# BIOLOGY

## SECTION I

**Time—1 hour and 20 minutes**

**Directions:** Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

1. The amino acid sequence of cytochrome *c* is exactly the same in humans and chimpanzees. There is a difference of 13 amino acids between the cytochrome *c* of humans and dogs, and a difference of 20 amino acids between the cytochrome *c* of humans and rattlesnakes. Which of the following statements is best supported by these data?

   (A) Rattlesnakes apparently gave rise evolutionarily to the dog, chimpanzee, and human.
   (B) Cytochrome *c* apparently has an entirely different function in rattlesnakes than in mammals, which explains the difference in the number of amino acids.
   (C) Cytochrome *c* is not found universally in animals.
   (D) Cytochrome *c* from a rattlesnake could function in a dog, but not in a chimpanzee.
   (E) The human is apparently more closely related to the chimpanzee than to the dog or rattlesnake.

2. A parasite may be described as an organism that derives nourishment from another living organism and

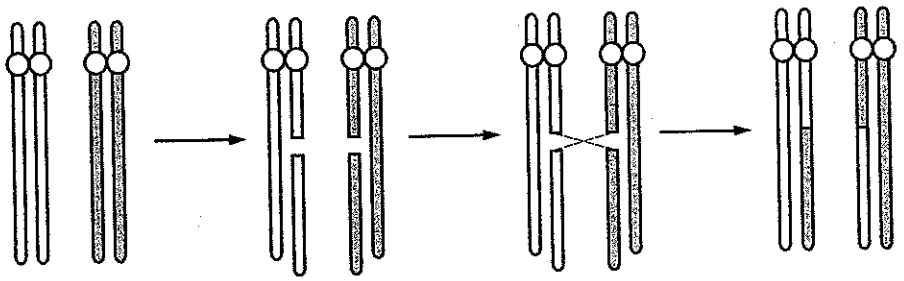
   (A) becomes necessary to the life of the host
   (B) is neutral in its effect on the host
   (C) benefits the host nutritionally
   (D) provides a supportive structure for the host
   (E) harms the host in the process

3. Countercurrent exchange in the gills of fish is an adaptation that accomplishes which of the following?

   (A) It limits the amount of blood going to the gills.
   (B) It decreases the thermal gradient between water and blood.
   (C) It improves the ability of blood to dissolve oxygen.
   (D) It maximizes oxygen transfer from water to the blood.
   (E) It maximizes heat retention in the fish.

4. The energy required to run the Calvin cycle reactions of photosynthesis comes from which two substances produced during the light-dependent reactions?

   (A) ATP and NADPH
   (B) ADP and $PO_4$
   (C) $H^+$ and $O_2$
   (D) $O_2$ and $CO_2$
   (E) $H_2O$ and $CO_2$



5. The diagram above illustrates which of the following processes?

   (A) Crossing-over
   (B) Base pair substitution
   (C) Duplication
   (D) Deletion
   (E) Posttranscriptional processing

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6. ATP is produced in all of the following EXCEPT

   (A) glycolysis
   (B) the Krebs cycle
   (C) the Calvin cycle
   (D) cyclic and noncyclic light reactions
   (E) the electron transport system with chemiosmosis

7. The creeping horizontal and subterranean stems of ferns are referred to as

   (A) prothalli
   (B) fronds
   (C) stipes
   (D) roots
   (E) rhizomes

| Level | Population |
|---|---|
| 4 | 4 |
| 3 | 360 |
| 2 | 780 |
| 1 | 5,782 |

8. In a simple ecosystem, a census of the populations in four successive trophic levels was taken as shown above. If level 1 is composed of photosynthetic autotrophs, then the trophic level with 780 individuals will most likely represent

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





GO ON TO THE NEXT PAGE

9. Which of the following is most directly responsible for water's unique properties?

(A) It contains oxygen atoms.
(B) It contains hydrogen atoms.
(C) It is an ionic compound.
(D) It forms hydrogen bonds.
(E) It is nonpolar.

10. Cells that contain only circular chromosomes are most probably which of the following?

(A) Protist cells
(B) Fungal cells
(C) Bacterial cells
(D) Plant cells
(E) Animal cells

11. Which of the following components of the cell membrane is responsible for active transport?

(A) Phospholipid
(B) Protein
(C) Lipid
(D) Phosphate
(E) Cholesterol

12. Evolutionary fitness is measured by

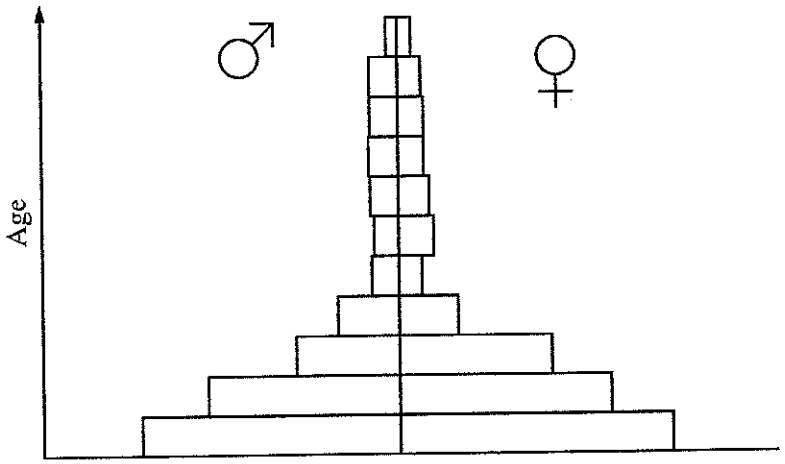
(A) physical strength
(B) reproductive success
(C) length of life
(D) resistance to disease
(E) competitiveness

13. Which of the following is true of mitosis?

(A) It is also known as cytokinesis.
(B) It maintains the same chromosome number in the daughter cells as in the parent cell.
(C) It is the last phase of interphase.
(D) It regulates the transfer of genetic information from one daughter cell to another.
(E) It moves homologous chromosomes to opposite poles.

