

BIOLOGY E/M

SUBJECT TEST 1

Your responses to the Biology E/M Subject Test 2 questions must be filled in on the Test 2 part of your answer sheet (at the back of the book). Marks on any other section will not be counted toward your Biology E/M Subject Test score.

When your supervisor gives the signal, turn the page and begin the Biology E/M Subject Test. There are 100 numbered ovals on the answer sheet. There are 60 questions in the core Biology test, 20 questions in the Biology-E section, and 20 questions in the Biology-M section. Therefore, use ONLY ovals 1-80 (for Biology-E) OR ovals 1-60 plus 81-100 (for Biology-M) for recording your answers.

BIOLOGY E/M SUBJECT TEST 1—*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 1-3

- (A) Mitochondria
- (B) Cytoplasm
- (C) Pyruvate
- (D) Lactic acid
- (E) Glucose

1. Location of cellular respiration in prokaryotes
2. End product of anaerobic metabolism in muscle cells
3. Location of glycolysis in eukaryotes

Questions 4-6

- (A) Anaphase II
- (B) Metaphase I
- (C) Prophase II
- (D) Metaphase II
- (E) Prophase I

4. Stage of meiosis during which recombination of genetic material occurs
5. Stage of meiosis during which pairs of homologous chromosomes align at the center of the cell
6. Stage of meiosis during which sister chromatids are separated

Questions 7-9

- (A) Reasoning/insight
- (B) Imprinting
- (C) Classical conditioning
- (D) Habituation
- (E) Instinct

7. A simple kind of learning involving loss of sensitivity to unimportant stimuli
8. Geese recognize a ticking clock as “mother” if exposed to it during a critical period shortly after hatching
9. Fish are given food at the same time as a tap on their glass bowl and soon learn to approach when a tap sounds even in the absence of food

Questions 10-12

- (A) Small intestine
- (B) Large intestine
- (C) Stomach
- (D) Esophagus
- (E) Mouth

10. Structure where most digestion and absorption of nutrients occurs
11. Structure where starch digestion first takes place
12. Structure with the lowest pH

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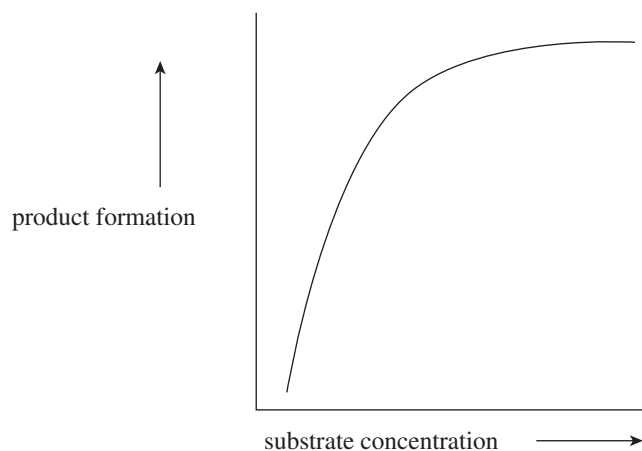
Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Some questions pertain to a set that refers to a laboratory or experimental situation. For each question, select the one choice that is the best answer to the question and then fill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

13. Homologous structures, which have similar underlying structures but may have different functions, are formed by
- (A) divergent evolution
 - (B) speciation
 - (C) segregation
 - (D) convergent evolution
 - (E) stabilizing selection
14. Hemoglobin is a protein in red blood cells that binds and carries oxygen and some carbon dioxide. Its affinity for oxygen changes as blood travels from the lungs to the body tissues and back to the lungs again. One could expect hemoglobin to have
- (A) a high carbon dioxide affinity in the lungs and a low oxygen affinity in the tissues
 - (B) a low carbon dioxide affinity in the lungs and a high oxygen affinity in the tissues
 - (C) a high oxygen affinity in the lungs and a low oxygen affinity in the tissues
 - (D) a low oxygen affinity in the lungs and a high oxygen affinity in the tissues
 - (E) a high oxygen affinity in the lungs and a high carbon dioxide affinity in the lungs
15. Which of the following RNA sequences would be transcribed from the DNA sequence ATGCCTAGGAC?
- (A) TACGGATCCTG
 - (B) UAGCGAUCCUG
 - (C) AUGCCUAGGAC
 - (D) UACGGAUCCUG
 - (E) GCAUUCGAAGU
16. Arthropods can be characterized by all of the following EXCEPT
- (A) a hard exoskeleton
 - (B) a water vascular system
 - (C) jointed appendages
 - (D) molting
 - (E) segmented body
17. Which of the following are functions of the kidney?
- I. filtration of blood to remove wastes
 - II. blood pressure regulation
 - III. pH regulation
- (A) I only
 - (B) I and II only
 - (C) I and III only
 - (D) II and III only
 - (E) I, II, and III
18. In chickens, the allele for long tail feathers (T) is dominant over the allele for short tail feathers (t). If a pure-breeding long-tailed chicken (TT) mates with a pure-breeding short-tailed chicken (tt), what percentage of their offspring (if mated with the correct genotype) could give rise to chickens with short tails?
- (A) 25%
 - (B) 50%
 - (C) 75%
 - (D) 100%
 - (E) unable to determine from the information given

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BIOLOGY E/M SUBJECT TEST 1—Continued

