

BIOLOGY E/M SUBJECT TEST 2—*Continued*

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

Directions: Each set of lettered choices below refers to the numbered 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 1-4

- (A) Hair
- (B) Epidermis
- (C) Cuticle
- (D) Guard cell
- (E) Sweat gland

1. Permits gas exchange and transpiration in leaves
2. Layer that restricts evaporation in humans
3. Layer that restricts evaporation in plants
4. Important thermoregulatory structure in humans

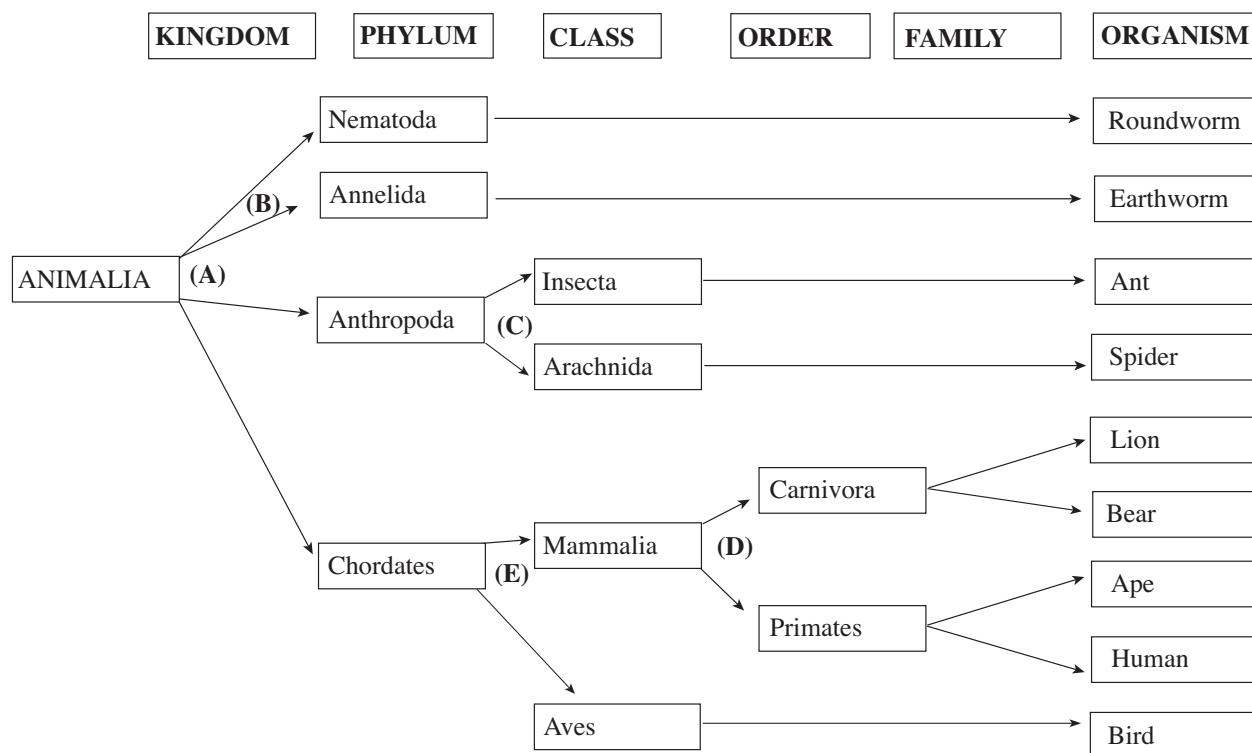
Questions 5-8

- (A) DNA
- (B) tRNA
- (C) mRNA
- (D) rRNA
- (E) RNA polymerase

5. Translated to synthesize protein
6. Transports amino acids during protein synthesis
7. Passed on to progeny cells during cell division
8. Includes a structure known as the “anticodon”

BIOLOGY E/M SUBJECT TEST 2—Continued

Questions 9-12



9. Separates animals with nails from animals with claws
10. Separates segmented worms from worms with no segmentation
11. Separates animals with feathers from animals with hair
12. Separates animals with exoskeletons from animals with no exoskeletons

GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—*Continued*

Questions 13-16

- (A) Predation
 - (B) Commensalism
 - (C) Interspecific competition
 - (D) Mutualism
 - (E) Parasitism
13. An albino plant with vascular connections to a green plant of the same species that drains food from the green plant
14. Algae that grows on the shell of a turtle; the turtle is not harmed
15. A tapeworm in the intestine of a human
16. A population that prevents other populations from using a particular limited resource

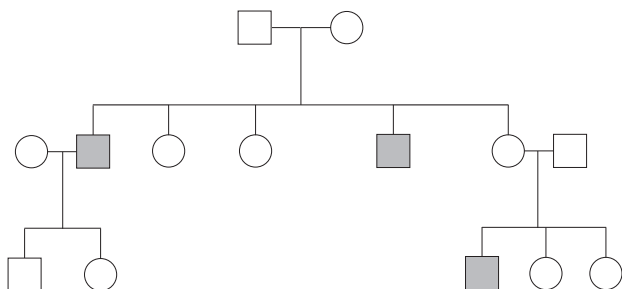
Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each situation, select the one choice that is the best answer to the question and then fill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

17. Which biome contains maples, squirrels, and black bears?
- (A) Tundra
 - (B) Tropical rain forest
 - (C) Temperate grasslands
 - (D) Taiga
 - (E) Deciduous forest
18. A man who is color blind marries a woman who is not color blind, and together they have a daughter who is not color blind. If the daughter marries a man with regular vision, what is the probability of their firstborn child being a son who is color blind?
- (A) 0%
 - (B) 25%
 - (C) 50%
 - (D) 75%
 - (E) 100%
19. All of the following are needed for photosynthesis EXCEPT
- (A) light
 - (B) glucose
 - (C) chlorophyll
 - (D) water
 - (E) carbon dioxide
20. Black coat color in horses is caused by a dominant allele, while white coat color is due to the recessive allele. Two black horses produce a foal with a white coat. If they were to produce a second foal, what would be the probability of the second foal having a black coat?
- (A) 0
 - (B) 1/4
 - (C) 1/2
 - (D) 3/4
 - (E) 1
21. If one ribose molecule were bonded to one adenine molecule and one phosphate molecule, we would have a
- (A) ribosome
 - (B) nucleotide
 - (C) nucleic acid
 - (D) ATP
 - (E) ADP

GO ON TO THE NEXT PAGE 

BIOLOGY E/M SUBJECT TEST 2—Continued

22. Consider this pedigree:



The allele causing the disorder (shaded individuals are affected) can best be described as

