BIOL 1114 EXAM 1 (No Star Form) 16 September 2002

Use a #2 pencil to fill in the information portion of your NCS answer sheet including the appropriate circles (bubbles). Write "**NO STAR FORM"** above your name in the margin of your answer sheet. Read all questions and answers ***carefully*** before choosing the **single BEST response** for each question. Feel free to ask the instructor for clarification. Really.

The first four questions deal with a scientist investigating roly-polys.

1. Roly-polys (sowbugs, pillbugs) stop moving when the air around them is cold. A scientist wants to know whether they move faster as the air around them becomes warmer. She puts 10 roly-polys in each of 4 dishes and keeps each dish at one of the following temperatures for 15 min: 18°C, 23°C, 28°C, 33°C. Which of the following would be a correct **dependent** variable for this experiment?

a) roly-poly body temperature
b) length of roly-poly
c) color of roly-poly
d) walking (crawling) speed
e) antenna length

2. The scientist wishes to know whether the roly-poly is a poikilotherm or a homeotherm. Which of the following would be the correct **dependent** variable for her to use in an experiment to answer that question?

a) roly-poly body temperature
b) length of roly-poly
c) color of roly-poly
d) roly-poly walking (crawling) speed
e) roly-poly antenna length

3. She decides that the roly-poly is a poikilotherm and correctly predicts that the animal stops walking at temperatures below 15°C. Which one or more of the following is (are) a correct explanation(s) for why the animal stops walking (crawling) at those temperatures?

a) The enzymes necessary for muscle contraction work too slowly at those temperatures.
b) Insufficient energy is available for muscle contraction at those temperatures.
c) H^+ ions (protons) do not accumulate in the mitochondrial intermembrane compartment at those temperatures.
d) ATP concentrations are too low to permit muscle contractions.
e) All of the above are correct explanations.

4. Young roly-polys are smaller than adult roly-polys but they are shaped the same. At 15°C they more quickly become motionless than do the adults. A correct hypothesis for this difference would be _____.

a) the young have fewer legs than the adults
b) the young only respire anaerobically
c) the young have a smaller surface area to volume ratio than the adults and lose body heat faster
d) the adults consume all the oxygen in the immediate environment, leaving none for the young
e) the young have a greater surface area to volume ratio than the adults and lose body heat faster

5. Ectotherms obtain heat from their surroundings and endotherms obtain it from metabolism within their bodies. If all organisms metabolize (metabolism goes on in all their cells), why don't ectotherms rely primarily on their metabolism to maintain body temperature?

a) Because ectotherms do not produce ATP.
b) Ectotherms do obtain some heat from their metabolism but they cannot retain it.
c) Because all ectotherms are larger than endotherms.
d) Because there is no connection between metabolism of ectotherms and temperature.
e) All of the above are true.

The next 18 questions are based on the following description:
Pogonomyrmex occidentalis, the western harvester ant, is common in the western United States where it is found even at cool and dry elevations above 5,000 feet. These ants live in colonies and build cone-shaped mounds that stand about 20 inches (50 cm) tall. The mounds have elliptical (oval) bases. The ants clear most of the vegetation from around the mounds for about 3-6 feet in all directions so that the mounds are not shaded. The colony's tunnels extend nearly 9 feet (2.7 meters) below the soil surface and connect various chambers. Because ants are poikilothermic, temperature of the mound is critical to activity levels of adults and developmental rates of juvenile ants. Several factors influence mound temperature. Externally, sunlight and air temperature will alter the temperature inside the mound. Internally, metabolic activity of bacteria decomposing waste material inside the mound and metabolic activity of the ants themselves will warm the mound. In many species of ants and termites, thermoregulation appears to be an important function of mound geometry and the asymmetrical shape of this species' mounds has led researchers to suspect the same for *P. occidentalis*.
In a recent study to examine whether *P. occidentalis* shapes its mounds to catch the morning sun and thus aid in thermoregulation, a researcher recorded subsoil temperatures on all 4 sides of the mound as well as 2 off-mound temperatures. This was accomplished by inserting the tip of a digital thermometer 1.6 inches (4 cm) into the mound on each of the 4 cardinal sides (E, W, N, S) at a distance of 4 inches (10 cm) from the apex (top) of the mound. The off-mound temperatures (at 4 cm depth) were recorded in sunlit, bare soil and then in a shaded area. Temperatures were recorded at two different times during the day (morning - when the sun was up and afternoon when the sun was going down) and on three different days during the summer. The investigator also measured the grade/steepness of each side of the mound. A less steep slope would expose more surface area to the sun and thus absorb more radiant energy during each day.

