

## BIOLOGY E/M TEST

### FOR BOTH BIOLOGY-E AND BIOLOGY M, ANSWER QUESTIONS 1-60

**Directions:** Each set of lettered choices below refers to the numbered questions or statements immediately following it. Select the one lettered choice that best answers each question or best fits each statement, and then fill in the corresponding oval on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1-3 refer to the following structures:

- (A) chloroplast
- (B) mitochondrion
- (C) ribosome
- (D) nucleus
- (E) cytoplasm

1. Site of DNA transcription in eukaryotes.
2. Location of aerobic respiration
3. Found in autotrophic cells

Questions 4-6 refer to the following chemicals:

- (A) enzymes
- (B) amino acids
- (C) glucose
- (D) fatty acids
- (E) nitrogenous bases

4. About 20 different forms exist naturally
5. Usually are paired up with each other by hydrogen bonds
6. An important source of energy for many living organisms

Questions 7-9 refer to the following parts of the circulatory system:

- (A) left ventricle
- (B) left atrium
- (C) capillary
- (D) pulmonary artery
- (E) aorta

7. Carries oxygen-deficient blood
8. Pumps blood to the tissues in the body
9. A blood vessel with walls that can be just one cell thick

Questions 10-12 refer to the following terms:

- (A) population
- (B) community
- (C) ecosystem
- (D) niche
- (E) biome

10. A single species in a localized area
11. Examples include desert, tundra, and tropical rain forest
12. Predators, prey, and the physical environment of a geographic location

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## BIOLOGY E/M TEST—Continued

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

13. Which of the following statements are true about amino acids?
- There are hundreds of varieties common in nature.
  - They form the basic components of protein molecules.
  - They are the primary source of energy for the cell.
- (A) I only  
(B) II only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III
14. For which of the following tasks would the use of an electron microscope NOT be appropriate?
- Examining the structure of a bacterial flagellum
  - Observing the feeding behavior of *Paramecium*
  - Identifying a virus by the shape of its protein coat
  - Differentiating between smooth and rough endoplasmic reticulum
  - Determining whether or not a cell contains centrioles
15. A person with blood type A can
- donate blood to someone with type O
  - receive blood from someone with type AB
  - receive blood from someone with type O
- (A) I only  
(B) III only  
(C) I and II only  
(D) I and III only  
(E) I, II, and III
16. If two organisms occupy the same ecological niche, which of the following is LEAST likely to happen?
- They will coexist peacefully.
  - One of the organisms will, over a long time, begin to change its habits so that it occupies a different niche.
  - One of the organisms will go extinct.
  - Both organisms will slightly modify their habits over time, dividing up what used to be only one ecological niche into two.
  - The population of one of the organisms will decrease dramatically.
17. Of the following, which organism is an annelid?
- Flatworm
  - Earthworm
  - Grasshopper
  - Spider
  - Scallop
18. Which of the following describes the physical passage of an action potential through a neuron?
- Dendrite, cell body, axon
  - Cell body, dendrite, axon
  - Axon, cell body, dendrite
  - Axon, dendrite, cell body
  - Dendrite, axon, cell body
19. Which of the following statements most accurately describes the structure of the cell membrane?
- A single layer of phospholipid molecules with larger proteins interspersed throughout
  - A double layer of protein molecules with larger phospholipid molecules interspersed throughout
  - A double layer of phospholipids with no associated proteins
  - A double layer of phospholipids with protein molecules that are rigidly attached and fixed in position
  - A double layer of phospholipids with protein molecules that are free to move throughout the membrane
20. Which of the following organisms are heterotrophs?
- Ferns
  - Deer
  - Tigers
- (A) I only  
(B) III only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III

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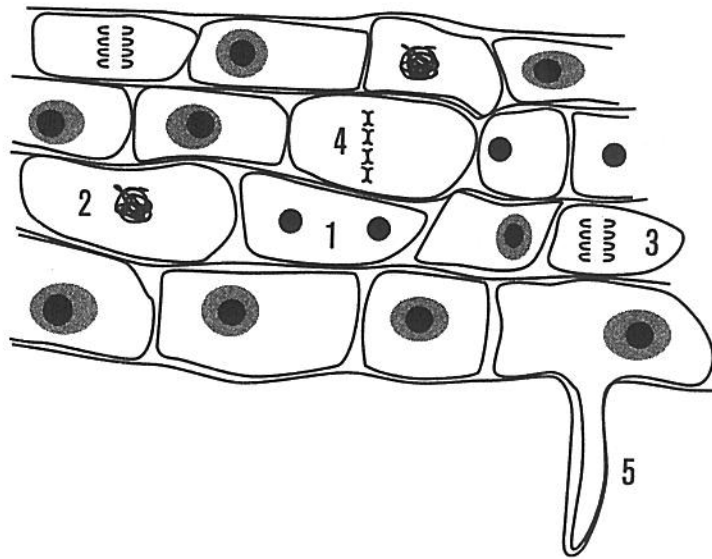
## BIOLOGY E/M TEST—Continued