14. Which of the following methods for the transport of $CO_2$ provides a buffering system for the blood?

(A) $CO_2$ is dissolved in the plasma.
(B) $CO_2$ combines with $H_2O$ to form carbonic acid and then bicarbonate.
(C) $CO_2$ combines with hemoglobin to form carboxyhemoglobin.
(D) $CO_2$ is carried in small gas bubbles.
(E) $CO_2$ is converted to CO for plasma transport.




15. The population of the country shown in the figure above will most likely

(A) stabilize within 20 years
(B) increase for many years
(C) not change
(D) reach zero population growth within 10 years
(E) decrease within 20 years

16. All of the following are examples of prezygotic genetic isolating mechanisms EXCEPT:

(A) Male fireflies of different species have differing flash patterns.
(B) Three closely related orchid species flower on different days.
(C) The progeny of a cross between two different lizard species fail to develop properly.
(D) One species of snake lives in water and another is terrestrial.
(E) Peeper frogs mate in April, and tree frogs mate in June.

17. The movement of the organic products of photosynthesis from the leaf to the roots is the result of what process?

(A) Cellular respiration
(B) Replication
(C) Germination
(D) Transcription
(E) Translocation

18. All of the following are included in the modern concept of a biological species EXCEPT

(A) genetic compatibility
(B) viable offspring
(C) fertile offspring
(D) gene flow inhibition
(E) reproductive compatibility

19. AIDS is caused by the retrovirus HIV, which makes DNA complementary to the viral RNA using

(A) RNA polymerase
(B) beta-galactosidase
(C) RNA synthase
(D) ATPase
(E) reverse transcriptase





GO ON TO THE NEXT PAGE.

20. Which two cellular organelles in eukaryotes have both electron transport systems and chemiosmotic mechanisms?

(A) Ribosomes and endoplasmic reticulum
(B) Chloroplasts and endoplasmic reticulum
(C) Chloroplasts and mitochondria
(D) Mitochondria and nuclei
(E) Nuclei and Golgi apparatus

21. A plant's lateral roots arise from the

(A) endodermis
(B) epidermis
(C) phloem
(D) xylem
(E) pericycle

22. When a substance moves across the plasma membrane along a concentration gradient at a rate faster than would be expected by simple diffusion alone but without the expenditure of metabolic energy, the process is best described as

(A) facilitated diffusion
(B) osmosis
(C) active transport
(D) pinocytosis
(E) the work of an ion pump

23. Which of the following would happen to an individual playing a long game of basketball outdoors on a hot afternoon?

(A) The production of thyroxin by the thyroid gland would decrease.
(B) The osmotic pressure of the blood would decrease.
(C) The volume of urine produced would increase.
(D) The concentration of urea in the urine would decrease.
(E) The secretion of antidiuretic hormone from the pituitary gland would increase.

24. The synthesis of protein or carbohydrate polymers always produces which of the following as a byproduct?

(A) ATP
(B) Oxygen
(C) Carbon dioxide
(D) Urea
(E) Water

25. Most photosynthesis in typical $C_3$ angiosperms takes place in the

(A) palisade mesophyll
(B) spongy mesophyll
(C) epidermis
(D) pericycle
(E) vascular bundles

26. Early spring flowers growing in a deciduous forest are adapted for that habitat in which of the following ways?

(A) They carry out their life cycles in dense shade.
(B) They take advantage of the greater amount of light available before the full development of tree leaves.
(C) The forest litter provides a source of carbohydrates needed for flowering.
(D) Early spring flowers and trees in a deciduous forest participate in a mutualistic relationship.
(E) The tree canopy shades flowering plants from harmful light intensity.

27. Which of the following is the correct sequence of events in an action potential after stimulation of a neuron?

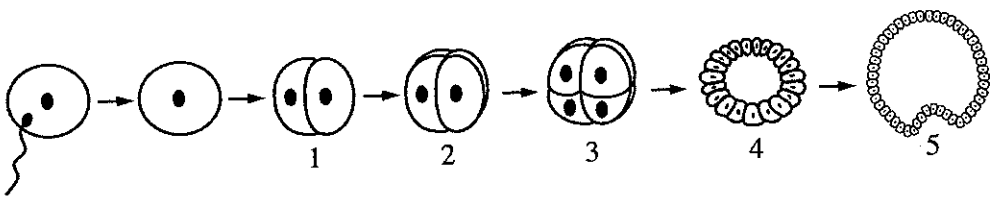
(A) $K^+$ moves in; $Na^+$ moves out.
(B) $Na^+$ moves in; $K^+$ moves out.
(C) $Na^+$ moves in; $Ca^{++}$ moves out.
(D) $Na^+$ moves in; $Cl^-$ moves out.
(E) $K^+$ moves in; organic anions move out.