6. To investigate whether the steepness of the mound sides had an effect on mound temperature, the researcher should correctly place _____ of each recording site on the **X axis** of her graph.
a) mean temperature
b) depth of measurement
c) cardinal direction
d) distance from the apex
e) grade/steepness

7. She should correctly place _____ for each recording site on the **Y axis** of her graph.
a) mean temperature
b) depth at which temperature was taken
c) cardinal direction
d) distance from the apex
e) grade/steepness

8. In this experiment _____ is the **independent/experimental/manipulated** variable.
a) mean temperature
b) depth at which temperature was taken
c) cardinal direction
d) distance from the apex
e) grade/steepness

9. In this experiment _____ is the **dependent/measured/response** variable
a) mean temperature
b) depth at which temperature was taken
c) cardinal direction
d) distance from the apex
e) grade/steepness

10. Which of the following hypotheses was tested in the above study?
a) That ants build mounds, proves that they can thermoregulate.
b) Ants build asymmetrical mounds to warm up the colony using the morning sun and allow them to carry out normal functions (such as feeding and egg development).
c) The function of an asymmetric mound is to reflect more heat for cooling purposes.
d) Because ants thermoregulate they have enough energy to build asymmetrical mounds.
e) The function of an asymmetric mound is to serve as a natural sundial for the ants.

11. Which one or more of the following are reasonable behaviors for ants living in these mounds?
a) When the temperature of the mound exceeds optimal levels, ants close off the mound openings and retreat to deeper tunnels in the nest.
b) When the temperature of the mound exceeds optimal levels, ants move to the mound opening and bask in the sun.
c) Ants continuously shuttle developing young among chambers to optimize their temperature for growth.
d) To escape the high temperatures ants move the entire mound to lower elevations during the summer.
e) Both (a) and (c) are reasonable behaviors.

12. Which one of the following would support the idea that the shape of the mound influences the mound temperature?
a) If the mound is asymmetrical and there is no difference in temperature between the east-facing side and the off-mound sites (shaded and sunlit) during the morning hours.
b) If the mound is asymmetrical and there is no difference between the temperature of any of the 4 sides and the off mound sites (shaded and sunlit).
c) If the mound is symmetrical and there is a difference between the temperature of the sunlit and shade sites.
d) If the mound is asymmetrical and the temperature of the east-facing side is higher than the off-mound sites (shaded and sunlit) during the morning hours.

13. When the ants' cells are respiring (Glycolysis, Krebs, chemiosmosis) they use _____ to produce _____.

a) glucose and CO_2;	oxygen
b) oxygen and water;	glucose and CO_2
c) oxygen and glucose;	CO_2, ATP, and water
d) ATP;	CO_2
e) CO_2 and oxygen;	ATP

14. A researcher placed a CO_2 probe inside a large ant mound and recorded the CO_2 levels for a 24-hour period in June. The most likely metabolic source of this carbon dioxide is _____.
a) conversion of glucose into pyruvate
b) the Krebs cycle
c) dune buggies belonging to adolescent ants in the colony
d) photosynthesis
e) production of ADP during chemiosmosis

15. Which one or more of the following would influence CO_2 levels inside the ant mounds described above?
a) number of bacteria in the mound
b) average mound temperature
c) number of ants in the mound
d) size of the CO_2 probe
e) CO_2 levels inside the mound would be influenced by (a), (b), and (c).

16. Which one of the following is a true statement about heat exchange between a poikilotherm - like the ant - and its environment?
a) While inside the mound, the ant's core body temperature remains fairly constant, regardless of how hot or cold the temperature inside the mound becomes.
b) The rate at which the ant gains and loses heat is related to its surface-area-to-volume ratio.
c) Heat energy will always move from the ant to the mound if the mound has a higher temperature than the ant.
d) Larger ants will heat up faster than smaller ants.
e) Regardless of where it is, the ant lowers its metabolic rate to stay cool.

17. A mutation (genetic change) that results in loss of folds in the inner mitochondrial membrane occurred in one of these ants. You would correctly predict which one or more of the following for this ant in comparison to an ant without this mutation (given that all other conditions are the same for both ants). In a given time period the ant with this mutation would _____.
a) produce more ATP
b) produce less ATP
c) produce more glucose
d) produce less oxygen
e) Both (b) and (d) are correct predictions.

18. Which one or more of the following organisms conduct glycolysis?
a) the ants in the mound
b) the bacteria associated with the ant waste in the mounds
c) the plants in the area surrounding the mound
d) All of the above.
e) Only (a) and (c).

