Use the following information to answer the next 7 questions.
The cantil is a snake found in Costa Rica. Humans rarely encounter it and little is known about its habits, diet, and venom composition. A scientist who specializes in the study of poisonous venom wishes to determine whether or not cantil bites will be fatal to humans. He will use mice as his experimental animal for finding a lethal dose and use the results to estimate a lethal dose value for humans. He collects venom from 21 cantils, evaporates the liquid portion and then uses the powder to mix varying concentrations of venom in a saline (salt) solution. Mice will be injected with one of four possible venom concentrations and the number of deaths will be recorded after 48 hours. The following experimental groups consisting of 6 mice each will be established

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 grams venom/ml of saline</td>
<td>1.0 grams of venom/ml of saline</td>
<td>1.5 grams of venom/ml of saline</td>
<td>pure saline</td>
</tr>
</tbody>
</table>

1. Is there a control group in this experiment?
   a) Yes - Group A
   b) Yes - Group B
   c) Yes - Group D
   d) Yes - Groups A, B, and C
   e) No

2. The reason a scientist should use a control in the above experiment is _____.
   a) he can test the effect of many different variables
   b) he can collect less data for future experiments
   c) it will take less time to complete the experiment
   d) to provide evidence that death of the mice is a result of the venom and not of the injection process

3. In the described experiment the scientist uses 6 mice in each experimental group instead of just 1 in each group. He does this so that _____.
   a) he can test the effect of many different variables
   b) he can collect less data for future experiments
   c) it will take less time to complete the experiment
   d) he can increase confidence in the results by increasing sample size
The cantil venom contains an enzyme that results in the rupturing of red blood cells and thus leads to death in the mice. The scientists’ next experiments involve the development of anti-venom to counteract this effect. He will combine various amounts of a particular anti-venom with a set amount of venom to determine the correct dosage for the anti-venom. The scientists’ assistant has just finished Biology 1114 and is helping him design the next set of experiments.

4. The assistant correctly suggests that the scientist conduct all of the anti-venom experiments in a chamber with a controlled temperature because of which one or more of the following?
   a) Cool temperatures will slow down reactions involving enzymes.
   b) Cool temperatures will speed up reactions involving enzymes.
   c) Warm temperatures will slow down reactions involving enzymes.
   d) Warm temperatures will speed up reactions involving enzymes.
   e) Both (a) and (d).

5. The assistant also suggests that the scientist set up experimental groups which involve the use of venom without the addition of anti-venom. This additional experimental group would _______.
   a) serve as the dependent/response variable for the experiment
   b) serve as the independent/manipulated variable for the experiment
   c) serve as the control for the experiment
   d) rule out the possibility that the venom was not working properly and demonstrate indeed that the results you observed were due to the anti-venom
   e) Both (c) and (d).

6. The scientist houses his experimental snakes in glass cages that contain a water source and a “hot-rock” (block composed of rock-like material which contains a heater set at 28°C). All cages are kept in the same lab. Which one or more of the following statements about heat exchange between a snake (a poikilotherm) and its environment is true?
   a) Heat energy always moves up the concentration gradient from cooler to warmer objects.
   b) When resting on a hot-rock, a snake with a large surface-to-volume ratio will warm (core body temperature) faster than a snake with a small surface-to-volume ratio.
   c) If the hot-rock was unplugged, the snake’s internal (core) body temperature would remain fairly constant due to metabolic processes, even when the room temperature varies.
   d) When resting on a hot-rock, a snake with a small surface-to-volume ratio will warm (core body temperature) faster than a snake with a large surface-to-volume ratio.
   e) When resting on a hot-rock, a snake with a large surface-to-volume ratio will warm (core body temperature) at the same rate as a snake with a small surface-to-volume ratio.