28. Which of the following is true of intercellular junctions, such as tight junctions, desmosomes, and gap junctions?

(A) They are specialized forms of communication among nerve cells.
(B) They are of primary importance in the contraction of skeletal muscle fibers.
(C) They are equally distributed among all tissue types.
(D) They help to integrate cells into a functioning unit.
(E) They aid in distributing DNA among cells.

29. A person with a systolic blood pressure of 120 mm Hg and a diastolic blood pressure of 80 mm Hg typically has a mean arterial blood pressure of 90 mm Hg. Which of the following offers the best explanation for why the mean arterial blood pressure is 90 mm Hg, and not the average of the two pressures (100 mm Hg)?

(A) The systolic blood pressure is higher than the diastolic blood pressure.
(B) The quantity of fluid in the person's circulatory system must be greater during diastole.
(C) The diastole of the heart lasts longer than the systole of the heart.
(D) The systolic blood pressure is not as high as the diastolic blood pressure.
(E) Angiotensin, produced from a blood protein by renin, elevates the diastolic blood pressure.




30. The picture above represents some stages in the early development of an embryo. In which of the stages does gastrulation begin?

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





GO ON TO THE NEXT PAGE

31. Which of the following characteristics is shared by echinoderms and chordates?

(A) Radial symmetry
(B) Dorsal hollow nerve cord
(C) Deuterostome development
(D) Pharyngeal gill slits
(E) Spiral determinate cleavage

32. During mitosis, which of the following normally occurs?

(A) Homologous chromosomes pair.
(B) Replicated chromosomes line up on the equatorial plate.
(C) Tetrads form.
(D) Unreplicated chromosomes become oriented in the center of the cell.
(E) Maternal and paternal chromatids pair.

33. Which of the following is a symbiotic relationship that was probably present in the first terrestrial plants and is still important for the mineral nutrition of present-day angiosperms?

(A) Mycorrhizae
(B) Lichens
(C) Insects pollinating flowers
(D) Carnivorous plants feeding on insects
(E) Epiphytes growing on a tree trunk

34. Nine percent of a population is homozygous recessive ($aa$) at a certain locus. Assuming that the population is in Hardy-Weinberg equilibrium, which of the following is closest to the frequency of the recessive allele ($a$) ?

(A) 0.09
(B) 0.27
(C) 0.30
(D) 0.90
(E) 0.97

35. A characteristic shared by fungi and protists is that both are generally

(A) aerobic
(B) haploid at all stages
(C) composed of mycelia
(D) propagated by spores
(E) capable of phagocytosis

36. Which of the following factors is the most effective in changing the allele frequency in a natural population?

(A) Large population size
(B) Low rate of mutation
(C) Negligible migration
(D) Random mating
(E) Selection

37. In the process of succession, which of the following is true of *K*-selected plant species?

(A) They keep their carrying capacity at a minimum level.
(B) They usually reproduce early in life.
(C) They are usually found in climax stages of succession.
(D) They are the dominant species in early stages of succession.
(E) They have a short lifespan.

38. Which of the following produces the secondary tissues of trees?

(A) Sapwood
(B) Cork
(C) Vascular cambium
(D) Heartwood
(E) Cortex

1. Appearance of terrestrial plants
2. Appearance of chloroplasts
3. Formation of complex organic compounds
4. Development of photosynthetic organisms
5. Development of anaerobic prokaryotes

39. From the list above, which is the most likely chronological order of events, from oldest to most recent, in the history of Earth?

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

40. An airtight, temperature-controlled glass box containing actively growing tomato plants was placed under a light source. Plastic wrapping that only transmits green light was placed over the box, and two days later air samples from inside the box were collected and analyzed. The most likely change in air quality is

(A) an increase in nitrogen $(N_2)$
(B) an increase in carbon dioxide $(CO_2)$
(C) an increase in oxygen $(O_2)$
(D) a decrease in nitrogen $(N_2)$
(E) a decrease in carbon dioxide $(CO_2)$

41. Which of the following parts of the vertebrate brain is most closely associated with motor (muscular) coordination?

(A) The hypothalamus
(B) The medulla oblongata
(C) The pineal body
(D) The thalamus
(E) The cerebellum

42. Which of the following cells or structures in flowering plants is a part of the gametophyte generation and therefore haploid?

(A) A flower petal cell
(B) A cell from the filament
(C) A cell from the style
(D) A megaspore
(E) The endosperm

43. Which of the following accurately describes the sequence of tissues from the pith outward to the cork in a woody stem?

(A) Secondary xylem, primary xylem, vascular cambium, cortex, primary phloem, secondary phloem, and cork cambium
(B) Primary xylem, secondary xylem, vascular cambium, secondary phloem, primary phloem, cortex, and cork cambium
(C) Primary xylem, secondary xylem, secondary phloem, primary phloem, cork cambium, cortex, and vascular cambium
(D) Primary xylem, secondary xylem, vascular cambium, primary phloem, secondary phloem, cortex, and cork cambium
(E) Cortex, secondary xylem, primary xylem, vascular cambium, primary phloem, secondary phloem, and cork cambium





GO ON TO THE NEXT PAGE.