19. Another researcher decided to do some additional studies on this particular species of ant and placed several hundred of the ants along with a food supply and suitable materials for building a mound inside a large glass terrarium. The glass would allow him to easily observe the activities of the ants. His lab was in a building infested with cockroaches. To prevent the cockroaches from getting the ants' food supply he placed an airtight top on the terrarium. Obviously he had forgotten what he learned in Biology 1114 class because the ants need oxygen _____.
a) to produce pyruvate for the Krebs cycle
b) to act as the final electron acceptor in aerobic cellular respiration
c) to catalyze the phosphorylation of ADP in the cytoplasm
d) to produce glucose
e) for all of the above

20. Fortunately he discovered his mistake before the entire colony of ants died. He then split the colony into two smaller terraria with lids that allowed air flow. He placed them both on the lab bench but one was directly in front of a window that received direct sunlight for several hours during the day. The other was further down the bench and was placed under the vent for the central air conditioning. After two weeks he noticed that the colony by the window had completed the building of their mound but that the one further down the bench had not. Which one or more of the following is(are) a reasonable explanation(s) for this observation?
a) Ants absorb sunlight to supply energy for chemiosmosis.
b) The increase in temperature inside the terrarium due to exposure to sunlight streaming through the window increased the ants' metabolic activity.
c) The ants near the air conditioning vent had to take time out to knit sweaters.
d) Because ants are poikilotherms, the speed of their enzyme-driven reactions is positively correlated with ambient temperature.
e) Both (b) and (d) are reasonable explanations.

21. Which one or more of the following is (are) an example(s) of a gradient?
a) Temperatures at the peak of the ant mound and deep within in one of the burrows.
b) Relative concentrations of H+ inside and outside of an ant's inner mitochondrial membrane.
c) Temperature within the head of an ant and within the body of the ant.
d) All of the above are examples of a gradient.
e) Only (a) and (b) are examples of a gradient.

22. Individual ants vary in size within a colony. A large ant has a __ surface area to volume ratio compared to a small ant, and it will lose/gain heat relatively __ compared to the small ant.
a) greater; faster
b) smaller; faster
c) greater; slower
d) smaller; slower
e) none of the above, because SA/V does not affect heat transfer

23. Anteaters are mammals found in Central and South America. As such, they do not eat harvester ants, but they do consume other ant species. If your lab group moved an anteater from a cage surrounded by warm air (30° C) into a cage surrounded by cool air (15° C), which is below the lower critical temperature for an anteater, you correctly predict which one or more of the following in the anteater.
a) Carbon dioxide production will increase.
b) Internal temperature of the anteater will remain constant.
c) ATP production will increase.
d) Oxygen consumption will increase.
e) All of these (a-d).

Use the following information for the NEXT 5 QUESTIONS.
Brady Brine lives on the Gulf of Mexico coast, and is a lifelong saltwater fisherman. Although he is very knowledgeable about ocean fishing, Brady has led a sheltered life and has little education or experience beyond his small town. While vacationing in the western U.S., Brady pulls off the road in his RV, and takes out his favorite fishing rod to try fishing in Great Salt Lake (GSL), Utah. He figures that any lake with the word "salt" in it must be just like the ocean, so he daydreams of grilling some fresh-caught flounder for dinner. Earlier, he had stopped by "Bubba's Bait-n-Tackle" shop near a (freshwater) stream to pick up some minnows for bait. Not wanting to brag about his fishing skills, Brady didn't tell the owner where he planned to fish. Too bad, because Bubba would have told him that his fishing efforts would be futile. GSL is about 25-30% salt (mostly NaCl, close to saturation), compared to only 3.5% in the oceans, so salty that only a few specially-adapted species of bacteria, algae and brine shrimp can survive.

Pleasantly surprised to have a lake full of fish all to himself, Brady hooks a minnow and casts into GSL. While waiting for the first bite on his line, he places the bait bucket (which has holes in it) into GSL to keep the minnows fresh. After 20 uneventful minutes, he reels in the minnow to cast again. He is puzzled because the minnow is dead. Opening the bait bucket to get another, he is horrified to see that all his minnows are shriveled up and dead.

On the way home to Louisiana, Brady stops at the Great Salt Plains Lake in western Oklahoma. This time he talks to the locals, who tell him that the fishing really is good in the lake. He learns that the salinity of the lake is only about 0.4% (less salty than fish cells), and the fish are typical freshwater species. He tries an experiment in which he mixes varying proportions of water from GSL (which he collected as a souvenir) and the Great Salt Plains Lake to make different salinities, and checks survival of freshwater minnows in each mixture.

