

## 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

- (A) Carnivores
- (B) Decomposers
- (C) Herbivores
- (D) Producers
- (E) Omnivores

1. Bacteria that convert the excrement of cattle into simpler substances
2. Rotifers that eat unicellular green algae
3. Minnows that eat only insect larvae

#### Questions 4-7

- (A) Phagocytosis
- (B) Spermatogenesis
- (C) Parthenogenesis
- (D) Homeostasis
- (E) Peristalsis

4. The formation of male gametes
5. The action of smooth muscle in the digestive tract
6. The action of white blood cells in destroying pathogens
7. The maintenance of a constant internal salt concentration by brine shrimp

#### Questions 8-12

- (A) Hydrolysis
- (B) Dehydration synthesis
- (C) Ionization
- (D) Phosphorylation
- (E) Fermentation (anaerobic respiration)

8.  $\text{H}_2\text{CO}_3 \longrightarrow \text{H}^+ + \text{HCO}_3^-$
9. Glucose  $\longrightarrow$  alcohol + carbon-dioxide
10. Fat + water  $\longrightarrow$  fatty acids + glycerol
11. Glucose + fructose  $\longrightarrow$  sucrose + water
12. Polypeptide + water  $\longrightarrow$  amino acids

#### Questions 13-15

- (A) Linked genes
- (B) Sex-influenced traits
- (C) Autosomal recessive traits
- (D) Sex-linked traits
- (E) Lethal alleles

13. The inheritance of blue eye color in humans
14. The occurrence of type O blood in children born to parents who each have type A blood
15. The more frequent occurrence of pattern baldness in men than in women.

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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.

16. Which of the following constitutes a likely food chain?
- (A) Snails → green algae → small fish → heron → bass  
(B) Snails → green algae → heron → small fish → bass  
(C) Green algae → snails → small fish → bass → heron  
(D) Green algae → small fish → snails → heron → bass  
(E) Heron → small fish → bass → green algae → snails
- 
17. Two animal populations are considered to be of the same species if their members
- (A) eat the same food  
(B) can live in similar ecological niches  
(C) can interbreed to produce live, fertile offspring  
(D) breed within the same geographic area  
(E) migrate to new locations at the same time of year
18. Which of the following are NOT members of the Arthropoda?
- (A) Grasshoppers  
(B) Lobsters  
(C) Centipedes  
(D) Earthworms  
(E) Spiders
19. Inbreeding tends to produce
- (A) an increase in the frequency of certain characteristics among the offspring  
(B) offspring that are larger than normal  
(C) heterozygous offspring  
(D) increased strength and vigor in the offspring  
(E) greater genetic diversity in the offspring
20. The main advantage in planting a legume such as soybeans in a field one year and corn in the same field the next year is that legumes
- (A) use less water than corn does  
(B) produce more oxygen than corn does  
(C) increase the aeration of the soil  
(D) increase the nitrogen content of the soil  
(E) increase the phosphorus content of the soil
21. Two mature plants that are each 12 centimeters in height are crossed and produce offspring ranging from 4 to 18 centimeters in height when mature. Of the following, which is the most likely explanation for these results?
- (A) Tallness is dominant over shortness.  
(B) Multiple genes affect height in plants.  
(C) Height is a sex-linked trait in plants.  
(D) Nondisjunction has occurred.  
(E) A mutation has occurred.

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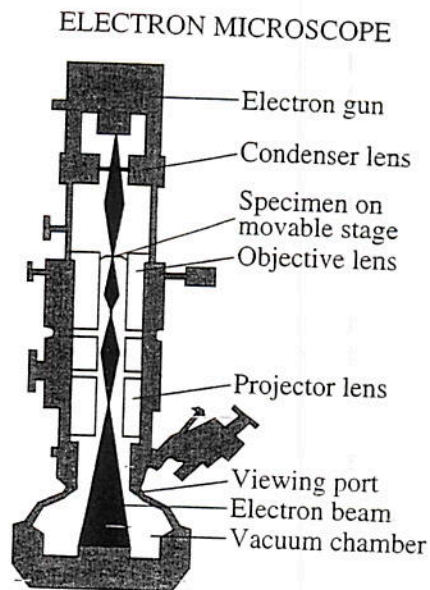
**BIOLOGY E/M TEST—Continued**

22. The two nucleotide chains of a DNA double helix are held together by hydrogen bonds between
- (A) sugars
  - (B) phosphates
  - (C) nitrogenous bases
  - (D) amino acids
  - (E) enzymes
23. Female moths release or secrete chemical substances that influence the behavior of male moths of the same species. Such substances are classified as
- (A) neurotransmitters
  - (B) hormones
  - (C) enzymes
  - (D) flavins
  - (E) pheromones
24. The human urinary bladder serves to
- (A) concentrate urine
  - (B) store urine
  - (C) reabsorb certain dissolved minerals
  - (D) change urea to urine
  - (E) detoxify certain components of excretion
25. The process by which a new allele of a gene arises within a population is
- (A) fertilization
  - (B) independent assortment
  - (C) mutation
  - (D) genetic drift
  - (E) natural selection
26. Of the following substances available to mammalian cells, which is most readily used as a source of energy?
- (A) Fat
  - (B) Glycogen
  - (C) Nucleic acid
  - (D) Protein
  - (E) Glucose
27. All of the following pairs of animals represent examples of similar ecological relationships EXCEPT
- (A) cat and sparrow
  - (B) hawk and mouse
  - (C) horse and donkey
  - (D) lizard and grasshopper
  - (E) fox and rabbit
28. Which of the following does NOT belong to the phylum Chordata?
- (A) Salamander
  - (B) Frog
  - (C) Octopus
  - (D) Shark
  - (E) Whale

