Use the following information to answer the next 4 questions.

In the Sonoran Desert of Arizona there are giant saguaros (cactus) which have large white flowers at the ends of their spine-covered branches. A single insect species and a single bird species visit the flowers during the day, and a single bat species visits by moonlight at night. All three animal species use their eyes to locate the flowers. Each type of pollinator fits into the blossom in a precise manner that allows pollen grains to stick to their bodies. The plant offers the animals nectar for food, and the animals move pollen grains from one cactus plant to another (pollination). This variety of pollinators ensures maximum pollination and successful reproduction for the cactus.

1. Which one or more of the following processes was (were) involved in the evolution of the situation described above?
   a) natural selection
   b) coevolution
   c) adaptive radiation
   d) Both (a) and (b).
   e) Both (a) and (c).

2. In which one or more the following would you correctly predict finding genetic variation?
   a) the population of bats in the Sonoran Desert
   b) the population of giant saguaros in the Sonoran Desert
   c) Both (a) and (b)
   d) Neither (a) nor (b)

3. Based on what you know about how the vertebrate eye works and the properties of light, you would correctly predict which one of the following?
   a) Bats that feed at night have proportionately more rods than do birds that feed during the day.
   b) Bats that feed at night have proportionately more cones than do birds that feed during the day.
   c) Bats that feed at night have the same proportions of rods and cones as do birds that feed during the day.
   d) Bats do not have either rods or cones.

4. You would correctly predict which one or more of the following to be true for the cells of the giant saguaro on a warm night in the desert?
   a) The rate at which protons are pumped across the inner mitochondrial membrane will be faster than on a cold night.
   b) The rate of CO₂ production will be faster than on a cold night.
   c) The splitting of H₂O by photosystem II will be slower than on a cold night.
   d) All of the above.
   e) Only (a) and (b).
After pollination, the flowers of the giant saguaro produce fruit, which contain seeds. Once the fruit is ripened white-winged doves consume the fruit and disperse the seeds across the desert in their feces. Seeds that are not harmed by the dove’s digestive enzymes will have a chance of growing into a mature giant saguaro.

5. As the cactus grows larger, the trunk of the cactus will contain large amounts of carbon. The primary source of this carbon for the cactus will be from _______.
   a) glucose uptake by roots from the soil
   b) FADH₂ and pyruvate
   c) carbon dioxide from the atmosphere
   d) sunlight
   e) water

6. In the green cells of the growing giant saguaro, which one or more of the following is true?
   a) The cells use light energy to convert H₂O and CO₂ into O₂ and glucose
   b) The cells give off CO₂ from cellular respiration.
   c) The cells use sugars (for example glucose) to produce ATP.
   d) None of the above are true.
   e) (a), (b), and (c) are true.

7. In which one or more of the following cell types would you find mitochondria?
   a) Cells of the ripening giant saguaro fruit.
   b) Neurons that synapse on the bat’s retina.
   c) Flight-muscle cells in the bat and bird.
   d) Bacteria in the intestines of white-winged doves.
   e) Only (a), (b) and (c).

8. Another prominent organism found in the Sonoran Desert is the scorpion. These are secretive creatures that usually hide in burrows during the day and hunt for prey (food) at night. Scorpions tend to have elaborate mating dances and toxic venom which they inject with a stinger located at the tip of their tails. In the desert you can find two different colors of scorpions – dark-chocolate brown and milk-chocolate brown. Which one or more of the following would provide the best evidence that scorpions of these two different colors represent two different species?
   a) the two forms do not mate and produce viable offspring
   b) the two forms select different prey items
   c) the two forms perform different mating dances
   d) the venom of the two forms results in different effects
   e) Both (a) and (b)

9. A chemical that inhibits the Na⁺/K⁺ pump in an axon is likely to _______________.
   a) prevent the regeneration of a resting potential
   b) increase the movement of Na⁺ ions out of the cell against a concentration gradient
   c) increase the movement of K⁺ ions into the cell against a concentration gradient
   d) cause an action potential to occur
   e) none of the above
Use the following information to answer the next 7 questions.

