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BIOL 1114   EXAM 3 (**STAR FORM**)   5 April 1999

Use a #2 pencil to fill in the information portion of your NCS answer sheet including the appropriate circles. Write "**Star Form**" in the margin above your name on the NCS sheet. Read all questions and answers *carefully* before choosing the **single BEST response** for each one, and feel free to ask an instructor/TA for clarification.

1. Water is split during photosynthesis to _____.
    a) provide oxygen for the formation of carbohydrates
    b) release hydrogen gas
    c) provide electrons to photosystem II to replace those lost by chlorophyll
    d) make ATP
    e) make chlorophyll

2. A scientist **changes** from shining red light to green light on a species of a green plant that contains chlorophyll as the only photosynthetic pigment. The concentration of H+ on the inside of its thylakoids (thylakoid space – see figure) would _____ under green light.
    a) increase
    b) decrease
    c) stay the same

3. If a chloroplast is prevented from creating a H+ gradient across the thylakoid membrane (see figure at right), the light **in**dependent portion of photosynthesis would _____.
    a) stop because there would be no light
    b) stop because there would be no action potential
    c) stop because there would be no ATP
    d) speed up because there would be more ATP
    e) speed up because the would be more NADPH

4. Both mitochondria and chloroplasts have many internal membranes. This _____.
    a) prevents H+ from escaping
    b) increases the surface-to-volume ratio of the metabolically important portion of the organelle
    c) provides a large area for sodium-potassium pumps to transfer ions
    d) increases the rate of cellular secretions of proteins and lipids
    e) decreases the surface-to-volume ratio of the metabolically important portion of these organelles while maintaining their shape

5. Which of the following hypotheses/predictions about red algae found at a depth of 15m is most likely to be correct?
    a) Red algae evolved to be red because they anticipated the need for it.
    b) Red algae produce a large quantity of red pigments to absorb the red light at that depth.
    c) Red algae will have chlorophyll-*a* to serve as the primary photosynthetic pigment.
    d) Red algae will not have chlorophyll-*a* because they are aquatic and therefore have plenty of H_2O to donate electrons.

6. A researcher notices that different colored algae are found at different depths in a lake. The algae she collects from the bottom of the lake (a depth of about 50 feet) have a red appearance at the surface, whereas they appear brownish green at the depth at which they are found. She extracts the pigments from the red algae and finds a very abundant red pigment (called phycoerythrin) as well as smaller amounts of chlorophyll. She correctly hypothesizes that the lake bottom algae contain abundant red pigments because _____.
    a) red light scarcely reaches the bottom of the lake because it is filtered out by the water.
    b) blue light scarcely reaches the bottom of the lake because it is filtered out by the water.
    c) yellow light scarcely reaches the bottom of the lake because it is filtered out by the water.
    d) green light scarcely reaches the bottom of the lake because it is filtered out by the water.
    e) damaging ultraviolet light is effectively screened by the red pigments preventing DNA damage (mutations).

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7. Accessory (antenna) pigments _____.
   a) transfer light energy to chlorophyll
   b) participate in the light-independent reactions of photosynthesis
   c) transfer electrons from the light-independent to the light-dependent reactions of photosynthesis
   d) make antibodies
   e) make light

8. Which one of the following is **FALSE** about the light-dependent reactions of photosynthesis?
   a) split H_2O
   b) make O_2
   c) make ATP
   d) convert CO_2 into organic compounds
   e) convert $NADP^+$ to NADPH

9. The light **in**dependent reactions of photosynthesis occur in which one or more of the following locations in a chloroplast?
   a) grana
   b) cristae
   c) thylakoid membranes
   d) stroma
   e) all of these

10. You and your lab partners design an experimental process that allows chloroplasts to make sugars in the dark. Which one or more of the following must be provided to the chloroplasts to make this possible?
    a) NADPH
    b) CO_2
    c) ATP
    d) only (a) and (c)
    e) (a), (b), and (c)

11. Which of the following might represent the absorption spectrum of an orange leaf?

12. Color-blindness exists in people who have a gene mutation causing faulty light-absorbing pigments in retina **cone** cells. Which one or more of the following is a likely cause for these people's inability to distinguish between some colors?
    a) Light does not pass through the eye to the retina.
    b) The pigment does not initiate an action potential in the cone cell.
    c) A color-blind person probably had an accident that damaged the retina.
    d) A color-blind person has rod cells that do not absorb enough light.
    e) All of these

13. If you moved a photosynthetic bacterial culture from a warm, well-lit place to a cold well-lit place, which one or more of the following would you correctly expect to occur?
    a) photosynthetic rate would decrease because enzyme-assisted reaction rates would slow down
    b) respiration rate would decrease because enzyme-assisted reaction rates would slow down
    c) overall metabolic rate would decrease because enzyme-assisted reaction rates would slow down
    d) All of these
    e) None of these