19. All of the following could be considered density-dependent factors affecting population growth EXCEPT
- (A) limited nutrients
 - (B) climate temperature
 - (C) build-up of toxins
 - (D) predation
 - (E) limited water
20. The best definition of a species is
- (A) a group of organisms that occupy the same niche
 - (B) a population that works together to defend itself from predators
 - (C) a group of organisms that can mate with each other
 - (D) a population that preys on other populations
 - (E) a population in which all members benefit from the association in some way
21. Which of the following contains blood poor in oxygen?
- I. Right ventricle
 - II. Pulmonary vein
 - III. Pulmonary artery
- (A) I only
 - (B) II only
 - (C) III only
 - (D) I and II only
 - (E) I and III only
22. An organism appears to be a segmented worm. Upon observation it is determined that the organism has a closed circulation, a mouth and an anus, and does NOT have an exoskeleton. The organism most likely belongs to the phylum
- (A) mollusca
 - (B) annelida
 - (C) echinodermata
 - (D) arthropoda
 - (E) chordata
23. Which of the following substances are produced by the light reactions of photosynthesis?
- (A) ATP and NADPH
 - (B) ATP and glucose
 - (C) NADH and glucose
 - (D) ATP and NADH
 - (E) NADPH and glucose
24. Consider the following graph of substrate concentration vs. product formation. Assume enzyme concentration to be constant. Why does the graph level off at high substrate concentrations?



- (A) All the enzyme is used up, and product formation cannot occur without it.
- (B) There is no more substrate to be converted into product.
- (C) Substrate concentration, exceeds enzyme concentration, and all active sites are saturated.
- (D) The reaction has run to completion.
- (E) An inhibitor has been added, and it has slowed down the rate of product formation.

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25. A bird that feeds on both insects and berries would be classified as a
- primary consumer
 - secondary consumer
 - tertiary consumer
- (A) I only
(B) II only
(C) III only
(D) I and II only
(E) II and III only
26. Which of the following chemical formulas could represent a monosaccharide?
- (A) $C_6H_6O_6$
(B) $C_3H_6O_3$
(C) $C_6H_{12}O_3$
(D) $C_5H_{10}O_{10}$
(E) CH_2O_4
27. A population of birds lives in an area with many insects upon which it feeds. The insects live inside trees, burrowing into the bark. Over many hundreds of years, the average beak size in the bird population has increased. This is due to
- increased fitness of the birds, leading to speciation
 - decreased fitness of the insects, allowing the birds to catch them more easily
 - increased fitness of large-beaked birds, leading to evolution
 - decreased fitness of small-beaked birds, leading to speciation
 - random mutation and genetic recombination
28. The location on an enzyme where a substrate binds is called the
- binding site
 - reaction center
 - allosteric site
 - lock-and-key model
 - active site
29. Human cells maintain concentration gradients across their plasma membranes, such that there is a high sodium concentration outside the cell and a high potassium concentration inside the cell. Suppose that within the cell membrane are sodium “leak” channels. These channels would allow sodium to
- move out of the cell by simple diffusion
 - move into the cell by simple diffusion
 - move out of the cell by facilitated diffusion
 - move into the cell by facilitated diffusion
 - move into the cell by active transport
30. The role of decomposers in the nitrogen cycle is to
- fix atmospheric nitrogen into ammonia
 - incorporate nitrogen into amino acids and organic compounds
 - convert ammonia to nitrate, which can then be absorbed by plants
 - denitrify ammonia, thus returning nitrogen to the atmosphere
 - release ammonia from organic compounds, thus returning it to the soil
31. All of the following are true about the endocrine system EXCEPT
- it relies on chemical messengers that travel through the bloodstream
 - it is a control system that has extremely rapid effects on the body
 - the hormones affect only certain “target” organs
 - it is involved in maintaining body homeostasis
 - its organs secrete hormones directly into the bloodstream, rather than through ducts

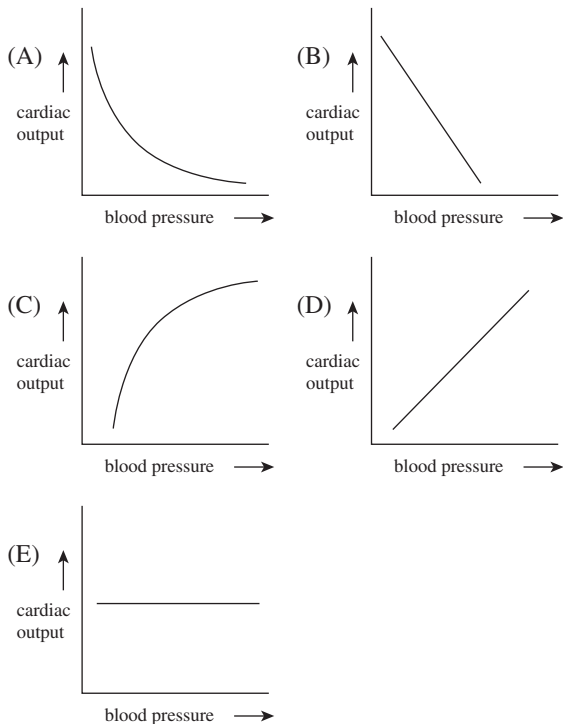
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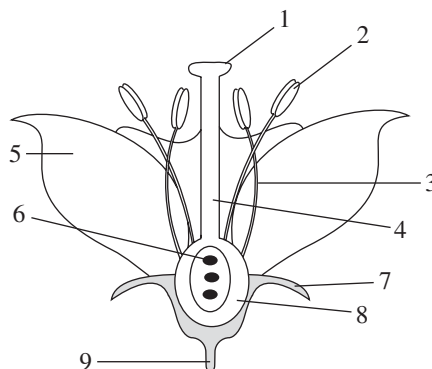
32. Two organisms live in close association with each other. One organism is helped by the association, whereas the other is neither helped nor harmed. Which of the following terms best describes this relationship?

(A) Mutualism
 (B) Commensalism
 (C) Symbiosis
 (D) Parasitism
 (E) Predator-prey relationship

33. Cardiac output (the amount of blood pumped out of the heart in one minute) and blood pressure are directly proportional. Which of the following graphs best depicts the relationship between cardiac output and blood pressure?