Tobacco plants produce nicotine, and insects of most species die when they eat it. Some, like the tobacco hornworm (a moth caterpillar), do not. Despite the obvious role of nicotine as an insecticide, many people still smoke and their neurons are bathed in nicotine. People are often attracted to smoking and become addicted to it because nicotine mimics acetylcholine. It does not do this at all acetylcholine-sensitive synapses, just those with nicotine-sensitive, acetylcholine receptors. Therefore nicotine affects neuromuscular junctions. Based on this information and what you have learned in class about acetylcholine's role in synaptic transmission, what would you correctly predict in each of the following situations?

10. Smoking _______ the stimulation of post-synaptic nicotine-sensitive receptors.
   a) increases
   b) decreases
   c) neither increases nor decreases

11. On the basis of the information provided, nicotine's effects would be _______ by drugs that block acetylcholine receptors.
   a) increased
   b) decreased
   c) unaffected

12. Nicotine would _______ the rate at which sodium enters the postsynaptic neuron (after the synapse) through sodium channels
   a) increase
   b) decrease
   c) have no effect on.

13. Addition of nicotine to a nicotine-sensitive synapse would result in ___ activity (action potentials/neurotransmitter release) at the pre-synaptic (before the synapse) membrane and _____ activity (action potentials) at the post-synaptic membrane.
   a) more, more
   b) more, less
   c) the same, more
   d) the same, less
   e) the same, the same

14. What would you correctly predict about the insects that die because they eat tobacco?
   a) All those that die would appear to have seizures.
   b) All those that die would appear to be paralyzed.
   c) Some of those that die would appear to be paralyzed and others would appear to have seizures.
   d) They would have neither paralysis nor seizures.
15. Tobacco hornworms and tobacco plants probably represent an example of
a) speciation
b) electron transport synthesis
c) coevolution
d) adaptive radiation
e) ATP synthesis

16. If the tobacco hornworm produced an enzyme (protein) that was released by exocytosis into synapses and broke down nicotine, then which of the following hypotheses would be reasonable?
a) If the vesicles could not bind with the cell membrane the protein could not be synthesized
b) If the golgi bodies were destroyed, the protein would not be synthesized
c) If the ribosomes were destroyed, the protein could be synthesized but not released from the cell.
d) If the cells were induced to form more mitochondria, enzyme synthesis would be halted.
e) If the amount of rough endoplasmic reticulum were increased, the cells could synthesize more of the detoxifying enzyme.

The following 4 questions deal with the rare plant species Rich is trying to preserve.
17. Rich’s plant contains a toxin that affects insects by blocking acetylcholine (neurotransmitter) receptors in the postsynaptic neuron membrane. Therefore, insects that eat parts of the plant would ________________.
a) die because oxygen cannot donate electrons to ATP synthase, and they run out of ATP
b) experience muscle paralysis
c) die because the presynaptic neuron membranes are not capable of generating an action potential
d) experience sudden involuntary contractions in their muscles (seizures)
e) choose to become resistant by spontaneously mutating

18. A biologist measures cellular respiration rates in leaf cells in Rich’s plants in the dark (when photosynthesis has stopped). You correctly predict that ______________.
a) carbon dioxide production increases when the air around the plant is warming
b) carbon dioxide production decreases when the air around the plant is warming
c) oxygen production increases when the air around the plant is warming
d) oxygen consumption decreases when the air around the plant is warming
e) the biologist is ill-informed that plant cells have mitochondria performing cellular respiration