21. Which of the following is the greatest component of human blood, by volume?
- (A) Plasma
  - (B) Red blood cells
  - (C) Platelets
  - (D) Lymphocytes
  - (E) Phagocytes
22. Which of the following is the best example of a biome?
- (A) A rocky cave
  - (B) A dry riverbed
  - (C) An expansive deciduous forest
  - (D) A tern nesting area and the terns that inhabit it
  - (E) The fish that inhabit the area around a coral reef
23. Which of the following organs is NOT a part of the alimentary canal?
- (A) Stomach
  - (B) Liver
  - (C) Esophagus
  - (D) Small intestine
  - (E) Large intestine
24. The 5-carbon sugar in DNA is
- (A) deoxyribose
  - (B) ribose
  - (C) glucose
  - (D) fructose
  - (E) pentane
25. A protein's tertiary structure refers to the
- (A) amino acid sequence
  - (B) attachment sites for ribosomes
  - (C) three-dimensional folding of the polypeptide
  - (D) sequence of nucleotides
  - (E) binding sites for oxygen
26. A forest is cleared for the lumber industry and the land is left bare. Soon afterward, lichens and mosses begin to grow on the rocks and stumps of the former forest. These organisms are called
- (A) pioneer organisms
  - (B) heterotrophs
  - (C) primary consumers
  - (D) decomposers
  - (E) climax organisms
27. Thyroid cells need to maintain a high concentration of iodide in order to produce the hormone thyroxin. Which of the following is most likely about the flow of iodide into the thyroid cells?
- (A) The iodide passively diffuses through the cell membrane into the thyroid cells, requiring no ATP.
  - (B) The iodide passively diffuses through specialized channels in the cell membrane, requiring no ATP.
  - (C) The iodide is transported into the cell by the Golgi apparatus of the thyroid cells, requiring ATP.
  - (D) The iodide flows into the cell by osmosis, requiring no ATP.
  - (E) The iodide is actively transported through the cell membrane, requiring ATP.
28. Which of the following statements is true about an enzymatic reaction?
- (A) The substrates always remain unchanged and are reusable.
  - (B) The enzymes always remain unchanged and are reusable.
  - (C) Enzymes often combine to form new enzymes.
  - (D) They can take place in a wide temperature range.
  - (E) They require a pH below 3.0.
29. The correct sequence of the progressive phases of mitosis is
- (A) telophase—metaphase—anaphase—prophase
  - (B) anaphase—telophase—metaphase—prophase
  - (C) prophase—anaphase—metaphase—telophase
  - (D) prophase—metaphase—anaphase—telophase
  - (E) metaphase—anaphase—telophase—prophase
30. Which of the following individuals is the MOST fit in evolutionary terms?
- (A) A healthy three-year-old child
  - (B) A 49-year-old woman with three adult children and one grandchild
  - (C) A healthy 30-year-old male with no children
  - (D) A 40-year-old male with cancer and three young children
  - (E) A 27-year-old woman with two young children who can no longer reproduce

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## BIOLOGY E/M TEST—Continued

A student prepared a slide with a longitudinal section of a stained onion root tip and drew this rendering at 400 $\times$  magnification.



31. Approximately how many cells in this sample are in mitotic prophase?
- (A) 0  
(B) 2  
(C) 4  
(D) 5  
(E) 7
32. The cell labeled 1 has yet to undergo
- (A) cytolysis  
(B) interphase  
(C) metaphase  
(D) telophase  
(E) cytokinesis
33. Onion cells have a diploid number of 16. How many chromosomes are in cell number 3?
- (A) 4  
(B) 8  
(C) 16  
(D) 32  
(E) 64
34. The protruding structure labeled 5 is most likely a
- (A) daughter cell  
(B) petiole  
(C) meristem  
(D) root hair  
(E) mitotic division
35. Why are root tips good places to observe mitosis?
- (A) They are a region of rapid growth.  
(B) They receive disproportionate amounts of water.  
(C) Underground tissues are not rendered sterile by UV rays.  
(D) Root cells are larger than other plant cells.  
(E) Nitrogen in the soil increases cellular reproduction rates.