Questions 34-36 refer to the following diagram.



34. Location where male haploid cells are produced

(A) 1
 (B) 2
 (C) 3
 (D) 6
 (E) 8

35. Sticky structure where pollen grains can attach and germinate

(A) 1
 (B) 2
 (C) 4
 (D) 6
 (E) 8

36. Structure which, when fertilized, develops into fruit

(A) 1
 (B) 2
 (C) 5
 (D) 6
 (E) 8

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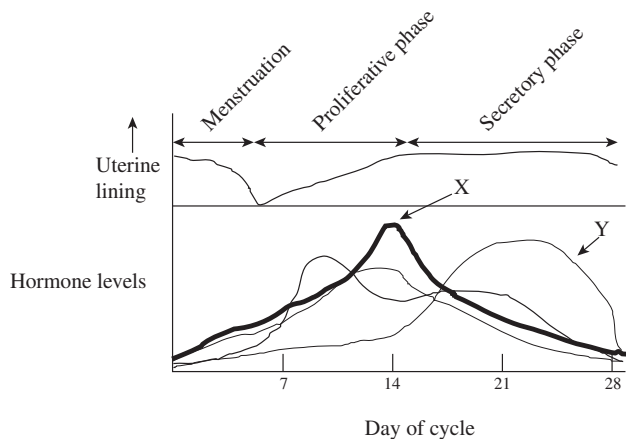
BIOLOGY E/M SUBJECT TEST 1—*Continued*

Questions 37-38

Tropisms refer to movements made by plants toward or away from certain stimuli. “Positive” tropisms refer specifically to movements toward a stimulus, whereas “negative” tropisms refer to movements made away from a stimulus.

37. A plant growing on the shady side of a building bends around the corner of the building toward the sunlight. This is an example of
- negative geotropism
 - negative phototropism
 - positive phototropism
 - positive hydrotropism
 - negative hydrotropism
38. The stem and leaves of the plant grow up, away from the soil. This is an example of
- negative geotropism
 - positive geotropism
 - negative phototropism
 - positive hydrotropism
 - negative hydrotropism

Questions 39-43 refer to the following diagram.



39. The hormone labeled X in the diagram is often used in over-the-counter diagnostic tests to determine when ovulation has occurred. This hormone is
- estrogen
 - progesterone
 - FSH
 - LH
 - testosterone
40. Based on the peak levels of hormone X, on what day of the cycle is ovulation most likely to occur?
- Day 21
 - Day 14
 - Day 12
 - Day 25
 - Day 28
41. The hormone labeled Y in the diagram is
- progesterone, secreted by the corpus luteum after ovulation has occurred
 - progesterone, secreted by the ovary after ovulation has occurred
 - estrogen, secreted by the corpus luteum after ovulation has occurred
 - estrogen, secreted by the ovary after ovulation has occurred
 - estrogen, secreted by the follicle before ovulation occurs
42. Immediately after fertilization, the zygote begins to undergo rapid cell division. This process is known as
- blastulation
 - gastrulation
 - neurulation
 - implantation
 - cleavage

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43. From which of the primary germ layers does the nervous system develop?
- (A) Endoderm
 - (B) Mesoderm
 - (C) Ectoderm
 - (D) Enteroderm
 - (E) Epidermis

Questions 44-46

A barren, rocky community near a lake has virtually no vegetation or animal life. After a period of approximately 75 years, the community boasts a wide variety of flora and fauna, including deciduous trees, deer, and raccoon.

44. The process which has taken place can best be described as
- (A) progression
 - (B) succession
 - (C) evolution
 - (D) habitation
 - (E) colonization
45. The stable community of deciduous trees and animals is known as the
- (A) final community
 - (B) climax community
 - (C) apex community
 - (D) summit community
 - (E) composite community
46. Usually the first organisms to colonize rocky areas are lichen. These are known as the
- (A) primary community
 - (B) starter community
 - (C) colony organisms
 - (D) pioneer organisms
 - (E) settler organisms

Questions 47-50 refer to the following experiment.

Diuretics are substances that help eliminate water from the body. The effects of various substances were tested on several volunteers. All volunteers had a mass of 70 kg. They drank nothing for eight hours before the test and urinated just prior to ingesting the test substance. The three substances (water, caffeine, and salt) were tested on three separate days. The results are shown in the tables below.

Table 1

volunteer	amount caffeine ingested (in 100 ml water)	volume urine collected after 1 hour
A	50 mg	302 ml
B	100 mg	492 ml
C	150 mg	667 ml
D	200 mg	863 ml

Table 2

volunteer	amount sodium chloride ingested (in 100 ml water)	volume urine collected after 1 hour
A	.9 g	201 ml
B	1.8 g	162 ml
C	2.7 g	125 ml
D	3.6 g	82 ml

Table 3

volunteer	volume water ingested	volume urine collected after 1 hour
A	100 ml	230 ml
B	200 ml	240 ml
C	300 ml	252 ml
D	400 ml	263 ml

