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**The Princeton Review
AP Biology
Practice Test 1**

BIOLOGY

Three hours are allotted for this examination: 1 hour and 20 minutes for Section I, which consists of multiple-choice questions, and 1 hour and 40 minutes for Section II, which consists of essay questions.

SECTION I

Time—1 hour and 20 minutes

Number of questions—100

Percent of total grade—60

Section I of this examination contains 100 multiple-choice questions, followed by 15 multiple-choice questions regarding your preparation for this exam. Please be careful to fill in only the ovals that are preceded by numbers 1 through 115 on your answer sheet.

General Instructions

INDICATE ALL YOUR ANSWERS TO QUESTIONS IN SECTION I ON THE SEPARATE ANSWER SHEET ENCLOSED. No credit will be given for anything written in this examination booklet, but you may use the booklet for notes or scratchwork. After you have decided which of the suggested answers is best, COMPLETELY fill in the corresponding oval on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely.

Example:

Chicago is a

- (A) state
- (B) city
- (C) country
- (D) continent
- (E) village

Sample Answer

(A) ● (C) (D) (E)

Use your time effectively, working as rapidly as you can without losing accuracy. Do not spend too much time on questions that are too difficult. Go on to other questions and come back to the difficult ones later if you have time. It is not expected that everyone will be able to answer all the multiple-choice questions.

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.

- The resting membrane potential depends on which of the following?
 - Active transport
 - Selective permeability
 - Differential distribution of ions across the axonal membrane
 - II only
 - III only
 - I and II only
 - II and III only
 - I, II, and III
- The Krebs cycle in humans occurs in the
 - cytoplasm
 - mitochondrial matrix
 - inner mitochondrial membrane
 - outer mitochondrial membrane
 - intermembrane space
- A botanist travels to a mountainous, tropical country to participate in an expedition to study the fauna on one of that country's highest peaks. As he travels up the mountain, what are the principal terrestrial biomes he will most likely encounter?
 - Tropical rain forest–temperate deciduous forests–taiga–tundra
 - Tropical rain forest–tundra–temperate deciduous forest–taiga
 - Temperate deciduous forest–tropical rain forest–tundra–taiga
 - Tropical rain forest–temperate deciduous forest–tundra–taiga
 - Tropical rain forest–taiga–temperate deciduous forest–tundra
- Regarding meiosis and mitosis, one difference between the two forms of cellular reproduction is that in meiosis
 - there is one round of cell division, whereas in mitosis there are two rounds of cell division
 - separation of sister chromatids occurs during the second division, whereas in mitosis separation of sister chromatids occurs during the first division
 - chromosomes are replicated during interphase, whereas in mitosis chromosomes are replicated during prophase
 - spindle fibers form during prophase, whereas in mitosis the spindle fibers form during metaphase
 - there is a reduction of the chromosome number, whereas in mitosis there is an increase in the chromosome number
- A feature of amino acids NOT found in carbohydrates is the presence of
 - carbon atoms
 - oxygen atoms
 - nitrogen atoms
 - hydrogen atoms
 - phosphorus atoms
- Which of the following is NOT a characteristic of bacteria?
 - Circular double-stranded DNA
 - Membrane-bound cellular organelles
 - Plasma membrane consisting of lipids and proteins
 - Ribosomes that synthesize polypeptides
 - Cell wall made of peptidoglycan