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## BIOLOGY E/M TEST—Continued

A population of deer is split in half after a landslide diverts the course of a massive river. Much time passes.

36. Which of the following is NOT a possible result of this division?
- (A) Homologous structures
  - (B) Speciation
  - (C) Adaptive mutations
  - (D) Divergent evolution
  - (E) Convergent evolution
37. A male and female from the separated populations were brought together by experimenters to breed. The offspring was sterile. This is a probable result of the two parents no longer sharing the same
- (A) drinking water
  - (B) species
  - (C) genus
  - (D) biome
  - (E) community
38. If both populations are in Hardy-Weinberg equilibrium, which of the following CANNOT be true?
- (A) Evolution proceeds slowly and evenly.
  - (B) Individuals mate at random.
  - (C) No migration occurs between populations.
  - (D) Natural selection does not occur.
  - (E) Populations are large.

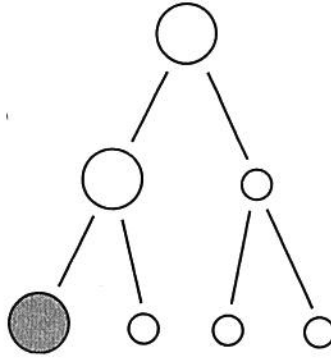
Questions 39–43 refer to the following sequence of nucleotides on a strand of mRNA: AUGGCAGGUGAAUA.

39. What is the sequence of nucleotides on the strand of DNA it translated?
- (A) UACCGUCCACUUAU
  - (B) AUCCGACCUCAAUA
  - (C) GTCCGTAGAATAGT
  - (D) TACCGTCCACTTAT
  - (E) UTCCGUCCTCUUTU
40. Which substance does this strand of mRNA NOT possess?
- (A) Phosphate
  - (B) Deoxyribose
  - (C) Nitrogen
  - (D) Adenine
  - (E) Cytosine
41. When the mRNA's code is used to synthesize a protein, the process is called
- (A) transcription
  - (B) splicing
  - (C) translation
  - (D) transduction
  - (E) crossing-over
42. Molecules of tRNA have three-nucleotide sequences that line up with mRNA during protein synthesis. This sequence on a tRNA molecule is called a(n)
- (A) anticodon
  - (B) A site
  - (C) allele
  - (D) P site
  - (E) gene
43. Of the following, where in a eukaryotic cell does protein synthesis occur?
- (A) Nucleus
  - (B) Golgi apparatus
  - (C) Mitochondria
  - (D) Nuclear membrane
  - (E) Endoplasmic reticulum

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## BIOLOGY E/M TEST—Continued

Questions 44–48 refer to the diagram below, which represents a single cell of an organism.

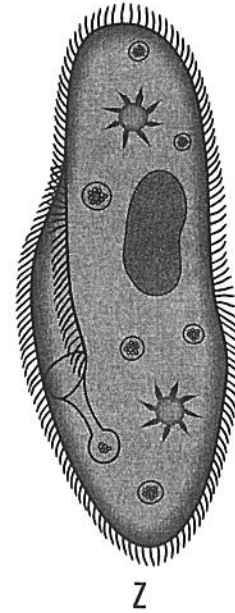
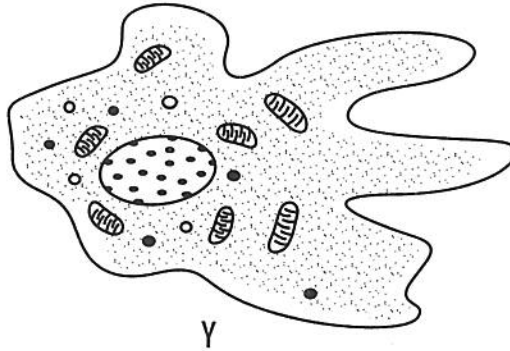
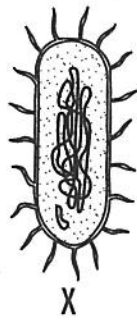


44. The structure in which this process occurs is called the
- (A) cervix
  - (B) uterus
  - (C) fallopian tube
  - (D) testes
  - (E) ovary
45. The shaded cell in the figure will have how many chromosomes?
- (A) 0
  - (B) 12
  - (C) 23
  - (D) 46
  - (E) 92
46. In human males, how many total chromosomes are eventually produced from a single germ cell after spermatogenesis?
- (A) 12
  - (B) 23
  - (C) 46
  - (D) 69
  - (E) 92
47. Immediately on fertilization, the fused egg and sperm become a(n)
- (A) zygote
  - (B) embryo
  - (C) gastrula
  - (D) haploid
  - (E) follicle
48. The release of the mature egg (ovulation) is triggered by which hormone?
- (A) Luteinizing hormone (LH)
  - (B) Prolactin
  - (C) Progesterone
  - (D) Estrogen
  - (E) Epinephrine

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## BIOLOGY E/M TEST—Continued

A student observes three unicellular organisms under a light microscope, and makes these renderings.



