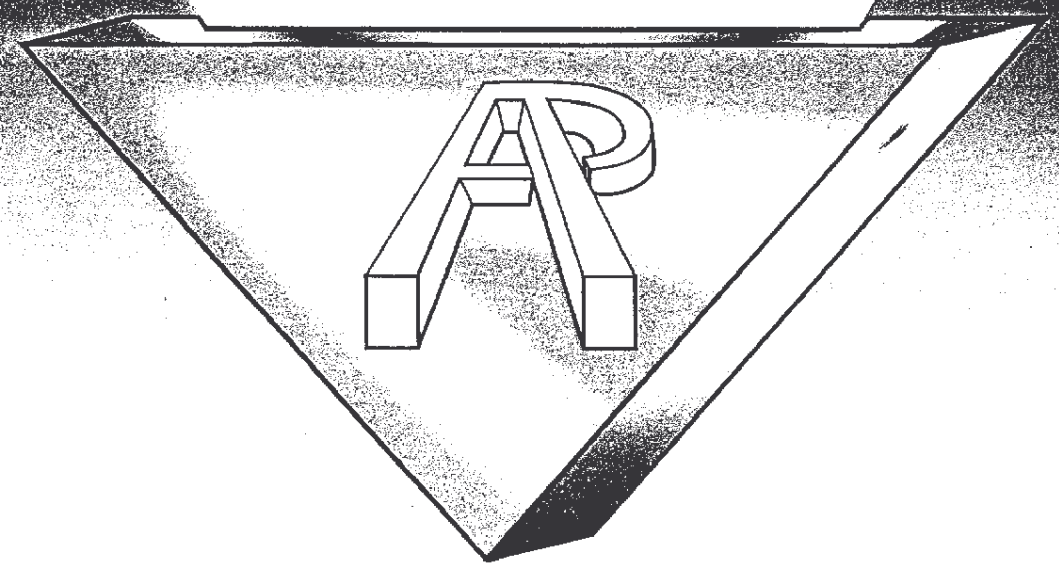

1994 AP BIOLOGY:

with Multiple-Choice Section

Advanced Placement Program®
THE COLLEGE BOARD

With analysis by Chief Faculty Consultant
John Smarrelli

BIOLOGY

SECTION I

Time—1 hour and 30 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. Which of the following is the most abundant carbon-containing compound in the atmosphere of the Earth?

   (A) Carbon monoxide
   (B) Carbon dioxide
   (C) Carbon tetrachloride
   (D) Ethane
   (E) Ozone

2. During hibernation, the rate of cellular respiration in a mammal is typically less than half the rate measured when the mammal is not hibernating. Such slowed cellular respiration is probably accompanied by which of the following?

	Pulse Rate	Body Temperature
(A)	Reduced	Reduced
(B)	Unchanged	Reduced
(C)	Reduced	Increased
(D)	Unchanged	Increased
(E)	Increased	Reduced

3. Members of which of the following animal groups were among the first to inhabit land and were ancestors of the reptiles?

   (A) Amphibia
   (B) Arthropoda
   (C) Aves
   (D) Mammalia
   (E) Echinodermata

4. If $2n = 48$ for a particular cell, then the chromosome number in each cell after meiosis would be

   (A) 96
   (B) 48
   (C) 24
   (D) 12
   (E) 6

5. Vascular plants with spores borne in sporangia on the underside of leaves are characteristic of which of the following plant groups?

   (A) Bryophyta (mosses)
   (B) Chrysophyta (golden algae)
   (C) Anthophyta (flowering plants)
   (D) Pteridophyta (ferns)
   (E) Coniferophyta (conifers)

6. If an invertebrate possesses nephridia as an excretory system, skin as a gas exchange system, and a closed circulatory system, the animal is most likely to be

   (A) a snail
   (B) a planarian
   (C) an earthworm
   (D) a grasshopper
   (E) a jellyfish

7. The wing of a bat, the flipper of a whale, and the forelimb of a horse appear very different, yet detailed studies reveal the presence of the same basic bone pattern. These structures are examples of

   (A) analogous structures
   (B) homologous structures
   (C) vestigial structures
   (D) balanced polymorphism
   (E) convergent evolution

8. The carbon that makes up organic molecules in plants is derived directly from

   (A) combustion of fuels
   (B) carbon fixed in photosynthesis
   (C) carbon dioxide produced in respiration
   (D) carbon in the lithosphere
   (E) coal mines

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9. Which of the following is a correct statement about mutations?

(A) They are a source of variation for evolution.
(B) They drive evolution by creating mutation pressures.
(C) They are irreversible.
(D) They occur in germ cells but not in somatic cells.
(E) They are most often beneficial to the organisms in which they occur.

10. A feature of organic compounds NOT found in inorganic compounds is the presence of

(A) ionizing chemical groups
(B) electrons
(C) carbon atoms covalently bonded to each other
(D) oxygen
(E) hydrogen bonds

11. Which of the following best explains why there are seldom more than five trophic levels in a food chain?

(A) Most carnivores function at more than one trophic level.
(B) Trophic levels above this number contain too many individuals.
(C) Top carnivores are too few in number to prey effectively.
(D) The ecosystem contains too much biomass.
(E) Energy is lost from each trophic level.

12. The nucleolus functions in the production of

(A) Golgi apparatus
(B) microtubules
(C) mitochondria
(D) ribosomes
(E) endoplasmic reticulum

13. All of the following are true statements about meiosis in mammals EXCEPT:

(A) It serves as a factor in bringing about variation among offspring.
(B) It follows DNA replication.
(C) It occurs only in reproductive structures.
(D) It produces cells with the haploid number of chromosomes.
(E) It produces four genetically identical gametes.

14. Segregation of alleles does NOT occur in which of the following groups of organisms?

(A) Flowering plants
(B) Insects
(C) Flatworms
(D) Bacteria
(E) Ferns

15. Members of the kingdom Fungi generally differ from members of the kingdom Plantae in that fungi

(A) have cell walls
(B) are multicellular
(C) are heterotrophic
(D) are both aquatic and terrestrial
(E) are eukaryotic

16. Which of the following statements concerning a gene is correct?

(A) A gene can code for a specific protein.
(B) A gene can exist in alternate forms called introns.
(C) A gene undergoes crossing-over during DNA replication.
(D) A gene that is very similar in sequence in a human and in a bacterium is probably a recent mutation.
(E) A gene that is expressed in every offspring of every generation is recessive.