- (A) autosomal dominant
 (B) autosomal recessive
 (C) X-linked dominant
 (D) X-linked recessive
 (E) There is not enough information to determine.
23. Which of the following is/are true for a resting human?
- I. Systolic blood pressure of 180 mm Hg
 - II. Heart rate of 60–80 beats per minute
 - III. Body temperature of 37°C
- (A) I only
 (B) II only
 (C) I and II
 (D) II and III only
 (E) I, II, and III
24. A researcher has a black guinea pig and wishes to determine if it carries a recessive allele for white hair. Both of the guinea pig's parents are black. Which of the following would be the best method for the researcher to use?
- (A) Mate the guinea pig with another black guinea pig and look for white offspring
 (B) Look for white hairs on the guinea pig
 (C) Mate the guinea pig with a white guinea pig and look for white offspring
 (D) Observe the chromosomes of a hair cell from a black hair
 (E) See if the guinea pig has any white siblings

25. A community includes seven different populations with various degrees of interbreeding. Population 1 shares genes only with Population 2. Population 2 shares genes only with Population 1. Population 3 has no gene flow with other populations. Population 4 shares genes only with Population 5. Population 5 shares genes with Population 4, Population 6, and Population 7. Population 6 shares genes with Population 5 and Population 7. Population 7 shares genes with Population 5 and Population 6. Which population(s) is (are) most likely to evolve after a change in its environment?
- (A) Populations 1 and 2
 (B) Population 3
 (C) Population 4
 (D) Population 5
 (E) Populations 6 and 7
26. A boy with red-green color blindness has a color blind father and a mother who is not color blind. From which parent did the boy inherit his color blindness?
- (A) There is no way to determine this.
 (B) His father
 (C) His mother
 (D) The boy inherited his color blindness from both his mother and father.
 (E) The boy's color blindness had nothing to do with his parents.

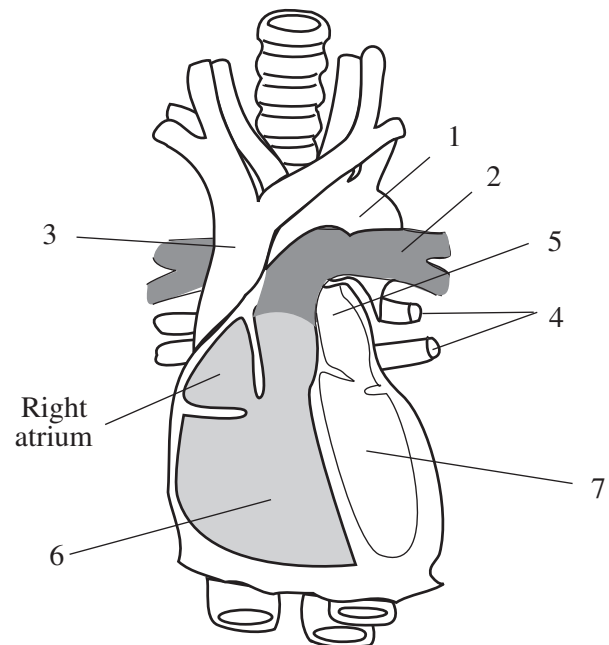
GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—*Continued*

27. A certain group of pine trees is observed to have a mutation that causes proteins to be retained in the cell instead of being secreted. This may likely indicate a problem with which of the following organelles?
- (A) Ribosome
(B) Lysosome
(C) Golgi apparatus
(D) Microtubules
(E) Mitochondria
28. Human ABO blood typing is determined by the proteins present on red blood cells. The gene that codes for these proteins has three alleles: I^A , I^B , and i . I^A codes for protein type A, I^B codes for protein type B, and i codes for the absence of protein. I^A and I^B are codominant, and i is recessive to both I^A and I^B . A woman with blood type A and a man with blood type AB marry and produce children. Which of the following blood types is NOT possible in their children?
- (A) Type A
(B) Type B
(C) Type O
(D) Type AB
(E) All blood types are possible in their children.
29. Which organism is the LEAST closely related to the others?
- (A) Lizard
(B) Frog
(C) Turtle
(D) Alligator
(E) Snake

30. Which of the following organelles would be present in a eukaryote but NOT in a prokaryote?
- I. Nucleus
II. Mitochondria
III. Ribosome
- (A) I only
(B) II only
(C) I and II only
(D) II and III only
(E) I, II, and III

Questions 31-33 refer to the following diagram of a human heart.



31. Which of the following represents the correct sequence of heart structures that blood would pass through when traveling from the right atrium to the lungs and then to the left ventricle?
- (A) 3, 2, 4, 5, 7
(B) 6, 2, 1, 4, 5
(C) 3, 2, 1, 5, 7
(D) 6, 2, 3, 4, 5
(E) 6, 2, 4, 5, 7

GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—Continued

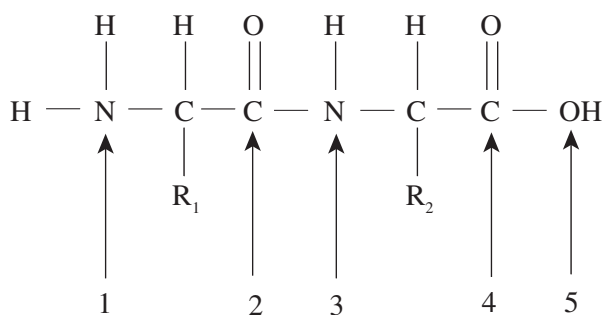
32. Which structures carry blood rich in oxygen?

- (A) 2, 3, 4
- (B) 3, 5, 7
- (C) 4, 5, 6
- (D) 1, 5, 7
- (E) 2, 4, 5

33. Which structure returns blood poor in oxygen to the heart?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5

Questions 34-36 refer to the following diagram.



34. What type of molecule is depicted in the drawing above?

- (A) Protein
- (B) Carbohydrate
- (C) Lipid
- (D) Nucleic acid
- (E) Starch

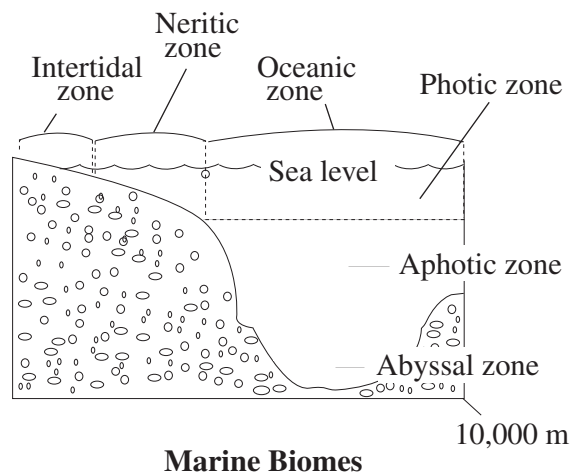
35. If we were to continue adding to this molecule to increase its size, to which atom would the next portion be bonded?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5

36. The synthesis of this molecule also results in the production of

- (A) carbon dioxide
- (B) water
- (C) lipids
- (D) ATP
- (E) NADH

Questions 37-39 refer to the following diagram of marine biomes.