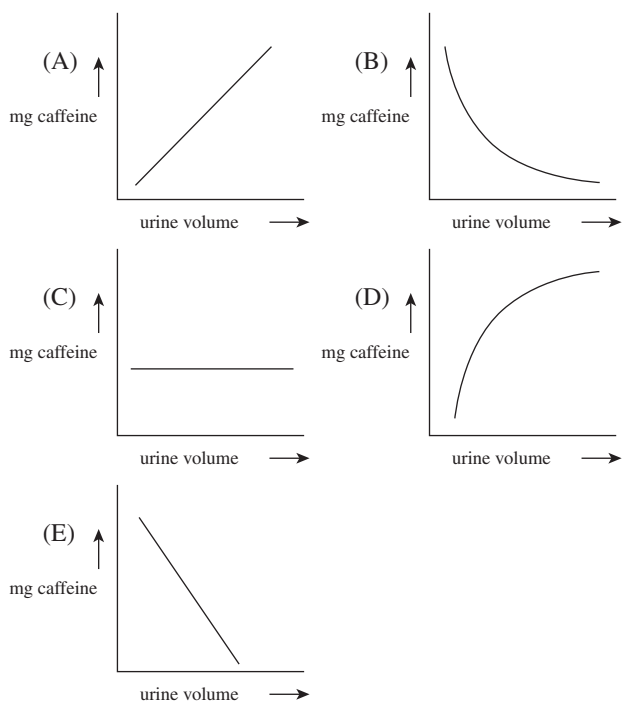
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BIOLOGY E/M SUBJECT TEST 1—Continued

47. Which of the following substances could be classified as a diuretic?

- I. Caffeine
 - II. Sodium
 - III. Water
- (A) I only
 (B) II only
 (C) I and II only
 (D) II and III only
 (E) I, II, and III

48. Which graph best represents the change in urine volume when ingesting caffeine?



49. The purpose of ingesting the plain water (Table 3) was to

- (A) rehydrate the volunteers
 (B) dissolve the substances
 (C) act as a control
 (D) flush out the kidneys
 (E) act as a positive test substance

50. Based on the results in Table 2, if a volunteer were to ingest 4.5 g sodium chloride dissolved in 100 ml water, what would be the approximate predicted urine volume collected after one hour?

- (A) 20 ml
 (B) 30 ml
 (C) 40 ml
 (D) 50 ml
 (E) 60 ml

Questions 51-53 refer to the following information on heredity.

Hemophilia is a disorder in which blood fails to clot. John, a male hemophiliac, marries Jane, a normal woman, and together they have four children, two boys (Mark and Mike) and two girls (Molly and Mary). None of the children display the symptoms of hemophilia. Mark, Mike, Molly, and Mary all marry normal individuals and have children. None of Mark's or Mike's children, male or female, display symptoms of hemophilia, but the sons of Molly and Mary all display symptoms of hemophilia while the daughters of Molly and Mary do not.

51. Which of the following best explains the reason that Mark, Mike, Molly, and Mary do not display symptoms of hemophilia, even though their father, John, is a hemophiliac?

- (A) Hemophilia is an X-linked disorder, and John can pass on only his Y chromosome.
 (B) Hemophilia is an X-linked disorder and even though Molly and Mary received a hemophiliac X chromosome from John, Jane gave them a normal X chromosome.
 (C) Hemophilia is a Y-linked disorder and therefore cannot be displayed in females.
 (D) Hemophilia is a Y-linked disorder and Mark and Mike must have received an X chromosome from John.
 (E) Hemophilia is an X-linked disorder, and even though Mark and Mike received a hemophiliac X chromosome from John, Jane gave them a normal X chromosome.

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BIOLOGY E/M SUBJECT TEST 1—*Continued*

52. If one of Mike's daughters marries a normal man, what is the probability that one of their children will display symptoms of hemophilia?
- (A) 0%
 (B) 25%
 (C) 50%
 (D) 75%
 (E) 100%
53. Which of the following individuals are heterozygous for hemophilia?
- (A) John, Mark, and Mike
 (B) Mark, Mike, Molly, and Mary
 (C) John and Jane
 (D) Molly and Mary
 (E) Mark and Mike
54. Based on the information in Table 1, which of the following is most likely substance B?
- (A) Calcitonin
 (B) Insulin
 (C) Parathyroid hormone
 (D) Glucagon
 (E) Aldosterone
55. Based on the information in Table 1, which of the following is most likely substance A?
- (A) Glucagon
 (B) Aldosterone
 (C) Calcitonin
 (D) Parathyroid hormone
 (E) Insulin
56. Under what conditions might substance D be released normally?
- (A) Soon after a meal
 (B) When blood pressure is low
 (C) Between meals
 (D) When there has been limited intake of dietary calcium
 (E) When dietary calcium is in excess

Questions 54-57

A volunteer was injected intravenously with several test substances to determine the effect of each substance on normal body variables. The results are shown in Table 1. Assume that enough time was allowed between injections so that the substances do not interfere with one another.

Table 1

variable	baseline values	values after injecting substance A	values after injecting substance B	values after injecting substance C	values after injecting substance D
serum Ca ⁺⁺	2.3 mmol/L	2.3 mmol/L	3.0 mmol/L	2.3 mmol/L	2.3 mmol/L
serum Na ⁺	135 mmol/L	135 mmol/L	136 mmol/L	135 mmol/L	147 mmol/L
serum glucose	5.6 mmol/L	3.3 mmol/L	5.6 mmol/L	7.4 mmol/L	5.6 mmol/L

57. All of the following changes in variable values are significant EXCEPT
- (A) the change in serum glucose when substance A is injected
 (B) the change in serum Na⁺ when substance D is injected
 (C) the change in serum Ca⁺⁺ when substance B is injected
 (D) the change in serum glucose when substance C is injected
 (E) the change in serum Na⁺ when substance B is injected

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Questions 58-60

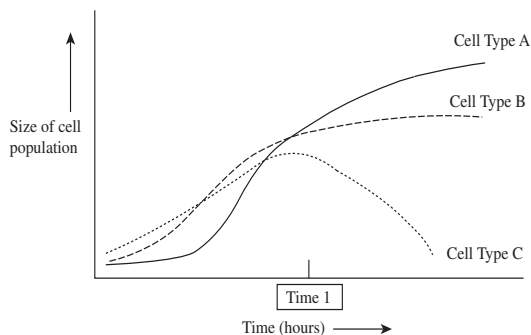
Three different cell types were observed under the microscope. The observations are summarized in Table 1.