17. The system of classification developed by Linnaeus is based primarily on differences in

(A) chemical composition of the genetic material
(B) method of feeding
(C) means of locomotion
(D) location of habitat
(E) organismal structure

18. Fats are emulsified by which of the following substances synthesized by the liver?

(A) Cholesterol
(B) Hydrochloric acid
(C) Lipase
(D) Bile salts
(E) Glycerol

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19. An overlap in the niches of two species will most frequently result in

(A) interspecific cooperation
(B) a hybridization of species
(C) a mutualistic symbiotic relationship
(D) an increase in the biomass
(E) interspecific competition

20. If plants are grown for several days in an atmosphere containing $^{14}CO_2$ in place of $^{12}CO_2$, one would expect to find

(A) very little radioactivity in the growing leaves
(B) large amounts of radioactive water released from the stomates
(C) a large increase in ^{14}C in the starch stored in the roots
(D) a large decrease in the rate of carbon fixation in the guard cells
(E) an increase in the activity of RuBP carboxylase in the photosynthetic cells

21. Ducklings and goslings begin to follow and congregate around whatever moving animate or inanimate object is presented to them within a few hours after hatching. This type of behavior is called

(A) unlearned
(B) trial and error
(C) habituation
(D) imprinting
(E) insight

22. Which of the following is true of humoral immunity but not of cell-mediated immunity?

(A) It is active in the early years of a person's life.
(B) It involves the activity of killer T-cells.
(C) Antigens are recognized in the lymph nodes.
(D) Antibodies are produced in response to antigens.
(E) Virus-infected cells are the primary targets.

23. Which of the following best describes a fern gametophyte?

(A) Its cells are haploid.
(B) It lacks chlorophyll.
(C) It is tough and woody.
(D) It is larger than the sporophyte.
(E) It can withstand severe drying.

24. Which of the following is an important characteristic of the tropical rain forest biome?

(A) High light levels on the forest floor
(B) The dominance of a small number of tree species
(C) More widely fluctuating temperatures than in most other biomes
(D) Distinct rainy and dry seasons
(E) Rapid recycling of nutrients

25. Which of the following characteristics indicates that molluscs are more closely related to arthropods than to chordates?

(A) Presence of a skeleton
(B) Type of respiratory structure
(C) Pattern of coelom formation
(D) Segmentation
(E) Symmetry

26. The movement of water to the top of a 15-meter tree is best explained by

(A) transpiration and cohesion
(B) root and stem pressure
(C) barometric pressure
(D) capillary action
(E) gravitational flow

27. In garden peas, a single gene controls stem length. The recessive allele (t) produces short stems when homozygous. The dominant allele (T) produces long stems. A short-stemmed plant is crossed with a heterozygous long-stemmed plant. Which of the following represents the expected phenotypes of the offspring and the ratio in which they will occur?

(A) 3 long-stemmed plants : 1 short-stemmed plant
(B) 1 long-stemmed plant : 1 short-stemmed plant
(C) 1 long-stemmed plant : 3 short-stemmed plants
(D) Long-stemmed plants only
(E) Short-stemmed plants only

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28. Although the seal and the penguin both have streamlined, fishlike bodies with a layer of insulating fat, they are not closely related. This similarity results from

(A) convergent evolution
(B) adaptive radiation
(C) homologous evolution
(D) coevolution
(E) parallel evolution

29. To observe the process of mitosis in plant root cells, a biologist should examine the plant's

(A) root hairs
(B) Casparian strip
(C) root cap
(D) zone of maturation
(E) apical meristem

30. Which of the following is characteristic of both cardiac-muscle and smooth-muscle tissue?

(A) Spindle-shaped cells
(B) Striated appearance
(C) Multinucleate cells
(D) Involuntary contraction
(E) Presence in walls of major blood vessels

31. In plants, the cells in which the greatest quantity of organic nutrients are translocated are

(A) companion cells
(B) tracheids
(C) trichomes
(D) sieve-tube elements
(E) vessel elements

32. Warning coloration is most effective against vertebrate predators that are

(A) color-blind
(B) able to learn through trial and error
(C) highly dependent on olfactory sensation
(D) camouflaged
(E) nocturnal hunters

33. The O_2 released during photosynthesis comes from

(A) CO_2
(B) H_2O
(C) NADPH
(D) RuBP (RuDP)
(E) $C_6H_{12}O_6$

34. Which of the following is an important difference between light-dependent and light-independent reactions of photosynthesis?

(A) The light-dependent reactions occur only during the day; the light-independent reactions occur only during the night.
(B) The light-dependent reactions occur in the cytoplasm; the light-independent reactions occur in chloroplasts.
(C) The light-dependent reactions utilize CO_2 and H_2O; the light-independent reactions produce CO_2 and H_2O.
(D) The light-dependent reactions depend on the presence of both photosystems I and II; the light-independent reactions require only photosystem I.
(E) The light-dependent reactions produce ATP and NADPH; the light-independent reactions use energy stored in ATP and NADPH.

35. All of the following cells have either cilia or flagella EXCEPT

(A) cells lining the oviduct in mammals
(B) pollen produced in the anthers of angiosperms
(C) the sperm produced in the antheridia of ferns
(D) cells lining the respiratory tract of humans
(E) *Paramecium* and *Euglena*

36. In human females fertilization normally occurs in the

(A) ovary
(B) uterus
(C) vagina
(D) oviduct
(E) cervix

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37. Which of the following can be used to determine the rate of enzyme-catalyzed reactions?

(A) Rate of disappearance of the enzyme
(B) Rate of disappearance of the substrate
(C) Rate of disappearance of the product
(D) Change in volume of the solution
(E) Increase in activation energy

38. A response of an organism to seasonal change is

(A) phototropism
(B) photoperiodism
(C) circadian rhythm
(D) photolysis
(E) the biological clock

39. Which of the following is probably the best explanation for the fact that Antarctic penguins cannot fly, although there is evidence that millions of years ago their ancestors could do so?

(A) Penguins live on land and feed in the water; therefore they have no need to fly.
(B) The Antarctic home of penguins is flat and barren; therefore there is no place to fly.
(C) Ancestral penguins without large wings were better able to swim and feed in the water; therefore they passed their genes for shorter wing structure on to their offspring.
(D) Ancestral penguins did not use their wings for long periods of time; therefore today's penguins have only tiny, nonfunctional wings.
(E) The cold and wind of Antarctica make flight impossible; therefore penguins that live there have lost the ability to fly.