7. As a side experiment the assistant is asked to measure oxygen consumption of 10 cantils. The assistant feels confident that he can handle this because of his experience in the Biology 1114 lab (however, he is a little concerned about how to transfer the snakes to the metabolic jar in that flimsy paperbag). His experimental design involves 10 snakes of equal length and weight. He will test 5 of them in metabolic jars placed on the lab bench. The room temperature is 25°C. He will test 5 of them in metabolic chambers placed in a refrigerator with a temperature of 10°C. Which one or more of the following would you correctly predict for this experiment.
   a) The snakes placed in the refrigerator will have a higher rate of oxygen consumption than the snakes on the lab bench.
   b) The snakes placed in the refrigerator will have a lower rate of oxygen consumption than the snakes on the lab bench.
   c) Enzyme activity in the snakes in the refrigerator will be higher than enzyme activity in the snakes on the lab bench.
   d) Enzyme activity will not vary between the two groups of snakes.
   e) Both (a) and (c).
Use the following information to answer the next 2 questions.
On a warm summer day at Boomer Lake you pour 5 pools of liquid, containing different solutions of water and soda pop, onto a park bench. You record the number of yellowjackets (wasps) that are attracted to each pool over a period of 30 minutes (see data below).

<table>
<thead>
<tr>
<th>Solution</th>
<th>Yellowjackets</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% water</td>
<td>2</td>
</tr>
<tr>
<td>90% water, 10% soda</td>
<td>1</td>
</tr>
<tr>
<td>80% water, 20% soda</td>
<td>6</td>
</tr>
<tr>
<td>70% water, 30% soda</td>
<td>11</td>
</tr>
<tr>
<td>60% water, 40% soda</td>
<td>15</td>
</tr>
</tbody>
</table>

8. Which of the following interpretations, best describes the overall trend(s) in the results?
   a) Yellowjackets are more abundant at Boomer Lake than at the OSU campus.
   b) Yellowjackets prefer Pepsi to Coke.
   c) Yellowjackets prefer water only to 20% soda in water.
   d) Yellowjackets are attracted to soda pop.
   e) Yellowjackets fly slower after consuming soda pop solutions.

9. To create a standard graph of your data, the best choice of labels for the X (horizontal) and Y (vertical) axis would be ___________.
   a) X axis - number of yellowjackets, Y axis - time
   b) X axis - time, Y axis - number of yellowjackets
   c) X axis - number of yellowjackets, Y axis - % water
   d) X axis - % water, Y axis - number of pools
   e) X axis - % soda pop, Y axis - number of yellowjackets

10. Which of the following organisms undertake glycolysis?
    a) plants
    b) bacteria
    c) dogs
    d) worms
    e) all of the above undertake glycolysis

11. The extensive folding of the inner membrane of the mitochondria provides __________.
    a) resistance to isotonic solutions
    b) greater matrix volume
    c) greater surface area for chemical exchange across the membrane
    d) a gradient of Na⁺ ions
    e) less surface area for chemical exchange across the membrane

12. Which of the following does not require oxygen?
    a) glycolysis
    b) respiratory chain (electron transport)
    c) plants
    d) animals
    e) none of the above require oxygen

13. After running around, a dog lies down to rest. Which of the following does not describe the flow of heat?
    a) the dog loses heat by conduction to the warmer ground
    b) the dog loses heat by the evaporation of body liquids (panting)
    c) the dog loses heat by convection to the wind
    d) the dog gains heat by the radiation from the sun
    e) the dog generates heat by respiration
14. The chemical reactions of glycolysis are catalyzed (facilitated) by __________.  
a) oxygen  
b) carbon dioxide  
c) enzymes  
d) glucose  
e) rotenone

15. Glycolysis and cellular respiration convert __________.  
a) carbon dioxide and glucose into water, oxygen and ATP  
b) glucose into carbon dioxide, oxygen, and water  
c) oxygen and glucose into carbon dioxide, water and ATP  
d) oxygen and carbon dioxide into glucose, water and ATP  
e) none of the above

16. The kangaroo rat is very well adapted to living in the desert. Which one or more of the following characteristics contribute to its success in that harsh environment?  
a) big feet and long tail  
b) high (large) surface area to volume ratio  
c) derives water from metabolizing its seed diet  
d) has a long nephron loop  
e) all of the above contribute to its success

17. A high concentration of $H^+$ ions within the intermembrane space compared to the concentration in the matrix is ______________.  
a) needed for chemiosmosis (oxidative phosphorylation)  
b) needed for glycolysis  
c) the result of rotenone poisoning  
d) can never happen because the membrane is permeable to $H^+$ ions  
e) none of the above

Use the following information to answer the next 8 questions.  
After winning a million dollars, Rich decides to establish a foundation to preserve a rare plant species he observed on the “Survivor” island off Borneo. Rich’s initial observation is that the plant is found most often on sites with full sun exposure. A biologist is employed to study the natural distribution of Rich’s rare plant before preservation efforts begin. She records the location of all individual plants, estimates the size of the plants, and measures the light intensity at mid-day where the individual plants are found.