24. Brady's bad experience could have been avoided if he had known that the high salinity of GSL would cause _____.
a) water to diffuse into the minnows, causing their cells to burst
b) salt to diffuse into the minnows, causing the bait bucket to burst
c) salt to diffuse out of the minnows, causing their cells to shrink
d) water to diffuse out of the minnows, causing their cells to shrink
e) both (a) and (b) to occur

25. When <u>first placed</u> into GSL, the cells of the minnows' gills (the gas-exchange tissue directly in contact with the water) begin to rapidly pump Na+ ions out, against the Na+ concentration gradient. You correctly hypothesize which one or more of the following? During this <u>initial ion-pumping</u>, the minnows' gill cells would _____.
a) convert Na+ into carbon dioxide (CO_2)
b) decrease use of oxygen
c) increase mitochondrial electron transport
d) switch to anaerobic respiration to make more ATP
e) Both (b) and (d) would occur.

26. In the low-salinity Great Salt Plains Lake in Oklahoma, you correctly hypothesize which one or more of the following? The fishes will _____.
a) excrete large volumes of dilute urine through their kidneys
b) excrete a small volume of very concentrated urine through their kidneys
c) experience rapid osmosis of water into their gills
d) Both (a) and (c) would occur.

27. Cellular respiration rates in _____ would be higher during warm summer months in the Oklahoma lake compared to those in cool winter months.
a) bacteria
b) plants
c) fish
d) all of the above (a-c)
e) none of the above

28. Rotenone could stun or kill fish in the Oklahoma lake by _____.
a) causing fish to become supersensitive to sunlight
b) inhibiting electron transport in mitochondria
c) damaging fish gills so they no longer absorb oxygen
d) removing oxygen from the lake
e) Rotenone does all of these.

29. If rotenone is sprayed into an anthill, which one or more of the following structures in the ants' cells contain the binding sites for rotenone?
a) outer mitochondrial membrane
b) inner mitochondrial membrane
c) outer cell membrane
d) mitochondrial matrix
e) both (a) and (c)

30. If a chemical that makes inner mitochondrial membranes permeable (leaky) to protons (H+) is sprayed into the anthill in the previous question, you correctly predict which one or more of the following will occur?
a) ATP production by ants will decrease.
b) ATP production by ants will increase.
c) The proton (H+) gradient in ant mitochondria will decrease.
d) The proton (H+) gradient in ant mitochondria will increase.
e) Both (a) and (c)

Use the following information for the next 4 questions
Seeds of plums, apricots, cherries, peaches and almonds contain a substance called amygdalin. Amygdalin is responsible for the familiar taste and scent of bitter almonds. Chemically it is a cyanogenic glycoside that can produce hydrogen cyanide (HCN, a secondary metabolite) whenever plant tissue containing it is crushed or damaged. Also, HCN molecules are released when the seeds are digested. The production of HCN from amygdalin is facilitated by enzyme activity. In intact tissue, the amygdalin and the enzyme reside in different compartments; therefore, no reaction occurs in the plant. When the tissue is damaged or digested by an animal, the walls of the compartments are destroyed, allowing the enzyme to bind with amygdalin and release HCN. In an animal, HCN molecules disrupt the metabolic activity of the mitochondria because they stop the electron transport.

31. Seeds containing amygdalin have been eaten by squirrels (homeothermic animals with body temperature of about 37^{o}C) and insects (poikilothermic animals). Under what conditions will amygdalin be digested at the lowest (slowest) rate?
a) Squirrels kept at 25^{o}C
b) Squirrels kept at 37^{o}C
c) Insects kept at 25^{o}C
d) Insects kept at 37^{o}C
e) Insects kept at 42^{o}C

32. Which one or more of the following is a correct hypothesis to explain the large amounts of amygdalin in the seeds of these plants?
a) These plants were favored by natural selection since they were not eaten by herbivores.
b) These plants decided to react to the herbivores by accumulating amygdalin.
c) Plants with amygdalin perform better under all circumstances and always survive.
d) This occurred without any involvement of natural selection.
e) (a) or (b) is correct depending on the species

33. You would correctly predict that once exposure to HCN has taken effect, which of the following would occur in the mitochondria?
a) O_2 consumption will stop.
b) A burst in ATP production will occur.
c) Water will split and O_2 will be released.
d) ADP will be converted into ATP.
e) ATP will be converted into glucose.