44. Which of the following is the best example of the behavior unit known as a fixed action pattern (FAP) ?

(A) Imprinting in newborn ducklings
(B) Egg retrieval in nesting geese
(C) Echolocation in porpoises
(D) Salivation in dogs
(E) Celestial navigation in birds

45. The first cell of the sporophyte generation in the life cycle of a pine tree is represented by the

(A) zygote
(B) microspore mother cell
(C) microspore
(D) pollen grain
(E) polar nucleus

46. The hypothesis of punctuated equilibrium was proposed by Eldredge and Gould to explain the apparent long-term genetic stability of

(A) many species occupying the same niche in an ecosystem
(B) organisms that encounter many environmental changes
(C) climax communities resulting from ecological succession
(D) some species as evidenced by the fossil record
(E) certain alleles common to a wide variety of organisms

47. The activation of the secondary immune response begins with which of the following?

(A) Antibodies
(B) Killer T-cells
(C) Memory cells
(D) Mast cells
(E) Suppressor T-cells

48. Many animal trainers give rewards to an animal when it performs a behavior correctly. This type of learning is called

(A) insight learning
(B) operant conditioning
(C) imprinting
(D) innate learning
(E) habituation

**Item 49 was not scored.**

**Directions:** Each group of questions below consists of five lettered headings followed by a list of numbered phrases or sentences. For each numbered phrase or sentence, select the one heading to which it is most closely related and fill in the corresponding oval on the answer sheet. Each heading may be used once, more than once, or not at all in each group.

**Questions 50-53 refer to the following molecules.**

(A) Adenylate cyclase
(B) G-protein
(C) Carrier protein
(D) cAMP
(E) Ion channel receptor protein

50. Activated by directly binding to GTP

51. Catalyzes the formation of cytosolic second-messenger molecules

52. Enhances the transport of lipophilic signals in the blood

53. Serves as an intracellular second-messenger molecule

**Questions 54-57 refer to the following proteins.**

(A) Keratin
(B) Hemoglobin
(C) Actin
(D) Insulin
(E) Pepsin

54. This protein requires iron as a cofactor.

55. This protein functions in muscle contraction.

56. This is the principal protein component of skin.

57. This protein functions optimally in high $H^+$ concentrations.

**Questions 58-61 refer to the following.**

(A) Crossing-over
(B) Inversion
(C) Translocation
(D) Nondisjunction
(E) Deletion

58. Part of a chromosome breaks away and then reattaches to the same chromosome in reverse orientation.

59. Part of a chromosome breaks away and attaches to a nonhomologous chromosome.

60. Part of a chromosome lacking a centromere breaks away and does not reattach to another chromosome.

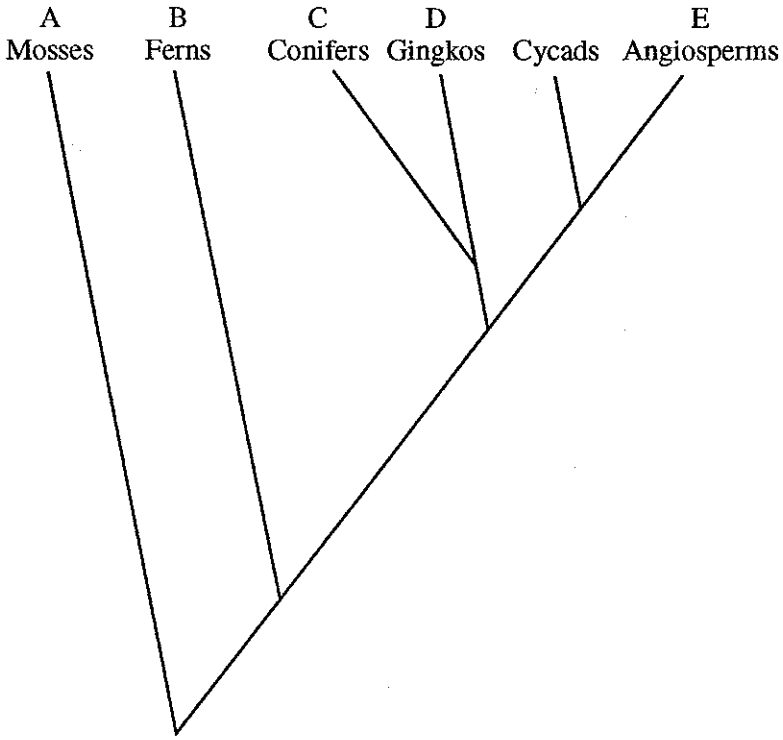
61. Tetrads fail to separate correctly during anaphase in this process.





