Crenicichla* inhabited stream to a site that lacked the predator. About 15 generations later (2 years), he found that the size of the males' spots and the diversity of color patterns had increased, so that the population now looked like those living in streams lacking the predator.

This is an example of:

A. balancing selection.
B. sexual selection.
C. disruptive selection.
D. directional selection.
E. kin selection.

64. A true story: A female hummingbird normally lays exactly two eggs each time she nests. Occasionally, a nest with three eggs is found, but the usual result is the loss of all three nestlings because the nest, built for two, breaks apart as they grow larger. Of course females that lay only one egg, which also occurs from time to time, raise only one young. Assuming egg number is inherited as a quantitative trait, this pattern is an example of:

A. directional selection
B. disruptive selection
C. stabilizing selection
D. kin selection
E. none of the above is correct

65. Female Red-winged Blackbirds are not lured by the bright red shoulder patch (epaulet) of the male, but select males that have managed to take over high-quality territories. The territorial display of the male Red-winged Blackbirds includes vocalizations and the exposure of their epaulets. The red epaulets play a crucial role in territorial contests between males and this is an example of:

A. directional selection.
B. balancing selection.
C. Mullerian mimicry.
D. Batesian mimicry.
E. sexual selection.

66. An example of Müllerian mimicry would be

A. a butterfly that resembles a leaf
B. two species of poisonous frogs that resemble one another in coloration
C. a minnow with spots that look like large eyes
D. a palatable species of butterfly that resembles an unpalatable one
E. a carnivorous fish with a worm-like tongue that lures prey

67. Bird guides once listed the myrtle warbler and Audubon's warbler as distinct species, but applying the biological species concept, recent books show them as eastern and western forms of a single species, the yellow-rumped warbler. Experts must have found that the two kinds of warblers:

A. live in the same area.
B. successfully interbreed in nature.
C. look enough alike to be considered one species.
D. are reproductively isolated from each other.
E. are allopatric.

68. Because of difference in peak breeding time, 5 species of frogs rarely produce interspecific hybrids. The isolating mechanism is

A. behavioral
B. ecological
C. geographical
D. mechanical
E. temporal

69. Suppose a species of grasshopper normally breeds in June and lays its eggs on the young shoots of an annual grass that comes up in June. A mutant female grasshopper in the population produces a batch of eggs that carry a new allele that delays sexual development until August. Her offspring feed on the young shoots of another grass, **in the very same habitat,** that comes up in August. Her offspring mate successfully with one another producing a new generation of August-mating grasshoppers. The August-mating sub-population of grasshoppers is a good candidate for:

A. allopatric speciation
B. stabilizing selection
C. sympatric speciation
D. directional selection
E. disruptive speciation

1.	E		48.	C
2.	E		49.	E
3.	B		50.	D
4.	D		51.	D
5.	C		52.	C
6.	C		53.	C
7.	C		54.	B
8.	E		55.	B
9.	B		56.	D
10.	E		57.	A
11.	D		58.	E
12.	D		59.	C
13.	D		60.	D
14.	A		61.	A
15.	E		62.	E
16.	A		63.	D
17.	D		64.	C
18.	B		65.	E
19.	A		66.	B
20.	B		67.	B
21.	B		68.	E
22.	B		69.	C
23.	C			
24.	D			
25.	C			
26.	D			
27.	D			
28.	A			
29.	B			
30.	B			
31.	D			
32.	C			
33.	E			
34.	E			
35.	D			
36.	C			
37.	B			
38.	C			
39.	B			
40.	D			
41.	E			
42.	E			
43.	A			
44.	D			
45.	C			
46.	C			
47.	A			