18. If the biologist draws a graph showing that the light intensity affects plant size, plant size should be displayed as the __________ variable on the __________ axis.  
a) dependent/response; horizontal (x)  
b) independent/manipulated; horizontal (x)  
c) dependent/response; vertical (y)  
d) independent/manipulated; vertical (y)  
e) none of these (a-d) are correct

19. From a scientist’s viewpoint, this is an example of a/an __________ experiment.  
a) controlled  
b) observational (correlational)  
c) irrelevant  
d) theory
20. Rich’s plants absorb some mineral nutrients from the soil solution by active transport. Knowing this, which one or more of the following statements are true?
   a) energy is required to move that mineral into a root
   b) the concentration of that mineral may be higher inside the plant root surface cell than outside
   c) a transport protein may be necessary
   d) both (a) and (b)
   e) (a) (b) and (c)

21. Rich’s plants absorb water from the soil by diffusion across cell membranes. This occurs by ________.
   a) active transport
   b) proton pumping
   c) osmosis
   d) glycolysis
   e) electron transport

The biologist observes only two insect species regularly associating with Rich’s plants. Species A eats leaves only, and species B visits only the flowers to drink nectar (sugar solution). A chemist is asked to determine whether or not Rich’s plants contain toxic compounds, and he reports that the leaves contain a powerful insecticide, but that the nectar is toxin-free.

22. Which one or more of the following may the biologist reasonably hypothesize to be true?
   a) Species A is resistant to the toxin.
   b) Species A makes the toxin and kills species B with it
   c) Species A has coevolved with Rich’s plants
   d) Both (a) and (b) are true
   e) Both (a) and (c) are true

23. Which one or more of the following may the biologist reasonably hypothesize to be true?
   a) Species B is resistant to the toxin.
   b) Species B uses the nectar as a source of glucose for cellular respiration.
   c) Species B does not visit any other species of plant.
   d) Species B used to be Species A, but got tired of eating toxic leaves.
   e) Both (a) and (d) are true

24. If the toxin manufactured by Rich’s plants kills insects by interfering with electron transport in cellular respiration, ________________.
   a) most insects die eating leaves because they cannot make enough ATP to support life
   b) Species A may have a modification of the electron transport system so it can continue to make ATP
   c) Rich’s plants are protected from insects forever
   d) Both (a) and (b)
   e) (a) (b) and (c)

25. If the toxin manufactured by Rich’s plants kills insects by interfering with glycolysis, ________________.
   a) it may also be toxic to bacteria
   b) it will never be toxic to fish or humans
   c) glucose may still be metabolized to produce ATP
   d) carbon dioxide will be used as an electron acceptor in mitochondria
   e) none of these (a-d) is correct
In a population of small homeotherms, a mutation arises that results in the inner mitochondrial membrane having fewer folds. A scientist measures the total length of the membrane in 10 members each of the two different types of animals. He finds that in the less folded membrane (animal type LF) the length is at about one-third that of the more folded membrane (animal type MF).

26. Based on the above finding he would correctly predict which one of the following.
   a) Animal type LF is capable of producing more ATP than animal type MF.
   b) Animal type MF is capable of producing more ATP than animal type LF.
   c) There is no difference in the amount of ATP produced by the 2 types of animals.
   d) Glycolysis does not occur in animal type LF.
   e) Glycolysis does not occur in animal type MF.

27. Which one or more of the following processes involve a gradient?
   a) A lizard emerges from its burrow under a large rock and presses its body on the warm surface of the rock in order to increase its metabolism.
   b) ATP production in the mitochondria of that same lizard.
   c) Urine production in the kidneys of the lizard.
   d) All of the above (a through c) involve gradients.
   e) Only (b) and (c) involve gradients.

Use the following information to answer the next 5 questions.
Ted and Agnes collected some isopods (roly-polys) living under damp leaves by their dorm to do some experiments. Ted thinks they stay under the leaves because it is damp there and Agnes claims they just don’t like light. Ted’s approach to supporting his hypothesis is to survey the campus, measuring the relative humidity in each place where he finds isopods. At each place, he first counts the number of isopods per square cm and then he measures the relative humidity. He has data from 50 locations.