40. If a stimulus on the receptor portion of a sensory neuron is above the threshold level, a further increase in the intensity of this stimulus will most likely cause the

(A) frequency of impulse production to increase
(B) strength of the neuronal impulse to increase
(C) impulse to move faster
(D) neuron membrane to become less permeable to sodium
(E) neuron membrane to become more negatively polarized

41. The appearance of a fertile, polyploid individual within a population of diploid organisms is a possible source of a new species. If this individual is capable of reproducing to form a new population, scientists would consider this to be an example of

(A) allopatric speciation
(B) sympatric speciation
(C) polygenic inheritance
(D) genetic drift
(E) Hardy-Weinberg equilibrium

42. Which of the following is a characteristic of mitochondria and chloroplasts that supports the endosymbiotic theory?

(A) Both have bacteria-like polysaccharide cell walls.
(B) Both can reproduce on their own outside of the cell.
(C) Both contain DNA molecules.
(D) Both contain endoplasmic reticulum and Golgi bodies.
(E) Both contain ribosomes that are identical to ribosomes of the eukaryotic cytoplasm.

43. Which of the following is LEAST likely to be associated with diabetes mellitus?

(A) Insulin receptors are insensitive to insulin.
(B) Urinalysis indicates a high concentration of sugar in urine.
(C) Pancreatic islet cells are destroyed.
(D) Liver cells absorb sugar from the blood at a rate that is greater than normal.
(E) Muscle cells readily oxidize fats and proteins.

44. The success of tracheophytes on land is probably due to the appearance of which of the following?

(A) Asexual reproduction
(B) Vascular tissue
(C) Photosynthesis
(D) Gametes
(E) Rhizoids

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45. All of the following statements about animals whose nitrogenous wastes consist primarily of uric acid are correct EXCEPT:

(A) They are usually terrestrial.
(B) They are able to conserve more water than if they excreted urea.
(C) They are at risk due to the high toxicity of uric acid.
(D) They include most birds and reptiles.
(E) They have specialized structures for uric acid storage and release.

46. During germination in most angiosperm seeds, food for the growing embryo is provided by the

(A) microgametophyte
(B) female gametophyte
(C) endosperm
(D) hypocotyl
(E) ovary

47. The embryo of which of the following organisms does NOT have an amnion?

(A) a bird
(B) a turtle
(C) a lizard
(D) a fish
(E) a human

48. A human cell in prophase of mitosis can be distinguished from a human cell in prophase I of meiosis by the presence of

(A) kinetochores in the mitotic cell
(B) a spindle in the mitotic cell
(C) twice as many chromosomes in the meiotic cell
(D) half as many chromosomes in the meiotic cell
(E) paired homologous chromosomes in the meiotic cell

Questions 49-50. In a certain flock of sheep, 4 percent of the population has black wool and 96 percent has white wool. Assume that the population is in Hardy-Weinberg equilibrium.

49. If black wool is a recessive trait, what percentage of the population is heterozygous for this trait?

(A) 4%
(B) 20%
(C) 32%
(D) 64%
(E) 80%

50. What percentage of the population is homozygous for white wool?

(A) 20%
(B) 40%
(C) 64%
(D) 80%
(E) 96%

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51. Which of the following are characteristic of both prokaryotic and eukaryotic cells?

(A) Cytoplasm and a well-defined nucleus surrounded by a membrane
(B) Membranous sites of ATP synthesis, Golgi complex, and ribosomes
(C) Mitochondria, nucleus, and ribosomes
(D) Cell wall, several chromosomes, and cytoplasm
(E) Cell membrane, ribosomes, DNA, and RNA

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52. All of the following statements about the pyramid of biomass are correct EXCEPT:

(A) Biomass is the total dry mass of the organisms present.
(B) The base of the pyramid generally represents primary consumers.
(C) The amount of biomass at a particular level of the pyramid depends on the amount of energy available.
(D) Certain toxins tend to become concentrated at upper levels of the pyramid.
(E) Biomass pyramids tend to vary for different ecosystems.

53. All of the following statements about a haploid cell in a plant are correct EXCEPT:

(A) It may have either an odd or even number of chromosomes.
(B) It may function as a gamete.
(C) It may have been formed as the result of a meiotic division.
(D) It may undergo meiosis to produce gametes.
(E) It may undergo mitosis.

54. There is some evidence that interferon may be effective against certain forms of cancer. This finding suggests that some cancers may involve

(A) viruses
(B) bacteria
(C) uric acid deposition
(D) allergic reactions
(E) an overproduction of white blood cells

55. Which of the following is characteristic of a fast-moving stream ecosystem?

(A) High levels of dissolved oxygen
(B) High salinity
(C) Large numbers of anaerobes
(D) Eutrophication
(E) Thermal stratification

56. In a mammalian embryo, the somites give rise to

(A) the notochord
(B) the central nervous system
(C) the lining of the mouth
(D) the eyes
(E) muscles and vertebrae

57. Which of the following is a correct statement about the relationship between pH and the hydrogen-ion concentration of a solution?

(A) There are no hydrogen ions present in a solution with a basic pH.
(B) There are no hydrogen ions present in a solution with a neutral pH of 7.0.
(C) The concentration of hydrogen ions in a solution with a pH of 7.0 is 100 times as great as that in a solution with a pH of 9.0.
(D) The concentration of hydrogen ions in a solution with a pH of 5.0 is twice that in a solution with a pH of 3.0.
(E) The concentration of hydrogen ions in a solution with a pH of 4.0 is 400 times as great as that in a solution with a pH of 1.0.

58. Carbohydrate-synthesizing reactions of photosynthesis directly require

(A) light
(B) products of the light reactions
(C) darkness
(D) O_2 and H_2O
(E) chlorophyll and CO_2

59. Phototropism in plants is mediated by what plant growth substance?

(A) Auxin
(B) Colchicine
(C) Chlorophyll
(D) Ethylene
(E) Lenticels

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60. Which of the following best describes the function of cholinesterase in neurotransmission?

(A) It decomposes, providing a source of choline for muscular contraction.
(B) It binds acetylcholine to receptors on the post-synaptic membrane.
(C) It blocks acetylcholine reception on the post-synaptic membrane.
(D) It breaks down acetylcholine, preventing continual neurotransmission.
(E) It releases ATP from acetylcholine, providing energy for neurotransmission.