37. Which of the following is the area of least productivity?

- (A) Intertidal zone
- (B) Oceanic zone
- (C) Photic zone
- (D) Aphotic zone
- (E) Neritic zone

38. Organisms that live in the abyssal zone would need all of the following adaptations EXCEPT

- (A) ability to withstand extreme pressures
- (B) well-developed eyes
- (C) tolerance of cold temperatures
- (D) ability to survive in areas of low nutrient density
- (E) ability to utilize limited resources

GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—Continued

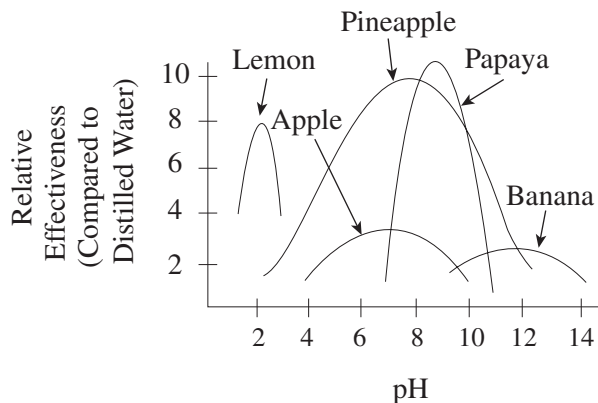
39. Organisms that live in the intertidal zone might have which of the following characteristics?

I. Ability to conduct photosynthesis
II. Tolerance of periodic drought
III. Tolerance of a wide range of temperatures

- (A) I only
(B) II only
(C) I and III only
(D) II and III only
(E) I, II, and III

Questions 40-43

Because some fruits contain enzymes that act as proteases, various fruit extracts were tested for use as possible meat tenderizers. The extracts were tested over a range of pH values. Below is a graph of relative effectiveness (compared to distilled water) versus pH.



40. Which fruit extract operates over the broadest pH range?

- (A) Lemon
(B) Pineapple
(C) Papaya
(D) Apple
(E) Banana

41. Over which pH range does pineapple extract operate at no less than 50% of its maximum effectiveness?

- (A) pH 4 to pH 10
(B) pH 2 to pH 12
(C) pH 6 to pH 8
(D) pH 7 to pH 11
(E) pH 10 to pH 14

42. Which fruit extract is most effective at a neutral pH?

- (A) Lemon
(B) Banana
(C) Papaya
(D) Pineapple
(E) Apple

43. What does it mean when a fruit extract has a relative effectiveness of 1 ?

- (A) It is 100% more effective than water.
(B) It is 10% as effective as water.
(C) It is 1% as effective as water.
(D) It is equally as effective as water.
(E) It is equally concentrated as water.

Questions 44-47

A self-pollinating plant with orange flowers and alternating leaf arrangement produces 47 plants with red flowers and alternating leaves, 103 plants with orange flowers and alternating leaves, and 51 plants with yellow flowers and alternating leaves.

44. The allele for yellow flower color is

- (A) recessive
(B) dominant
(C) incompletely dominant
(D) incompletely recessive
(E) codominant

45. If a yellow-flowered offspring were self-pollinated, what would the resulting plants' flowers look like?

- (A) 100% yellow
(B) 100% red
(C) 100% orange
(D) 50% yellow, 50% red
(E) 75% red, 25% yellow

GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—Continued

46. The genotype of the original parent plant is
- (A) heterozygous for both flower color and leaf arrangement
 - (B) homozygous for both flower color and leaf arrangement
 - (C) homozygous for flower color and heterozygous for leaf arrangement
 - (D) heterozygous for flower color and homozygous for leaf arrangement
 - (E) heterozygous for flower color but unable to determine genotype for leaf arrangement

47. Suppose the original parent plant is cross-pollinated with a plant that has red flowers and non-alternating leaves. All of the resulting offspring have non-alternating leaves. Which of the following is/are true?

I. None of the offspring have orange flowers.

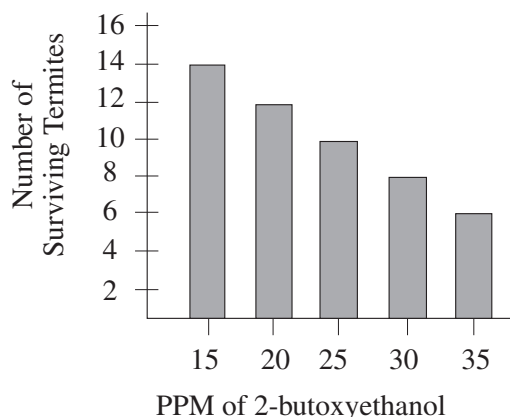
II. The allele for alternating leaves is recessive.

III. Approximately half of the offspring have red flowers.

- (A) I only
- (B) II only
- (C) III only
- (D) I and III only
- (E) II and III only

Questions 48-50

2-butoxyethanol, a substance found in a general household cleaner, was tested for toxicity to termites. Solutions were made that contained various parts per million (PPM) of 2-butoxyethanol, and 15 mL of each of these diluted solutions was mixed with 150 g of wood chips. Twenty mature termites were added to the wood chips, and the number surviving after 24 hours was determined and recorded. The following graph presents the results.



48. At which dose does 50% of the termite population survive?

- (A) 15 PPM
- (B) 20 PPM
- (C) 25 PPM
- (D) 30 PPM
- (E) 35 PPM

49. How is this substance toxic to termites?

- (A) It paralyzes their jaws so they are unable to eat.
- (B) It prevents digestion of wood.
- (C) It kills the microorganisms in the termites' digestive tracks that digest wood.
- (D) At 40 PPM only 20% of the termites survive.
- (E) There is no information given that describes the mechanism of toxicity.

50. Based on the data for 20 PPM 2-butoxyethanol, what concentration of solution would be required to kill the entire 20-member termite population?

