1. In one of your BIOL 1114 lab experiments this semester you used bacteria that had previously been exposed to UV light. If this exposure resulted in a mutation in one of the bacterial cells, which one or more of the following are possible outcome(s).
   a) synthesis of a nonfunctional protein
d) change in DNA base sequence
e) All of the above (a - d) are possible outcomes.
   b) change in mRNA sequence
c) change in amino acid sequence

Use the following information to answer the NEXT 5 QUESTIONS.
Spiders eat insects. Thus, they are secondary consumers. Spiders produce silk streamers that allow young spiders to be carried long distances on air currents. Thus spiders are often the first animals carried to new islands. Suppose that a new island has just appeared in an extremely large lake at Hogwarts School for Wizards. The wizards named it New Island.

2. Spider populations will become permanently established on New Island as soon as _______ established on the island.
   a) some plant species become
   b) some plants and some small insects that can eat the plants become
c) some plants, some small insects that eat plants, and some fish-eating birds become

3. Over the centuries, the number of different eye colors and patterns in jumping spiders (called Brilliant Jumpers) on New Island becomes much greater than in the founding population. These different eye colors and patterns were first thought to be the result of too much magic in the neighborhood, but Professor Dumbledore (who is an excellent biologist) reports that he has found no influence of magic on eye color in spiders. You correctly conclude that the different colors and patterns are the result of ______________.
   a) low salinity water in the lake increasing mutation rate in spiders
   b) spiders wanting to be more colorful
c) random mutations resulting in different colors
d) too much production of oxygen by spiders on the island
e) overpopulation of the island by insects

4. The eyes of some spiders on the island appear red to us because _________.
   a) yellow light is reflected by their legs
   b) they are only active at Valentine’s Day
c) red light is absorbed by spiders’ eyes
d) blue light is reflected by spiders’ eyes
e) red light is reflected by spiders’ eyes

5. In the last 2 years, the Brilliant Jumpers have become specialized. Spiders with red eyes eat only blind ants. Spiders with yellow eyes eat only small red-eyed spiders. Spiders with purple eyes eat only cockroaches. Professor Dumbledore reports that yellow-eyed spiders breed only with yellow-eyed spiders. Purple-eyed spiders breed only with other purple-eyed spiders. Red-eyed spiders breed only with other red-eyed spiders. This pattern of change is called ____________.
   a) color gradient
   b) adaptive radiation
   c) founder effect
d) multiple alleles
e) X-linked inheritance

6. Brilliant Jumpers that are most successful as hunters tend to jump fast and far. You would correctly hypothesize that the most successful hunters _________.
   a) have weak (poor) gradients of protons (H+) across the inner mitochondrial membrane
   b) take oxygen into the body at high rates
c) release oxygen from the body at high rates
d) produce lots of ATP
e) (b) and (d) are true.
Members of the Conidae family (Cone snails) have been collected for centuries for their beautiful and intricately designed shells. Cone snails are marine mollusks (includes clam, snail, octopus, and squid) and they are found in reef environments throughout the world. Most species are found in the Indo-Pacific region in temperate or tropical waters (22° - 29° C), but others live along the southern Australian coast where the water temperature is only 5° - 12° C. They feed upon other marine organisms (mollusks, fish, worms) that they capture by immobilizing them with venom that contains some of the most potent neurotoxins known. The venom is injected by way of a hollow spear-like tooth and it has an immediate effect. *Conus pruipurascens*, a fish-eating snail, can paralyze its prey in about two seconds. This is advantageous for an organism such as the snail that has limited mobility.

Cone snail venoms are variable mixtures of 10 to 30 amino acid-long polypeptides (proteins). Each species' venom may contain 2 to 3 different types of neurotoxins. The venoms are very prey-specific and although Cone snails do not feed on humans they will sting if disturbed and this can result in death without proper medical treatment.