28. Based on the description of his work, Ted has __________.
   a) tested a theory
   b) performed an observational (correlational) experiment
   c) proved that isopods prefer damp places to dry places
   d) performed a controlled experiment
   e) proved a theory

Agnes borrows 50 isopods from Ted. She takes a small wooden box, covers one half of the top opening of the box with thick black paper, and sets up a light to shine on the other half of the box. Then she releases the isopods, one at a time, at the middle of the box so that each can choose to walk into the dark half of the box or walk into the light half. The bottom of the box is uniformly dry. She records the choice of each isopod.

29. Agnes has done a(n)_________ experiment in which ________is the manipulated or experimental variable.
   a) controlled, light
   b) observational, isopod size
   c) hypothesis, number of isopods
   d) controlled, number of isopods
   e) disorganized experiment, relative humidity
Agnes builds a small treadmill for her isopods and places them, one at a time, on it for 10 min. First she lets each of them walk while the treadmill is in a box that is maintained at 40°F (about 5°C). The next day she moves the treadmill into a box heated to about 90°F (approximately 33°C) and lets each isopod walk again. The isopods walk faster on the heated treadmill and slower on the cooled treadmill.

30. You correctly predict that Agnes’s isopods are ____________.
   a) homeotherms
   b) hypothetical
   c) two-legged
   d) poikilotherms
   e) without mitochondria

31. If the isopods are held on the cold treadmill longer than 10 min, they roll up and don’t walk anywhere until they are warmed up again. You would correctly conclude that ________.
   a) they are tired
   b) their enzymes do not work at low temperatures
   c) the joints in their legs freeze
   d) they are dead
   e) they are hibernating

32. Agnes wants to breed isopods that will gain or lose heat faster. She should then select and breed the isopods that _____.
   a) have especially long legs and a flattened body
   b) are shorter and rounder in the body
   c) have small eyes
   d) have very short legs and small antennae
   e) grow fur

33. In order for a lizard to conduct heat away from its body, it must be ________.
   a) in contact with air that is cooler than its body
   b) in contact with air that is warmer than its body
   c) resting on a rock that is cooler than its body
   d) resting on a rock that is warmer than its body
   e) resting in water

34. The change in body temperature described correctly in the preceding question depends upon _____.
   a) evaporation
   b) the lizard and its surroundings being the same temperature
   c) a size gradient among lizards
   d) a temperature gradient
   e) the lizard and its prey being different temperatures

35. At the Colvin Center the other day, the temperature in the weight room was 100°F. The students who stayed healthy working out in that room on that day probably were
   a) sweating and cooling by evaporation
   b) drinking a great deal of water
   c) experiencing vasodilation of many blood vessels at the body surface
   d) (a) and (b) are true
   e) (a), (b) and (c) are true
36. Among athletes who compete during hot weather, we would expect that those men and women who have ____________ are best adapted to keep body temperature in a healthy range.
   a) a very large (thick) trunk
   b) low (small) surface area to volume ratio
   c) long arms and legs and thin bodies
   d) high (large) surface area to volume ratio
   e) both (c) and (d)

37. *Ichthyophthirius* is a one-celled parasite that lives in the skin of freshwater fishes (those that live in ponds, lakes and streams). When it lives in the fish, the concentration of salts in the parasite is the same as that in the fish tissue. When the parasite leaves the fish to swim and look for another fish, it lives in fresh water, which has a lower concentration of salts than the parasite or the fish. When the parasite moves into the fresh water, water will move _____.
   a) mostly into the parasite cell
   b) mostly out of the parasite cell
   c) at the same rate into and out of the parasite cell
   d) to make the cell shrink

38. Oxygen is used in aerobic respiration ___________.
   a) to split glucose
   b) capture light energy
   c) as an enzyme in the mitochondrion
   d) as the final electron acceptor in the electron transport chain
   e) none of the above

39. The product of aerobic cellular respiration which provides energy for contracting muscles in Olympic athletes is ___________.
   a) carbon dioxide
   b) ATP
   c) oxygen
   d) glucose
   e) protein

40. If the inner membrane of the mitochondrion is disrupted (e.g., torn) during aerobic cellular respiration, ____________.
   a) the proton (H+) gradient is made stronger than in normal mitochondria
   b) concentrations of protons (H+) will become equal on both sides of the membrane
   c) greater amounts of ATP will be produced than normally
   d) less ATP will be produced than normally
   e) both (b) and (d) are true