1. Which of the following factor(s) limit(s) exponential growth of a population?
   A. limited resource availability
   B. increases in predator populations
   C. competition between members
   D. competition with other species
   E. All of these choices limit exponential growth

2. A small marine amphipod has recently been discovered that carries a bad-tasting organism on its back, which is contrary to its normal behavior. If a fish ingests the pair, it immediately spits them back out. If the amphipod is alone, however, it is readily eaten. There is no apparent benefit or harm in this relationship for the "backpack" organism. This is probably a case of
   A. mutualism.
   B. parasitism.
   C. commensalism.
   D. competitive exclusion.

3. Primary succession takes much longer than secondary succession because it involves
   A. colonization by more K-selected species.
   B. time for development of the soil.
   C. more time for development of a seed bank.
   D. colonization by organisms that are farther away.
   E. redevelopment of the atmospheric gases.

4. MacArthur discovered that five species of warblers coexisted on spruce trees by foraging on the same caterpillar, but in different places of the tree canopy. This is
   A. an exception to the competitive exclusion principle.
   B. an exception based on birds taking longer to eventually compete and eliminate competitors.
   C. confirmation that all warblers were actually variations of the same species because different species couldn't coexist.
   D. an example of resource partitioning.

5. If the members of a population are small in size, mature early, and have high parity and fecundity, they are
   A. K-strategists
   B. r-strategists
   C. neither K-strategists nor r-strategists, but have characteristics of both.
6. Renewable energy resources include all of the following except
   A. the sun.
   B. the wind.
   C. biomass.
   D. natural gas.

7. Consider that a species of salmon lays 20,000 eggs per pair when it spawns and dies. At the end of five years, an average of one pair of mature salmon from this group of hatched eggs returns again to spawn in the parent stream (19,998 have not survived). What is the growth rate of this population?
   A. 10,000, because there were that many eggs produced per parent fish \(r\)
   B. 2,000, because this must be divided by five years
   C. zero, because there is exact replacement of the previous generation
   D. 2,000, because there was this much average die-off per year
   E. 19,998, because there was this much total loss

8. As the carrying capacity of an environment is approached by a population,
   A. births begin to exceed deaths.
   B. deaths begin to exceed births.
   C. the rate of reproduction increases.
   D. population growth begins to be exponential.
   E. density-dependent environmental resistance increases.

9. Opportunistic species
   A. are composed of large individual organisms.
   B. are good dispersers and colonizers of new habitats.
   C. are slow to mature.
   D. have long life spans.
   E. are adapted to stable environments

10. Consider the life of the praying mantis. The large predatory female lays several hundred eggs in a foam mass in the fall. The young are most vulnerable when they emerge in the spring, but the few that survive spread out over the countryside and, if they find a mate, lay eggs the following fall. Which type of survivorship curve does this represent?
    A. type I
    B. type II
    C. type III
    D. exponential growth followed by a decline from resource depletion
    E. maximal exponential growth and minimal use of carrying capacity

11. Which of the following statements about the value of the nitrogen cycle to an ecosystem is NOT true?
    A. Denitrification removes nitrogen from the atmosphere and converts it to a form that plants can use.
    B. Nitrogen fixation can occur in aquatic systems or in soil bacteria.
    C. Nitrification occurs as ammonium is converted to nitrate.
    D. Nitrification occurs as nitrogen gas is converted to nitrate.
    E. Both ammonium and nitrate ions are highly water-soluble
12. A population had a growth rate of 1.7 in 1995. In what year would the population be double its current value? Assume all other factors are constant. Choose ALL the correct responses that describe this calculation.
A. rule of 70
B. 2 years; 1997
C. 41 years; 2036
D. death rates would effect this calculation
E. carrying capacity

13. All of the following are volatile organic compounds (VOCs) except
A. methane.
B. chlorofluorocarbon.
C. carbon monoxide.
D. benzene.