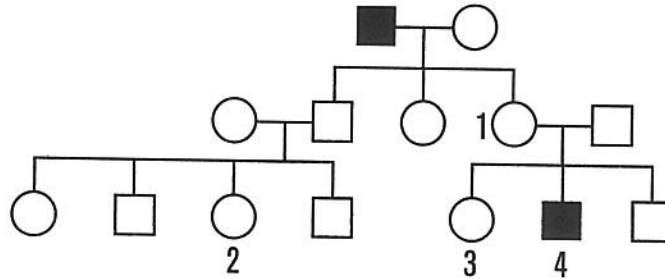
49. Which of these cells are protists?
- I. Cell X
  - II. Cell Y
  - III. Cell Z
- (A) I only  
(B) II only  
(C) III only  
(D) II and III only  
(E) I, II, and III
50. The oozing arms of cell Y are called
- (A) pseudopods  
(B) flagellates  
(C) vacuoles  
(D) cilia  
(E) lysosomes
51. What structure is common to all three cells?
- (A) Cell wall  
(B) Nucleus  
(C) Mitochondria  
(D) Cilia  
(E) Ribosomes
52. Cell X could be all of the following EXCEPT
- (A) moneran  
(B) prokaryotic  
(C) heterotrophic  
(D) autotrophic  
(E) eukaryotic
53. The cell wall in cell X is composed of
- (A) chitin  
(B) cellulose  
(C) glucose  
(D) glycogen  
(E) peptidoglycan

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## BIOLOGY E/M TEST—Continued

Questions 54–57 refer to the following pedigree chart, in which squares indicate males and circles indicate females.



54. Based on this information, the allele causing the shaded trait is likely
- codominant
  - X-linked recessive
  - autosomal dominant
  - Y-linked
  - X-linked dominant
55. What is the probability that individual 3 is a carrier?
- 0%
  - 25%
  - 50%
  - 75%
  - 100%
56. What is the probability that individual 2 is a carrier?
- 0%
  - 25%
  - 50%
  - 75%
  - 100%
57. In order for individual 4 to have a son expressing the phenotype, he could mate with
- a female carrier (heterozygous)
  - an affected female (homozygous)
  - a noncarrier female
- I only
  - II only
  - III only
  - I and II only
  - I, II, and III

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## BIOLOGY E/M TEST—Continued

A student makes the following observations about three plant samples.

Structure	Plant X	Plant Y	Plant Z
Flower	6 petals	none	8 petals
Leaf	veins in parallel	none	branched veins
Roots	fibrous	none	tap

58. Which plant(s) could be classified as an angiosperm?

- I. Plant X
  - II. Plant Y
  - III. Plant Z
- (A) I only  
(B) II only  
(C) III only  
(D) I and II only  
(E) I and III only

59. Plant Y is most likely a(n)

- (A) fern  
(B) gymnosperm  
(C) bryophyte  
(D) angiosperm  
(E) fungus

60. In which plant(s) could the student expect to find seeds with two halves?

- I. Plant X
  - II. Plant Y
  - III. Plant Z
- (A) I only  
(B) II only  
(C) III only  
(D) I and II only  
(E) I and III only

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## BIOLOGY E SECTION

If you are taking the Biology E test, continue with questions 61–80.

If you are taking the Biology M test, go to question 81 now.

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

61. The correct order of plant and animal classification is
- (A) kingdom, phylum, order, family, genus, class, species
  - (B) species, genus, family, class, order, phylum, kingdom
  - (C) kingdom, phylum, class, order, family, genus, species
  - (D) class, order, family, genus, kingdom, species, phylum
  - (E) species, family, genus, order, class, phylum, kingdom
62. Which of the following is the best example of an ecosystem?
- (A) All crocodiles in northeastern Australia
  - (B) The snakes, birds, cacti, rodents, sand, and weather patterns of the desert in Arizona
  - (C) The temperate forests of the world
  - (D) The squirrels, birds, chipmunks, and other animals of Central Park
  - (E) A large herd of bison
63. Which of the following digestive secretions helps to emulsify fats?
- (A) Lipase
  - (B) Amylase
  - (C) Saliva
  - (D) Bile
  - (E) Hydrochloric acid
64. All of the following are homologous structures EXCEPT
- (A) horse forelimb
  - (B) whale flipper
  - (C) human arm
  - (D) lobster claw
  - (E) dog's front paw
65. In the nitrogen cycle, nitrogen returns to the environment when organisms
- I. die and decompose
  - II. excrete waste
  - III. exhale
- (A) I only
  - (B) II only
  - (C) III only
  - (D) I and II only
  - (E) I, II, and III
66. All of the following describe characteristics of bryophytes EXCEPT
- (A) they grow to great heights
  - (B) they lack vascular tissue
  - (C) they live in damp areas
  - (D) they are eukaryotic
  - (E) they lack roots