34. An animal poisoned by HCN will die quickly because of _____.
a) deficiency in ATP
b) deficiency in ADP
c) deficiency in glucose
d) deficiency in O_2
e) All of these (a)-(d)

35. Large trees are not found in the tundra because _____.
a) burrowing of rodents prevents extensive root development
b) permafrost prevents deep penetration of roots in the soil
c) they have all been cut down and removed for lumber
d) they have gone extinct because huge populations of caribou ate all of them when the trees were small
e) hot dry winds prevent development of leaves that can store water

36. Choose the sequence below that represents the correct size order from smallest to largest.
a) proton - H_2O – glucose – mitochondria – cell
b) cell - proton - H_2O – glucose – mitochondria
c) H_2O – glucose – mitochondria - cell – proton
d) mitochondria - cell – proton - H_2O – glucose
e) glucose - mitochondria - cell – proton - H_2O

Use the following account to answer the next 4 questions.
An entomologist interested in the life history of a particular moth species has been collecting data on the feeding habits of the caterpillar stage (the immature or juvenile). After closer examination, she notices that the caterpillars spin silk over the surfaces of the leaves on which they feed. On closer inspection, she notices that the caterpillars use the silk to protect themselves from the trichomes (tiny, hooked, sharp, plant hairs that puncture and kill insects) found on these leaves. Curious about her observations, she looked back in her notes. She found that 20 years ago the caterpillars in her lab did not spin silk over the leaves as they walked. Then she went to the library and read that other scientists had observed this type of caterpillar eating such leaves 100 years ago, but they did not report the caterpillars spinning silk over the leaves. She then checked leaf samples in the herbarium and discovered that 50 years ago, these plants did not possess as many trichomes. "Eureka", she remarks, "I have proven that coevolution has occurred in these two species."

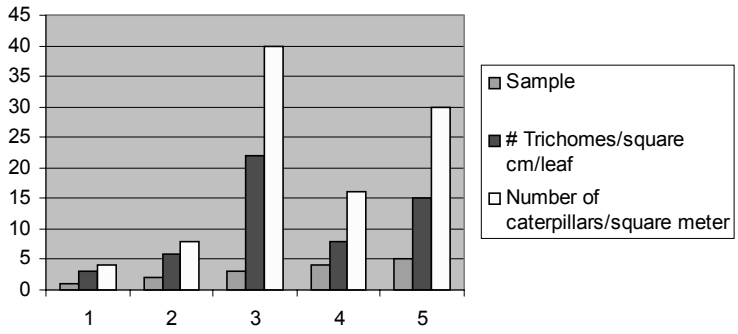
37. Which of the following provides sufficient evidence that coevolution may have occurred?
a) The caterpillars ate the plants.
b) The caterpillars spun silk over the leaves.
c) The leaves began producing trichomes after caterpillars began eating them and caterpillars covered the leaves with silk after the trichomes became plentiful.
d) Caterpillars had been eating leaves of all types for many years then began to eat these leaves after which evolution began to take place for the first time.
e) Both the caterpillars and the leaves were able to survive only when they lived on different continents.

38. Which of the following would provide evidence that natural selection was at work in the example described in the paragraph above?
a) Caterpillars ate the plants.
b) Caterpillars all survived.
c) The caterpillars that spun silk survived and produced more offspring than those that did not spin silk.
d) The caterpillars that spun silk were equally likely to survive and produce offspring as the caterpillars that did not spin silk.
e) The plants with the smallest number of trichomes were the greenest.

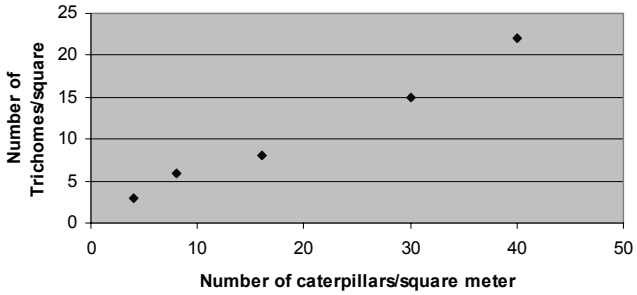
39. Why would you correctly criticize the last sentence in the second paragraph above?
a) There is no reason to believe that the scientist was a woman.
b) Since evolution is only a theory it has not yet been proven.
c) Regardless of the evidence provided, no theory or hypothesis is ever considered proven to be true.
d) Until a specific, controlled experiment is conducted it is not correct to say that any hypothesis or theory is proven.
e) Eureka is a brand of vacuum cleaner used in Greece but not in America.

40. Which of the following graphs best represents data that indicate the relationship between the number of caterpillars present and the number of trichomes found on leaves?

a) Sample Graph # 1



b) Sample Graph # 2



c) Sample Graph # 3

d) Sample Graph # 4