14. Which of these diagrams represents an age structure diagram of more-developed countries?

![Age structure diagrams]

A. Diagram A
B. Diagram B

15. Waste soil and rock removed during surface mining is called
A. hazardous waste.
B. spoil.
C. gangue.
D. tailings.

16. Which of the following associations is incorrect?
A. omnivore - eats both producers and consumers
B. herbivore - eats producers and performs photosynthesis
C. detritivore - feeds on decomposing organic matter
D. autotroph - performs photosynthesis or chemosynthesis
E. carnivore - feeds on other consumers

17. The only heterotrophs required in an ecosystem are
A. omnivores.
B. herbivores.
C. decomposers.
D. autotrophs.
E. carnivores.
18. Energy flow in an ecosystem is not cyclic because energy is
A. destroyed as it is used.
B. evenly spread out over many organisms.
C. converted to many kinds of useful energy.
D. increased as you go up the energy pyramid.
E. converted to heat, which is no longer useful.

19. What is the correct sequence of organisms if a community is going through secondary succession?
   a. grasses establish themselves in the community
   b. shrubs establish themselves in the community
   c. soil formation occurs
   d. trees establish themselves in the community

Answer Choices

20. What occurs when two species with very similar niches live in an overlapping range?
   A. speciation
   B. adaptive radiation
   C. competitive exclusion
   D. total extinction of one species
   E. a switch in habitat for one of the organisms

21. The frequent change in HIV surface proteins is a type of
   A. mutualism.
   B. parasitism.
   C. coevolution.
   D. commensalism.

22. Consider the consequences of a harmless prey that evolves toward mimicry of a model that has an antipredator defense (Batesian mimicry). What happens to the effectiveness of this defense as more and more prey in the population are harmless mimics? Then consider what happens when a species with bad taste evolves to resemble a model that stings (Mullerian mimicry).

   A. The number of Mullerian mimics is limited because they dilute the protection afforded by the warning color pattern, but the addition of more Batesian mimics only strengthens the protective mimicry complex.

   B. The increase number of Batesian mimics dilutes or weakens the protection afforded by the warning color pattern, but the addition of more Mullerian mimics only strengthens the protective mimicry complex.

   C. The number of both Batesian and Mullerian mimics is limited because both dilute the protection afforded by the warning color pattern.

   D. The number of both Batesian and Mullerian mimics is unlimited because they both reinforce the protection afforded by the warning color pattern.
23. Which of the following statements about parasitism is NOT true?
A. The host is generally larger than the parasite.
B. An efficient parasite usually kills its host.
C. Smaller parasites often live as endoparasites within the body of the host.
D. Ectoparasites are attached to the outside of the host's body by specialized organs.
E. Some organisms and all viruses are obligate parasites and must live inside a host.

24. Which of the following features is not part of the ecological niche of a white tailed deer?
A. The number of acorns it consumes during the fall.
B. The availability of woods for it to use as cover in order to escape from predators.
C. The presence of a water source within its habitat.
D. All of these are part of a white tailed deer's ecological niche.

25. _____ lakes are nutrient rich and tend to have large populations of algae.
A. Oligotrophic
B. Eutrophic
C. Temperate
D. Stratified

26. All of the following are on EPA's "four most dangerous indoor air pollutants list" except
A. asbestos
B. radon-222
C. sulfur dioxide
D. cigarette smoke

27. Temperate deciduous forests are characterized by
A. dry climates with rainfall averages around 25-75 cm per year.
B. the highest variation in day and night length.
C. the highest amount of organisms living in tree canopy.
D. a growing season that ranges between 140 and 300 days.
E. the richest topsoil horizon.

28. A forest found in a broad belt in northern Eurasia and North America, with conifers and swamps, is called the
A. tropical rain forest.
B. tundra.
C. taiga.
D. chaparral.
E. temperate deciduous forest.

29. Kansas and Pennsylvania are approximately at the same latitude. Yet why are the potential natural communities in Kansas mostly grassland and in Pennsylvania mostly temperate forest?
A. different temperatures
B. different levels of moisture
C. different soil texture and pH levels
D. different vegetation due to different seed banks
E. different altitudes
30. Approximately what % of the known biodiversity on Earth is composed of plants?
A. 18 - 20%
B. 50 - 55%
C. 12 - 15%
D. 63 - 67%
E. 6 - 8%

31. What biome has a mean annual precipitation over 100 cm with relatively little seasonal variation, and the average temperature is freezing?