GO ON TO THE NEXT PAGE

**Questions 62-64 refer to the following.**




62. Broad, flat, deciduous leaves are fan shaped; ovules develop into naked seeds.

63. Heart-shaped gametophytes produce swimming sperm; leaves of sporophytes develop from fiddleheads.

64. The embryo sac with seven cells and eight nuclei undergoes double fertilization.

**Questions 65-68 refer to the following aspects of control of eukaryotic gene expression.**

(A) Methylation
(B) Enhancer activity
(C) RNA capping
(D) RNA spliceosome activity
(E) Reverse transcription

65. Associated with inactivated DNA

66. Protects RNA from hydrolysis

67. Selectively removes RNA segments

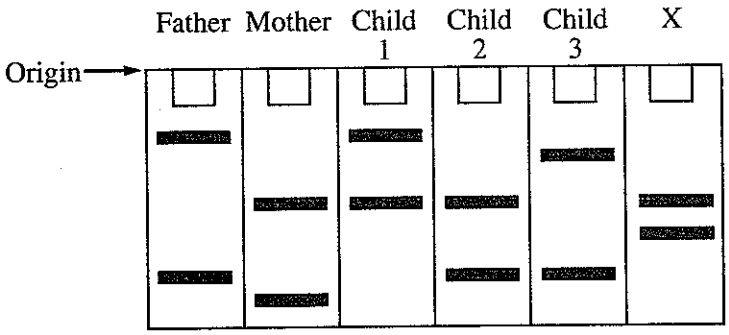
68. Increases RNA polymerase activity

## Section I

**Directions:** Each group of questions below concerns an experimental or laboratory situation or data. In each case, first study the description of the situation or data. Then choose the one best answer to each question following it and fill in the corresponding oval on the answer sheet.

**Questions 69-72 refer to the following.**

The diagram below illustrates the results of electrophoresis of DNA sequences obtained from a family of two adults and three children, and amplified using PCR. The bands represent short repeating sequences of variable length. Results for another female (X) are included for comparison.




69. The banding patterns of the DNA fragments reveal that
    (A) child 1 and child 2 cannot be biological siblings
    (B) child 1 and child 3 probably look like the mother
    (C) the mother cannot be the biological parent of all three children
    (D) the mother's DNA has the same DNA sequence as the father's DNA
    (E) child 2 and child 3 inherited all of their DNA from the father

70. All of the following made the separation of these DNA fragments possible EXCEPT
    (A) the negative charge of the DNA
    (B) the percentage of G + C bases
    (C) the porous nature of the gel
    (D) different fragment sizes
    (E) positive electrode placement

71. Which of the following is the best explanation for the fragment pattern for individual X ?
    (A) She has only one member of this chromosome pair.
    (B) She has only one living parent.
    (C) She is homozygous for this particular DNA fragment.
    (D) She is the mother's child from another marriage.
    (E) She is not related to any member of the family being tested.

72. All of the following are likely steps that would lead to the production of these gel patterns EXCEPT
    (A) isolating the DNA from each individual
    (B) using a different restriction enzyme to treat the DNA of each individual
    (C) loading the DNA into separate wells in an agarose gel
    (D) separating the fragments in an electrical field
    (E) probing the DNA with an oligonucleotide specific to the short repeating sequence



GO ON TO THE NEXT PAGE

**Questions 73-76**

In the first step of an experiment, rat liver cells were exposed for 5 minutes to amino acids labeled with a radioactive isotope. The cells were then washed to stop any further incorporation of radioactive amino acids. The cells were sampled periodically thereafter, and the radioactivity of a certain protein (protein X) was measured in various cell components, as shown below.

RADIOACTIVE COUNTS (PROTEIN X)

| Sampling Time (minutes) | Cell Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | Endoplasmic Reticulum | Golgi Apparatus | Cytoplasm | Nucleus | Mitochondria | Lysosomes | Extracellular Space |
| 5 | 980 | 20 | 50 | 4 | 2 | 6 | 2 |
| 20 | 135 | 760 | 20 | 3 | 5 | 120 | 9 |
| 45 | 50 | 195 | 4 | 6 | 2 | 800 | 3 |
| 120 | 15 | 30 | 8 | 6 | 8 | 975 | 4 |

73. What is the most likely identity of protein X ?

(A) An enzyme that is involved in transcription
(B) An electron transport protein that participates in respiration reactions
(C) A protein secreted from liver cells into the blood stream that permits proper capillary function
(D) An enzyme that participates in the degradation and recycling of cell components
(E) A building block of the microtubules that are part of the cytoskeleton

74. Which of the following correctly shows the order in which protein X moves through the cell?

(A) Endoplasmic reticulum → Golgi apparatus → lysosomes
(B) Endoplasmic reticulum → Golgi apparatus → nucleus → cytoplasm → lysosomes
(C) Extracellular space → mitochondria → cytoplasm
(D) Golgi apparatus → cytoplasm → lysosomes
(E) Cytoplasm → mitochondria → extracellular space

75. The same procedure was repeated with a second protein (protein Y). If the function of Y is protein processing and packaging, the most radioactivity would be found in the

(A) Golgi apparatus
(B) Nucleus
(C) Mitochondria
(D) Lysosomes
(E) Cytoplasm

76. In graphing the data from this experiment, the sampling time would be shown on the *x*-axis because

(A) cell components were shown on the *y*-axis
(B) radioactivity level shows the most variation
(C) time values are always located on the horizontal axis
(D) all quantitative values are represented on the *x*-axis
(E) sampling time is the independent variable

**Questions 77-79.**

A survey reveals that 25 percent of a population of 1,000 individuals have attached earlobes (are homozygous recessive for the trait). For the following questions, assume that the population fits the parameters of the Hardy-Weinberg law.