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7. Which of the following best explains why a population is described as the evolutionary unit?
- Genetic changes can only occur at the population level.
 - The gene pool in a population remains fixed over time.
 - Natural selection affects individuals, not populations.
 - Individuals cannot evolve, but populations can.
 - Most changes in a population's gene pool do not result in evolution.
8. The part of the brain that controls involuntary actions is known as the
- cerebellum
 - cerebrum
 - hypothalamus
 - medulla
 - thalamus
9. In woody dicots, primary xylem and phloem cells are replaced by secondary xylem and phloem cells that arise from the
- apical meristem
 - epidermis
 - vascular cambium
 - cork cambium
 - lenticels
10. A scientist carries out a cross between two guinea pigs, both of which have black coats. Black hair coat is dominant over white hair coat. Three quarters of the offspring have black coats, and one quarter have white coats. The genotypes of the parents were most likely
- $bb \times bb$
 - $Bb \times Bb$
 - $Bb \times bb$
 - $BB \times Bb$
 - $BB \times bb$
11. A large island is devastated by a volcanic eruption. Most of the horses die except for the heaviest males and heaviest females of the group. They survive, reproduce, and perpetuate the population. Since weight is highly heritable and the distribution of weights approximates a binomial distribution, the offspring of the next generation would be expected to have
- a higher mean weight compared with their parents
 - a lower mean weight compared with their parents
 - the same mean weight as members of the original population
 - a higher mean weight compared with members of the original population
 - a lower mean weight compared with members of the original population
12. Which of the following represents the correct sequence of events in embryonic development?
- Blastula–cleavage–morula–gastrula–neurula
 - Blastula–neurula–cleavage–morula–gastrula
 - Cleavage–morula–blastula–neurula–gastrula
 - Cleavage–morula–blastula–gastrula–neurula
 - Morula–blastula–gastrula–cleavage–neurula
13. During the period when life is believed to have begun, the atmosphere on primitive Earth contained abundant amounts of all the following gases EXCEPT
- oxygen
 - hydrogen
 - ammonia
 - methane
 - water
14. A woman with blood genotype $I^A i$ and a man with blood genotype $I^B i$ have two children, both type AB. What is the probability that a third child will be blood type AB?
- $\frac{3}{4}$
 - $\frac{1}{2}$
 - $\frac{1}{4}$
 - $\frac{1}{8}$
 - 0

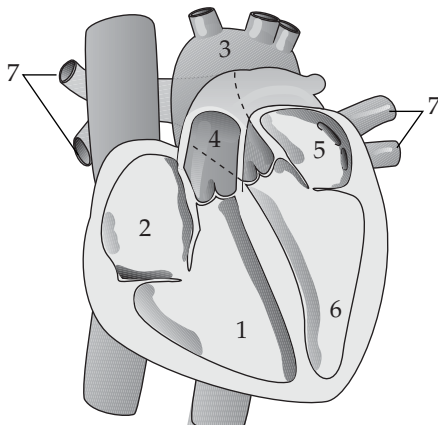
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15. The trophic level efficiency of large herbivores such as elks is frequently only about 5 percent. Which of the following is the most likely explanation for this low efficiency?
- (A) Elks have a lower rate of consumption than do other herbivores.
 - (B) The digestive systems of large herbivores are not entirely efficient.
 - (C) Large herbivores expend greater amounts of energy in respiration during their search for food than do carnivores.
 - (D) Consuming producers is an inefficient way of obtaining energy.
 - (E) Large herbivores lose more body heat than other herbivores.
16. An organism that is more complex than a platyhelminth but more primitive than an arthropod is most likely to be
- (A) an annelid
 - (B) an echinoderm
 - (C) a chordate
 - (D) a sponge
 - (E) a coelenterate
17. Which of the following does NOT take place in the small intestine?
- (A) Pancreatic lipase breaks down fats to fatty acids and glycerol.
 - (B) Pepsin breaks down proteins to amino acids.
 - (C) Pancreatic amylase breaks down carbohydrates into simple sugars.
 - (D) Bile emulsifies fats into smaller fat particles.
 - (E) Digested food is absorbed by capillaries in the villi.
18. In animal cells, which of the following represents the most likely pathway that a secretory protein takes as it is synthesized in a cell?
- (A) Plasma membrane–Golgi apparatus–ribosome–rough ER–secretory vesicle
 - (B) Plasma membrane–Golgi apparatus–ribosome–secretory vesicle–rough ER
 - (C) Ribosome–Golgi apparatus–rough ER–secretory vesicle–plasma membrane
 - (D) Plasma membrane–Golgi apparatus–ribosome–secretory vesicle–rough ER
 - (E) Ribosome–rough ER–Golgi apparatus–secretory vesicle–plasma membrane
19. All of the following statements are correct regarding alleles EXCEPT:
- (A) Alleles are alternative forms of the same gene.
 - (B) Alleles are found on corresponding loci of homologous chromosomes.
 - (C) A gene can have more than two alleles.
 - (D) One allele can be dominant, and the other recessive.
 - (E) An individual with two identical alleles is said to be heterozygous with respect to that gene.
20. Once a plasmid has incorporated specific genes, such as the gene coding for the antibiotic ampicillin, into its genome, the plasmid may be cloned by
- (A) inserting it into a virus to generate multiple copies
 - (B) treating it with a restriction enzyme in order to cut the molecule into small pieces
 - (C) inserting it into a suitable bacterium in order to produce multiple copies
 - (D) running it on a gel electrophoresis in order to determine the size of the gene of interest
 - (E) infecting it with a mutant cell in order to incorporate the gene of interest
21. Although mutations occur at a regular and predictable rate, which of the following statements is the LEAST likely reason the frequency of mutation appears to be low?
- (A) Some mutations produce alleles that are recessive and may not be expressed.
 - (B) Some undesirable phenotypic traits may be prevented from reproducing.
 - (C) Some mutations cause such drastic phenotypic changes that they are removed from the gene pool.
 - (D) The predictable rate of mutation results in ongoing variability in a gene pool.
 - (E) The predictable rate of mutation is offset by a small rate of back mutation.