A. tropical dry forest
B. temperate rainforest
C. taiga
D. tropical rainforest
E. savanna

32. Which of the following biomes is characterized by little rainfall, permafrost, and an average temperature below 0°C?  A. grasslands
B. tundra
C. desert
D. taiga
E. temperate deciduous forest

33. There are tubeworms and clams that live at the bottom of the ocean near thermal vents that do not have direct access to sunlight so they derive their energy from
A. the sun by way of burning fossil fuels like we do with coal and oil.
B. the sun, but they are deep in the dark ocean and live off dead detritus that sink to them.
C. chemosynthetic bacteria.
D. sources not yet known.

34. A rain shadow is the region where heavy condensation precipitates out, as warm, moist air rises and then cools on the windward side of mountain ranges.
A. True
B. False
C. Depends upon the height of the mountain range
35. What is a major disadvantage of wind power?
A. low net energy  
B. high noise levels  
C. time consuming to construct  
D. low efficiency

36. Which of the following statements about keystone species is NOT true?
A. The extinction of keystone species can lead to other extinctions and a loss of biodiversity.  
B. Keystone species are defined as a population subdivided into several small isolated populations due to habitat fragmentation.  
C. Examples of keystone species are grizzly bears, bats, beavers and alligators.  
D. The numbers of individuals in the keystone species in their respective community may or may not be excessively high.

37. Biodiversity is a resource of immense value. All of the following are ways in which biodiversity is directly valuable to humans EXCEPT
A. agricultural.  
B. medicinal.  
C. consumptive use.  
D. contributions to biogeochemical cycles.

38. Lichens are particularly useful for indicating
A. water pollution.  
B. air pollution.  
C. toxic-waste sites.  
D. pesticides.

39. One of the two main reasons for the changes that are occurring in the Earth’s climate?
A. Large scale deforestation  
B. Disruption of the waste recycling by decomposers  
C. Over harvesting of wild species for consumptive value  
D. Drainage of wetlands producing a disruption of water purification  
E. An increase in soil erosion leading to siltation of rivers and estuaries

40. Advantages of using microorganisms for mining include all of the following except reduced
A. land disturbance.  
B. air pollution.  
C. water pollution.  
D. time to remove minerals.

41. Which of the following statements about ecological pyramids is true?
A. Pyramids built upon the biomass of organisms at each level eliminate size as a factor.  
B. Energy gains between trophic levels occur based upon biomass conversion.  
C. The limited number of trophic levels in an ecological pyramid is due to increasing complexity and size of organisms at each greater trophic level.  
D. A pyramid of organism numbers will always have a large base and a small top.  
E. None of the choices are true.

42. Photochemical smog is formed when primary pollutants interact with
A. sunlight.  
B. water vapor.  
C. sulfur dioxide.  
D. oxygen levels and temperature
43. Consider the following food chain: hawk - rabbit - clover. Each species will contain a different amount of calories in its body (clover: 10 calories, rabbit: 500 and hawk: 1200). Each species has a different daily caloric requirement (clover: sunlight, rabbit: 100 calories, hawk: 300).

How many rabbits, per day, does it take to support the hawk?
A. approximately 6  
B. about 1/2 a rabbit  
C. 2 whole rabbits  
D. 12 rabbits

44. Two communities may have exactly the same number of species, yet one might be measured as having a greater species diversity. Why?
A. composition or a listing of the various species in a community  
B. a community and all of the abiotic factors associated with it  
C. the native species plus the introduced species  
D. the potential number of species that should exist in a community minus the species that have gone locally extinct  
E. both the number of species and the evenness or relative abundance of individuals of the different species

45. In an Asian rice paddy, carp eat decaying material from around the base of rice plants while a snail scrapes algae from the leaves, stems, and roots of the same plant. They can survive at the same time in the same rice paddy because they occupy
A. the same habitat but different niches.  
B. the same habitat and the same niche.  
C. the same niche but different habitats.  
D. different habitats and different niches.

46. The science of collecting, analyzing, and making readily available biological information is
A. habitat restoration planning.  
B. landscape preservation.  
C. bioinformatics.  
D. a population viability analysis.