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Use the following information for the NEXT **3** QUESTIONS
A 100 year old volcanic island far out in the ocean, previously occupied only by bacteria, fungi and algae, receives its first
flowering plant by means of 3 seeds deposited in droppings from a lone stray bird that subsequently leaves the isolated
island (because there are no flowering plants to eat). By sheer luck, a botanist happens to have been on the island at the
time to study this sort of thing. She carefully monitors the fate of the seeds without interfering in any way. All 3 seeds,
based on their characteristic size and shape, appear to be from a single grass species common on the mainland (1000 miles
away). Within a few weeks, all three seedlings were growing equally well in a small patch of sand, well-fertilized thanks
to the bird droppings. Curiously, one of the grass plants has red leaves, never before seen in this or any other grass
species in the well-studied mainland population. Like most grasses, this species is known to be wind-pollinated.

14. Hypothesize about the origin of the individual red grass plant.
    a) Its parent must have grown in a location that received mostly red light.
    b) Its parent must have grown in a location that received mostly blue-green light.
    c) It is a mutant containing a large amount of a pigment that absorbs mainly blue-green light.
    d) It is a mutant that makes a large amount of a pigment that absorbs mainly red light.
    e) It coevolved with the species of bird that brought it to the island.

15. Assuming all three seeds came from the same mainland population, hypothesize about the evolutionary relationship
    between the red and green grasses.
    a) They are the same species because they can interbreed (cross-pollinate).
    b) They are already different species.
    c) Their different color means they must eventually become different species.
    d) Their different color means the red and green grasses cannot wind-pollinate each other.
    e) The red grass, because it is unique, cannot reproduce, leaving only green grasses on the island.

16. The botanist wants to request research funding to continue her study of the colonization of the island by the grasses.
    What should she propose to do if she wants to study natural selection of the green and red grasses on this island?
    a) Grow them in a laboratory growth chamber under ideal conditions (light, water, nutrients).
    b) Measure the overall population growth rate of herbivores on the island.
    c) Measure the absorption spectrum of both types of grasses.
    d) Count the number of red and green individuals in the population over several generations.

17. Based on the logistic (sigmoidal) model $G = rN(K-N)/K$, if a population size (N) is 952 and the carrying capacity (K)
    is 837, then _____.
    a) population size will not change the following year
    b) population size will continue to grow exponentially
    c) population size will increase, but only slightly
    d) population size will go to zero, or close to zero
    e) population size will decrease by a small amount

18. In the graph at right, the annual growth (G) of the population is highest _____.
    a) towards the right side of the graph
    b) towards the left side of the graph
    c) in the middle of the graph
    d) at both the left and right sides but not in the middle
    e) The annual population growth (G) is the same over the entire time period
       shown.

19. The graph at right shows
    a) Logistic growth
    b) Exponential growth
    c) Disease susceptibility in a population
    d) Antibiotic resistance in a pathogen
    e) Density-dependence

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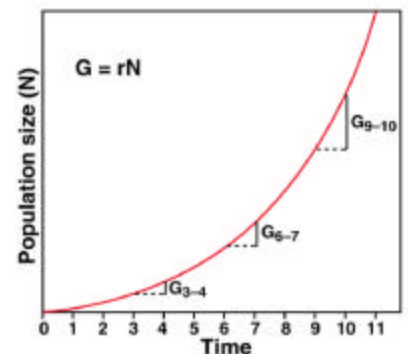
20. If a population had no density-dependent controls working on it, it would grow _____.
    a) exponentially
    b) rhythmically
    c) arbitrarily
    d) logistically
    e) altruistically

Use the following information for the NEXT **3** QUESTIONS: A population of 100 bluejays lives in your neighborhood (10 acres). This year, 45 bluejays will be born, and 35 bluejays will die. Please calculate the following:

21. Beginning population density
    a) 100 bluejays
    b) 145 bluejays
    c) 100 bluejays per acre
    d) 10 bluejays per acre
    e) 0.45 bluejay per bluejay per year

22. Growth increment (G) for this year
    a) 110 bluejays
    b) 10 bluejays
    c) 10 bluejays per bluejay
    d) 0.10 bluejays per bluejay per year
    e) 45 bluejays

23. At some point, the bluejay population will reach a maximum population size that can be supported by the environment (your neighborhood). That number (K) is called:
    a) growth rate
    b) maximum growth
    c) logistic growth
    d) carrying capacity
    e) exponential growth

24. Overuse of antibiotics is a human health concern because
    a) Resistant bacteria may be destroyed and are lost to the gene pool.
    b) Overuse eliminates resistant bacteria.
    c) It causes resistant strains of bacteria to increase in the human population.
    d) It causes human resistance to increase.
    e) It causes natural selection of new antibiotics.