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22. Which of the following adaptive features would be found in flowering plants that live in an arid climate?
- (A) Vascular tissues
 - (B) Stomates
 - (C) Thick cuticles
 - (D) Multiple leaves
 - (E) Megaspores
23. Which of the following best accounts for the ability of legumes to grow well in nitrogen-poor soils?
- (A) These plants make their own proteins.
 - (B) These plants have a mutualistic relationship with nitrogen-fixing bacteria.
 - (C) These plants are capable of directly converting nitrogen gas into nitrates.
 - (D) These plants do not require nitrogen to make plant proteins.
 - (E) These plants have developed nitrogen-absorbing root hairs.
24. In a mammalian embryo, the mesoderm gives rise to
- (A) the brain
 - (B) the nerves
 - (C) the skin
 - (D) the eyes
 - (E) the ovaries
25. In chick embryos, the extraembryonic membrane that provides nourishment to the fetus is the
- (A) amnion
 - (B) chorion
 - (C) placenta
 - (D) ovary
 - (E) egg yolk
26. Some strains of viruses can change normal mammalian cells into cancer cells in vitro. This transformation of the mammalian cell is usually associated with the
- (A) formation of a pilus between the mammalian cell and the virus
 - (B) incorporation of the viral genome into the mammalian cell's nuclear DNA
 - (C) conversion of the host's genome into the viral DNA
 - (D) release of spores into the mammalian cell
 - (E) incorporation of free-floating DNA from the environment
27. The major difference between cartilage and bone is that cartilage
- (A) is a part of the skeletal system
 - (B) is composed of collagen and salts
 - (C) lacks blood vessels and nerves
 - (D) secretes a matrix
 - (E) is a type of connective tissue
28. All of the following are examples of events that can prevent interspecific breeding EXCEPT:
- (A) The potential mates experience geographic isolation.
 - (B) The potential mates experience behavioral isolation.
 - (C) The potential mates have different courtship rituals.
 - (D) The potential mates have similar breeding seasons.
 - (E) The gametes of potential mates have biochemical differences.

Question 25 refers to the diagram below.



25. Which of the following chambers or vessels carry deoxygenated blood in the human heart?
- (A) 4 only
 - (B) 1 and 2 only
 - (C) 5 only
 - (D) 1, 2 and 4
 - (E) 3, 5, and 6