61. In humans, the largest amount of the carbon dioxide produced in the cells is carried to the lungs as

(A) carbaminohemoglobin
(B) CO_2 gas in solution in plasma
(C) CO_2 gas in the red blood cells
(D) bicarbonate in the plasma
(E) bicarbonate in the red blood cells

62. In mosses, unlike angiosperms, the developing sporophyte is

(A) haploid in chromosome number
(B) part of the gametophyte generation
(C) covered by a seed coat
(D) dependent on the gametophyte for nutrients
(E) the structure that becomes an independent plant

63. Which of the following would occur as a result of increased activity of the sympathetic nervous system?

(A) Accelerated digestion
(B) Decreased heart rate
(C) Increased adrenalin secretion
(D) Increased salivation
(E) Decreased glucose release by the liver

64. Unlike the cells of flowering plants, the cells of animals are characterized by which of the following?

(A) Mitochondria
(B) A nucleus surrounded by a double membrane
(C) Centrioles
(D) A plasma membrane surrounded by a nonliving cell wall
(E) A single large central vacuole

65. The process by which some bacteria use nitrates for their own respiration and release nitrogen into the atmosphere is

(A) ammonification
(B) excretion
(C) assimilation
(D) denitrification
(E) nitrogen fixation

66. Within the cell, many chemical reactions that, by themselves, require energy input (have a positive free-energy change) can occur because the reactions

(A) may be coupled to the hydrolysis of ATP
(B) take place very slowly
(C) take place when the cells are at unusually high temperatures
(D) are catalyzed by enzymes
(E) are aided by various metal ions that act as catalysts

67. Embryonic induction is best illustrated by which of the following?

(A) Formation of the lens in the ectoderm after contact with the underlying optic cup
(B) Replacement of cartilage by bone
(C) Lysosomal action on the degenerating tail of a tadpole
(D) Development of the amnion surrounding the embryo
(E) Development of the mesoderm into the notochord

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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 that is most closely related to it 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 68-71

(A) Comparative biochemistry
(B) Comparative anatomy
(C) Comparative embryology
(D) Geographical distribution
(E) Paleontology

From the fields of study listed above, choose the field that has provided each of the following pieces of evidence that biological evolution has occurred.

68. *Archaeopteryx* is an extinct feathered reptile.

69. *Peripatus* has claws like an insect and paired nephridia like a segmented worm.

70. Most human diabetics can use insulin derived either from pigs or from humans.

71. During early development, a human fetus has a tail and gill arches.

Questions 72-74

(A) Symbiosis
(B) Law of tolerance
(C) Energy pyramid
(D) Ecological succession
(E) Net primary productivity

72. The relationship of a fungus and an alga in a lichen

73. The gain in biomass remaining after respiratory loss in plants

74. Gradual transition over time from one type of biological community to another

Questions 75-77

(A) Root pressure
(B) Transpiration
(C) Translocation
(D) Adhesion
(E) Guttation

75. Is the loss of water vapor through stomata

76. Accounts for water being held to the walls of xylem vessels

77. Is the exudation of water droplets from the tip of a leaf or stem

Questions 78-81

(A) LH (luteinizing hormone)
(B) FSH (follicle-stimulating hormone)
(C) Testosterone
(D) Adrenalin
(E) Progesterone

78. A steroid hormone, produced by the placenta, which functions in maintaining the uterine lining during pregnancy

79. A hormone that brings about the formation of the corpus luteum

80. A pituitary hormone that causes ovulation to occur

81. Primary hormone produced in male gonadal tissue

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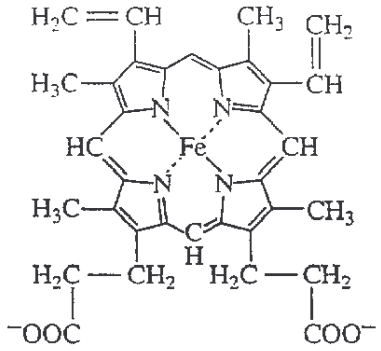
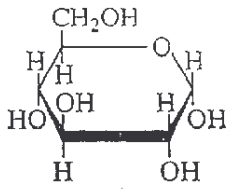
Questions 82-85 refer to the diagrams of organic molecules below.

(A)



(B)



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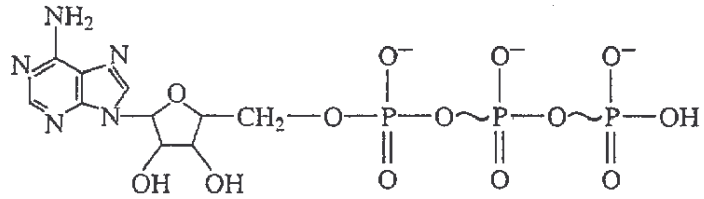
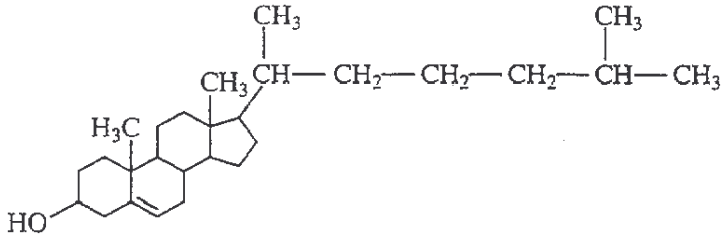
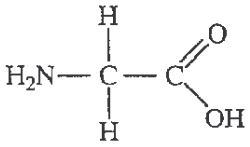


(D)



(E)