Table 1

Cell type	Nucleus?	Cell wall?	Chloroplasts?
A	No	Yes	No
B	Yes	Yes	No
C	Yes	Yes	Yes

The three cell types were grown in separate cultures with plenty of oxygen and nutrients available. Figure 1 shows their rates of growth. At Time 1, oxygen was no longer available to the cells.

Figure 1



58. Based on the information in Table 1, which of the following is the most likely classification of cell Type A?

- (A) Fungi
- (B) Plant
- (C) Bacteria
- (D) Animal
- (E) Protist

59. Which of the following equations is cell Type C able to run?

- I. $C_6H_{12}O_6 + 6 O_2 \rightarrow 6 CO_2 + 6 H_2O + ATP$
- II. $H_2O + \text{light} \rightarrow O_2 + ATP + NADPH$
- III. $6 CO_2 + 6 H_2O + ATP + NADPH \rightarrow C_6H_{12}O_6$

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

60. Consider Figure 1. Which of the following statements best describes the reason for the difference between the curves for cell Type B and cell Type C?

- (A) Cell Type B is unable to survive in the presence of oxygen, while cell Type C can ferment.
- (B) The products of fermentation in cell Type C are toxic to the cells and they are dying.
- (C) Cell Type B is an obligate aerobe while cell Type C is able to ferment.
- (D) Cell Type B is a facultative anaerobe, while cell Type C is an obligate aerobe.
- (E) Cell Type C is an obligate aerobe, while cell Type B is an obligate anaerobe.

**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 TEST

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.

Questions 61-64

- (A) Tundra
(B) Taiga
(C) Tropical rain forest
(D) Deciduous forest
(E) Desert
61. The driest of all terrestrial biomes, characterized by low and unpredictable precipitation
62. Coniferous forests, characterized by long, cold winters and short, wet summers
63. Biome characterized by great diversity of flora and fauna and high levels of precipitation
64. Northern areas, characterized by permafrost, extremely cold temperatures, and few trees
65. Plants that have true roots, stems, and leaves, as well as flowers and seeds enclosed in fruit, are classified as
- (A) bryophytes
(B) tracheophytes
(C) gymnosperms
(D) angiosperms
(E) endosperms
66. Which of the following indicates that animals have internal biological clocks?
- (A) A mouse kept in constant darkness shows a daily rhythm of activity.
(B) A rooster crows whenever the sun rises in both winter and summer.
(C) An owl kept in constant light drifts away from a 24-hour cycle.
(D) Some species of birds can sense fluctuations in the Earth's magnetic field.
(E) A squirrel whose night and day are artificially reversed soon adapts to its new schedule.
67. Which of the following correctly lists the phylogenetic hierarchy?
- (A) Domain, kingdom, phylum, family, class, order, genus, species
(B) Phylum, family, order, domain, class, kingdom, species, genus
(C) Kingdom, domain, family, order, class, phylum, genus, species
(D) Domain, kingdom, phylum, class, order, family, genus, species
(E) Family, kingdom, order, domain, phylum, genus, class, species
68. A rattlesnake would be classified as a
- (A) tertiary consumer and a heterotroph
(B) secondary consumer and an autotroph
(C) producer and an autotroph
(D) producer and a heterotroph
(E) primary consumer and a heterotroph
69. At some point in their development, chordates possess all of the following EXCEPT
- (A) a dorsal hollow nerve cord
(B) a notochord
(C) gill slits
(D) postanal tail
(E) an exoskeleton

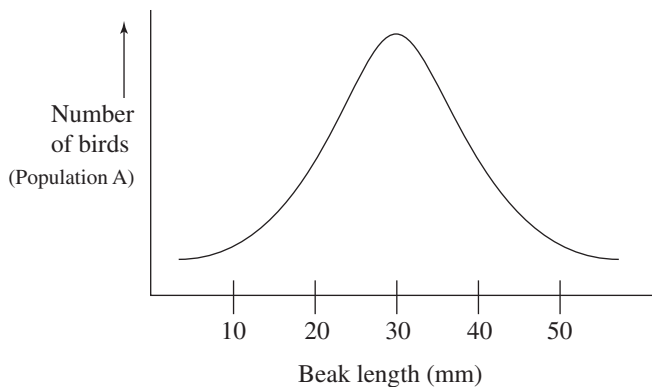
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BIOLOGY-E TEST 1—Continued

Questions 70-73

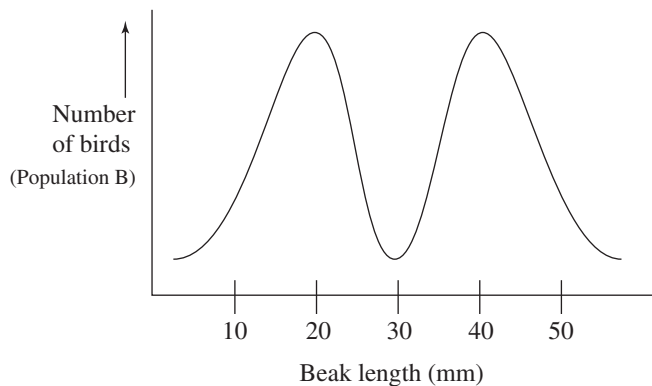
A population of birds (Population A) on a remote, isolated island is studied to determine beak length. The resulting data are plotted in Figure 1.

Figure 1



Suppose that 200 years later, the beaks of the birds on the island were again measured (Population B). The data, when plotted, yielded a graph as in Figure 2.