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BIOLOGY E/M TEST—Continued

29. Which of the following biomes contains the greatest diversity of species?
- (A) Temperate forest
  - (B) Temperate grassland
  - (C) Boreal taiga
  - (D) Tropical savanna
  - (E) Tropical rain forest
30. A major ecological role of heterotrophs is to
- (A) recycle carbon and oxygen
  - (B) control soil erosion
  - (C) provide organic compounds for autotrophs
  - (D) purify water
  - (E) act as primary producers
31. A pea plant with the genotype  $Aa$  for one trait and  $Bb$  for another trait is allowed to self-pollinate, and the characteristics of all the offspring are recorded, with the results shown below.
- 307 offspring with both dominant traits  
110 offspring with both recessive traits
- These results are most likely accounted for by which of the following?
- (A) Crossing-over occurred between the genes for these traits.
  - (B) The genes for these traits are on the same chromosome.
  - (C) The alleles for the traits segregated independently during meiosis.
  - (D) Multiple alleles exist for these traits.
  - (E) The traits are codominant.



32. In the instrument shown above, which of the following serves as the energy source for the formation of the image?
- (A) Vacuum chamber
  - (B) Condenser lens
  - (C) Projector lens
  - (D) Specimen
  - (E) Electron gun

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## BIOLOGY E/M TEST—Continued

33. Which of the following represents the correct sequence of events that occurs within a cell during mitosis?
- The chromosomes migrate to opposite poles of the cell.
  - The nuclear membrane disappears.
  - The chromosomes line up along the equator of the cell.
  - The chromatids of each chromosome separate.
- (A) I, II, III, IV  
(B) I, II, IV, III  
(C) II, III, I, IV  
(D) II, III, IV, I  
(E) III, IV, II, I
34. Which of the following statements is NOT a part of Darwin's original theory of natural selection?
- There is a struggle for survival.
  - Variations arise from gene mutation.
  - Variations are found among individuals in each species.
  - More organisms are born than can survive to reproduce.
  - Some variations are favorable to an organism and help it to survive.
35. Which of the following are the genotypes of a couple that have four children, each with a different blood type?
- AA and BO
  - AB and BO
  - AO and AB
  - AO and BO
  - AB and OO
36. The presence of hydrochloric acid in the stomach of mammals is responsible for the
- conversion of starch to sugar
  - conversion of pepsinogen to pepsin
  - secretion of bile
  - secretion of insulin
  - secretion of glucose
37. One important adaptation that developed in terrestrial arthropods such as insects, but not in aquatic arthropods such as crayfish, and that allowed the insects to invade the terrestrial environment is
- jointed appendages
  - digestive system
  - tracheal respiratory system
  - muscular system
  - central nervous system
38. Important functions of the stomata include which of the following?
- Transporting water to mesophyll cells
  - Facilitating an exchange of carbon dioxide and oxygen
  - Preventing excessive loss of water
- I only
  - III only
  - I and II only
  - II and III only
  - I, II, and III

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**BIOLOGY E/M TEST—Continued**

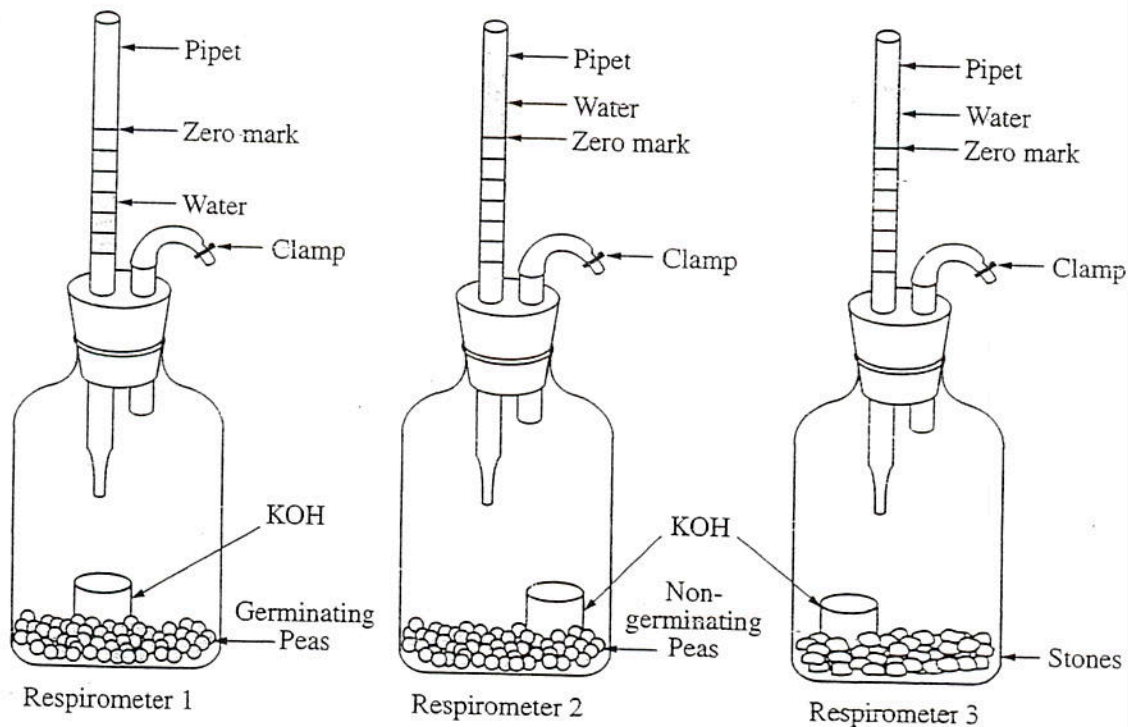
39. In humans, the rate of breathing is primarily controlled by the
- (A) cerebral cortex
  - (B) medulla oblongata
  - (C) cerebellum
  - (D) pituitary gland
  - (E) olfactory bulbs
40. Which of the following statements is true of most vitamins?
- (A) They catalyze the digestion of starches.
  - (B) They have similar molecular structures.
  - (C) They must be present in large amounts to be effective.
  - (D) They cannot be synthesized by animals and therefore must be ingested.
  - (E) All animals require the same vitamins.
41. Ferns (Pterophyta) have all of the following EXCEPT
- (A) seeds
  - (B) xylem
  - (C) true leaves
  - (D) roots
  - (E) chloroplasts
42. Which of the following colors of light is LEAST likely to be absorbed by an ordinary plant leaf?
- (A) Violet
  - (B) Blue
  - (C) Green
  - (D) Yellow
  - (E) Red
43. The largest population of omnivores can be supported if they secure their food predominantly from
- (A) primary producers
  - (B) primary consumers
  - (C) secondary consumers
  - (D) decomposers
  - (E) other omnivores
44. An earthworm and a snake both possess which of the following characteristics?
- (A) Radial symmetry
  - (B) Dorsal tubular nervous system
  - (C) Closed circulatory system
  - (D) Chitinous exoskeleton
  - (E) Scales
45. The trunk of a dicot tree grows in-diameter largely from cell divisions that occur in the
- (A) apical meristem
  - (B) vascular cambium
  - (C) cortex
  - (D) phloem
  - (E) xylem
46. A mouse is placed in a maze containing food. The behavior of this mouse in its first search for food is an example of
- (A) conditioning
  - (B) habituation
  - (C) imprinting
  - (D) insight
  - (E) trial and error