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30. Which of the following is NOT a characteristic of asexual reproduction in animals?
- (A) Daughter cells have the same number of chromosomes as the parent cell.
 - (B) Daughter cells are identical to the parent cell.
 - (C) The parent cell produces diploid cells.
 - (D) The daughter cells fuse to form a zygote.
 - (E) The chromosomes replicate during interphase.
31. Which of the following is the correct characteristic of arteries?
- (A) They are thin-walled blood vessels.
 - (B) They contain valves that prevent backflow.
 - (C) They always carry oxygenated blood.
 - (D) They carry blood away from the heart.
 - (E) Blood is kept moving by the contraction of voluntary muscles.
32. Plant hormones that promote elongation and the development of buds and fruits are
- (A) cytokinins
 - (B) auxins
 - (C) gibberellins
 - (D) abscisic acids
 - (E) ethylenes
33. In angiosperms, when the ovule is fertilized, the zygote develops into an embryonic plant. During this process, which part of the plant becomes a seed?
- (A) The ovule
 - (B) The ovary
 - (C) The pollen grains
 - (D) The cotyledons
 - (E) The fertilized egg
34. If the genotype frequencies of an insect population are $AA = 0.49$, $Aa = 0.42$, and $aa = 0.09$, what is the gene frequency of the dominant allele?
- (A) 0.07
 - (B) 0.30
 - (C) 0.49
 - (D) 0.50
 - (E) 0.70
35. Crossing-over occurs during which of the following phases in meiosis?
- (A) Prophase I
 - (B) Metaphase I
 - (C) Anaphase I
 - (D) Prophase II
 - (E) Metaphase II
36. Which of the following statements about sexual reproduction in flowering plants is NOT true?
- (A) Meiosis takes place in the ovules.
 - (B) A megaspore becomes the female gametophyte.
 - (C) A pollen tube grows down the style and into the ovary.
 - (D) Microspores are produced in the style.
 - (E) The triploid cell becomes the endosperm, which nourishes the embryo.
37. Bryophytes generally differ from tracheophytes in that bryophytes have
- (A) a protective layer around their gametes
 - (B) conducting tissues
 - (C) stomates in leaf surfaces
 - (D) waxy cuticles on their outer surfaces
 - (E) water-borne motile sperm
38. In most ecosystems, net primary productivity is important because it represents the
- (A) energy available to producers
 - (B) total solar energy converted to chemical energy by producers
 - (C) biomass of all producers
 - (D) energy available to heterotrophs
 - (E) chemical energy expended by producers
39. Hawkmoths are insects that are similar in appearance and behavior to hummingbirds. Which of the following is LEAST valid?
- (A) These organisms are examples of convergent evolution.
 - (B) These organisms were subjected to similar environmental conditions.
 - (C) These organisms are genetically related to each other.
 - (D) These organisms have analogous structures.
 - (E) These organisms can survive in similar habitats.
40. If an invertebrate possesses malpighian tubules, a tracheal breathing system, and an open circulatory system, it is most likely to be
- (A) a snail
 - (B) a sponge
 - (C) a butterfly
 - (D) an earthworm
 - (E) a flatworm

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41. Destruction of all beta cells in the pancreas will cause which of the following to occur?
- Glucagon secretion will stop and blood glucose levels will increase.
 - Glucagon secretion will stop and blood glucose levels will decrease.
 - Glucagon secretion will stop and digestive enzymes will be secreted.
 - Insulin secretion will stop and blood glucose levels will increase.
 - Insulin secretion will stop and blood glucose levels will decrease.
42. All of the following are stimulated by the sympathetic nervous system EXCEPT
- dilation of the pupil of the eye
 - constriction of blood vessels
 - increased secretion of the sweat glands
 - increased peristalsis in the gastrointestinal tract
 - increased heart rate
43. The calypso orchid, *Calypso bulbosa*, grows in close association with mycorrhizae fungi. The fungi penetrate the roots of the flower and take advantage of the plant's food resources. The fungi concentrate rare minerals, such as phosphates, in the roots and make them readily accessible to the orchid. This situation is an example of
- parasitism
 - commensalism
 - mutualism
 - endosymbiosis
 - altruism
44. Which of the following are characteristics of both bacteria and fungi?
- Cell wall, DNA, and plasma membrane
 - Nucleus, organelles, and unicellularity
 - Plasma membrane, multicellularity, and Golgi apparatus
 - Cell wall, unicellularity, and mitochondria
 - Nucleus, RNA, and cell wall
45. A sustained decrease in circulating Ca^{2+} levels might be caused by decreased levels of which of the following substances?
- Growth hormone
 - Parathyroid hormone
 - Thyroid hormone
 - Calcitonin
 - Glucagon
46. The synthesis of new proteins necessary for lactose utilization by the bacterium *E. coli* using the *lac* operon is regulated
- by the synthesis of additional ribosomes
 - at the transcription stage
 - at the translation stage
 - by differential replication of the DNA that codes for lactose-utilizing mechanisms
 - by a positive-feedback system
47. Which of the following statements about trypsin is NOT true?
- It is an organic compound made of proteins.
 - It is a catalyst that alters the rate of a reaction.
 - It is operative over a wide pH range.
 - The rate of catalysis is affected by the concentration of substrate.
 - It denatures if exposed to high temperatures.
48. A population of paramecia has the scientific name *P. aurelia*, whereas another population has the name *P. caudatum*. This method of classification indicates that the organisms do NOT belong to the same
- phylum
 - class
 - family
 - genus
 - species
49. In DNA replication, which of the following does NOT occur?
- Helicase unwinds the double helix.
 - DNA ligase links the Okazaki fragments.
 - RNA polymerase is used to elongate both chains of the helix.
 - DNA strands grow in the 5' to 3' direction.
 - Complementary bases attach to each DNA strand.
50. A change in a neuron membrane potential from +50 millivolts to -70 millivolts is considered
- depolarization
 - repolarization
 - hyperpolarization
 - an action potential
 - saltatory conduction