7. Which one or more of the following are possible modes of action for Cone snail venom that results in paralyzing the prey item?
   a) blocking acetylcholine receptors at the neuromuscular junction  
   b) holding sodium gates open  
   c) holding potassium gates closed  
   d) All of the above (a-c)  
   e) Only (a) and (b)

8. *Conus textile* feeds on other mollusks and has an unique venom that includes among other things a substance that causes seizures that prevent the prey from retreating back into its shell, which most snails do when attacked. Thus, the prey item is easily accessible to the Cone snail. Which one or more of the following would you correctly predict to be consistent with a toxin that results in seizures?
   a) blocking acetylcholine receptors  
   b) holding sodium gates open  
   c) increasing the rate of neurotransmitter release  
   d) All of the above (a-c)  
   e) Only (a) and (b)

9. Cone snails are poikilothermic, therefore you would correctly predict which one or more of the following concerning the snail and the temperature of the water in which it is found?
   a) Movement of H+ across the inner mitochondrial membrane will be faster in the snails found in the warmer Indo-Pacific region than those along the cooler southern Australian coast.  
   b) Surface-area to volume ratio plays a role in heat transfer only for those snails in the Indo-Pacific region.  
   c) On a sunny day in shallow water, larger Cone snails will gain heat faster than smaller Cone snails in the same area.  
   d) All of the above (a-c) are correct predictions.  
   e) Only (a) and (c) are correct predictions.

10. You would correctly predict that the rate of enzyme-facilitated venom production in Cone snails found in the warmer Indo-Pacific region would be ________ Cone snails found in the cooler waters around south Australia.
   a) faster than  
   b) slower than  
   c) the same as

11. In Cone snail cells that produce and secrete venom proteins, you would expect to find an abundance of which one or more of the following?
   a) ribosomes  
   b) rough endoplasmic reticulum  
   c) cell walls  
   d) chloroplasts  
   e) Both (a) and (b)

12. Cone snails of the same species often exhibit variation in the patterns on their shells even when grown under identical conditions. What best explains this phenotypic variation?
   a) differences in weight of the individuals  
   b) differences in water temperature  
   c) differences in body length  
   d) genotypic (DNA) differences

13. Stings (envenomation) by certain species of Cone snails (particularly *C. geographus*) may be fatal for humans. Stings can occur when walking or swimming in shallow tropical waters or incorrectly handling a snail. Symptoms include paralysis (including the muscles involved in breathing), nausea, and weakness. Necessary medical treatment includes immediate resuscitation (CPR) and treatment of respiratory failure. It is important to restore breathing to provide ________.
   a) oxygen for glycolysis  
   b) an electron donor for neural transmission  
   c) electrons for the Krebs cycle  
   d) a final electron acceptor in the mitochondria  
   e) O2 for the Calvin cycle
14. Which one or more of the following describes what happens to a snail’s cells when placed in saltwater that contains a lower concentration of salts than its cells? Water moves _______________.
   a) into the cells by osmosis, and they swell.  c) into the cells by osmosis and they shrink.
   b) out of the cells by osmosis and they swell.  d) out of the cells by osmosis and they shrink.

15. The specific neurotoxin produced by *C. textile* contains 27 amino acids. It would require the translation of ___________ to assemble this protein.
   a) 3 codons  b) 9 codons  c) 27 codons  d) 81 codons

16. T-A-C-C-T-G represents a portion of a Cone snail neurotoxin gene. The complementary DNA sequence is ___________.

17. The result of transcribing T-A-C-C-T-G would be ___________.

18. Translation of RNA that was transcribed from the DNA sequence T-A-C-C-T-G-A-T-A-G-G-C would result in ___________.
   a) met-asp-ala-pro  d) tyr-leu-ile-gly
   b) met-asp-tyr-pro  e) All of these (a-d) are possible.
   c) ser-val-phe-pro

Use the following information for the NEXT 3 QUESTIONS.

Northern Florida has over 300 freshwater springs, which provide recreational sites and drinking water. Rainfall seeps through the subsoil to replace the groundwater that feeds these springs. Rainwater carries any surface pollutants, unfiltered by the grass and soil above, into the groundwater. The watersheds include many residential lawns, golf courses, sewage treatment plants, and poultry and livestock operations. Each spring receives enough seepage from its own watershed to reflect local conditions above ground. As the numbers of farm animals and humans living above the springs continue to grow, the pollutant concentration in the spring water is likely to increase. In recent years, chemists have begun to detect high concentrations of nitrogen (nitrates) in springs located in certain counties in Florida.