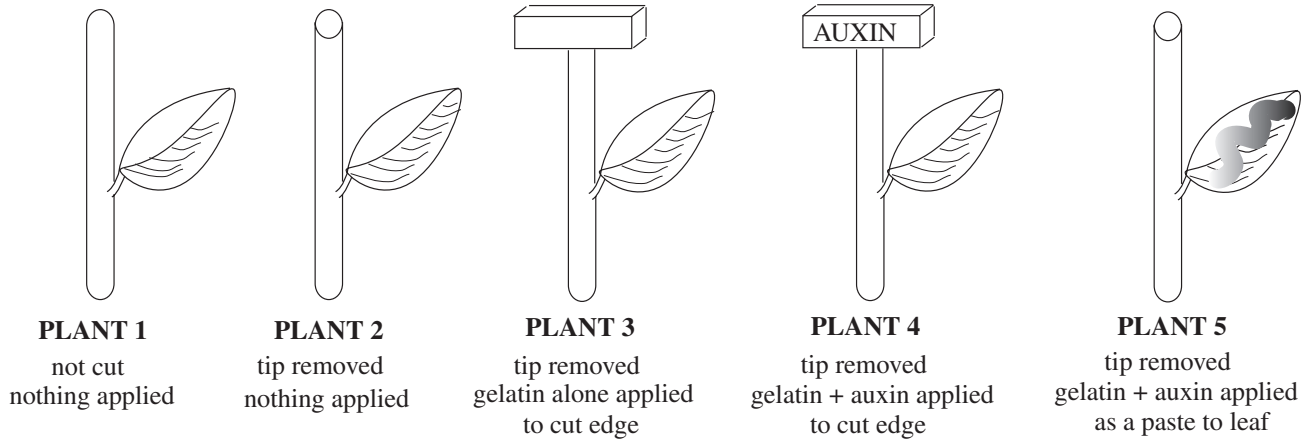
- (A) 40 PPM
- (B) 50 PPM
- (C) 60 PPM
- (D) 70 PPM
- (E) 80 PPM

GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—Continued

Questions 51-54

The following experiment was performed to test the effect of an auxin on plant growth. The auxin was dissolved in a gelatin block; gelatin does not affect the biological activity of the auxin. Several plant seedlings were prepared as described below and growth was measured every five days.



Plant	Growth After 5 Days	Growth After 10 Days
1	15 mm	29 mm
2	4 mm	9 mm
3	5 mm	10 mm
4	14 mm	31 mm
5	8 mm	20 mm

51. Based on the results of the experiment, one can conclude that the tip of the plant contains
- (A) gelatin
 - (B) water
 - (C) auxin
 - (D) paste
 - (E) nothing significant
52. Which of the following plants in the experiment acted as a control?
- I. Plant 1
 - II. Plants 2 and 3
 - III. Plant 5
- (A) I only
 - (B) II only
 - (C) III only
 - (D) I and II only
 - (E) I, II, and III

GO ON TO THE NEXT PAGE

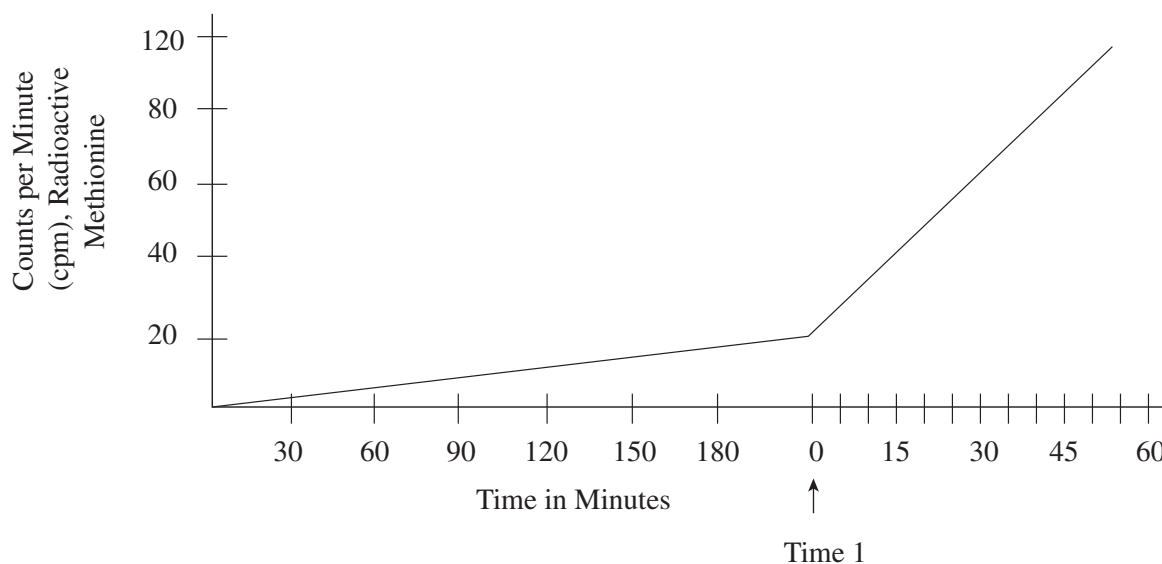
BIOLOGY E/M SUBJECT TEST 2—Continued

53. What proves that auxin is necessary for plant growth?
- (A) Plant 1 grew faster than Plants 2 or 3.
 - (B) Plant 4 grew faster than Plants 2 or 3.
 - (C) Plant 5 grew faster than Plant 1.
 - (D) Plant 3 grew faster than Plant 2.
 - (E) Plant 4 grew faster than Plant 5.
54. In a separate experiment, an auxin/gelatin block applied to only half the cut edge of the tip caused the plant to grow and bend in the opposite direction. For example, if the auxin/gelatin block was applied to the left side of the cut edge, the plant grew and bent toward the right. Which of the following is the most likely explanation for this observation?
- (A) Sunlight caused the plant to bend.
 - (B) The plant exhibited gravitropism.
 - (C) Auxin stimulated cell division on the opposite side of the plant.
 - (D) Auxin stimulated cell division on the same side of the plant.
 - (E) Auxin stimulated cell growth toward a light source.

Questions 55-58 refer to the following experiment performed on frog oocytes.

Unfertilized frog oocytes were bathed in a neutral, isotonic solution (Frog Ringer's solution) to prevent changes in volume due to osmosis. The Frog Ringer's solution was supplemented with radiolabeled amino acids. A sample of oocytes was taken every 30 minutes and assayed for radioactivity.

At Time 1, the oocytes were fertilized. Samples were taken at five-minute intervals after fertilization and assayed for radioactivity. The results are presented in the graph below.