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51. The energy given up by electrons as they move through the electron transport chain is used to
- (A) break down glucose
 - (B) make glucose
 - (C) produce ATP
 - (D) make NADH
 - (E) make FADH_2
52. If a photosynthesizing plant began to release $^{18}\text{O}_2$ instead of normal oxygen, one could most reasonably conclude that the plant had been supplied with
- (A) H_2O containing radioactive oxygen
 - (B) CO_2 containing radioactive oxygen
 - (C) $\text{C}_6\text{H}_{12}\text{O}_6$ containing radioactive oxygen
 - (D) NO_2 containing radioactive oxygen
 - (E) oxygen from the atmosphere
53. All of the following statements describe the unique characteristics of water EXCEPT:
- (A) It is a polar solvent.
 - (B) It is relatively resistant to temperature changes.
 - (C) It forms hydrogen bonds with disaccharides.
 - (D) It can dissociate into hydrogen ions and hydroxide ions.
 - (E) It is a hydrophobic solvent.
54. Chemical substances released by organisms that elicit a physiological or behavioral response in other members of the same species are known as
- (A) auxins
 - (B) hormones
 - (C) pheromones
 - (D) enzymes
 - (E) coenzymes
55. Homologous structures are often cited as evidence for the process of natural selection. All of the following are examples of homologous structures EXCEPT
- (A) the wings of a bird and the wings of a bat
 - (B) the flippers of a whale and the arms of a man
 - (C) the pectoral fins of a porpoise and the flippers of a seal
 - (D) the forelegs of an insect and the forelimbs of a dog
 - (E) the hind legs of a lizard and the legs of a chicken
56. The sliding action in the myofibril of skeletal muscle contraction requires which of the following?
- I. Ca^{2+}
 - II. ATP
 - III. actin
- (A) I only
 - (B) II only
 - (C) I and III
 - (D) II and III
 - (E) I, II, and III
57. Certain populations of finches have long been isolated on the Galapagos Islands off the western coast of South America. Compared with the larger stock population of mainland finches, these separate populations exhibit far greater variation over a wider range of species. The variation among these numerous finch species is the result of
- (A) convergent evolution
 - (B) divergent evolution
 - (C) disruptive selection
 - (D) stabilizing selection
 - (E) directional selection
58. Which of the following contributes the MOST to genetic variability in a population?
- (A) Mitosis
 - (B) Sporulation
 - (C) Binary fission
 - (D) Vegetative propagation
 - (E) Mutation

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Directions: Each group of questions consist 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 59–62 refer to evolutionary relationships

- (A) Analogous structures
- (B) Homologous structures
- (C) Vestigial structures
- (D) Convergent evolution
- (E) Divergent evolution

From the terms listed above, choose the one that most clearly accounts for the similarities between the members of each pair listed below.

- 59. The lung of a reptile and the air bladder of a fish
- 60. The spine of a sea urchin and the quill of a porcupine
- 61. The appendix of a human and the hipbone of a whale
- 62. The large digging claws and long snouts seen in both marsupial moles and placental moles

Questions 63–65 refer to plant structures

- (A) Stomata
- (B) Lenticel
- (C) Palisade
- (D) Stroma
- (E) Cuticle

- 63. Porous area that facilitates gas exchange in woody stems
- 64. Tiny opening that regulates gas exchange in the leaf
- 65. Layer of leaf mesophyll with chloroplast-containing cells

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Questions 66–69 refer to different types of reproduction