82. This molecule is used to transport oxygen.

83. Starch is a polymer of this molecule.

84. This sterol is found in cell membranes and is associated with atherosclerosis.

85. This molecule could result from the hydrolysis of a protein.

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Questions 86-90

(A) Glycocalyx
(B) Cholesterol
(C) Triglyceride
(D) Phospholipid
(E) Protein

86. Carbohydrate-containing layer at the surface of the plasma membrane

87. The major component of the fluid bilayer of a plasma membrane

88. Carrier molecule in the plasma membrane

89. Steroid affecting the fluidity of the plasma membrane

90. ATP synthase (synthetase) in the inner mitochondrial and chloroplast membranes

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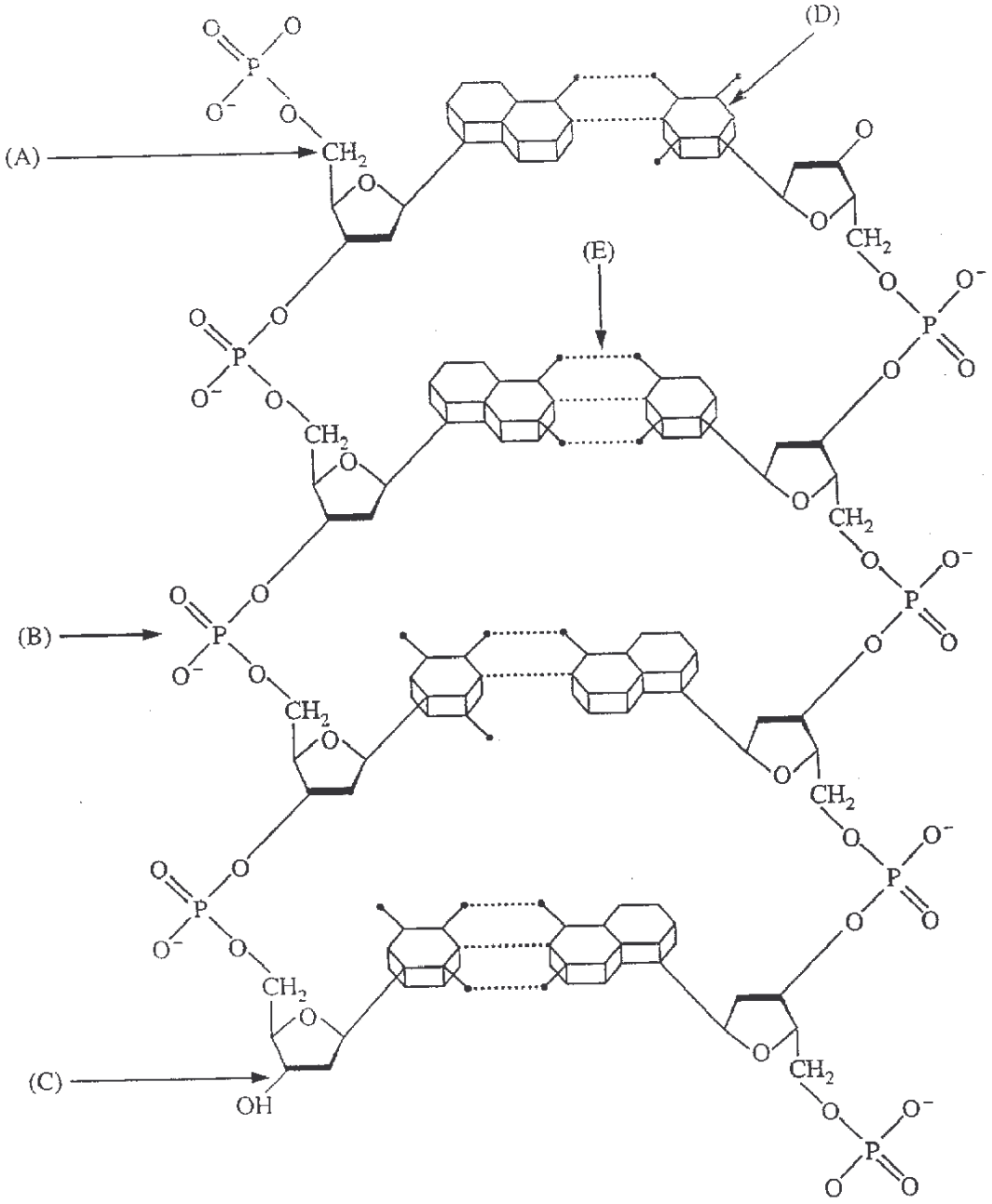
Questions 91-95 refer to the following diagram.



91. A chemical group that, together with a sugar and a nitrogen base, makes up a nucleotide

92. A hydrogen bond

93. A pyrimidine

94. A 5' carbon of deoxyribose

95. Most likely to be broken during replication

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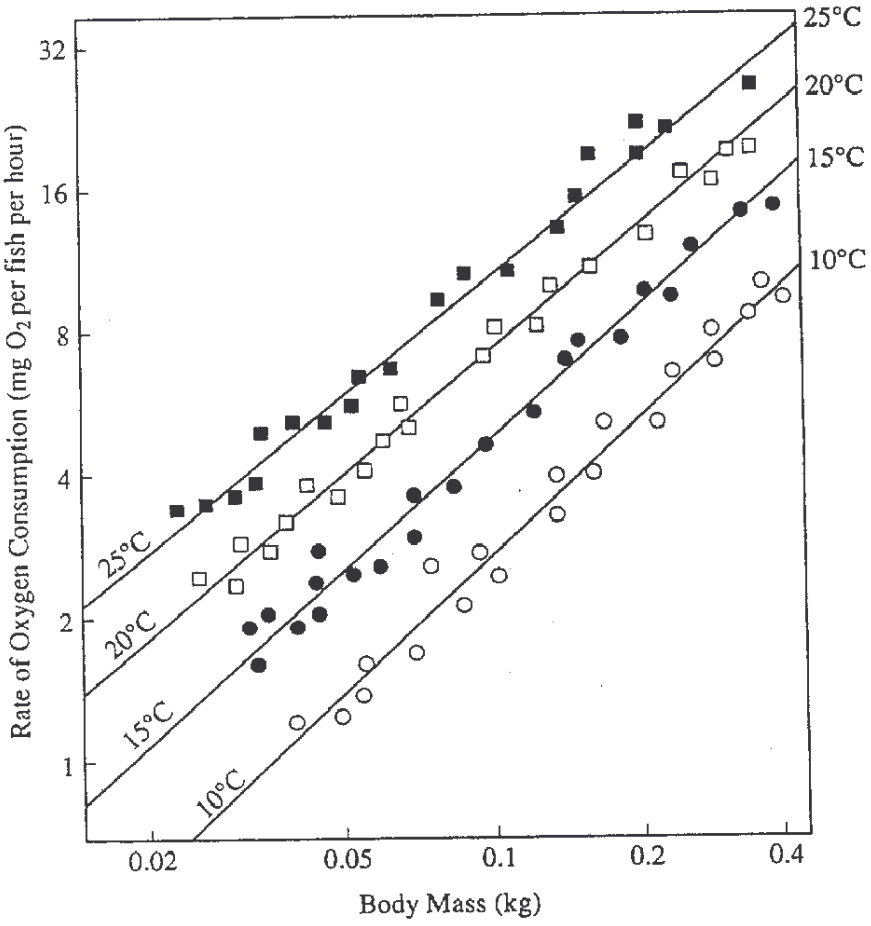
Directions: Each group of questions below concerns an experimental or laboratory situation or data. In each case, first study the description of the situation or data. Then choose the one best answer to each question following it and fill in the corresponding oval on the answer sheet.

Questions 96-98 refer to the following information and graph.

The data presented in the figure below are measurements of the rate of oxygen consumption at differing body masses in a species of fish. Each point represents measurements from a different fish. Measurements were taken at different temperatures. (○ = 10°C, ● = 15°C, □ = 20°C, ■ = 25°C.)