77. What is the frequency of the recessive allele?

(A) $\sqrt{0.75}$
(B) 0.75
(C) $\sqrt{0.50}$
(D) $\sqrt{0.25}$
(E) 0.25

78. Unlike most natural populations, this population is best characterized in which of the following ways?

(A) There is genetic equilibrium.
(B) There is gene flow.
(C) There is genetic drift.
(D) Mutations occur.
(E) Mating is nonrandom.

79. If $p$ equals the frequency of the dominant allele and $q$ equals the frequency of the recessive allele, which of the following terms represents the frequency of the individuals who show the dominant phenotype?

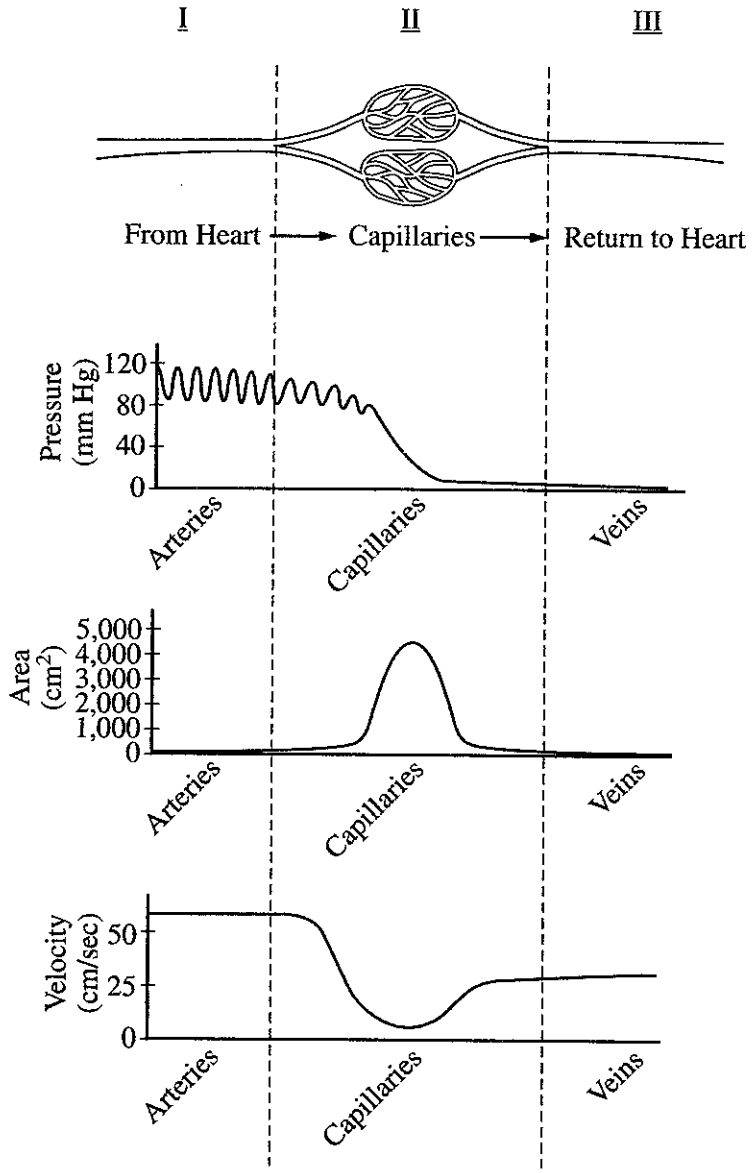
(A) $p^2$
(B) $q^2$
(C) $2pq$
(D) $p^2 + 2pq$
(E) $p^2 + q^2$





GO ON TO THE NEXT PAG

**Questions 80-82 refer to the following.**








GO ON TO THE NEXT PAGE

80. The fluctuation in blood pressure shown in section I is caused by the

(A) systole-diastole cycle
(B) the atrial contraction–atrial relaxation cycle
(C) comparison of pressure in the artery to pressure in the corresponding vein
(D) tidal breathing rate of the subject
(E) rhythmic contraction of the veins

81. The changes in velocity of blood flow seen in section II are most directly influenced by which of the following?

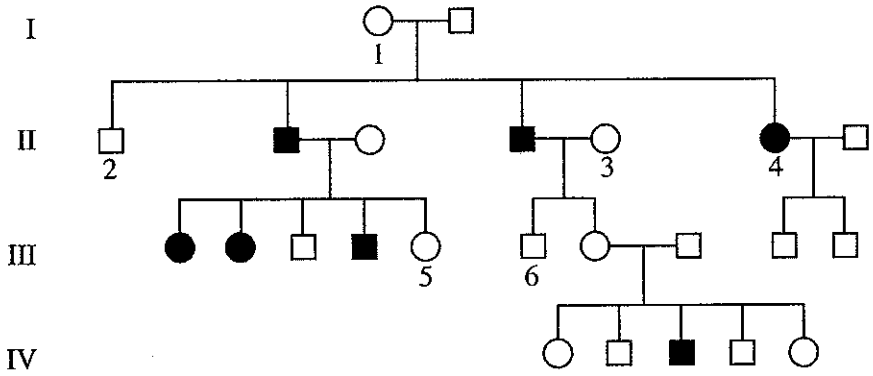
(A) The increasing blood pressure within the vessels
(B) The distances of the vessels from the heart
(C) The volume of blood pumped in one systole-diastole cycle
(D) The cross-sectional area of vessels
(E) The thickness of the vessel walls

82. Given the very low pressure for the blood's return to the heart shown in section III, which of the following is NOT a mechanism for assisting blood's movement?