Figure 2



70. What is the average beak length (in cm) of the birds in Figure 1 ?
- (A) 30 cm
 - (B) 15 cm
 - (C) 5 cm
 - (D) 3 cm
 - (E) 1 cm

71. What is the most likely reason for the difference in distribution of beak lengths between the data plotted in Figure 1 and the data plotted in Figure 2 ?
- (A) All birds with beaks of 30 mm flew to a new island over the 200-year time span.
 - (B) Birds with beaks of 30 mm were selected against.
 - (C) Predators consumed birds with beaks of 40 mm.
 - (D) Predators consumed birds with beaks of 20 mm.
 - (E) Birds with beaks of 30 mm were selected for extinction.
72. Suppose that a researcher studying Population B found that birds with beaks of 20 mm were unable to mate with birds that had 40 mm beaks. These two groups of birds would now be classified as
- (A) occupying different niches
 - (B) separate species
 - (C) competitors
 - (D) predators
 - (E) separate populations

73. How would beak length in the bird population change after another 200-year time span?
- (A) The average beak length would return to 30 mm.
 - (B) The average beak length would shift to 40 mm.
 - (C) The average beak length would shift to 20 mm.
 - (D) The differences in beak length would be more pronounced.
 - (E) It is not possible to determine how beak length might change.

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BIOLOGY-E TEST 1—Continued

Questions 74-78

Acid rain is formed after the burning of fossil fuels releases compounds containing nitrogen and sulfur into the atmosphere. Sunlight and rain bring about chemical reactions that convert these compounds into nitric acid and sulfur dioxide, which combine with water droplets to form acid rain. Acid rain typically has a pH of approximately 5.5.

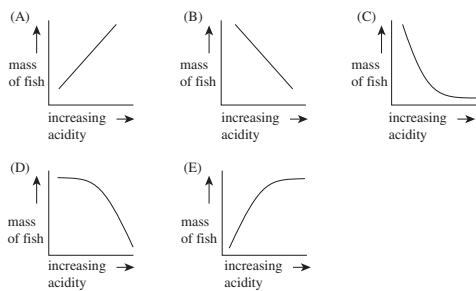
The higher acidity of soil and water affects many living organisms adversely. As the pH of lake water falls, fish become ill and die. Table 1 shows the effects of pH on the size of adult fish.

Table 1

pH of lake	Average length of fish (cm)	Average mass of fish (g)
7.5	30 cm	454 g
7.0	28 cm	450 g
6.5	29 cm	453 g
6.0	25 cm	401 g
5.5	20 cm	288 g
5.0	17 cm	127 g
4.5	all fish dead	all fish dead

Mycorrhizal fungi, which form a mutualistic association with many plant roots, are particularly sensitive to the effects of acid rain. These fungi facilitate the absorption of water and nutrients by the plants; in turn, the plants provide sugars and amino acids without which the fungi could not survive.

74. The effect of acid rain on fish size is best represented by which of the following graphs?



75. The relationship between mycorrhizal fungi and plants can best be described as one in which
- one partner benefits from the association and the other partner is harmed
 - one partner benefits from the association and the other partner is neither harmed nor helped
 - one partner preys upon the other partner
 - both partners benefit from the association
 - neither partner benefits from the association
76. If the pH of the soil were 7.0, what would be the effect on the mycorrhizal fungi and plants?
- The fungi would survive but the plant would be harmed.
 - The fungi would be harmed but the plant would survive.
 - The fungi would be slightly harmed and the plant would be slightly harmed.
 - Neither the fungi nor the plant would survive.
 - Neither the fungi nor the plant would be harmed.
77. What might be the best strategy to prevent ecological damage due to acid rain?
- Stock the lakes with bigger fish so that they can resist the effects of the acid better
 - Reduce the amount of fossil fuels that are burned
 - Supply plants with excess phosphorus and water
 - Supply fungi with excess sugars and amino acids
 - Add alkalines to soil and water to neutralize the acid

78. Fungi are classified as
- prokaryotic decomposers
 - eukaryotic producers
 - eukaryotic decomposers
 - eukaryotic autotrophs
 - prokaryotic consumers

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BIOLOGY-E TEST 1—Continued

Questions 79-80

The following graphs show the growth of two closely related species of paramecia, both when grown alone (Figure 1) and when grown together (Figure 2). Both species consume bacteria as their food source and reproduce by binary fission as often as several times a day.

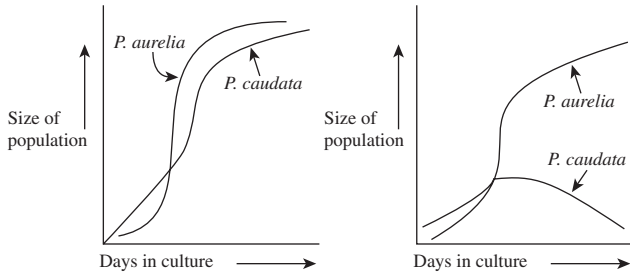


Figure 1

Figure 2

80. Paramecia are members of the kingdom
- (A) fungi
 - (B) animalia
 - (C) archaea
 - (D) protista
 - (E) plantae
79. The data in Figure 2 indicate that
- (A) *P. aurelia* is preying on *P. caudata*
 - (B) *P. aurelia* is a better competitor than *P. caudata*
 - (C) *P. aurelia* and *P. caudata* are in a symbiotic relationship
 - (D) *P. aurelia* is a parasite of *P. caudata*
 - (E) *P. aurelia* grew better when combined with *P. caudata* than it did when grown alone