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## BIOLOGY E SECTION—*Continued*

A scientist incubates several geese eggs in a laboratory until they hatch.

67. The goslings' first experience outside the shell is an encounter with a ticking clock, which they take to be their "mother." What best describes their reaction?
- (A) Fixed-action pattern
  - (B) Imprinting
  - (C) Conditioned reflex
  - (D) Associative learning
  - (E) Intuitive reasoning
68. The experimenter rings a small bell before each feeding of the goslings. After a few days, the goslings scramble toward the hatch of their pen at the sound of the bell. This is due to
- (A) imprinting
  - (B) instinctual behavior
  - (C) associative learning
  - (D) habituation
  - (E) intuitive reasoning
69. What experiment would best test the goslings' capacity for intuitive reasoning?
- (A) Placing their food at the end of a maze
  - (B) Ringing a bell but no longer bringing food
  - (C) Providing food after a gosling presses a small switch
  - (D) Hanging the food out of reach with a movable step nearby
  - (E) Bringing more food than the goslings can eat

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## BIOLOGY E SECTION—Continued

Three types of mites were introduced to three groups of rats to observe their interactions. The mites and rats established a symbiotic relationship in each case. The experimenter observed the groups and their individual rats for two weeks.

End of 2 weeks	Rat individuals	Rat population
Group 1	More vigorous and healthy	Shows increase
Group 2	No observable change	No change
Group 3	Sickly and desiccated	Decrease

70. What relationship exists between the two species in colony 1?
- (A) Parasitism
  - (B) Commensalism
  - (C) Mutualism
  - (D) Predation
  - (E) Competition
71. During the observation period, the mite population could potentially increase in
- I. group 1
  - II. group 2
  - III. group 3
- (A) I only
  - (B) II only
  - (C) III only
  - (D) I and II only
  - (E) I, II, and III
72. A month after the initial observations, the population of rats in group 3 remains constant. What best explains this?
- (A) Parasites commonly do not eradicate their hosts.
  - (B) The hosts establish a commensalistic relationship with the parasites.
  - (C) The hosts begin to prey on the parasites.
  - (D) The parasites die off from starvation.
  - (E) Pathogenic bacteria kill off the parasites.
73. The introduction of a new organism into a population can create
- (A) new mutations
  - (B) new selection pressure
  - (C) adaptive radiation
  - (D) genetic drift
  - (E) biological magnification

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## BIOLOGY E SECTION—Continued

A species of finch was under observation on a small, isolated island in the South Pacific Ocean. Scientists measured the beak width of a wide selection of individuals.

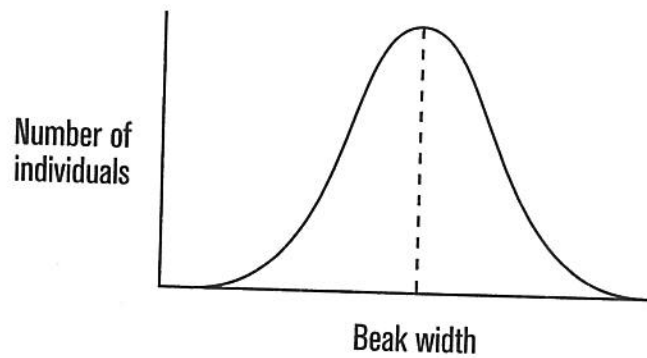


Figure 1: Initial measurement

Forty years later, a second team of scientists returned to the island to check up on the finch population. After measuring beaks and counting individuals, they found a population with a new distribution of beak widths.