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96. The fact that each line on the graph rises from left to right means that

(A) higher temperatures produce higher rates of metabolism
(B) there were more large fish in the samples taken at high temperatures
(C) larger fish consume more oxygen than smaller fish at all four temperatures
(D) when measurements are taken for larger fish late in the day, observed values are higher
(E) larger fish prefer to live at higher temperatures than do smaller fish

97. The best explanation for the fact that not all points lie on any given line is that

(A) the thermometer was incorrectly calibrated
(B) the scale used to weigh the fish registered 0.001 kg too little
(C) the fish grew during the course of the experiment
(D) errors were made in plotting the data
(E) organisms within populations show variability

98. Which of the following is NOT a likely explanation for the observed results?

(A) Rates of fermentation are higher at 25°C than at 10°C.
(B) Enzymes are affected by temperature.
(C) Larger fish have higher respiratory-oxygen needs than do smaller fish.
(D) Electron transport occurs more rapidly at higher temperatures than at lower temperatures.
(E) Rate of oxygen consumption increases with temperature in this species of fish over this temperature range.

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Questions 99-101 refer to the following information.

Achondroplastic dwarfism is a dominant genetic trait that causes severe malformation of the skeleton. Homozygotes for this condition are spontaneously aborted (hence, the homozygous condition is lethal) but heterozygotes will develop to be dwarfed.

Matthew has a family history of the condition, although he does not express the trait. Jane is an achondroplastic dwarf. Matthew and Jane are planning a family of several children and want to know the chances of producing a child with achondroplastic dwarfism.

99. The genotypes of Matthew and Jane are best represented as

	Matthew	Jane
(A)	*AA*	*Aa*
(B)	*Aa*	*aa*
(C)	*aa*	*aa*
(D)	*aa*	*Aa*
(E)	*Aa*	*Aa*

100. The probability that Matthew and Jane's first child will be an achondroplastic dwarf is

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

101. If three children are born to Matthew and Jane, what are the chances that the first two children will not express the trait but that the third child will be an achondroplastic dwarf?

(A) $\frac{5}{8}$
(B) $\frac{4}{8}$
(C) $\frac{3}{8}$
(D) $\frac{1}{8}$
(E) $\frac{1}{16}$

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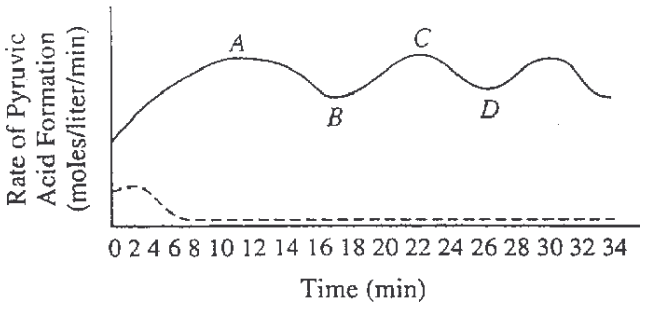
Questions 102-105 refer to the following graph and information.



A tissue culture of vertebrate muscle was provided with a constant excess supply of glucose under anaerobic conditions starting at time zero and the amounts of pyruvic acid and ATP produced were measured. The solid line in the graph above represents the pyruvic acid produced in moles per liter per minute. ATP levels were also found to be highest at points *A* and *C*, lowest at *B* and *D*. A second culture was set up under the same conditions, except that substance *X* was added, and the results are indicated by the dotted line.

102. The rate of pyruvic acid formation fluctuates because

(A) all glucose has reacted
(B) all enzymes have been used up
(C) the reaction is accelerated by positive feedback
(D) The reaction is affected by negative feedback
(E) coenzymes have begun to function

103. Which of the following best accounts for the shape of the solid line between points *A* and *D*?

(A) After ten minutes the cellular enzymes became ineffective.
(B) Respiration became uncontrolled.
(C) ATP acted as an allosteric inhibitor on one or more of the enzymes.
(D) The measurements of pyruvic acid were unreliable.
(E) The cells required more glucose than was being provided.

104. It is most reasonable to hypothesize that, in the breakdown of glucose, substance *X* is

(A) an activator
(B) an inhibitor
(C) a substrate
(D) a coenzyme
(E) a cofactor

105. Which of the following is most likely to result if oxygen is added to the tissue culture?

(A) Lactic acid formation will increase.
(B) For each glucose molecule consumed, more ATP will be formed.
(C) The levels of ATP produced will decrease.
(D) Ethyl alcohol will be produced.
(E) No change in the production of pyruvic acid will be observed.

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Questions 106-108

A male fruit fly (*Drosophila melanogaster*) with red eyes and long wings was mated with a female with purple eyes and vestigial wings. All of the offspring in the F_1 generation had red eyes and long wings.

These F_1 flies were test crossed with purple-eyed, vestigial-winged flies. Their offspring, the F_2 generation, appeared as indicated below.

	F_2 Generation
125	red eyes, long wings
124	purple eyes, vestigial wings
18	purple eyes, long wings
16	red eyes, vestigial wings
283	Total

106. If in the F_1 and F_2 generations the same characteristics appeared in both males and females, it would be safe to assume that these traits for eye color and wing length

(A) are sex-linked
(B) vary in dominance according to sex
(C) are sex-influenced characteristics
(D) are autosomal characteristics
(E) follow the Mendelian rule of independent assortment

107. In the F_2 generation, the results are best explained by the fact that

(A) the test cross with the F_1 flies resulted in sterile offspring
(B) these genes for eye color and wing shape do not pass through the F_1 generation
(C) these genes for eye color and wing shape are found on the same chromosome
(D) crossing-over decreases variability
(E) the genes are sex-linked

108. If a single locus controls wing shape, then the alleles for this gene act as

(A) dominant-recessive alleles
(B) incomplete-dominance alleles
(C) codominant alleles
(D) multiple alleles
(E) variable alleles

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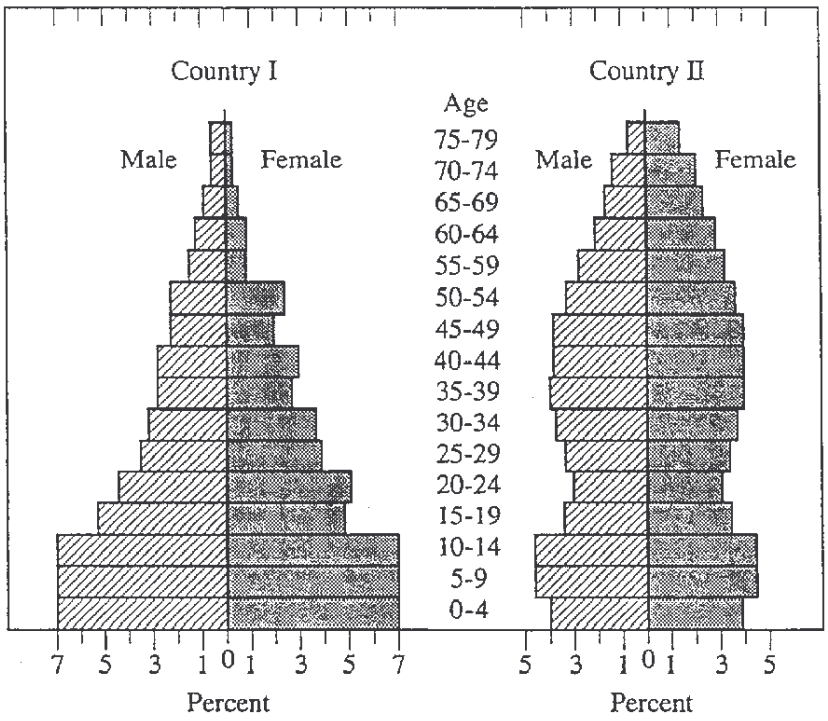
Questions 109-112 refer to the following information.