19. Because Rich’s plants are mainly found in full sun exposure, the biologist suspects they contain several different photosynthetic pigments. She grinds up some leaves and isolates only two different pigments with the colors: green and yellow. She correctly hypothesizes that Rich’s plants___________.
a) obtain most of their energy from green and yellow light
b) obtain most of their energy from red and blue light
c) obtain energy by absorbing glucose from the air
d) make sugars from oxygen in the air
e) both (a) and (d)
20. The root tip cells in Rich’s plants secrete slime to lubricate the tip as it moves through soil. You correctly hypothesize that these cells contain many ____ to process, package and secrete the slime.
   a) flagella and cilia
   b) neurotransmitters and sodium-potassium pumps
   c) nuclei
   d) exocytosis
   e) golgi bodies and vesicles

21. During photosynthesis, _____ produced in the light dependent reactions provide energy to run ______.
   a) ATP and NADPH; the Krebs cycle
   b) ADP and FAD; the Krebs cycle
   c) ATP and NADPH; the Calvin cycle (light independent reactions)
   d) ADP and NADP; the light independent reactions
   e) electron carriers; ATP

22. Which of the following is directly responsible for making the enzymes necessary for photosynthesis?
   a) smooth endoplasmic reticulum
   b) ribosome
   c) mitochondrion
   d) Golgi body
   e) ADP

23. A detective gathers cell evidence at a crime scene. The victim is a 37 year old man, killed by a blow to the head. Possible murder weapons include a metal rod, a brick, and a piece of firewood (formerly a tree branch). Closer examination of the evidence leads the detective to conclude that firewood was used. Which of the following evidences best supports his conclusion?
   a) cells with cell walls found on the victim’s head
   b) cells with mitochondria found on the victim’s head
   c) cells with nuclei found on the victim’s head
   d) cells with ribosomes found on the victim’s head
   e) cells with cell walls found on the firewood

24. Which one or more of the following is (are) examples of active transport in cells?
   a) proton transport across the thylakoid membrane by the electron transport chain in chloroplasts
   b) sodium/potassium movement across the neuron membrane while creating or reestablishing a membrane resting potential
   c) osmosis
   d) all of the above
   e) only (a) and (b)
25. You discover a population of mice that has survived for many generations on a volcanic island. Which one or more of the following must have occurred for their survival?
   a) All of the founder mice population had appearances and behavior identical to the mice currently living on the island.
   b) The founder population of mice had the opportunity to reproduce.
   c) The founder population of mice had the opportunity to fill a niche.
   d) (a) and (b)
   e) (b) and (c)

Use the following information to answer the next 4 questions.

When the Hawaiian Islands were discovered by European explorers, there were 14 species of Hawaiian honeycreepers on the islands. The closest relatives of the Hawaiian honeycreepers are the honeycreepers of tropical Central and South America. The honeycreepers on the mainland feed on fruit. Some Hawaiian honeycreepers feed on fruit, but others feed on the nectar of flowers, on insects and on seeds. The beaks of the Hawaiian honeycreepers range from thin and pointed to long and decurved (down-curving). It is thought that the Hawaiian honeycreepers are descended from a population of honeycreepers from the mainland which somehow reached Hawaii.

26. The best hypothesis to explain why the new species of Hawaiian honeycreepers evolved is that natural selection ____________.
   a) made the finches want to change bill size and shape
   b) favored the survival of birds with certain mutations controlling beak size and shape
   c) made the finches want to eat seeds
   d) increased calcium in the diet so that larger beaks could be produced

27. The best explanation for how the original honeycreepers were able to survive when they reached the Hawaiian Islands is that the honeycreepers__________.
   a) lived in seabird colonies
   b) were fed by early human inhabitants of the islands
   c) ate fruit from plants already found in the Islands
   d) preyed upon insects and the eggs of reptiles

28. The best explanation(s) for these observations about beak shapes of Hawaiian honeycreepers is (are)__________.
   a) cross-breeding occurred with other bird species
   b) adaptive radiation has occurred
   c) mutations exist in the genes for beak shape
   d) the female Hawaiian honeycreepers chose new beaks
   e) both (b) and (c)

29. Because of the founder effect, the founding honeycreepers reaching Hawaii had ____.
   a) less genetic variability than the original honeycreeper population of the mainland
   b) more genetic variability than the original honeycreeper population of the mainland
   c) the same amount of genetic variability as the original honeycreeper population of the mainland
   d) no genetic variability
Use the following information to answer the next two questions.