19. In which Florida counties would you correctly predict to find springs with the highest nitrate levels?
   a) counties with the fewest people and croplands    d) counties closest to the ocean
   b) counties with the most chickens, dairy cows and people  e) counties with the most sunshine
   c) counties with the fewest chickens and dairy cows

20. We should be concerned about the level of nitrates in our water sources for which one or more of the following reasons?
   a) possible eutrophication  c) toxins produced by algae  e) All of the above (a-d) are reasons for concern.
   b) decreased biodiversity  d) fish kills

21. A pond fed by spring water containing high levels of nitrogen and phosphorous might become anoxic (no O_2) if ...
   a) an algae bloom results in high photosynthesis rates  d) water temperatures get too low to allow cellular respiration
   b) an algae bloom results in increased cellular respiration  e) mosquitoes infect anglers (people fishing) with malaria
   c) fish produce too much oxygen
In the past few years, homeowners have become fascinated with water gardens, and the number of homes with these small ponds has dramatically increased. Many cities including Stillwater host annual water garden tours. The gardens contain various types of plants and fish. **Floating plants** float freely on the surface of the water and can be placed in all areas of the pond. **Surface plants** have their roots in the soil and leaves on long stems that float on the water's surface. Floating and surface plants shade the underlying water. They may root in the soil or float freely. Some people use large goldfish in their gardens, however, the most popular fish are Koi. Koi reach a maximum length of 1 meter and are white with colored (red, black, yellow, orange) blotches. Koi can produce thousands of eggs in a single breeding. The eggs hatch in 3-7 days, and the young must be separated from the adults to prevent them from eating their offspring.

To maintain good water quality, some water garden experts recommend using many submerged plants in your water garden. Experts also suggest that you monitor the temperature of your water garden and feed Koi according to the following guidelines.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Feeding Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>No food at all</td>
</tr>
<tr>
<td>11 to 15</td>
<td>Feed once a week</td>
</tr>
<tr>
<td>16 to 18</td>
<td>Feed every 3 to 4 days</td>
</tr>
<tr>
<td>19 to 23</td>
<td>Feed every day</td>
</tr>
<tr>
<td>24 to 26</td>
<td>Feed 2 - 3 times per day</td>
</tr>
<tr>
<td>27 to 30</td>
<td>Feed 2-3 times per day and increase amount to no more than fish can eat in 5 minutes</td>
</tr>
<tr>
<td>&gt;30</td>
<td>Decrease amount of food to prevent oxygen depletion</td>
</tr>
</tbody>
</table>

22. Based on what you have learned in this class, which one or more of the following statements is (are) consistent with the information provided in the fish-feeding chart?
   a) Koi are poikilothermic animals.
   b) At 15 °C, Koi have a slow rate of glycolysis, and they do not require as much food to keep them alive as at 25 ºC.
   c) Koi use oxygen as the final electron acceptor in aerobic cellular respiration.
   d) All of the above (a-c) are consistent with the information in the chart.
   e) Only (a) and (c) are consistent with the information in the chart.

23. Some water garden experts recommend using many submerged plants in your water garden to maintain good water quality. Which one or more of the following describe the possible role(s) of submerged plants in a water garden?
   a) provide oxygen to support aerobic respiration by decomposers such as bacteria
   b) provide oxygen to support chemiosmosis in fish cells
   c) utilize phosphorus released from decaying plant material, thus depriving algae of nutrients
   d) utilize nitrogen from fish waste products, thus limiting algal growth
   e) All of the above (a-d) are possible roles of submerged plants in a water garden.

Note that \( r = b - d \), and \( G = rN \text{ OR } G = rN^*((K-N)/K) \), where \( r \) is the exponential growth rate, \( N \) is the population size, \( G \) is the growth increment, and \( K \) is the carrying capacity.