The illustrations below show the age and sex of the human populations in Country I and Country II. The ages are grouped by 5-year classes, and the sexes are represented separately. The percentages in the different age classes are shown by the relative widths of successive horizontal bars.



109. In Country I, approximately what percentage of the individuals were younger than fifteen years of age?

(A) 10%
(B) 21%
(C) 42%
(D) 52%
(E) It cannot be estimated from the graph.

110. Which of the following best approximates the ratio of males to females among individuals below fifteen years of age?

	Country I	Country II
(A)	1 : 1	1 : 1
(B)	0.75 : 1	0.75 : 1
(C)	0.5 : 1	0.5 : 1
(D)	1 : 1	0.5 : 1
(E)	0.75 : 1	1 : 1

111. If, in Country I, infant mortality declined and the birth rate remained the same, then initially the population would be expected to

(A) be more evenly distributed among the age classes
(B) be even more concentrated in the young age classes
(C) stabilize at the illustrated level for all age classes
(D) increase in the oldest age classes
(E) increase in the median age classes

112. Over the next 10-15 years, the stabilization of Country I's population at its current size would require that

(A) infant mortality be reduced to about half the present level
(B) the death rate be reduced drastically
(C) each couple produce fewer children than the number required to replace themselves
(D) about 15 years be added to the life expectancy of each person
(E) couples have an average of only 3 children

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Questions 113-114 refer to the data below concerning a newly discovered organism.

Usual mode of reproduction:	Sexual
Type of fertilization:	External
Embryology:	Blastopore contributes to the formation of anus; cleavage is radial.
Symmetry:	Immature form is bilateral; mature form is five-part radial.
Body cavity:	Lined with tissue derived from mesoderm
Segmentation:	Not evident
Skeleton:	Spiny endoskeleton secreted by the dermis and covered with a thin epidermis
Habitat:	Marine

113. Which of the following pairs of terms best describes this organism?

(A) Coelomate. .deuterostome
(B) Acoelomate. .metazoan
(C) Diploblastic. .parazoan
(D) Pseudocoelomate. .segmented
(E) Protostome. .unsegmented

114. Into what phylum should this organism be placed?

(A) Chordata
(B) Nematoda
(C) Echinodermata
(D) Mollusca
(E) Annelida

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Questions 115-116 refer to the chart below.

mRNA Codons	Amino Acids
AGA	arginine
GGA	glycine
AGC	serine
GCA	alanine
CAG	glutamine

115. . . . glutamine-glutamine-glutamine . . .
. . . serine-serine-serine . . .

Which of the following messenger RNA sequences could code for both of the two amino acid sequences above, simply by a shift in the reading frame?

(A) . . . AGCAGCAGCAGC . . .

(B) . . . AGUAGUAGUAGU . . .

(C) . . . CAACAACAACAA . . .

(D) . . . GCUGCUGCUGCU . . .

(E) . . . GCAAGCGCAAGC . . .

116. glycine-serine-glycine

Which of the following DNA strands will code for the amino acid sequence shown above?

(A) ACTCCTTCT

(B) TCTCCGTCG

(C) CCGTCGACT

(D) CCTCCGTCG

(E) CCTTCGCCT

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Questions 117-120 refer to the data in Figures 1 through 4 below, which were collected during a study of the growth of plant seedlings.

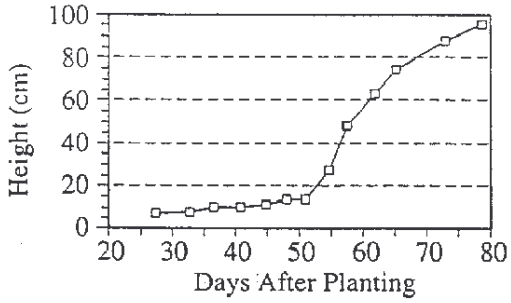

Figure 1

Figure 1 shows the average height of control seedings as a function of time after planting.

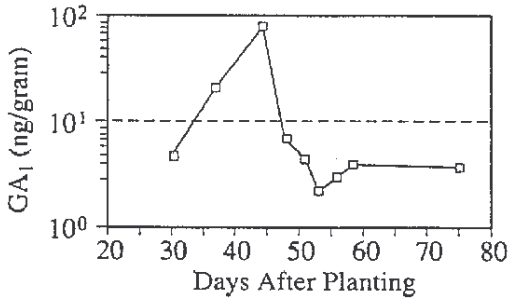

Figure 2

Figure 2 shows the concentration of one specific gibberellin compound, GA_1, that can be extracted from the plant seedling tissues (in units of nanograms of GA_1 per gram of plant tissue).

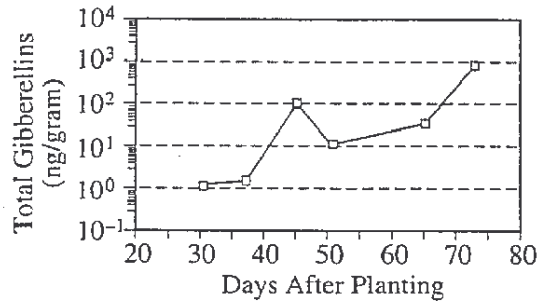

Figure 3

Figure 3 shows the concentration of all gibberellins that have physiological activity, including GA_1.

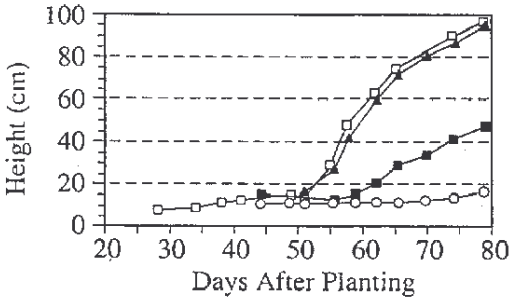

Figure 4

Figure 4 shows the patterns of growth that result when solutions containing different concentrations of an inhibitor of GA_1 synthesis are sprayed on the plant seedlings at regular intervals during the growth period.