(A) The presence of one-way valves embedded in the vein's walls
(B) A thoracic pump powered by breathing movements
(C) A transpirational pull using hydrogen bonding
(D) Skeletal muscle assists
(E) The reduced pressure in the relaxing heart chambers after the blood is forced out

**Questions 83-85**

The pedigree of a family with a history of a particular genetic disease is shown below. Squares represent males and circles represent females. Shaded symbols represent those who have the disease.




83. Which of the following is the most likely mode of inheritance for the disease?

(A) Codominance
(B) Autosomal dominant
(C) Autosomal recessive
(D) Sex-linked dominant
(E) Sex-linked recessive

84. If Individual 2 were to marry a woman with no family history of the disease, which of the following would most likely be true of their children?

(A) All of the children would have the disease.
(B) None of the children would have the disease.
(C) Only the sons would have the disease.
(D) All of the sons would be carriers of the disease.
(E) None of the daughters would be carriers of the disease.

85. If Individual 6 marries a woman with the disease, what is the probability that their first child will have the disease?

(A) 0
(B) 25%
(C) 50%
(D) 75%
(E) 100%

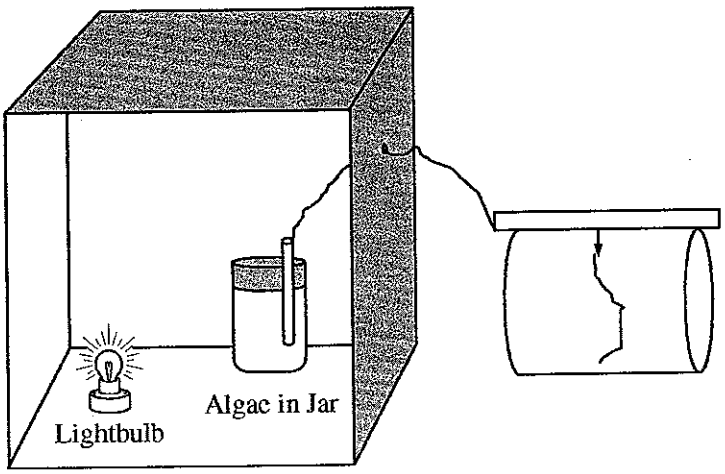




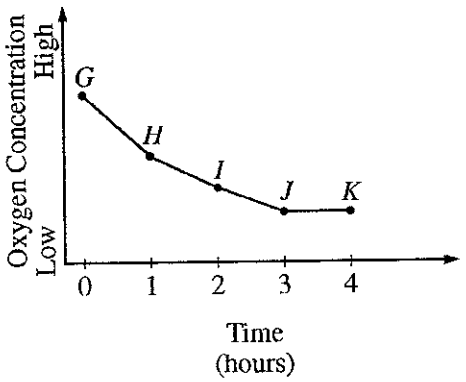
GO ON TO THE NEXT PA

**Questions 86-88**

A student studied the effects of light intensity on oxygen production in green algae. The algae were suspended in water inside a sealed glass jar, and the jar was placed into a constant-temperature, lightproof box containing a light source. A probe was inserted into the jar to record the concentration of oxygen. The probe was connected to a recording device. The setup is shown below.




The student decreased the intensity of the light hourly and recorded the corresponding changes in oxygen concentration. The graph below shows the results from the recording device.




86. Based on the data shown, changes in the light intensity resulted in changes in the rate of which of the following processes?

(A) Excretion
(B) Photosynthesis
(C) Respiration
(D) Translation
(E) Transcription

87. The rate of oxygen production equaled the rate of oxygen consumption during which of the following time periods?

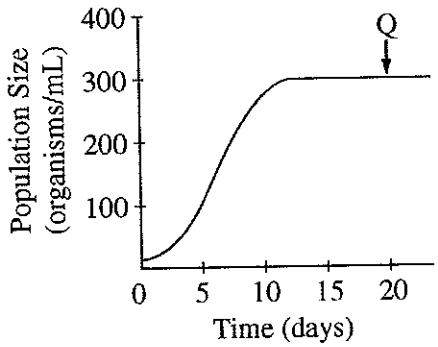
(A) *G* to *H*
(B) *H* to *I*
(C) *I* to *J*
(D) *J* to *K*
(E) *G* to *K*

88. An increase in the rate of oxygen production by algae would be accompanied by a comparable increase in the rate of production of which of the following substances?

(A) $C_6H_{12}O_6$
(B) $CO_2$
(C) $CH_4$
(D) $NH_3$
(E) $H_2O$

**Questions 89-90**

The graph below illustrates a logistic growth curve for a population of *Euglena*.




89. The population density at point Q indicates that

(A) exponential population growth is occurring
(B) predation is beginning to occur
(C) the reproductive rate equals the death rate
(D) the average age of individuals is decreasing
(E) the reproductive capacity for each individual is increasing

90. The population would be most likely to remain at the level shown at Q under which of the following conditions?

(A) All predators are eliminated.
(B) The population size is well below its carrying capacity.
(C) *Euglena* is a primary producer.
(D) *Euglena* is a primary consumer.
(E) Environmental conditions do not fluctuate.