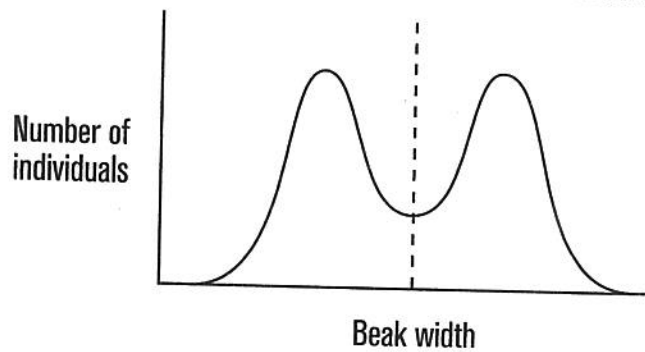


Figure 2: Forty years later

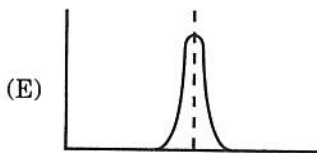
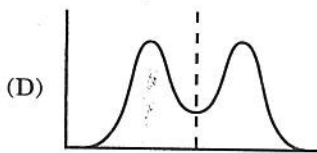
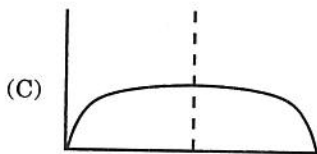
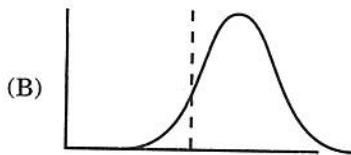
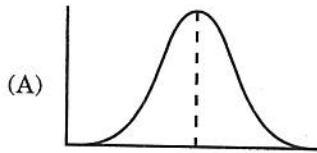
74. What has happened to the finch population over time?

- (A) It reached Hardy-Weinberg equilibrium
- (B) Directional selection
- (C) Speciation
- (D) Stabilizing selection
- (E) Disruptive selection

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**BIOLOGY E SECTION—Continued**

75. A strong beak is needed to crack open a big seed. What would have happened to beak width of the original population if seeds on the island grew progressively larger for 40 years and no other changes in the environment occurred? (Graphs show number of individuals vs. beak width.)



76. Which of the following individuals is the most fit in evolutionary terms?
- (A) Short-beaked male finch with 4 offspring
  - (B) Long-beaked female finch with 6 unhatched eggs
  - (C) Long-beaked male finch just before sexual maturity
  - (D) Medium-beaked female finch with three suitors
  - (E) Medium-beaked hatchling finch

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## BIOLOGY E SECTION—Continued

Farmers frequently grow legume crops, such as alfalfa, as “green cover” during winter seasons. By their association with nitrogen-fixing bacteria of the genus *Rhizobium*, legumes produce a great deal of nutrients, so much so that alfalfa is sometimes plowed directly into the ground to improve the soil for the next rotation of crops.

77. Of the following, which explains the behavior of *Rhizobium* bacteria and legumes?
- (A) *Rhizobium* cause legumes to grow nitrogen-fixing fungus
  - (B) *Rhizobium*, in the legumes' root nodules, fix nitrogen from the soil
  - (C) Legumes synthesize *Rhizobium* and release them into the soil
  - (D) *Rhizobium* break down nitrogen gas absorbed through legumes' leaves
  - (E) *Rhizobium* steadily decompose the roots of legumes to fix nitrogen
78. The relationship between legumes and nitrogen-fixing bacteria demonstrates
- (A) mutualism
  - (B) commensalism
  - (C) parasitism
  - (D) predation
  - (E) convergent evolution
79. Plants may use the ammonia ( $\text{NH}_3$ ) released by nitrogen-fixing bacteria to synthesize all of the following EXCEPT
- (A) cytosine
  - (B) methionine
  - (C) enzymes
  - (D) carrier proteins
  - (E) cellulose
80. The process by which some bacteria transform ammonia ( $\text{NH}_3$ ) into gaseous  $\text{N}_2$  and  $\text{N}_2\text{O}$  in the atmosphere is called
- (A) transpiration
  - (B) nitrogen fixation
  - (C) denitrification
  - (D) ammonifying
  - (E) nitrification

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## BIOLOGY M SECTION

If you are taking the Biology M test, continue with questions 81–100.  
Be sure to start this section of the test by filling in oval 81 on your answer sheet.

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill in the corresponding oval on the answer sheet.