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## BIOLOGY E/M TEST—Continued

### Questions 47-50

An experiment was conducted to measure the rate of respiration by germinating pea seeds. Pea seeds were soaked in water overnight to initiate germination. The volume of germinating pea seeds was measured by water displacement. The germinating peas were placed in a respirometer containing a 5 mL solution of potassium hydroxide (KOH), which reacts with  $\text{CO}_2$  and removes it from the gas phase. Nongerminating pea seeds equal to the total volume of the germinating pea seeds were placed in a second respirometer that also contained KOH. Stones equal in volume to the germinating pea seeds were placed in a third respirometer that also contained KOH. Each respirometer was sealed with an airtight stopper fitted with a graduated pipet. At the beginning of the experiment, several drops of water were placed in each of the three pipets so that the top of the water was at the zero mark. The respirometers were then allowed to stand for 2 hours. The diagrams below show the water levels in each of the pipets at the end of the 2-hour period.



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**BIOLOGY E/M TEST—Continued**

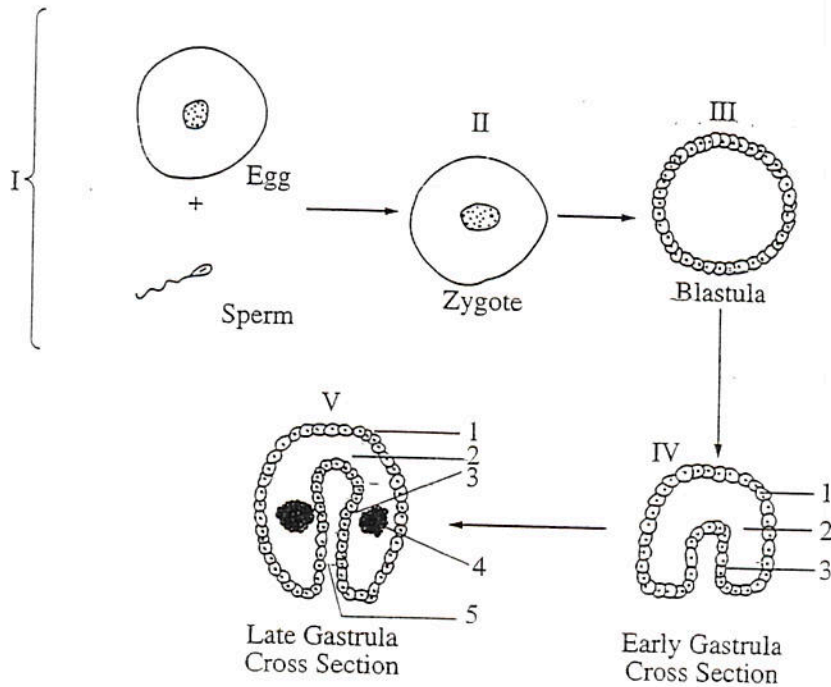
47. The experiment is designed to test which of the following hypotheses?
- (A) Seeds consume oxygen when they germinate.
  - (B) Seeds produce oxygen as they germinate.
  - (C) Seeds break down water when they germinate.
  - (D) The volume of  $\text{CO}_2$  consumed is greater than the volume of  $\text{O}_2$  produced when seeds germinate.
  - (E) Water evaporates less rapidly from stones than from seeds.
48. Which of the following explains why the water level in respirometer 1 is lower than the water levels in respirometers 2 and 3 at the end of the 2-hour period?
- (A) The molecular structure of carbon dioxide is heavier than the molecular structure of oxygen.
  - (B) The temperature of the germinating peas in respirometer 1 increased.
  - (C) Oxygen produced in respirometer 1 dissolved in the KOH solution.
  - (D) The carbon dioxide gas produced in respirometer 1 reacted with KOH, which reduced the volume of gas.
  - (E) The amount of water vapor from the KOH in respirometer 1 increased.
49. Which of the following is a possible explanation for the rise in the water levels in respirometers 2 and 3?
- (A) The atmospheric pressure decreased.
  - (B) Respiration occurred in the nongerminating pea seeds.
  - (C) Photosynthesis occurred in the nongerminating pea seeds.
  - (D) The abiotic stones underwent respiration in the presence of KOH.
  - (E) The airtight seal in each of these respirometers was broken.
50. In order to measure the rate of respiration from the experiment, all of the following conditions must be met EXCEPT:
- (A) The respirometers must have the same volume.
  - (B) The stoppers must fit tightly in the respirometers.
  - (C) The volume of pea seeds, germinating and nongerminating, and the volume of stones must be equal.
  - (D) The volume in the respirometers must be recorded several times at fixed intervals.
  - (E) The temperature of each respirometer must fluctuate by  $10^\circ\text{C}$ .