GO ON TO THE NEXT PAGE

BIOLOGY E/M SUBJECT TEST 2—*Continued*

55. The radioactivity measured after fertilization was taken up by

- (A) being incorporated into DNA
- (B) being incorporated into proteins
- (C) attaching to the cell membrane
- (D) endocytosis
- (E) associating with carbohydrates

56. How could a control be created for this experiment?

- (A) Immerse the oocytes in non-radiolabeled Frog Ringer's solution prior to fertilization.
- (B) Sample the oocytes at five-minute intervals prior to fertilization.
- (C) Sample the oocytes at 30-minute intervals after fertilization.
- (D) Divide the oocytes into two groups, immerse one group in non-radiolabeled Frog Ringer's solution and one group in radiolabeled solution.
- (E) Divide the oocytes into two groups, fertilize one group, and simulate fertilization in the other, but do not actually introduce sperm into the oocytes.

57. Based on the results of the experiment, the process most likely occurring after fertilization is

- (A) DNA replication
- (B) organogenesis
- (C) protein synthesis
- (D) RNA transcription
- (E) endocytosis

58. The Frog Ringer's solution in the experiment is described as being isotonic. An isotonic solution

- (A) has more DNA than another solution
- (B) has more protein than another solution
- (C) is more concentrated than another solution
- (D) is less concentrated than another solution
- (E) is equally concentrated to another solution

Questions 59-60

A group of 10 newly hatched chicks was separated into two smaller groups containing five chicks each. One group (Group A) was left with the mother hen, the other group (Group B) was taken shortly after hatching and kept with a mother goose. The chicks in Group A displayed normal behavior and followed the mother hen around. The chicks in Group B followed the mother goose around and exhibited goose-like behavior such as swimming. After one week, Group B was reunited with the mother hen, but ignored her, and instead continued to follow the mother goose around the barnyard.

59. The behavior exhibited by the chicks in Group B is

- (A) imprinting
- (B) instinct
- (C) insight
- (D) habituation
- (E) conditioning

60. If exposed to a mother pig during the period shortly after hatching, the chicks in Group B would exhibit

- (A) pig like behavior
- (B) goose like behavior
- (C) chick like behavior
- (D) unique behavior
- (E) unknown behavior

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.

GO ON TO THE NEXT PAGE 

BIOLOGY-E TEST 2

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. Which of the following organisms is able to regulate its own body temperature?
- (A) Frog
 - (B) Fish
 - (C) Snake
 - (D) Sparrow
 - (E) Turtle
62. A virus is considered a parasite because it
- I. harms its host
 - II. kills its host
 - III. cannot reproduce outside its host
- (A) I only
 - (B) II only
 - (C) I and III only
 - (D) II and III only
 - (E) I, II, and III
63. An organism that feeds at several trophic levels is
- (A) a carnivore
 - (B) an omnivore
 - (C) a primary consumer
 - (D) an herbivore
 - (E) a primary producer
64. Yeast are cultured in a flask of nutrient broth under anaerobic conditions. The yeast that are most fit are those that
- (A) ferment the fastest
 - (B) consume less of the limited oxygen supply
 - (C) survive the longest
 - (D) produce the most ATP
 - (E) produce the most buds
65. A mushroom is most like a
- (A) moss
 - (B) fern
 - (C) yeast
 - (D) pine
 - (E) seaweed
66. In a certain ecosystem, the primary producers represent 100,000 kcal of energy. Assuming a 10% transfer of energy between trophic levels, how much energy is available to the fourth trophic level?
- (A) 10 kcal
 - (B) 100 kcal
 - (C) 1,000 kcal
 - (D) 10,000 kcal
 - (E) 100,000 kcal
67. Which of the following represents the proper ecological hierarchy?
- (A) Population → community → ecosystem → biosphere
 - (B) Ecosystem → community → population → biosphere
 - (C) Population → ecosystem → community → biosphere
 - (D) Biosphere → ecosystem → population → community
 - (E) Community → population → biosphere → ecosystem

GO ON TO THE NEXT PAGE 

BIOLOGY-E TEST 2—*Continued*

Questions 68-69

The following data table shows the number of different amino acids in the beta hemoglobin chain of various organisms compared to the human beta chain.

Organism	Number of Different Amino Acids
Human	0
Mouse	27
Frog	68
Monkey	11
Lamprey	125
Chicken	35
Gibbon	2

68. To which of the following organisms are humans most closely related, based on hemoglobin amino acid sequence?

- (A) Mouse
- (B) Monkey
- (C) Chicken
- (D) Gibbon
- (E) Lamprey

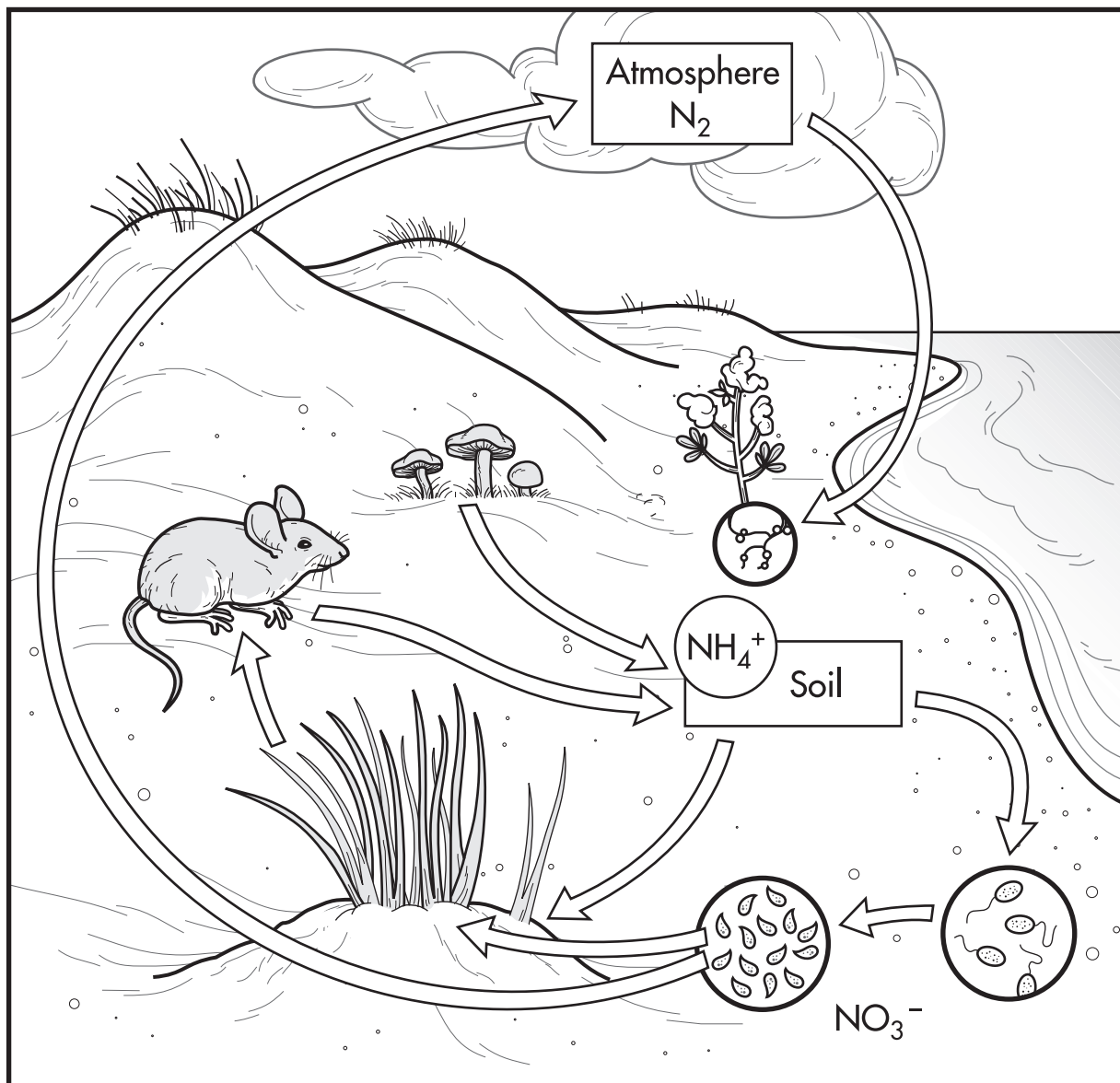
69. Human hemoglobin and gorilla hemoglobin are even more closely related than the organisms shown in the table; they differ by only a single amino acid. Yet humans and gorillas are considered to be separate species. This is because