24. If you had a water garden containing 6 Koi and during a single year they produced 10,000 offspring of which 7,000 were eaten, what would the growth rate (\( r \)) be for this year?
   a) 3,000 Koi/Koi/year  b) 18,000 Koi  c) 10,000 Koi  d) 500 Koi/Koi/year  e) 0.002 Koi/Koi/year

25. What would the growth increment (\( G \)) be for this year?
   a) 12 Koi  b) 500 Koi  c) 3,000 Koi  d) 10,000 Koi  e) 17,000 Koi

26. If a 10 square meter water garden contains 5 Koi, the Koi density is ______________.
   a) 5 Koi  b) 0.5 Koi per square meter  c) 2 Koi per square meter  d) 50 Koi per square meter

27. Which of the following would best support the hypothesis that Koi and goldfish are not the same species?
   a) Koi and goldfish placed in the same water garden never mate with each other to produce viable young.
   b) The Koi lay more eggs than goldfish.
   c) The Koi eat different food items than goldfish.
   d) The Koi have a different color pattern than goldfish.
   e) The Koi and goldfish spend most of their time in different parts of the water garden.
28. Which one or more of the following would be useful in controlling the growth of unwanted algae in a water garden?  
a) A high density of floating and surface plants to shade the pond.  
b) Removing dead and decaying plant material (a source of nutrients) before it accumulates at the bottom of the pond.  
c) Install the pond higher than the surrounding lawn to prevent runoff into the pond.  
d) Keep many algae-eating fish in the pond.  
e) All of the above (a-d) would be useful in controlling algae in a water garden.

29. Which one or more of the following Koi has/have the greatest fitness?  
a) a Koi that swims fast and never mates  
b) a brightly colored Koi that mates and produces 1000 offspring, then gets eaten by a predator  
c) a small, drab Koi that mates and produces 500 offspring before it dies of old age  
d) a brightly colored Koi that swims fast and produces 100 fast-swimming offspring before it dies of old age  
e) all of these Koi (a-d) have equal fitness

30. You hypothesize that water temperature affected growth rate in Koi, and conduct an experiment to test your hypothesis. The independent variable would be _______ and the dependent variable would be _______.  
a) growth rate; water temperature  
b) water temperature; growth rate  
c) food consumption; water temperature  
d) water temperature; nitrate concentration  
e) both (b) and (c)

31. A water garden owner introduced antibiotics into the pond, because he thought that would keep the fish healthy. You would correctly predict that ___________.  
a) the antibiotic would inhibit bacterial growth and reproduction in the pond  
b) the antibiotic would produce bacterial antigens  
c) mutations in some bacteria, present prior to introduction of antibiotics, would allow antibiotic resistant bacteria to thrive  
d) the antibiotic would cause mutations in bacteria that would allow them to become resistant  
e) both (a) and (c)

32. Albinism is an **autosomal recessive** trait. If an albino Koi mates with a spotted Koi that is **homozygous dominant**, what is the probability that any one of their offspring will be albino?  
a) 100%  
b) 75%  
c) 50%  
d) 25%  
e) 0%

33. If two of the offspring produced by the fish couple in the previous question mate, what percentage of their offspring are predicted to be albino?  
a) 100%  
b) 75%  
c) 50%  
d) 25%  
e) 0%

34. The source of the carbon in the leaves of floating plants is _______________.  
a) ATP formed in photosynthesis  
b) ATP formed in cellular respiration  
c) atmospheric CO₂ that is incorporated into glucose during photosynthesis  
d) O₂ released in aerobic respiration  
e) NADH and FADH formed in aerobic respiration

35. All types of aquatic plants make _______ from _______ during photosynthesis.  
a) glucose and water; carbon dioxide and oxygen  
b) oxygen and ATP; glucose and carbon dioxide  
c) glucose and oxygen; carbon dioxide and water  
d) carbon dioxide and water; glucose and oxygen  
e) carbon dioxide and ATP; water and oxygen

36. For any given water garden, which one or more of the following would you correctly predict?  
a) Amount of oxygen produced by plants would fluctuate with water temperature.  
b) Amount of oxygen consumed by Koi would fluctuate with water temperature.  
c) Amount of oxygen consumed by plants would fluctuate with water temperature.  
d) All of the above (a-c) are correct predictions.  
e) Only (a) and (b) are correct predictions.
37. All types of aquatic plants produce _________ from __________ during cellular respiration.
   a) glucose and water; carbon dioxide and oxygen  
   b) oxygen and ATP; glucose and carbon dioxide  
   c) glucose, oxygen and ATP; carbon dioxide and water  
   d) carbon dioxide, water and ATP; glucose and oxygen  
   e) None of these (a-d) – plants don’t do cellular respiration

38. In the Krebs cycle, plants produce __________.
   a) energy-rich electron carriers (NADH and FADH$_2$) and CO$_2$  
   b) glucose and oxygen  
   c) water and oxygen  
   d) thylakoids  
   e) both (b) and (d)