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## BIOLOGY E/M TEST—Continued

Questions 51-53 refer to the diagrams below, which illustrate the stages in the development of an ovum into an early embryo.

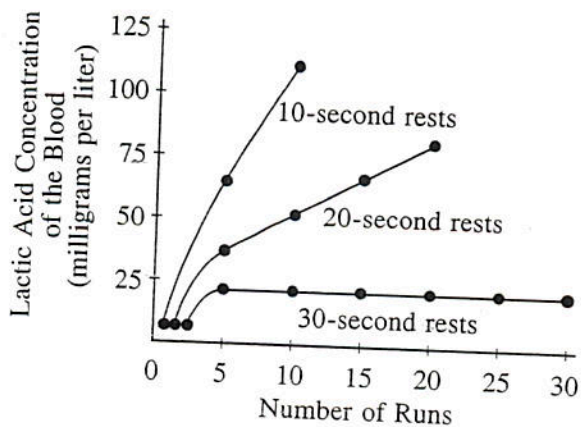


51. In the late gastrula (stage V), some of the cells of layer number 1 will differentiate and become the
- skeleton
  - epidermis
  - circulatory system
  - reproductive system
  - excretory system
52. Which of the stages is characterized by haploid cells?
- I
  - II
  - III
  - IV
  - V
53. The blastula (stage III) is the product of
- transcription
  - many meiotic divisions
  - many mitotic divisions
  - conjugation
  - cellular fusion

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## BIOLOGY E/M TEST—Continued

Questions 54-57 refer to an experiment in which people were asked to run on a treadmill moving at 18 kilometers per hour for 8 seconds, followed by rest periods of either 10 or 20 or 30 seconds each. The data shown in the graph below were recorded for each person as long as the person was able to keep pace with the treadmill, up to a maximum of 30 runs.



Rodolfo Margaria, "The Sources of Muscular Energy," *Scientific American*, March 1972. Reprinted by permission.

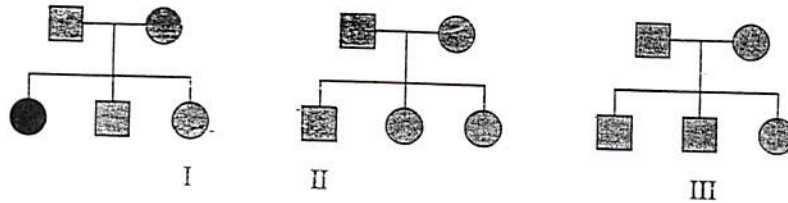
54. According to the data, when the rest period was 20 seconds, exhaustion occurred after how many runs?
- (A) 5  
(B) 10  
(C) 15  
(D) 20  
(E) 30
55. An inference consistent with the data obtained is that lactic acid is
- (A) formed in the blood during rest  
(B) produced when oxygen intake is inadequate, as during continuous exercise  
(C) removed from the blood faster during exercise than it is during rest  
(D) unrelated to exercise rates  
(E) decomposed readily when it reaches saturation levels in the blood
56. Which of the following statements about lactic acid is supported by the data in the graph?
- (A) The more frequent the rest periods, the less the accumulation of lactic acid.  
(B) The longer the period of rest, the less the accumulation of lactic acid.  
(C) The greater the accumulation of lactic acid, the slower the person runs.  
(D) For the runs with 30-second rest periods, exhaustion is reached at 23 milligrams of lactic acid per liter.  
(E) There is no relationship between the lactic acid levels of the blood and the number of runs achieved.
57. According to the data, which of the following would maximize the amount of running a person could perform?
- I. Allowing running periods that are about 16 seconds long  
II. Allowing rest periods that are about 30 seconds long  
III. Setting the treadmill to move at a faster rate
- (A) II 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

### Questions 58-60

Tay-Sachs disease is a genetic defect controlled by a single pair of alleles. The recessive allele, when homozygous, causes the disease, which is characterized by the inability to synthesize a particular enzyme. For the three families depicted below, circles represent females and squares represent males. Symbols for individuals who have Tay-Sachs disease are shaded. Testing has shown that Person I and Person III are carriers of the Tay-Sachs allele and that Person II is not.



58. What is the probability that a child of Persons I and II will have Tay-Sachs disease?
- (A) 0  
 (B) 25%  
 (C) 33%  
 (D) 50%  
 (E) 75%
59. If Person I and Person III have a child, what is the probability that the child will not have Tay-Sachs disease?
- (A) 0  
 (B) 25%  
 (C) 33%  
 (D) 50%  
 (E) 75%
60. What is the probability that the mother of Person I is a carrier?
- (A) 100%  
 (B) 75%  
 (C) 50%  
 (D) 33%  
 (E) It cannot be determined from the information given.

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.