A biologist hypothesizes that ticks find dogs because the ticks are attracted to carbon dioxide. She exposes groups of ticks to the following percentages of carbon dioxide in air: 0, 25, 50, 75, 100 and measures the ticks' rates of activity during exposure.

30. The control group of ticks is exposed to _____% carbon dioxide in this experiment.
   a) 0
   b) 25
   c) 50
   d) 75
   e) 100

31. The activity of ticks is the ______variable and is correctly plotted on the ___ axis.
   a) independent, X
   b) independent, Y
   c) dependent, X
   d) dependent, Y

32. Some scientists are interested in characteristics of desert plant photosystems. They measure the H⁺ (proton) concentration inside the thylakoid spaces while they are exposed to light and while they are not. You would correctly predict that the H⁺ concentration is ____________.
   a) higher when the plant is exposed to light
   b) lower when the plant is exposed to light
   c) the same whether the plant is exposed to light or not
   d) dependent on the amount of ATP available
   e) dependent on the amount of ADP available

33. The Calvin or light-independent cycle produces ____.
   a) glucose and carbon dioxide
   b) glucose and water
   c) glucose and oxygen
   d) glucose only
   e) ATP

34. The overall reactions of photosynthesis convert ________________.
   a) glucose into carbon dioxide, water, and oxygen
   b) oxygen and glucose into carbon dioxide and water
   c) carbon dioxide and water into glucose and oxygen
   d) carbon dioxide, oxygen, and water into glucose and oxygen
   e) water, oxygen, and carbon dioxide into glucose

35. Which of the following is not a similarity between cellular respiration and photosynthesis?
   a) Both involve chemiosmosis.
   b) Both use an electron transport system.
   c) Both have proton(H⁺) pumps.
   d) Both use oxygen as the final electron acceptor.
   e) Both can occur in eukaryotic cells.
36. Red algae are well adapted to survive at ocean depths greater than 5 meters because ____.
   a) red pigments absorb the yellow light available there
   b) red pigments absorb the red light available there
   c) red algae use red light to manufacture glucose
   d) red algae use yellow light to manufacture glucose
   e) both (a) and (d)

**Use the following information to answer the next 4 questions.**

Several individuals of a beautiful purple species of butterfly are carried by the wind to an island that it has not occupied previously. Some of those individuals produce a toxin that affects birds.

37. If the butterfly is herbivorous, in order for the butterfly species to survive on this island it must already be occupied by which one or more of the following?
   a) consumers
   b) plants
   c) herbivores
   d) carnivores
   e) both (a) and (c)

38. If fringed redbirds are the only predators of the butterfly on the island, a biologist would correctly predict that 100 years after founding, ____ on the island.
   a) fringed redbirds would become extinct
   b) the purple butterfly would become extinct
   c) the proportion of butterflies that produce toxin would be the same as at founding
   d) the proportion of butterflies that produce toxin would be greater (larger) than at founding

39. The fringed redbird on the island often rests and builds its nests in the flame tree, which has red leaves. The light which is reflected by the flame tree is ________; the redbird probably nests in the tree to ________.
   a) blue; attract butterflies
   b) red; repel butterflies
   c) purple; pollinate the flowers on the tree
   d) red; be camouflaged
   e) blue; be camouflaged

40. During photosynthesis by the flame tree, ____ is produced; during cellular respiration, ____ is produced.
   a) oxygen, carbon dioxide
   b) ATP, oxygen
   c) carbon dioxide, oxygen
   d) FAD, NADPH
   e) oxygen, nothing is released because plants do not perform cellular respiration.