39. In glycolysis, plants consume __________.
   a) glucose  
   b) oxygen  
   c) carbon dioxide  
   d) mitochondria  
   e) NADPH

40. In the light-dependent reactions, plants produce __________
   a) glucose to run the Calvin cycle  
   b) NADH to run the electron transport system in mitochondria  
   c) NADPH and ATP to run the Calvin cycle  
   d) ATP to run the sodium potassium pump  
   e) carbon dioxide to use as an electron acceptor in cellular respiration

41. In the Calvin cycle, plants produce __________.
   a) oxygen to act as the terminal electron acceptor in electron transport  
   b) glucose as a building block for other compounds  
   c) carbon dioxide to run cellular respiration  
   d) electrons to provide electricity  
   e) all of these (a-d)

The NEXT 6 QUESTIONS go together.

42. In 1859, 24 rabbits were introduced into Victoria, a state of Australia. There were previously no rabbits in Australia. At that time, excessive food was available to the rabbits, and there were very few competitors, predators, or parasites. Predictably, the rabbit population soon underwent ____________.
   a) spontaneous generation  
   b) rapid mutations  
   c) exponential growth  
   d) extinction

43. In the first 10 years following their release, the rabbit’s population growth increment (G) would have _________
   a) increased each year  
   b) decreased each year  
   c) remained constant each year  
   d) equaled the carrying capacity (K) of the environment  
   e) None of the above (a-d)

44. Thirty years after their release, when the rabbit population size was constant, the rabbit population growth increment (G) would have ____________.
   a) continued to increase  
   b) been zero  
   c) continued to decrease  
   d) equaled the carrying capacity of the environment  
   e) become infinite

45. In the 1920s, biologists introduced a deadly virus, myxovirus, into the population of rabbits to reduce their population size. An estimated 98% of the rabbits were killed in the first year. After the virus was released, which one or more of the following occurred?
   a) a density dependent control factor  
   b) a density independent control factor  
   c) an epidemic  
   d) an emerging disease in Australian rabbits  
   e) (a), (c) and (d) occurred

46. Two percent of the rabbit population survived the initial exposure to the deadly virus. You would correctly hypothesize that _______________.
   a) these rabbits had been immunized against myxovirus by veterinarians  
   b) these rabbits’ parents gave them B cells that initiated a rapid immune response to defend against the virus  
   c) these rabbits had genetic mutations permitting an effective immune response to defend against the virus  
   d) the virus caused the rabbits to mutate and become more resistant to the virus
47. Today, most of the rabbits are immune to the virus. The virus is still spread among rabbits, but its effects are mild (like a cold). This is an example of which one or more of the following?
a) natural selection  
b) evolution  
c) adaptive radiation  
d) exocytosis  
e) both (a) and (b)

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48. Based on the data, which one or more force(s) were at work in selecting for wing pigmentation?
a) Both sexual selection and natural selection are reasonable hypotheses.  
b) Sexual selection only, because males with more pigmentation attracted more mates.  
c) Natural selection only, because males with more pigmentation survived longer.  
d) Neither natural selection nor sexual selection can affect wing color.

49. For which one of the following reasons would you correctly predict that this species is polygamous?
a) Insects are small.  
b) Females are very choosy about their mates.  
c) Males are very choosy about their mates.  
d) There is no parental care after the eggs are laid.  
e) There is no mechanism by which females can select males.

50. Based on the experiments and their results, you would correctly hypothesize that 
a) females choose males on the basis of the males’ quality  
b) females choose males on the basis of the quality of the territory they posses.  
c) females choose males at random.  
d) only the males are choosing; the females are not.  
e) damselflies are unable to see clearly under the conditions tested.
51. IF females are choosing males based on wing pigmentation, then this would be consistent with ____________.
   a) the good genes hypothesis – wing color is an indicator of ability to resist parasites.
   b) the good genes hypothesis – those with less wing color fly better.
   c) the handicap hypothesis – those with colored wings attract more parasites but survive anyway.
   d) the handicap hypothesis – those with colored wings attract more predators but survive anyway.
   e) Neither the handicap hypothesis nor the good genes hypothesis applies.