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 TEST

**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. All of the following are true about RNA EXCEPT
- (A) it is single-stranded
 - (B) its bases are adenine, thymine, guanine, and uracil
 - (C) it has a sugar-phosphate backbone
 - (D) its sugar is ribose
 - (E) it is found in the both the nucleus and the cytoplasm of the cell
82. The function of the Golgi apparatus is to
- (A) package and store proteins for secretion
 - (B) synthesize proteins
 - (C) function in cellular respiration
 - (D) help the cell expel waste
 - (E) digest foreign substances
83. A eukaryotic cell that has a cell wall but lacks chloroplasts would be classified as a
- (A) bacteria
 - (B) chordate
 - (C) plant
 - (D) fungus
 - (E) bacteria
84. All of the following could give rise to new species EXCEPT
- (A) variations in antler size between male and female reindeer
 - (B) an earthquake that physically separates a population of lizards into two separate groups
 - (C) divergent evolution
 - (D) evolution of a population of cats such that they can no longer mate with their ancestors
 - (E) a massive flood that separates a population of frogs onto opposite sides of a large lake
85. The base composition of DNA varies from one species to another. Which of the following ratios would you expect to remain constant in the DNA?
- (A) Cytosine : Adenine
 - (B) Pyrimidine : Purine
 - (C) Adenine : Guanine
 - (D) Guanine : Deoxyribose
 - (E) Thymine : Guanine
86. Which of the following groups have the most in common with one another?
- (A) Members of the same kingdom
 - (B) Members of the same genus
 - (C) Members of the same phylum
 - (D) Members of the same class
 - (E) Members of the same family
87. Which of the following individuals is the LEAST fit in evolutionary terms?
- (A) A 45-year-old male with a terminal disease who has fathered three children
 - (B) A 20-year-old man who has fathered one child
 - (C) A 35-year-old woman with four children
 - (D) A healthy 4-year-old child
 - (E) A 25-year-old woman with one child, who has had a tubal ligation to prevent future pregnancies

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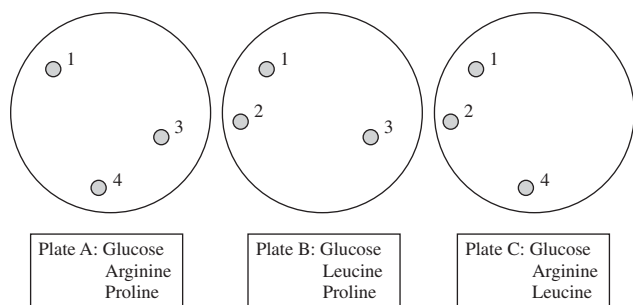
BIOLOGY-M TEST 1—Continued

Questions 88-92

Most bacteria can be grown in the laboratory on agar plates containing glucose as their only carbon source. Some bacteria require additional substances, such as amino acids, to be added to the growth medium. Such bacteria are termed *auxotrophs*. These bacteria are denoted by the amino acid they require followed by a “-” in superscript (e.g., arg⁻). Bacteria that do not require that particular amino acid can be indicated by a “+” in superscript.

Different strains of bacteria were grown on several plates containing a variety of nutrients. Figure 1 shows the colonies (numbered) that grew on each plate. The supplements in each plate are indicated.

Figure 1



In a second experiment, Colony 1 was mixed with soft agar and spread over a plate so that an even lawn of bacteria grew. Bacterial lawns appear cloudy on agar plates. A single drop of an unknown organism was placed in the center of the bacterial lawn, and after 24 hours, a clear area known as a “plaque” appeared at that spot. The clear area continued to expand at a slow rate. Although new colonies could be grown from samples taken from the lawn, attempts to grow new colonies from samples taken from the plaque area were unsuccessful.

88. Referring to Figure 1, what is the genotype of Colony 3 ?
- (A) arg⁺, leu⁺, pro⁺
 (B) arg⁺, leu⁻, pro⁺
 (C) arg⁺, leu⁺, pro⁻
 (D) arg⁻, leu⁻, pro⁺
 (E) arg⁻, leu⁻, pro⁻
89. Is Colony 1 an auxotroph?
- (A) Yes, it is able to grow in the presence of the three amino acids being tested.
 (B) Yes, it can only grow if glucose is present.
 (C) No, it is able to grow in the absence of glucose.
 (D) No, it is able to grow in the absence of any additional amino acids.
 (E) The data available are insufficient to determine the answer.
90. Which structures could be observed in a sample of Colony 2 ?
- I. Nuclei
 II. Ribosomes
 III. Mitochondria
- (A) I only
 (B) II only
 (C) I, and III
 (D) II and III only
 (E) I, II, and III

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BIOLOGY-M TEST 1—*Continued*

91. If a liquid culture medium containing glucose, leucine, and proline was inoculated with Colony 4, would bacterial growth be observed?
- (A) No, Colony 4 is an arginine auxotroph (arg^-).
 - (B) No, Colony 4 cannot grow in the presence of leucine.
 - (C) Yes, Colony 4's genotype is leu^- , pro^- .
 - (D) Yes, Colony 4 requires only glucose to grow.
 - (E) The data available are insufficient to make a prediction.
92. What is the most likely reason for the clearing (the plaque) in the lawn of bacteria in the second experiment?
- (A) The unknown organism is bacterial Colony 2, and these bacteria are eating the bacteria from Colony 1 forming the lawn.
 - (B) The unknown organism is a virus that is infecting the bacteria and causing them to lyse (killing them).
 - (C) The drop placed in the center of the lawn contained a strong acid that destroyed the bacteria at that spot.
 - (D) Bacteria are very delicate and the disturbance caused them to die.
 - (E) The unknown organism began producing threonine, which is toxic to Colony 1.

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BIOLOGY-M TEST 1—Continued

Questions 93-96

In 1910, a small town on the East Coast of the United States relied primarily on agriculture to support its economy. In the mid-1930s, a steel mill was built, and the economy shifted from being agriculturally supported to being industrially supported. The steel mill released a lot of smog and soot into the air, which collected on the bark of trees in a wooded area near the outskirts of town. Over a period of ten years the bark gradually darkened, then maintained a constant dark color.