## BIOLOGY-E SECTION

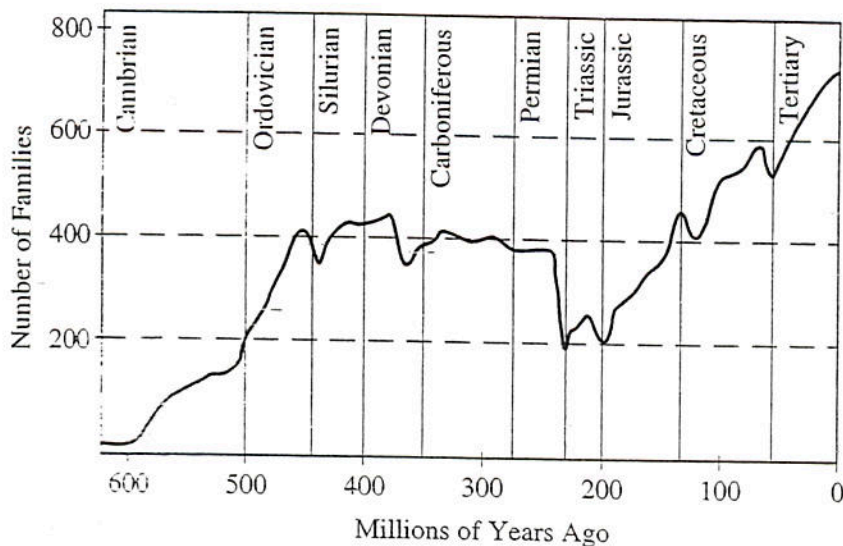
**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill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

61. Factors that influence population density include which of the following?
- I. Competition within the same species
  - II. Competition among different species
  - III. Predation
- (A) II only  
(B) III only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III
62. Today's worldwide human population can best be described as
- (A) oscillating  
(B) declining  
(C) fluctuating near equilibrium  
(D) growing arithmetically  
(E) growing exponentially
63. Characteristics of the arctic tundra biome include which of the following?
- I. Long, cold winters
  - II. Coniferous trees as the dominant species
  - III. High levels of precipitation
- (A) I only  
(B) III only  
(C) I and II only  
(D) II and III only  
(E) I, II, and III
64. All of the following processes occur as part of the carbon cycle EXCEPT
- (A) organic decay  
(B) forest fires  
(C) photosynthesis  
(D) respiration  
(E) transpiration
65. Which of the following plays the greatest role in producing acid rain?
- (A) Methane  
(B) Sulfur dioxide  
(C) Carbon dioxide  
(D) Carbon monoxide  
(E) Ozone
66. A trophic level within an ecosystem is best defined by the
- (A) total chemical energy contained in nutrients within the ecosystem  
(B) total available energy captured by photosynthesis within an ecosystem  
(C) amount of pollution within the ecosystem  
(D) main source of nutrition of the organisms within it  
(E) density of the population relative to the carrying capacity of the environment

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## BIOLOGY-E SECTION—Continued

Questions 67-70 refer to the following diagram, which shows the numbers of families of marine organisms over geologic time.



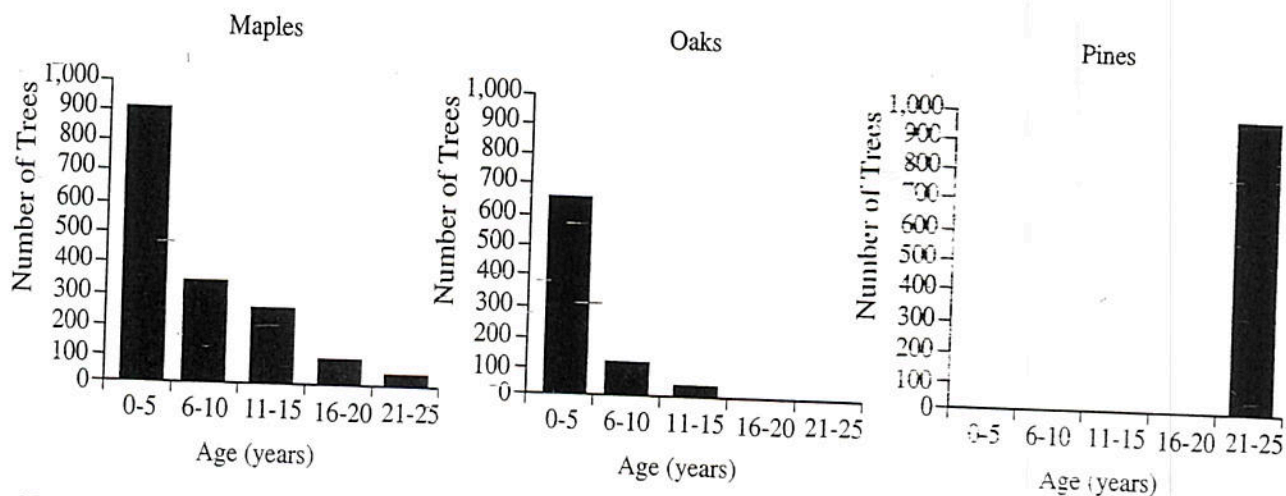
67. During the geological period that appears to have had the most severe mass extinction, approximately what percentage of the families of marine animals living at that time became extinct?
- (A) 1%  
 (B) 10%  
 (C) 33%  
 (D) 50%  
 (E) 98%
68. About the same number of families of marine organisms existed at the beginning of the Carboniferous period as at the end. Which of the following is the best hypothesis to explain this pattern?
- (A) Homeostasis stabilized the number of families.  
 (B) The number of families that appeared was approximately equal to the number that became extinct.  
 (C) Evolution did not occur during this period.  
 (D) The mutations that occurred during this period were harmful.  
 (E) The populations were too large to allow the appearance of new families.
69. The greatest number of families of marine animals existed on Earth during which of the following time periods?
- (A) The present time  
 (B) 25 million years ago  
 (C) 50 million years ago  
 (D) 200 million years ago  
 (E) 400 million years ago
70. Useful methods for obtaining the kind of data presented in the graph include which of the following?
- I. Analyses of geological formations  
 II. Radioactive dating  
 III. Study of fossils
- (A) II only  
 (B) III only  
 (C) I and II only  
 (D) I and III only  
 (E) I, II, and III