81. When examined under a microscope, the cytoplasm of an amoeba can be seen moving across the cell in a process known as cytoplasmic streaming, which allows the amoeba to change shape and move in its environment. Which of the following cell structures are most likely to play a direct role in this process?
- (A) Endoplasmic reticulum
  - (B) Mitochondria
  - (C) Chloroplast
  - (D) Cytoskeleton
  - (E) Golgi apparatus
82. Plants store glucose in long starch chains. What by-product results when molecules of glucose are linked into the growing polysaccharide?
- (A) Water
  - (B) Carbon dioxide
  - (C) Oxygen
  - (D) Peptide bonds
  - (E) ATP
83. An example of a gymnosperm is a
- (A) moss
  - (B) brown alga
  - (C) sequoia redwood
  - (D) daisy
  - (E) mold
84. A woman with type B blood and a man with type AB blood can produce offspring with blood type(s)
- (A) A only
  - (B) A, B, and AB only
  - (C) B only
  - (D) A, B, and O only
  - (E) B and O only
85. An organism lays soft eggs, breathes through primitive lungs, and has a metabolism that slows down when the temperature drops. It is most likely a(n)
- (A) protist
  - (B) arthropod
  - (C) amphibian
  - (D) reptile
  - (E) bird
86. In order to travel from the outside of a plant cell to the innermost part of one of its chloroplasts, a molecule would have to pass through a minimum of how many separate phospholipid bilayer membranes?
- (A) 1
  - (B) 2
  - (C) 3
  - (D) 4
  - (E) The molecule would not have to travel through any phospholipid membranes.

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## BIOLOGY M SECTION—*Continued*

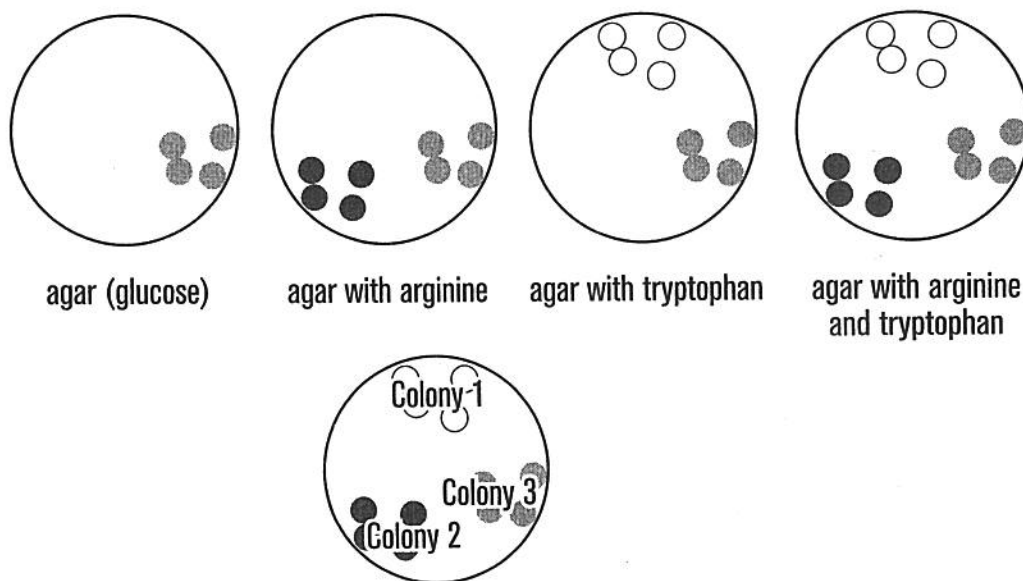
Brewer's yeast (*Saccharomyces cerevisiae*) is commonly used in the fermentation of alcoholic beverages. Tanks with a carbohydrate food source are sealed off to force the yeast into anaerobic respiration.

87. Yeast cells possess all of the following characteristics EXCEPT
- (A) cell wall
  - (B) mitochondria
  - (C) asexual reproduction
  - (D) prokaryotic
  - (E) anaerobic respiration
88. Yeast cannot produce alcohol concentrations greater than 12%. Why?
- (A) At 12%, the toxicity of the alcohol is lethal to yeast.
  - (B) They begin the Krebs cycle.
  - (C) They succumb to lactic acid buildup.
  - (D) There is no longer any oxygen in concentration.
  - (E) They run out of sugar food supply.
89. What is the by-product of anaerobic respiration in muscle tissue?
- (A) Ethanol
  - (B) Oxygen
  - (C) Glucose
  - (D) Glycolysis
  - (E) Lactic acid

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## BIOLOGY M SECTION—Continued

A scientist conducted an experiment with three strains of bacteria: a normal or "wild type" strain and two mutant strains that were unable to synthesize one essential amino acid, either arginine or tryptophan. The strains were inoculated on four test plates covered with glucose-containing agar; agar on some of the plates contained supplemental arginine or tryptophan, as indicated below. The scientist recorded colony growths for each test.