52. Which of the following observations would support the hypothesis that symmetry was a characteristic that females use in choosing mates?
   a) Males with the shortest wings mate most.
   b) Males with the longest wings have the most offspring.
   c) Males with each of their wings of equal length have the smallest territories.
   d) Males with each of their wings of equal length have the most offspring.
   e) Males with wings with the greatest amount of pigment have the most offspring.

53. It appears that males with more pigmented wings live longer. Which of the following experiments would provide the best evidence to support the hypothesis that pigmented wings increase lifespan (average age at death)?
   a) Examining the stomachs of birds for the presence of more/less pigmented wings.
   b) Measuring the amount of pigment in wings and the number of offspring produced.
   c) Altering the amount of wing pigment in males of similar wing pigment and observing how long the males live.
   d) Counting the number of eugregarines in the stomachs of males with more/less pigmented wings.
   e) Altering the amount of wing pigment in males of similar wing pigment and observing how many times the males mate.

54. While number of matings is the best estimate of evolutionary success that the scientist used, a better measure would have been ____________________.
   a) number of mates
   b) number of eggs layed
   c) number of offspring that grew to maturity and reproduced
   d) number of days males survived before mating
   e) number of days males survived after mating

For the NEXT 3 QUESTIONS, suppose that leptin affects damselflies the same way it does mice.

55. A damselfly that could NOT produce leptin would ________________.
   a) have more fat in its flight muscles than a normal damsel fly.
   b) have less fat in its flight muscles than a normal damsel fly.
   c) have the same amount of fat in its flight muscles than a normal damsel fly.
   d) any of the above depending on the availability of N & P in the environment.

56. If a female damselfly incapable of producing leptin was crossed with a normal male damselfly, and their offspring were all normal, you would correctly hypothesize that the inability to produce leptin was caused by an ________________.
   a) X-linked recessive allele
   b) X-linked dominant allele
   c) autosomal recessive allele
   d) autosomal dominant allele
   e) autosomal co-dominant allele

57. Suppose you inject leptin into a damselfly that had an excess of fat in its muscles, and it does NOT lose weight. Given what you have learned in this class, which of the following is a reasonable hypothesis to explain this result?
   a) This damselfly was not producing enough leptin.
   b) This damselfly was producing too much ATP.
   c) This damselfly was not producing leptin receptors.
   d) This damselfly was producing too many leptin receptors.
   e) This damselfly was producing excess NPY (an appetite stimulating neurosecretion).

58. Which one or more of the following parents could possibly have a child with blood type A?
   a) Father = type A; mother = type O.
   b) Father = type AB; mother = type O.
   c) Mother = type AB; father = type AB.
   d) Mother = type B; father = type AB.
   e) All of these parents (a-d) could have a child with blood type A.
59. An OSU student received a free flu vaccination in the Starlite Terrace. The vaccine contained killed flu virus. Which one or more of the following conditions would he/she soon experience?
   a) Flu vaccine would be replicating in his/her body, and he/she would have a flu infection.
   b) B cells (lymphocytes) would be making flu antigens.
   c) B cells (lymphocytes) would be making antibiotics.
   d) Activated B cells would be undergoing mitosis.
   e) All of these (a-d)

60. Which one or more of the following illustrate(s) a gradient?
   a) protons (H\(^+\)) outside and inside the intermembrane compartment of carp mitochondria
   b) Na\(^+\) ions on the outside and inside of a carp axon at resting potential
   c) the water temperature at the surface and near the bottom of a deep lake on a sunny summer day
   d) the temperature of the outside of the student’s nose and the inside of her/his heart
   e) all the above (a-d) illustrate gradients

61. Enzymes __________.
   a) catalyze (speed up) metabolic reactions.
   b) may be inhibited (slowed or blocked) by poisons.
   c) work faster at higher temperatures.
   d) can have different functions and amino acid compositions because of mutations in DNA.
   e) All of these (a-d) are true.

_____________________________________________________________________________________________

The NEXT 4 QUESTIONS go together.

62. Carp, prized as food, were abundant in Eastern Europe in the 19th century. When Eastern Europeans came to the U.S. near the end of the 19th century, they brought a small number of carp to use as breeding stock in the U.S. You would correctly predict that the genetic variation in the founding population brought to the U.S. was _______ populations of the same species of carp.
   a) equal to that in late 19th century Eastern Europe
   b) greater than that in late 19th century Eastern Europe
   c) less than that in late 19th century Eastern Europe
   d) greater than present-day U.S.
   e) Both (b) and (d) are correct.