25. A student in Biology 1114 has recently become obsessed with the new antibacterial soaps, lotions, sparkling gel, and handy wipes from *Bath and Body Works*. He/She uses a different scent everyday. Unfortunately, he/she must have been absent when antibiotic resistance was discussed during lecture. What <u>SERIOUS</u> problem does this student run the risk of creating?
    a) Running out of different perfumed products to buy.
    b) Distracting other students in class with his/her brightly colored glitter gel.
    c) Killing off the stronger bacteria on the skin that normally feeds on the weaker bacteria.
    d) Killing off the weaker bacteria, leaving only the stronger, more resistant bacteria.
    e) Allowing the bacterial plasmid to gain resistance by inserting part of the antibacterial gel DNA into the plasmid, forming a new recombinant DNA.

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26. Antibiotic resistance is more likely to occur in which one or more of the following situations?
    a) When genetic variation exists within the population of bacteria you are targeting.
    b) When persons taking an antibiotic fail to take the entire prescription.
    c) In areas without access to antibiotics.
    d) All of the above (a-c).
    e) Only (a) and (b).

27. Most human immune systems would recognize proteins on the surface of *Mycobacterium tuberculosis* as _____.
    a) Antibodies
    b) Antigens
    c) B-cells
    d) (a) and (b)
    e) (b) and (c)

28. After disappearing for awhile, a virus once again causes a local epidemic of influenza. No other diseases are on the rise. Which of the following is the most probable cause of this?
    a) The viruses increase their production of ATP.
    b) A mutation in the virus gave rise to different antigens (surface glycoproteins) that the human immune systems did not recognize.
    c) A mutation in humans caused an increase in their antibody production in response to viruses.
    d) The human population had decreased thereby increasing the chances that infected people would encounter uninfected people.
    e) A mutation in the human population causes excess production of macrophages.

29. Which of the following is **true**?
    a) Adults pass acquired immunity (memory cells) to their offspring.
    b) Offspring of parents who have natural resistance to a disease are more likely to have resistance also.
    c) Human resistance to disease increases in a population over time because the pathogen (disease causing organism) becomes more resistant to antibiotic drugs.
    d) Antibodies are located in/on the cell membranes of a pathogen.
    e) Macrophages secrete antibodies to control infection.

30. The faster response of the immune system to a second exposure (compared to the first exposure) to a particular antigen is primarily because of _____.
    a) antibodies
    b) the action potential
    c) lower metabolic rate
    d) memory cells
    e) all of the above

31. Increasing population **density** is likely to
    a) increase the spread of a disease.
    b) decrease the spread of a disease.
    c) have no effect on the spread of disease.
    d) actually contribute to the eradication of the disease.
    e) increase the rate of mutation in the disease-causing organism.

32. Which one or more of the following factor(s) could influence the spread of a virus in a mouse population?
    a) The genetic diversity of each population.
    b) The population density.
    c) Past exposure to the same antigens that are present on the virus.
    d) The abundance and quality of food resources for each population.
    e) All of the above.

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33. Surface compounds such as glycoproteins (glyco = carbohydrate) or glycolipids serve as antigens by which cells are identified as self or foreign. Remembering the process of cellular secretion, which one or more of the following organelles would be involved in antigen production?
    a) nucleus
    b) smooth endoplasmic reticulum
    c) rough endoplasmic reticulum
    d) golgi body
    e) all of the above

34. Disease-causing protozoans evolve various mechanisms to prevent their hosts from detecting and destroying them. The hosts tend to evolve to resist/detect the protozoans. Such responses are examples of _____.
    a) adaptive radiation
    b) divergence
    c) viscosity
    d) manipulation
    e) co-evolution

35. A disease caused by a virus is found to produce only mild disease symptoms in humans. Researchers correctly hypothesize that _____.
    a) the virus has only recently begun to parasitize the human host population and one can expect the symptoms to get progressively worse as the host-parasite relationship evolves
    b) the virus has quite recently come from some domesticated animal species and as a newcomer, hasn't had the opportunity to develop into a life-threatening parasite
    c) the virus is one that has co-evolved for a long time with the human host population
    d) (a) and (b)
    e) none of the above

36. What is the correct **D**NA complementary sequence for ATGGGCCCTAGC?
    a) UACCCGGGUTCG
    b) TUCCGGGCAUGC
    c) UUCCCGGGUUCG
    d) TUCCCGGGUTGC
    e) TACCCGGGATCG

37. Which one or more of the following is TRUE?
    a) The DNA of pathogens (bacteria and viruses) mutates.
    b) The DNA of hosts (humans, for example) mutates.
    c) Pathogens can sometimes successfully infect more than one host species.
    d) Genetically diverse host populations are more likely than genetically uniform populations to survive epidemics.
    e) All of the above.