90. The ability or inability of bacteria to synthesize a particular amino acid is indicated by a superscript + or -, respectively. For example, bacteria capable of synthesizing arginine are  $\text{arg}^+$ ; bacteria unable to synthesize tryptophan are  $\text{trp}^-$ . Colony 2 is
- (A)  $\text{arg}^+ \text{trp}^+$   
 (B)  $\text{arg}^+ \text{trp}^-$   
 (C)  $\text{arg}^- \text{trp}^+$   
 (D)  $\text{arg}^- \text{trp}^-$   
 (E) wild type
91. What would the experimenter observe if an  $\text{arg}^- \text{trp}^-$  strain were inoculated in the agar with tryptophan plate?
- (A) Bacteria would convert tryptophan to arginine  
 (B) A large bacterial lawn would form  
 (C) The strain would mutate to  $\text{arg}^- \text{trp}^+$   
 (D) Colonies would form on half of the plate  
 (E) No growth
92. Colonies 1 and 2 were mixed in a test tube and left overnight in a heated incubator. The following day, the mixture was spread over four new plates prepared as
- above. After time, large bacterial lawns were observed in each plate. What explains why?
- (A) The bacteria formed a mutualistic relationship.  
 (B) Genetic recombination created a strain of  $\text{arg}^+ \text{trp}^+$  bacteria.  
 (C) If given enough time, bacteria will form under any conditions.  
 (D) The heat from incubation mutated each strain.  
 (E) Each strain overproduced critical amino acids.
93. By what other method could an experimenter introduce arginine production capabilities into  $\text{arg}^-$  bacteria?
- (A) Increasing the temperature of bacteria incubation  
 (B) Running the tests repeatedly in the absence of arginine  
 (C) Extended incubation of the strain with arginine  
 (D) Exposing the strain to intense ultraviolet light  
 (E) Introducing a bacteriophage virus with  $\text{arg}^+$  DNA

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## BIOLOGY M SECTION—*Continued*

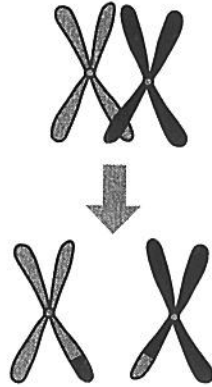
In 1953, Stanley Miller conducted an experiment to examine how biotic life might have formed on Earth. In a closed glass vessel, he re-created the earliest conditions of Earth's atmosphere with gases and high-energy electricity. The resulting "primordial soup" in the bottom of the chamber included compounds that resembled amino acids.

94. Which of these chemicals were NOT originally present in Earth's earliest atmosphere according to current theory?
- (A) Hydrogen
  - (B) Water
  - (C) Methane
  - (D) Ammonia
  - (E) Oxygen
95. Why were these amino acids a significant discovery?
- (A) mRNA was formed in the chamber.
  - (B) Amino acids are the building blocks for living cells.
  - (C) It showed the spontaneous formation of ribosomes.
  - (D) The "primordial soup" was cellular cytoplasm.
  - (E) It showed that amino acids were present in Earth's early atmosphere.
96. The elemental composition of the Earth's crust and the human body differ significantly. What best explains why?
- (A) Biotic tissue once contained all such elements but has discarded them in the course of evolution.
  - (B) Humans evolved from aquatic life; the available elements in marine environments are different from those on land.
  - (C) Not all elements in the Earth's crust are suitable or have properties compatible with living processes.
  - (D) The elemental composition of the Earth has changed significantly since the ancestors of humans first appeared.
  - (E) Life first reached the Earth as bacteria on a meteorite with significant chemical differences from Earth.

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**BIOLOGY M SECTION—Continued**

Questions 97–100 refer to the following diagram, which depicts an interaction between a homologous pair of chromosomes.



97. This transfer of genetic material is called
- (A) transcription
  - (B) transduction
  - (C) crossing-over
  - (D) translation
  - (E) substitution
98. The depicted exchange of genetic material can occur during
- (A) prophase I of meiosis
  - (B) anaphase I of meiosis
  - (C) telophase of mitosis
  - (D) metaphase II of meiosis
  - (E) interphase of mitosis
99. After the chromosomes exchange material, which of the following could NOT result in the next generation?
- (A) Adaptive mutation
  - (B) Same phenotype
  - (C) Debilitating mutation
  - (D) Change in diploid number
  - (E) Further transfers of genetic material
100. The exchange of genetic material only occurs in sexual reproduction and offers a significant advantage over asexual reproduction. Why?
- (A) Genetic recombination increases variation of species.
  - (B) Random mutations are usually beneficial.
  - (C) It alters the number of base pairs in the species' genetic code.
  - (D) It increases reproduction rates.
  - (E) It provides stability in the gene pool.

**S T O P**

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