- (A) their hemoglobin chains differ by a single amino acid
- (B) human hemoglobin and gorilla hemoglobin have different functions
- (C) they are unable to interbreed
- (D) they are the result of convergent evolution
- (E) they are the result of parallel evolution

GO ON TO THE NEXT PAGE 

BIOLOGY-E TEST 2—Continued

Questions 70-71 refer to the diagram below.



Nitrogen Cycle

GO ON TO THE NEXT PAGE

BIOLOGY-E TEST 2—Continued

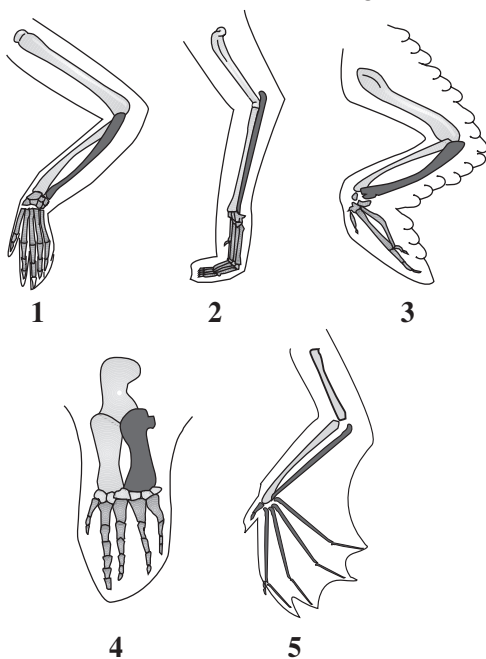
70. Can both animals and plants obtain their nitrogen from the atmosphere?

- (A) Yes, both animals and plants take in nitrogen during respiration.
- (B) Yes, most of the nitrogen in the cycle is in the atmosphere.
- (C) No, only plants can take in nitrogen from the atmosphere.
- (D) No, they must consume it through eating or uptake from the soil.
- (E) No, they must obtain it through symbiotic relationships.

71. Bacteria in the soil are

- (A) primary producers
- (B) primary consumers
- (C) secondary consumers
- (D) tertiary consumers
- (E) decomposers

Questions 72-73 refer to the following structures.



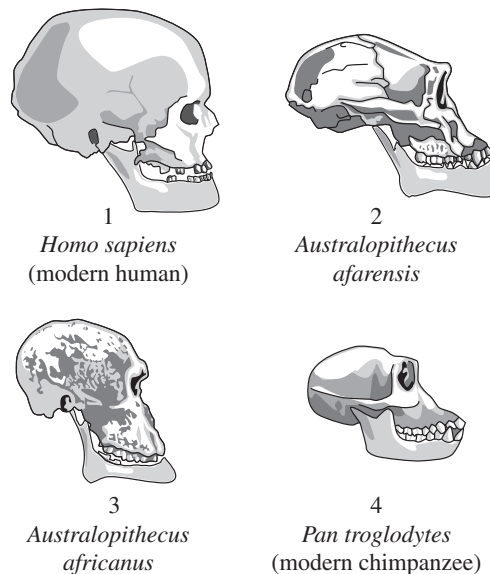
72. Which of these structures would be used for grasping?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 5

73. All of the structures are the result of

- (A) mutation
- (B) succession
- (C) convergent evolution
- (D) divergent evolution
- (E) regression

Questions 74-75 refer to the following diagrams.



74. Based on physical similarity, which skulls appear to be most closely related?

- (A) 1 and 2
- (B) 1 and 3
- (C) 2 and 3
- (D) 2 and 4
- (E) 1 and 4

75. What is the most advantageous difference between the ancestral primate skulls and the modern human skull?

- (A) Forward-facing eyes
- (B) Increased brain capacity
- (C) Loss of canine teeth
- (D) Loss of brow ridge
- (E) Reduction in jaw size

GO ON TO THE NEXT PAGE

BIOLOGY-E TEST 2—Continued

Questions 76-77

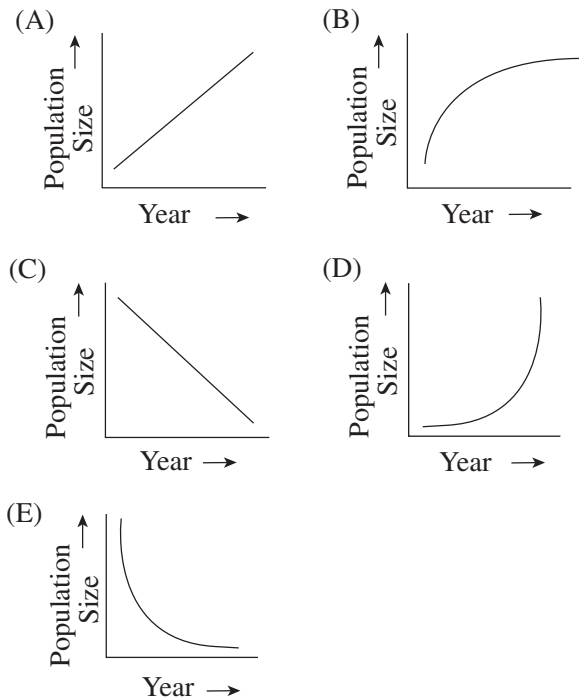
Six pairs of bald eagles were released into the wild in Indiana. Four of the pairs of birds successfully nested and raised young. Two of the pairs nested near an industrial complex that released waste products (PCBs) into a nearby lake. These birds laid eggs, but the embryos failed to develop.