GO ON TO THE NEXT PAG

**Questions 91-94.**

The activity of digestive enzymes was examined in three regions of the digestive system of a crayfish. The stomach, the digestive gland, and the intestine were assayed for enzyme activity at 25°C and pH 7.6. The following results were recorded after repeated measurements.

Enzyme Activity ($\mu$mole substrate hydrolyzed/min/mL extract)

| Enzyme | Stomach | Digestive Gland | Intestine |
|---|---|---|---|
| Amylase | 0.01 | 0.19 | 0.00 |
| Protease | 0.03 | 11.4 | 0.01 |
| Lipase | 0.02 | 0.89 | 0.00 |

91. From the data presented, which of the following can correctly be concluded about crayfish?

(A) Their diet contains no fat.
(B) Most digestive enzymes are produced in the stomach.
(C) Most digestive enzymes are found in the digestive gland.
(D) Amylase is produced in the esophagus.
(E) The primary function of the intestine is to digest proteins.

92. Based on the data presented, which of the following statements regarding crayfish digestion is consistent with the data?

(A) Little digestion occurs before food enters the stomach.
(B) Most digestion occurs in the stomach.
(C) Little digestion occurs in the intestine.
(D) Enzymes are used up as they catalyze hydrolysis.
(E) Digestion is optimal at 25°C.

93. The experiment demonstrates which of the following about the digestive system of crayfish?

(A) Amylase is the most active digestive enzyme.
(B) Crayfish have only three kinds of digestive enzymes.
(C) Most enzyme activity occurs in the intestine.
(D) Different regions of the digestive system are specialized for different functions.
(E) The esophagus serves no real function.

94. Which of the following would be useful as a substrate to measure the activity of amylase in crayfish?

(A) Cellulose
(B) Starch
(C) Glucose
(D) An amino acid
(E) A nucleic acid

**Questions 95-96**

Researchers applied radioactive phosphorus and radioactive calcium to a freshly cut tree stump. Eight days later, they came back to measure the distribution of the radioisotopes. They found that nineteen different species of shrubs and trees within a seven-meter radius had taken up the radioactive elements. No radioactivity was detected in the air.

95. Radioactive isotopes were never detected in any samples containing just soil taken during the experiment. The finding implies that the

(A) soil does not provide the ecosystem with minerals
(B) isotopes were undetectable in very small amounts
(C) isotopes were transported via vascular tissues
(D) plants quickly return minerals to the soil in which they grow
(E) soil speeds up radioactive decay

96. Radioactively labeled starch was later added to the stump; in subsequent observations, no labeled starch molecules were ever detected in neighboring plants. Which of the following is the most logical explanation for the observation?

(A) During transport, the radioactive atoms are removed from the starch molecules.
(B) Starch molecules are too large to cross cell membranes.
(C) The radioactivity caused the starch molecules to break down.
(D) Water in the soil dissolved the starch molecules.
(E) The radioactive carbon atoms decayed into other atoms that are undetectable.





GO ON TO THE NEXT PAG

**Questions 97-100**

To study the actions of the enzyme catalase on hydrogen peroxide, students performed the following experiment. Catalase was extracted from potatoes by blending raw potatoes in a blender with cold distilled water. The filtrate was stored on ice. The following hydrogen peroxide solutions were made: 1 percent, 5 percent, 10 percent, and 15 percent. Filter paper disks were soaked in the catalase filtrate and dropped into beakers containing the various solutions. The activity of the enzyme was measured by the amount of time it took for the disks to float to the surface of the solution on the bubbles produced by the reaction. The following data were obtained.

| Hydrogen Peroxide Solution | Average Time, in Seconds, for Disks to Float |
|---|---|
| 1% | 30 sec |
| 5% | 25 sec |
| 10% | 20 sec |
| 15% | 10 sec |

97. Which of the following best describes why the disks rose to the surface faster in the more concentrated hydrogen peroxide solutions?

(A) There was more enzyme present in the more concentrated solutions.
(B) A greater amount of heat was generated in the more concentrated solutions.
(C) The more concentrated solutions lowered the activation energy of the reaction.
(D) The higher substrate concentrations in the more concentrated solutions speeded the reaction.
(E) The density of the water was lower in the more concentrated solutions.

98. Which of the following experimental designs should the students use as a control for the experiment?

(A) Place a catalase-soaked disk in a beaker of water.
(B) Drop the disks from different heights into the solution.
(C) Poke the floating disks back down to the bottom of the beaker and retime the rise of the disks.
(D) Shake the beakers during the time the disks are rising.
(E) Dip the disks in the 5% solution before putting them in any other solution.

99. Which of the following best describes why ice was used during this experiment?

(A) To increase the activity of the enzyme
(B) To retard the breakdown of the catalase
(C) To purge the solution of excess air trapped during blending
(D) To slow the catalase molecules to increase the probability of contact with the hydrogen peroxide molecules
(E) To increase the size of the active site on the enzyme

100. If the potato solution was boiled for 10 minutes and cooled for 10 minutes before being tested, the average time for the disks to float to the surface of the hydrogen peroxide solution would be

(A) less than 1 second
(B) 5 seconds
(C) 10 seconds
(D) 30 seconds
(E) more than 30 seconds

**END OF SECTION I**