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## BIOLOGY-E SECTION—*Continued*

### Questions 71-75

An ecology class counted every tree in a 3-hectare woodland and measured ~~the trees' diameter~~ diameter at a height of 1 meter. By measuring annual growth rings in samples of trees cut in a nearby woodland, the class found that all of the species grew about 2 cm in diameter each year. It was also discovered that each tree species requires about 5 years to grow to a height of 1 meter. The measurements of the growth rings were converted into an approximate age for each tree. Data for the three most common species are graphed below. By interviewing nearby residents, the class learned that the 3-hectare site had been a hay field until 25 years ago.



71. Trees of which of the following species are reproducing in the 3-hectare woodland?
- (A) Maples only  
 (B) Oaks only  
 (C) Pines only  
 (D) Pines and oaks only  
 (E) Maples and oaks only
72. The age of the woodland is approximately equaled by the average age of which of the following populations?
- (A) Maples only  
 (B) Oaks only  
 (C) Pines only  
 (D) Maples and pines only  
 (E) Oaks, maples, and pines
73. The data collected suggest that the woodland is undergoing
- (A) desertification  
 (B) succession  
 (C) eutrophication  
 (D) biological magnification  
 (E) speciation
74. Some trees of which of the following species are about 2 meters tall?
- (A) Maples only  
 (B) Oaks only  
 (C) Pines only  
 (D) Maples and oaks only  
 (E) Oaks and pines only
75. For the oldest trees, the diameter of the trunk at the height of one meter above the ground is closest to
- (A) 10 cm  
 (B) 20 cm  
 (C) 25 cm  
 (D) 40 cm  
 (E) 75 cm

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**BIOLOGY-E SECTION—Continued**

Questions 76-80 refer to the study of three artificial ponds that are essentially identical in depth, surface area, volume, and site characteristics (soil type, elevation, slope orientation). The ponds differ in nutrients, turbidity, and the predominant organisms that cause the turbidity, as shown in the table below.

Location of Pond	Nitrogen Concentration (mg/m <sup>3</sup> )	Phosphorus Concentration (mg/m <sup>3</sup> )	Potassium Concentration (mg/m <sup>3</sup> )	Turbidity	Predominant Organisms
Undisturbed field	517 ± 17	8 ± 2	844 ± 26	Very low	Autotrophs
Cow pasture	942 ± 88	11 ± 4	827 ± 32	Moderate	Decomposers and autotrophs
Cultivated field	1,445 ± 263	87 ± 24	854 ± 81	Very high	Autotrophs

76. Which of the following most likely accounts for the difference in the predominant organisms in the pond in the undisturbed field and those in the pond in the cow pasture?
- (A) The difference in potassium concentration in the two ponds
  - (B) The difference in phosphorus concentration in the two ponds
  - (C) The greater input of organic matter into the pond in the cow pasture
  - (D) The release of oxygen by the decomposers into the pond in the cow pasture
  - (E) The release of methane by the autotrophs into the pond in the cow pasture
77. Which of the following best accounts for the relatively high concentration of phosphorus in the pond in the cultivated field?
- (A) Organic compounds in the pond have decomposed.
  - (B) Runoff water from the field contains excess fertilizers.
  - (C) The soil beneath the pond is releasing more phosphorus.
  - (D) The high turbidity inhibits the evaporation of phosphorus into the atmosphere.
  - (E) Nitrogen fixation promotes the release of phosphorus from plants in the field.

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**BIOLOGY-E SECTION—Continued**

78. The data suggest that the low turbidity in the pond in the undisturbed field can be the result of which of the following?
- I. Relatively limited availability of nitrogen and phosphorus for autotrophs
  - II. Relatively limited availability of potassium for autotrophs
  - III. Relatively high activity of decomposers
- (A) I only  
(B) II only  
(C) III only  
(D) I and II only  
(E) I, II, and III
79. The most likely source of the additional nitrogen compounds in the cow pasture pond is
- (A) animal excrement
  - (B) the trampled plants in the pasture
  - (C) the soil churned up by the cows' hooves
  - (D) the carbon-fixing actions of the autotrophs
  - (E) methane produced in the cows' stomachs
80. In a special study, 200 seedlings of the same species were divided into groups. The water from each pond was given to a different group of seedlings, and the fourth group was watered with distilled water. Each group received the same volume of water. After 2 months, which of the following is the most likely result?
- (A) All four groups will have the same total biomass.
  - (B) The seedlings watered from the cow pasture pond will be dead.
  - (C) The seedlings watered from the cultivated field pond will have the greatest biomass.
  - (D) The seedlings watered with distilled water will have the greatest biomass.
  - (E) The seedlings watered from the pond in the undisturbed field will be greener.

**STOP**

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THE ENTIRE BIOLOGY-E TEST ONLY. DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.