76. Which of the following is the LEAST likely reason for the failure of the embryos to develop?
- (A) Mutations in the embryos halted their development.
 - (B) The adult birds failed to exhibit proper nesting behavior and did not care for the eggs.
 - (C) The contaminated lake water that the birds consumed affected the development of their young.
 - (D) The sperm of the males were affected by the PCBs in such a way that they were unable to fertilize the eggs.
 - (E) Indiana is not a good location for bald eagles to mate and reproduce.
77. The eggshells of the embryos that failed to develop were tested and were found to contain more PCBs than the nearby plants and insects. This is due to
- (A) biomagnification
 - (B) increased levels of PCBs in the lake
 - (C) the resistance of the insects to PCBs
 - (D) failure of the plants to take up PCBs
 - (E) absorption of PCBs from the nesting site into the eggshell

Questions 78-80 refer to the following data obtained for a rabbit population over a period of several years.

Year	Number of Rabbits
1	4
2	17
3	62
4	245

78. Which of the following graphs best represents the data on rabbit population size?



GO ON TO THE NEXT PAGE

BIOLOGY-E TEST 2—*Continued*

79. Assuming unlimited resources, what would be the approximate expected rabbit population in Year 5 ?
- (A) 5,000
 - (B) 1,000
 - (C) 500
 - (D) 300
 - (E) 100
80. Ultimately, the amount of nutrients and other resources would become limiting. What would happen to the rabbit population at that time?
- I. It would reach the carrying capacity of the environment.
 - II. It would continue to grow indefinitely.
 - III. It would engage in intraspecific competition.
- (A) I only
 - (B) II only
 - (C) I and II only
 - (D) I and III only
 - (E) I, II, and III

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR
WORK ON THE ENTIRE BIOLOGY-E TEST.

BIOLOGY-M TEST 2

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. An animal cell placed into a 0.9% solute solution would do which of the following?
- (A) Remain unchanged
 - (B) Swell and burst
 - (C) Shrink
 - (D) Swell and divide
 - (E) Release solute by exocytosis
82. When during cell division do chromosomes move to opposite poles of the cell?
- (A) When the centrioles replicate
 - (B) After the nuclear membrane disintegrates
 - (C) Immediately following DNA replication
 - (D) When the DNA condenses
 - (E) Immediately after the centromere splits
83. Convergent evolution can result in all of the following EXCEPT
- (A) structures that have similar functions
 - (B) behaviors that are similar
 - (C) different species that resemble one another
 - (D) production of a single species from two originally different species
 - (E) niches that are similar
84. What structure is common to ALL cell types?
- (A) Chloroplast
 - (B) Plasma membrane
 - (C) Cell wall
 - (D) Mitochondria
 - (E) Flagella
85. A buck with a large, impressive rack of antlers sires four offspring: three males and one female. The three male offspring also have large, impressive antlers, but before being able to reproduce, two of the male offspring get their antlers tangled in a low-hanging tree and are caught and killed by wolves. A second buck with a smaller set of antlers sires three male offspring; all of these males have smaller antlers, like their father. They are more effective at escaping predators and successfully reproduce. In terms of evolution, which of the original bucks is more fit?
- (A) The buck with the larger antlers because he sired more offspring
 - (B) The buck with the smaller antlers because more of his offspring survived
 - (C) The buck with the larger antlers because he will be more successful at attracting a mate and continuing to reproduce
 - (D) The buck with the smaller antlers because he is more effective at escaping predators and will continue to reproduce
 - (E) Both bucks are equally fit.

GO ON TO THE NEXT PAGE 

BIOLOGY-M TEST 2—*Continued*

Questions 86-89 refer to the following experiment.

A population of ampicillin-resistant bacteria (Strain 1) is grown in a laboratory and is infected with a virus. The bacterial population begins to decline as the virus initially goes through the lytic cycle, then rebounds as the virus integrates into the bacterial chromosome to begin the lysogenic cycle.

The bacteria reproduce normally until they are heat-shocked. The rapid increase in temperature causes the virus to remove itself from the bacterial genome and enter the lytic cycle. Within several hours, all bacteria are dead and a free virus is found in high concentration in the bacterial growth medium.

This free virus is used to infect a population of bacteria that is sensitive to ampicillin (Strain 2). After the expected decrease and rebound of this bacterial population (as above), the rebounded population was found to be ampicillin-resistant.

86. Evolution of a bacterial population occurs much more rapidly than evolution of a human population. This is because
- (A) the bacteria are smaller and thus more susceptible to change
 - (B) the bacterial life cycle is short and many new generations can be produced quickly
 - (C) humans do not evolve
 - (D) humans can only reproduce during a portion of their life cycle, whereas bacteria can reproduce throughout their entire life cycle
 - (E) bacteria do not require oxygen to survive
87. The acquisition of ampicillin resistance by bacterial Strain 2 is due to
- (A) evolution
 - (B) speciation
 - (C) conjugation
 - (D) transformation
 - (E) transduction
88. The bacterial culture is constantly infused with oxygen to ensure a high rate of reproduction among the bacteria and a healthy population. One evening, the oxygen delivery system gets clogged; the bacteria receive no oxygen, yet they survive and continue to reproduce, just at a slower rate. These bacteria can be classified as
- (A) obligate aerobes
 - (B) obligate anaerobes
 - (C) tolerant anaerobes
 - (D) facultative anaerobes
 - (E) simple anaerobes
89. Which of the following increase genetic diversity in bacteria?
- I. Conjugation
 - II. Transformation
 - III. Crossing over
- (A) I only
 - (B) I and II only
 - (C) III only
 - (D) II and III only
 - (E) I, II, and III

GO ON TO THE NEXT PAGE 

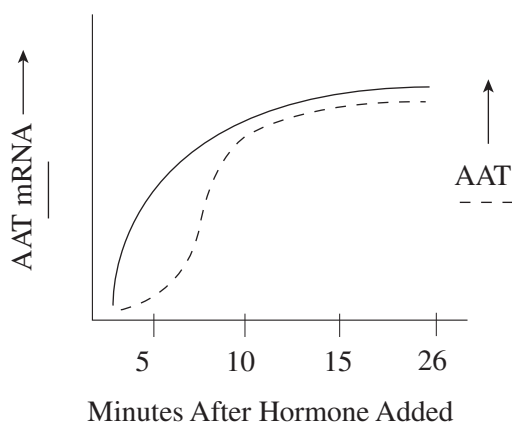
BIOLOGY-M TEST 2—Continued

Questions 90-93 refer to the following experiment involving human liver cells.