Key

- □ Control seedlings not treated with inhibitor
- ▲ Seedlings treated with inhibitor at a concentration of 0.6 mg/ml
- ■ Seedlings treated with inhibitor at a concentration of 6.0 mg/ml
- ○ Seedlings treated with inhibitor at a concentration of 60.0 mg/ml

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117. The concentration of all gibberellins 65 days after planting is approximately

(A) 5 ng/gram
(B) 10 ng/gram
(C) 20 ng/gram
(D) 120 ng/gram
(E) 150 ng/gram

118. When the concentration of GA_1 is highest, the average height of the control seedlings is approximately

(A) 10 cm
(B) 30 cm
(C) 60 cm
(D) 85 cm
(E) 95 cm

119. Which of the following is a correct conclusion that can be drawn from the data in Figures 1, 2, and 3 ?

(A) Most of the increase in the concentration of all gibberellins 40 to 45 days after planting is due to an increase in the concentration of GA_1.
(B) The concentration of all gibberellins is three times as great at 75 days as it is at 30 days after planting.
(C) An increase in GA_1 levels occurs a day or two before the seedlings start to grow rapidly.
(D) An increase in the concentration of GA_1 inhibits the synthesis of other gibberellins.
(E) The concentration of GA_1 is a thousand times as great at 45 days as it is at 30 days after planting.

120. Which of the following is a correct conclusion that can be drawn based only on the data in Figure 4 ?

(A) Seedling growth rates decrease between 50 and 80 days after planting at all concentrations of the inhibitor.
(B) The greater the inhibition of GA_1 synthesis, the lower the plant height after 80 days.
(C) The spraying of GA_1 on seedlings results in an increase in seedling growth rates.
(D) The inhibitor kills the seedlings when it is applied in very high concentrations.
(E) The growth of the seedlings is directly proportional to the concentrations of inhibitor.

S T O P

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION.

DO NOT GO ON UNTIL YOU ARE TOLD TO DO SO.

1994

The College Board

Advanced Placement Examination

BIOLOGY

SECTION II

You are expected to answer each of the four questions in this green essay booklet. Since each question will be weighted equally, you are advised to divide your time equally among them, without spending too much time on any one question. Suggested times will not be announced, and you may proceed freely from one question to the next. Do not spend too much time on any one question. A writing time of approximately 22 minutes is suggested for each question.

Although this green booklet may be used for reference and/or scratchwork, be sure to write your answers in the pink booklet. No credit will be given for anything written in the green booklet.

DO NOT BREAK THE SEAL UNTIL YOU ARE TOLD TO DO SO.

BIOLOGY

SECTION II

Time—1 hour and 30 minutes

Answer all questions. Number your answer as the question is numbered below.

Answers must be in essay form. Outline form is NOT acceptable. Labeled diagrams may be used to supplement discussion, but in no case will a diagram alone suffice. It is important that you read each question completely before you begin to write.

1. Genetic variation is the raw material for evolution.
   a. Explain **three** cellular and/or molecular mechanisms that introduce variation into the gene pool of a plant or animal population.
   b. Explain the evolutionary mechanisms that can change the composition of the gene pool.

2. Discuss how cellular structures, including the plasma membrane, specialized endoplasmic reticulum, cytoskeletal elements, and mitochondria, function together in the contraction of skeletal muscle cells.

3. Enzymes are biological catalysts.
   a. Relate the chemical structure of an enzyme to its specificity and catalytic activity.
   b. Design a quantitative experiment to investigate the influence of pH **or** temperature on the activity of an enzyme.
   c. Describe what information concerning the structure of an enzyme could be inferred from your experiment.

4. Select **two** of the following three pairs and discuss the evolutionary relationships between the two members of each pair you have chosen. In your discussion include structural adaptations and their functional significance.

   PAIR A: green algae
   vascular plants

   PAIR B: prokaryotes
   eukaryotes

   PAIR C: amphibians
   reptiles

END OF EXAMINATION

Chapter III

Answers to the 1994 AP Biology Examination

SECTION I: MULTIPLE-CHOICE

Listed below are the correct answers to the multiple-choice questions and the percentage of AP candidates who answered each question correctly. As a general rule, candidates who did well in this section also achieved a higher mean score on the exam as a whole than candidates who did not do as well. An answer sheet gridded with the correct responses appears on the next page.

Section I Answer Key and Percent Answering Correctly

Item No.	Correct Answer	Percent Correct	Item No.	Correct Answer	Percent Correct	Item No.	Correct Answer	Percent Correct
1	B	84%	41	B	28%	81	C	97%
2	A	82%	42	C	41%	82	A	42%
3	A	77%	43	D	18%	83	B	54%
4	C	79%	44	B	54%	84	D	36%
5	D	75%	45	C	50%	85	E	48%
6	C	69%	46	C	54%	86	A	34%
7	B	64%	47	D	52%	87	D	66%
8	B	66%	48	E	36%	88	E	57%
9	A	85%	49	C	50%	89	B	56%
10	C	73%	50	C	49%	90	E	30%
11	E	68%	51	E	56%	91	B	61%
12	D	65%	52	B	49%	92	E	54%
13	E	58%	53	D	50%	93	D	56%
14	D	68%	54	A	43%	94	A	43%
15	C	71%	55	A	45%	95	E	74%
16	A	67%	56	E	19%	96	C	77%
17	E	64%	57	C	42%	97	E	91%
18	D	51%	58	B	49%	98	A	45%
19	E	75%	59	A	71%	99	D	60%
20	C	40%	60	D	27%	100	C	86%
21	D	65%	61	D	21%	101	D	52%
22	D	21%	62	D	29%	102	D	55%
23	A	59%	63	C	59%	103	C	51%
24	E	71%	64	C	51%	104	B	77%
25	C	42%	65	D	29%	105	B	48%
26	A	63%	66	A	30%	106	D	47%
27	B	76%	67	A	17%	107	C	58%
28	A	46%	68	E	86%	108	A	51%
29	E	48%	69	B	94%	109	C	56%
30	D	60%	70	A	95%	110	A	91%
31	D	39%	71	C	95%	111	B	79%
32	B	61%	72	A	84%	112	C	43%
33	B	51%	73	E	58%	113	A	52%
34	E	56%	74	D	93%	114	C	55%
35	B	65%	75	B	88%	115	A	60%
36	D	59%	76	D	86%	116	E	83%
37	B	61%	77	E	52%	117	C	48%
38	B	38%	78	E	61%	118	A	68%
39	C	73%	79	A	64%	119	A	37%
40	A	30%	80	A	13%	120	B	57%