47. What is the correct sequence of events that has led to the decimation of the kelp beds along the west coast of the U.S.?

a. Sea otters decline in numbers  
b. Increase in orca predation on sea otters  
c. Decline in the seals and sea otters  
d. Over fishing of the herring and perch  
e. Increase in the sea urchin population

Answer Choices
A. d - c - b - a - e  
B. d - c - b - e - a  
C. a - d - c - b - e  
D. d - b - c - a - e  
E. b - d - c - a - e
48. Which of the following statements best describes the difference in approach to studying the environment by early naturalists compared to present-day ecologists?

| A) Early naturalists were interested in interactions between organisms and their environment; present day ecologists are interested in interactions between organisms. | D) Early naturalists were interested with man's interaction with the natural world; present-day ecologists seek to link ecology to developmental biology. |
| B) Early naturalists manipulated the environment and observed changes in plant and animal populations, while modern ecology focuses on population dynamics. | E) Early naturalists employed a descriptive approach; present-day ecologists generate hypotheses, design experiments, and draw conclusions from their observations. |
| C) Early naturalists systematically recorded what they observed in their environment; modern ecology is only concerned with man's impact on the environment. |

49. Which of the following statements about wave power is false?

A. Wave power is created primarily by wind.
B. Wave power is expected to be a key contributor to global electric production by 2110.
C. Net useful energy is moderate.
D. Equipment may be damaged by storms.

50. Which of the following events will occur as an ocean current moves from an equatorial region towards a polar region?

| A. The current will be warm as it leaves the equatorial region and begins to cool as it moves towards the polar region. This in turn will cause the air currents to become cooler as they move closer to the poles creating a tundra type of biome. | D. The current will be warm as it leaves the equatorial region and begins to cool as it moves towards the polar region. This in turn will cause the air currents to become warmer as they move closer to the poles creating a desert type of biome. |
| B. The current will be cool as it leaves the equatorial region and begins to warm as it moves towards the polar region. This in turn will cause the air currents to become cooler as they move closer to the poles creating a tundra type of biome. | E. The current will be warm as it leaves the equatorial region and become even warmer as it moves towards the polar region. This in turn will cause the air currents to become warmer and drier as they move closer to the poles creating a tundra type of biome. |
| C. The current will be warm as it leaves the equatorial region and begins to cool as it moves towards the polar region. This in turn will cause the air currents to become warmer as they move closer to the poles creating a grassland type of biome. |
An experiment was completed which shows the effects of organic waste on the dissolved oxygen (DO) content in lake water. Five tanks were set up, each containing the same amount of water and the same amount of phytoplankton. Carefully measured amounts of organic wastes were added to each tank. The results below show the amount of DO in each tank after a period of one week.

<table>
<thead>
<tr>
<th></th>
<th>TANK 1</th>
<th>TANK 2</th>
<th>TANK 3</th>
<th>TANK 4</th>
<th>TANK 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial DO</td>
<td>25ppm</td>
<td>25ppm</td>
<td>25ppm</td>
<td>25ppm</td>
<td>25ppm</td>
</tr>
<tr>
<td>Organic waste added</td>
<td>0g</td>
<td>10g</td>
<td>20g</td>
<td>30g</td>
<td>40g</td>
</tr>
<tr>
<td>DO after one week</td>
<td>25ppm</td>
<td>25ppm</td>
<td>20ppm</td>
<td>13ppm</td>
<td>0ppm</td>
</tr>
</tbody>
</table>

51. What is the independent variable in this experiment?
A. initial DO
B. tank conditions
C. amount of organic waste added
D. DO measurements after one week

52. What would be an important purpose for constructing and running a lab under these conditions?
A. To demonstrate that DO is not important
B. To observe how DO levels react to various amounts or organic waste
C. To show how much CO₂ is consumed by the process of decomposition
D. To determine how much O₂ the phytoplankton can produce in one week
E. To collect data to determine how waste in water can be useful

53. Which of the following would best improve the validity of this experiment:
A. Adding different forms of organic waste to each tank
B. Eliminating tank 1 because no organic waste was added to that tank
C. Increasing the amount of phytoplankton in each tank with tank 5 having the most added
D. Observing the results of adding organic waste to tanks containing salt water
E. Have several colleagues repeat the experiment to compare results

54. Which of the following would be the control in this experiment?
A. Tank 1
B. amount of lake water is the same
C. initial DO measurement
D. Tanks 3, 4, & 5
E. Both B & C

55. What is the science behind these results?
A. The phytoplankton could not consume the waste materials fast enough
B. The oxygen came out of solution and into the air
C. The CO₂ increased due to phytoplankton respiration
D. The turbidity of the water increased causing the phytoplankton population to increase
E. The phytoplankton reproduced, died and decomposition removed the oxygen