Aspartate aminotransferase (AAT) is an enzyme produced in liver cells that catalyzes an important step in the metabolism of amino acids. The production of AAT is dependent upon various hormonal stimuli. Human liver cells were cultured; half the cultured cells were used to measure the amount of AAT mRNA present, and half were used to measure the amount of AAT present. Measurements were taken at five-minute intervals following hormonal stimulation of the cells.

Figure 1 shows the results of this experiment.

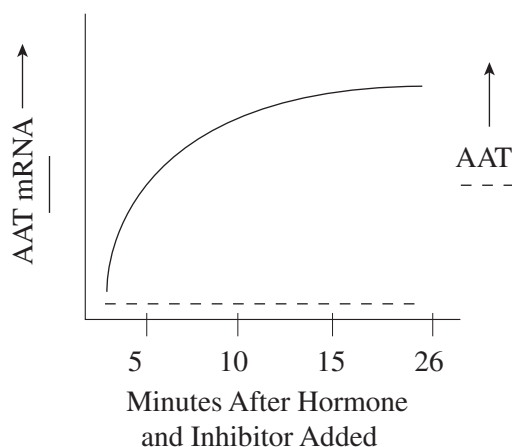
Figure 1



The experiment was repeated, this time adding an inhibitor of protein synthesis along with the hormone.

Figure 2 shows the results of this experiment.

Figure 2



90. Figure 2 shows that AAT is a(n)

- (A) protein
- (B) hormone
- (C) lipid
- (D) inhibitor
- (E) amino acid

91. Figure 1 shows that the hormone is needed to

- (A) induce protein synthesis
- (B) induce RNA transcription
- (C) induce DNA replication
- (D) inhibit protein synthesis
- (E) induce cell division

92. The enzyme that transcribes mRNA is a protein, and the enzyme that produces AAT is a protein. However, in the presence of an inhibitor of protein synthesis, mRNA production occurs unhindered while AAT production is inhibited (Figure 2). This is because

- (A) mRNA production does not require an enzyme
- (B) mRNA is not a protein
- (C) the enzyme needed to make mRNA is not a protein
- (D) the enzyme needed to make mRNA still needs to be translated
- (E) the enzyme needed to make mRNA is already present in the cell

93. Consider Figure 1. If radiolabeled uracil were added to the cultured liver cells BEFORE the addition of hormone, and the mRNA and AAT were analyzed at one-minute intervals to determine the presence of radioactivity, at what time would radioactivity first be detected?

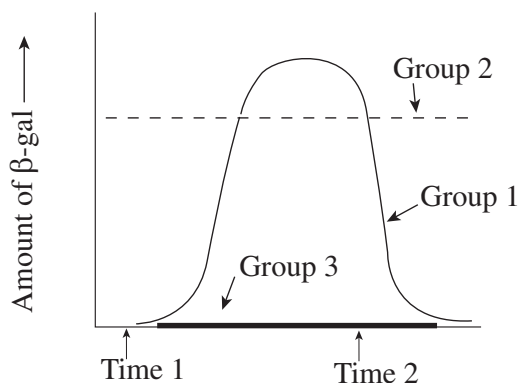
- (A) Immediately upon addition of hormone
- (B) 1 minute after addition of hormone
- (C) 3 minutes after addition of hormone
- (D) 8 minutes after addition of hormone
- (E) 20 minutes after addition of hormone

GO ON TO THE NEXT PAGE

BIOLOGY-M TEST 2—Continued

Questions 94-96 refer to the following experiment.

β -galactosidase (β -gal) is a bacterial enzyme used in the metabolism of lactose. Three different groups of human intestinal bacteria were cultured in a glucose-based medium. At Time 1, the bacteria were transferred to media containing lactose as a nutrient source instead of glucose. At Time 2, the bacteria were returned to the glucose-based medium. Samples of bacteria were removed at five-minute intervals and tested for the presence of β -gal. The results are presented below.



94. What could account for the delay in β -gal production after Time 1 seen in Group 1?
- (A) An inability to synthesize β -gal
 - (B) Transcription of β -gal mRNA
 - (C) Continued use of glucose as a nutrient
 - (D) Replication of the bacterial DNA
 - (E) Infection by a virus
95. Why is it an advantage to intestinal bacteria to be able to induce β -gal production in this way?
- (A) Humans do not consume foods containing lactose all the time.
 - (B) It prevents toxic buildup of lactic acid.
 - (C) β -gal is harmful to bacteria.
 - (D) It prevents the bacteria from using glucose as a nutrient source.
 - (E) Lactose is harmful to bacteria.

96. Which of the following could be reasons for the inability of Group 3 to produce β -gal?

- I. Error in DNA replication
- II. Error in RNA transcription
- III. Error in protein translation

- (A) I only
- (B) III only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

Questions 97-100

Situation 1: A species of moth is preyed on by bats. Over hundreds and hundreds of years, the moths develop a sophisticated pattern of flying when they hear the screech of a bat. This helps them escape danger. Other changes occur as well, and when an attempt is made to mate the current moth with its ancestor moth, no viable eggs are produced.

Situation 2: A species of frogs is living in a pond near an earthquake fault line. A sizable earthquake separates the frog population into two separate populations. After hundreds and hundreds of years, the two groups are unable to mate.

97. Consider Situation 2. Because the two groups of frogs are unable to mate, they are now considered to be different
- (A) populations
 - (B) communities
 - (C) species
 - (D) organisms
 - (E) amphibians
98. A similarity between Situation 1 and Situation 2 is
- (A) reproductive isolation
 - (B) genetic drift
 - (C) increased fitness
 - (D) geographic separation
 - (E) competition

GO ON TO THE NEXT PAGE

BIOLOGY-M TEST 2—*Continued*

99. Another term used to describe what happened in Situation 2 is
- (A) survival of the fittest
 - (B) convergent evolution
 - (C) divergent evolution
 - (D) stabilizing selection
 - (E) directional selection
100. If the earthquake in Situation 2 left one group of frogs without a water source, would the frogs be able to survive and reproduce?
- (A) No, frogs are amphibians and can live only in water.
 - (B) No, frog eggs must be laid in water because they lack a shell.
 - (C) Yes, because amphibians frogs can live on both land and water.
 - (D) Yes, frogs have a thick scaly skin, which protects them from dehydration.
 - (E) Yes, the frogs would quickly adapt to the new environment.

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR
WORK ON THE ENTIRE BIOLOGY-M TEST.