A variety of animals and insects lived in the wooded area. In particular, a certain species of moth served as the primary food source for a population of birds. The moths lay their eggs in the bark of the trees and, thus, must spend a fair amount of time sitting on the tree trunks. Table 1 presents data on the moth population.

Table 1

Year	% white moths	% black moths
1910	95	5
1920	95	5
1930	95	5
1940	50	50
1950	20	80
1960	5	95

93. The wings of the moths and the wings of the birds are both used for flight (similar functions); however, their underlying structures are very different. Moth wings and bird wings are thus classified as
- (A) homologous structures
 - (B) autologous structures
 - (C) divergent structures
 - (D) analogous structures
 - (E) emergent structures

94. What is the most likely explanation for the shift in the percentage of black moths in the population?
- (A) The white moths no longer blended with the color of the tree bark and, thus, were selected for.
 - (B) The black moths blended better with the color of the tree bark and, thus, were selected for.
 - (C) The black moths blended better with the color of the tree bark and, thus, were selected against.
 - (D) The white moths blended better with the color of the tree bark and, thus, were selected against.
 - (E) The black moths did not blend with the color of the tree bark and, thus, were selected against.
95. If a seed from one of the trees was planted in an area far from the steel mill, what color would the bark of the tree be?
- (A) Black, because the parent tree had black bark
 - (B) White, because the gene causing black bark was mutated due to environmental pollution
 - (C) Black, because the gene causing white bark was mutated due to environmental pollution
 - (D) White, because the black bark was an acquired characteristic and is therefore not passed on to progeny
 - (E) The color of the bark is not able to be determined.
96. Birds track their prey visually, whereas bats rely on sonar to locate their food. If the bird population were replaced with a bat population in 1940, what would be the ratio of white moths to black moths?
- (A) 95% white, 5% black
 - (B) 80% white, 20% black
 - (C) 50% white, 50% black
 - (D) 20% white, 80% black
 - (E) 5% white, 90% black

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BIOLOGY E/M SUBJECT TEST 1—Continued

Questions 97-100

Dialysis tubing is a semipermeable membrane. It allows small molecules, such as water, to pass through easily, while larger molecules, such as sucrose, are restricted. Movement of molecules across the tubing is due to concentration gradients. In an experiment designed to study osmosis, several pieces of dialysis tubing were filled with sucrose solutions of varying concentration and placed in beakers containing distilled water. The rate and direction of water movement was determined by weighing the bags before and after placing them in the distilled water. The data are recorded below.

Table 1

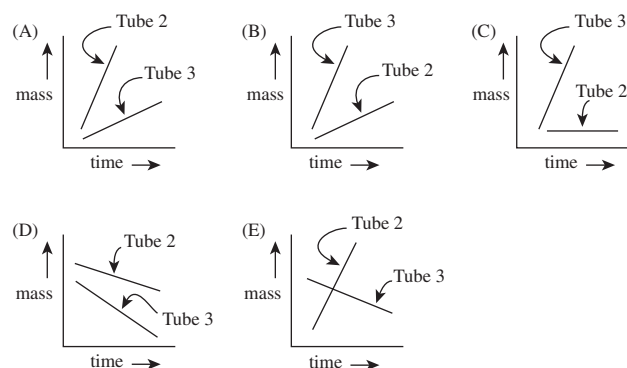
Tube number	Tube contents (beaker contents)	Mass (g) 0 minutes	Mass (g) 15 minutes	Mass (g) 30 minutes	Mass (g) 45 minutes	Mass (g) 60 minutes
1	Distilled water (distilled water)	22.3 g	22.4 g	22.2 g	22.3 g	22.3 g
2	10% sucrose (distilled water)	24.8 g	25.3 g	25.7 g	26.4 g	26.9 g
3	40% sucrose (distilled water)	25.1 g	26.3 g	27.5 g	28.9 g	29.6 g
4	Distilled water (40% sucrose)	22.7 g	21.3 g	20.5 g	19.8 g	18.7 g

97. Why does the mass of Tube 3 increase while the mass of Tube 4 decreases?

- (A) Water is moving into Tube 3, and sucrose is moving into Tube 4.
- (B) Water is moving into Tube 4, and sucrose is moving into Tube 3.
- (C) Water is moving into Tube 3, and water is moving out of Tube 4.
- (D) Sucrose is moving into Tube 3, and sucrose is moving out of Tube 4.
- (E) Sucrose is moving out of Tube 3, and water is moving out of Tube 4.

98. Why does the mass of Tube 1 remain relatively unchanged throughout the experiment?
- (A) The dialysis tubing in Tube 1 is defective and does not allow water to cross.
 - (B) There is no concentration gradient to drive the movement of sucrose.
 - (C) The dialysis tubing broke, allowing the tube contents to mix with the beaker contents.
 - (D) There is no concentration gradient to drive the movement of water.
 - (E) The experimenter failed to record the data properly.

99. Which of the following graphs best illustrates the relationship between Tube 2 and Tube 3?



100. Cell membranes are also semipermeable, allowing water but not other substances to cross easily. A red blood cell placed in a 0.9% NaCl solution will neither swell nor shrivel. Based on this knowledge, and the information presented in Table 1, what would happen to a red blood cell placed in a 20% NaCl solution?
- (A) Water would be drawn out of the cell and the cell would swell.
 - (B) Water would be drawn into the cell and the cell would swell.
 - (C) Water would be drawn out of the cell and the cell would shrivel.
 - (D) Water would be drawn into the cell and the cell would shrivel.
 - (E) No change would occur to the cell.

STOP

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