38. In a laboratory situation you can maintain human skin cells in small culture flasks for short periods of time if you place them in the appropriate growth medium. If you were measuring the amount of DNA per cell in these culture flasks when would the amount of DNA double?
    a) Between the beginning and end of mitosis
    b) Between G1 and G2
    c) After mitosis
    d) At the beginning of G1

39. Which one or more of the following would allow you to distinguish RNA from DNA?
    a) Test for the presence of uracil (U).
    b) Test for the presence of adenine (A).
    c) Test for the amount of cytosine (C).
    d) All of the above (a-c)
    e) Only (b) and (c).

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Use the following information for the NEXT **5** QUESTIONS.

Dr. Oklahoma Smith (an ethnobotanist) is hired by a large pharmaceutical company to spend a year following native healers in the rainforest. His assignment is to watch local medical practices and discover plants that might provide cancer treatments for his employer to research and develop. Dr. Smith knows that cancer chemotherapy agents usually work by interfering with the cell cycle to stop rapid cell division. He plans to watch carefully and identify any plant used by a native healer to treat tumors and to note which ones are most effective.

Dr. Smith works closely with one successful medicine man administering a plant extract orally (by mouth), who allows him to interview the patients and make simple measurements.   Dr. Smith carefully measures tumor size and estimates patient height, weight, and sex in his diary with dates through the course of treatment. When Dr. Smith presents results from his simple experiments to the pharmaceutical company, he shows them two graphs:

Graph 1: Tumor size vs. Time (with daily treatments)   **Graph 2**: Tumor size reduction vs. Patient age

After some time, the pharmaceutical company is convinced that Dr. Smith may have discovered something important in the treatment of cancer. A team of scientists is assigned to isolate chemicals from the plant and determine their effects on cells. One of the compounds is shown to prevent cells from proceeding from G2 to mitosis in the cell cycle.

40. In theory, plants might manufacture compounds that inhibit cell division because
    a) they choose to
    b) cell division inhibitors encountered by invading fungi would give the plant greater survival advantage
    c) plants making these compounds have greater fitness in their environment
    d) a and b
    e) b and c

41. In graph #1, the dependent variable is:
    a) tumor size
    b) tumor reduction
    c) time
    d) patient sex
    e) patient age

42. In graph #2, Dr. Smith is showing results from
    a) a controlled experiment
    b) a correlation experiment
    c) a placebo
    d) a sham operation
    e) random chance

43. Cells held in the G2 phase would have which of the following characteristics?
    a) one copy of all DNA
    b) two copies of all DNA
    c) two nuclei
    d) no nuclei
    e) none of these

44. One of the negative side effects of this drug in clinical trials is that a patient's immunity to bacterial infection is **decreased**. Which of the following is the correct hypothesis about this drug's effect on immunity?
    a) rate of cell division in the body would increase if cells are held in G2, thus any bacterial infection would spread rapidly
    b) rate of cell division in the body would increase if cells are held in G2, thus the immune system would go out of control
    c) rate of cell division in the body would decrease if cells are held in G2, thus B cells could not rapidly divide to manufacture and secrete antibodies
    d) rate of cell division in the body would decrease if cells are held in G2, thus B cells could not recognize antigens

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45. According to complementary bonding rules, if the proportion of adenine (A) in a molecule of human DNA is 40%, what are the proportions of the other bases?
   a) C = 10%; G = 40%; T = 10%
   b) C = 40%; G = 10%; T = 10%
   c) C = 20%; G = 20%; T = 40%
   d) C = 10%; G = 10%; T = 40%

46. What normally stops the synthesis of a protein?
   a) Supply of transfer RNA is exhausted
   b) Supply of messenger RNA is exhausted
   c) Supply of amino acids is exhausted
   d) A stop codon on the messenger RNA
   e) An enzyme produced by the DNA

Use this information to answer the NEXT **2** QUESTIONS:

   met-trp-tyr-arg-ser   represents a tiny portion of a gene that has been transcribed and translated.

47. How many <u>codons</u> does ***met-trp-tyr-arg-ser*** represent?
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5

48. How many <u>nucleotides</u> does ***met-trp-tyr-arg-ser*** represent?
   a) 1
   b) 5
   c) 10
   d) 15
   e) 20

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49. Which one or more of the following processes would stop if <u>nothing</u> could exit the nucleus of an eukaryotic cell?
   a) transcription
   b) translation
   c) cellular secretion of an enzyme
   d) all of the above
   e) b and c

50. DNA is _____ stranded; RNA is _____ stranded.
   a) single; single
   b) single; double
   c) double; single
   d) double; double