## 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.

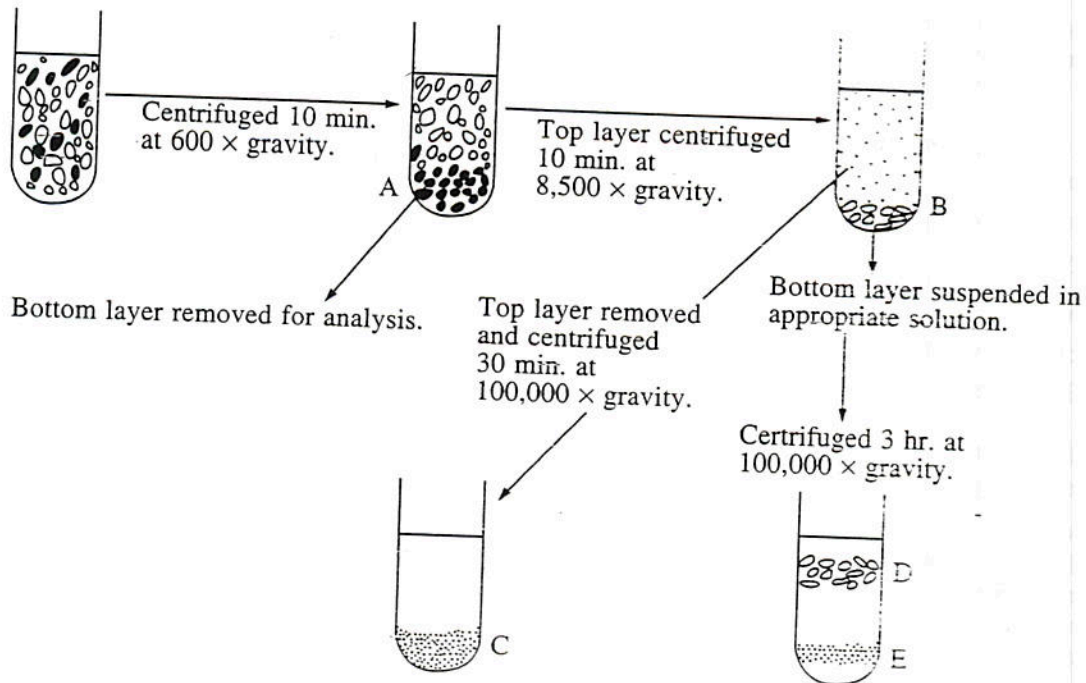
Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill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

81. The initial role of chlorophyll in photosynthesis is to
- (A) absorb light energy
  - (B) fix  $\text{CO}_2$
  - (C) convert ADP to ATP
  - (D) synthesize glucose
  - (E) oxidize water
82. Which of the following processes utilizes atmospheric oxygen?
- (A) Photosynthesis
  - (B) Cellular respiration
  - (C) Fermentation
  - (D) Glycolysis
  - (E) Hydrolysis
83. Which of the following characteristics directly contributes to the function of a protein?
- (A) Tertiary structure
  - (B) Base pairing
  - (C) Atomic mass
  - (D) Nucleic acid composition
  - (E) Type of peptide bonds
84. Which of the following is an end product of both cellular respiration and the light-dependent reactions of photosynthesis?
- (A) Glucose
  - (B)  $\text{CO}_2$
  - (C) Chlorophyll
  - (D) Oxygen
  - (E) ATP
85. What is the maximum number of amino acids that could be incorporated into a polypeptide encoded by 15 nucleotides of messenger RNA?
- (A) 3
  - (B) 5
  - (C) 15
  - (D) 30
  - (E) 45
86. Solutions of lactose and lactase are placed together in a test tube. After 30 minutes at  $37^\circ\text{C}$ , lactose, lactase, and equal amounts of glucose and galactose are found in the tube. Which of the following is a reasonable interpretation of these data?
- (A) Lactose and lactase decompose at  $37^\circ\text{C}$ .
  - (B) Lactose consists of glucose and galactose monosaccharide units.
  - (C) Lactose consists only of galactose monosaccharide units that can further decompose into glucose.
  - (D) The concentration of lactase at the end of the experiment is smaller than at the beginning.
  - (E) The concentration of lactose is the same at the beginning and at the end of the experiment.
87. When a mutation in a particular gene prevents the synthesis of a particular enzyme, it is most likely that
- (A) the messenger RNA with the correct sequence for that enzyme is not produced
  - (B) ATP will no longer be synthesized
  - (C) the ribosomes of the cell become inactive
  - (D) transfer RNA in the cell is no longer functional
  - (E) some essential amino acids from the cell are missing

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## BIOLOGY-M SECTION—Continued

Questions 88-90 refer to an experiment in which liver cells from a live culture were mechanically ruptured to release the cell components. The resulting suspension was centrifuged several times in succession to produce layers in which certain cell organelles predominated, as shown in the diagram below.



88. Upon analysis, layer A was found to have the highest proportion of DNA, indicating that the layer contained the major portion of the
- mitochondria
  - nuclei
  - ribosomes
  - lysosomes
  - endoplasmic reticulum
89. Upon analysis, layer D was found to have the highest rate of oxygen uptake. This layer most likely contained
- mitochondria
  - nuclei
  - ribosomes
  - lysosomes
  - endoplasmic reticulum
90. Upon analysis, layer C had the greatest concentration of RNA and was probably made up mostly of
- mitochondria
  - nuclei
  - ribosomes
  - lysosomes
  - plasma membrane

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## BIOLOGY-M SECTION—*Continued*

Questions 91-93 refer to the following laboratory experiment.

A student tests the effect of pH on the enzymatic activity of pepsin. Ten test tubes are set up, each with 5 milliliters of a gelatin (a protein) solution. To each tube, drops of hydrochloric acid or sodium hydroxide are added to adjust the pH. To each of tubes 1-5, 2 milliliters of a 5 percent pepsin solution added and 2 milliliters of distilled water added to each of tubes 6-10. All tubes are placed in an incubator at 37°C. After 1 hour, the contents of each tube are tested for the presence or absence of gelatin. The results are summarized in the table below.