63. The founding U.S. carp population prospered in ponds in Minnesota where they were introduced. The fish isolated in these ponds were not permitted to be moved to lakes or rivers in Minnesota. When the carp populations increased and fish growers thought they would not become extinct, groups of young adult carp regularly were shipped in railroad cars filled with water (called live cars) to New York City. There, wealthy people paid high prices to eat the fish in expensive restaurants. Two rich old brothers ate at one of these restaurants frequently. The food was so good that, over the decades, they ate a great deal of it. One of them remained thin and the other became obese, even though they ate the same amount of food. Which of the following hypotheses might correctly explain the difference in their weights.
   a) The thin brother produced less ATP than did the obese brother.
   b) The thin brother produced more thyroxin than did the obese brother.
   c) The thin brother produced more oxygen in cellular respiration than did the obese brother.
   d) The obese brother produced more NADPH than did the thin brother (per pound of body weight).
   e) Both (a) and (b) occurred.

64. One day, the train hauling carp to New York in a live car derailed, and the water spilled out into a ditch. The carp swam away into the small creeks that flow into the Mississippi River. Carp became established in the entire Mississippi River drainage (streams and lakes). Because carp are highly effective herbivores, they outcompeted many species that were native to the U.S. You would correctly predict that, as a result ________.
   a) where carp were found, biodiversity increased
   b) carp became extinct in the U.S.
   c) biodiversity decreased in streams that flow into the Mississippi River
   d) (a) and (b) are true
   e) (a), (b) and (c) are true

65. Ores containing metals have been mined extensively in Minnesota. In a mining area in northern Minnesota, the water contains lead, which is biomagnified. You correctly predict that the highest (greatest) concentrations of lead in a contaminated lake would be found ________.
   a) in the algae and aquatic plants
   b) in the carp
   c) in the carnivorous fish that eat carp
   d) in the birds that eat the carp-eating carnivorous fish
   e) (a), (b) and (c) are true
66. Minnesota babies who go ice fishing with their parents are always dressed in warmer clothing than their parents. A correct hypothesis for why this is the case is _______.
   a) parents have more hand-me-down clothes for babies than for themselves
   b) babies have a higher surface area-to-volume ratio than parents and babies become cold more easily
   c) babies have a lower (smaller) surface area-to-volume ratio than parents and babies become cold more easily
   d) adults are older, therefore they do not need to regulate their body temperature
   e) (c) and (d) are true

67. Adaptive radiation ____________.
   a) causes mutations needed so that organisms can survive better in their habitat
   b) is a rapid decrease in species diversity
   c) is most likely to occur where there are many competing species and limited resources
   d) is most likely to occur where there is little competition for abundant and diverse resources
   e) both (a) and (c)

68. As eutrophication proceeds, different species of algae become most abundant, and the average cell size of the most abundant species of algae in a lake increases. You correctly hypothesize (assuming cell shape is constant) _________.
   a) larger-celled algae have a higher surface area to volume ratio (SA/V) compared to smaller-celled algae.
   b) larger-celled algae have a smaller surface area to volume ratio (SA/V) compared to smaller-celled algae.
   c) larger-celled algae and smaller-celled algae have the same surface area to volume ratio (SA/V).
   d) environmental changes always cause changes in the genetic code, which makes larger codons (thus larger cells).
   e) both (a) and (d) are correct.

69. Which of the following human diets will use the largest amount of Earth’s primary production, assuming all diets include equal numbers of calories?
   a) Diet of only meat.
   b) Diet of only vegetables.
   c) Diet of meat and vegetables.
   d) All diets use the same amount of primary production.

70. Which of the following statements regarding the nitrogen cycle is FALSE?
   a) All organisms need nitrogen for protein synthesis.
   b) All organisms need nitrogen for nucleic acid (DNA, RNA) synthesis.
   c) Animals directly use atmospheric nitrogen (N₂) to synthesize proteins.
   d) Decomposition of dead organic material is a source of nitrogen for plants.
   e) Animals excrete wastes that contain organic nitrogen.