Tube Number	pH	Presence of Gelatin at End of Incubation (relative units)
1	1.0	+ (Trace)
2	3.0	- (None)
3	5.0	+++
4	7.0	++++
5	9.0	++++
6	1.0	++++
7	3.0	++++
8	5.0	++++
9	7.0	++++
10	9.0	++++

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BIOLOGY-M SECTION—Continued

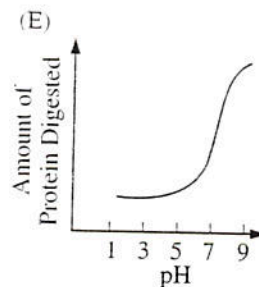
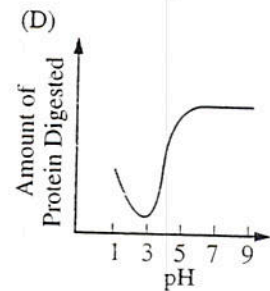
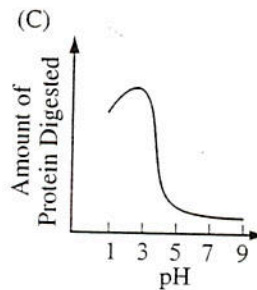
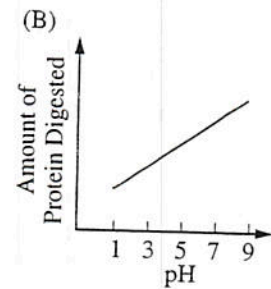
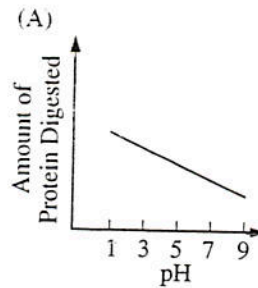
91. According to the data, the digestion of gelatin by pepsin is accomplished most effectively under which of the following conditions?

- (A) At any pH when the reaction is carried out for 12 hours at 37°C
- (B) At neutral pH only
- (C) At a pH between 8.0 and 11.0
- (D) In any acid medium
- (E) At a pH between 1.0 and 3.0

92. The experiment lends support to which of the following statements?

- (A) All foods are digested by pepsin.
- (B) Some enzymes operate most efficiently within a narrow range of pH.
- (C) The lower the pH, the better the digestive process.
- (D) Enzyme activity is not appreciably affected by variations in temperature.
- (E) Certain proteins are digested only in alkaline solutions of pepsin.

93. Which of the following graphs most closely represents the relationship between pH and the digestion of gelatin by pepsin?

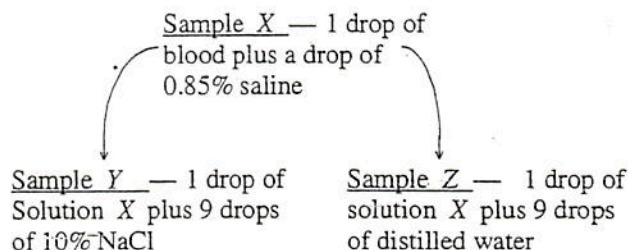


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**BIOLOGY-M SECTION—Continued**

Questions 94-97

Three blood samples are prepared according to the following procedure.



Slides are made of each sample and the cells are viewed microscopically. The concentration of solutes in the solution used in preparing sample X is the same as that of the red blood cells.

94. The blood cells in sample Z would
- (A) look the same as those in solution Y
  - (B) undergo lysis
  - (C) shrink
  - (D) exhibit turgor pressure
  - (E) show wilting
95. Which of the following is true regarding the blood cells in sample Y?
- (A) The cells would look like those in sample X when viewed microscopically.
  - (B) The cells would lose water to the surrounding solution.
  - (C) The concentration of the  $\text{Na}^+$  and  $\text{Cl}^-$  ions in the cells would decrease.
  - (D) The amount of  $\text{Na}^+$  entering the cells will equal the amount of  $\text{Cl}^-$  leaving the cells.
  - (E) The cells would swell.
96. The cells in sample X are unaffected because
- (A) sample X is unstable at temperatures below  $37^\circ$
  - (B) sample X has a higher solute concentration than human plasma
  - (C) sample X has the same solute concentration as human plasma
  - (D) sample X has the same concentration as seawater from which animals evolved
  - (E) red blood cells are selectively impermeable to water
97. The results of the experiment illustrate which of the following processes?
- (A) Dehydration
  - (B) Active transport
  - (C) Cellular homogeneity
  - (D) Osmosis
  - (E) Hydrolysis

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## BIOLOGY-M SECTION—Continued

### Questions 98-100

The gene for a certain protein has been isolated and sequenced from five different species. During their evolution from a common ancestor, these species have undergone only single-nucleotide mutations. A partial DNA sequence from each of the five species is

- I. 3'...AGTAC...5'
  - II. 3'...AGTTC...5'
  - III. 3'...AGTAT...5'
  - IV. 3'...TG TTC...5'
  - V. 3'...ACTTC...5'
98. The sequence 5'...UGAAG...3' would most likely represent an RNA sequence transcribed from which of the following species?
- (A) I
  - (B) II
  - (C) III
  - (D) IV
  - (E) V

99. Which of the species would require the fewest point mutations in the original sequence in order to give rise to the new sequence 3'...GGTAT...5'?

- (A) I
- (B) II
- (C) III
- (D) IV
- (E) V

100. Which is most likely to be the oldest species if 3'...AGAAC...5' were the partial DNA sequence of the common ancestor of the group?

- (A) I
- (B) II
- (C) III
- (D) IV
- (E) V

# STOP

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