- (A) Sporulation
- (B) Budding
- (C) Regeneration
- (D) Binary fission
- (E) Vegetative propagation

66. Asexual reproduction in bacteria
67. The restoration of severed appendages
68. Asexual reproduction in yeasts in which smaller cells grow from a parent cell
69. Asexual reproduction in which new plants develop from roots, stems, or leaves of the parent plant

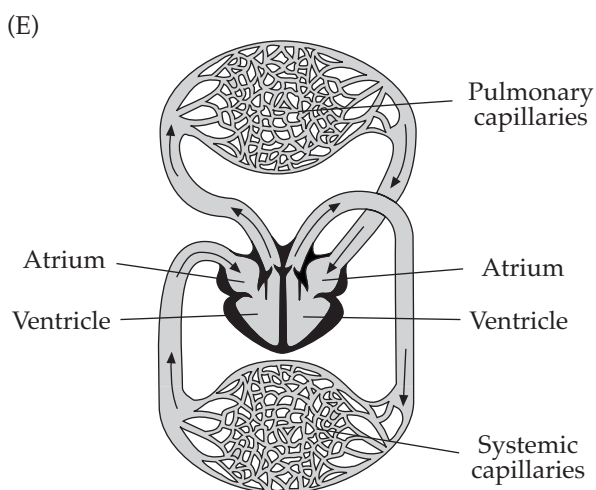
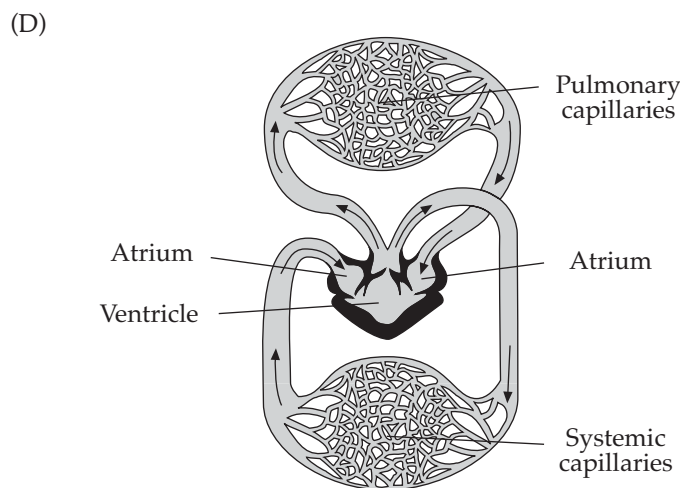
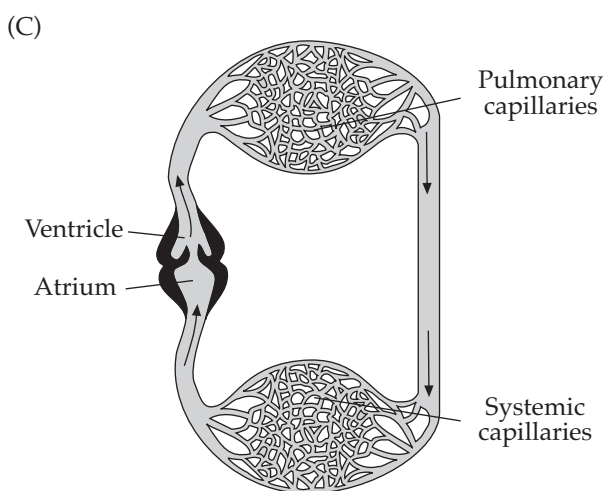
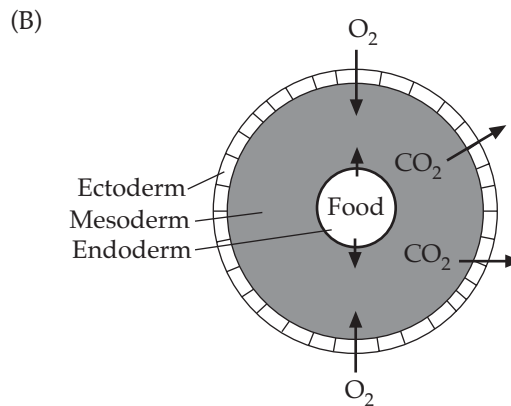
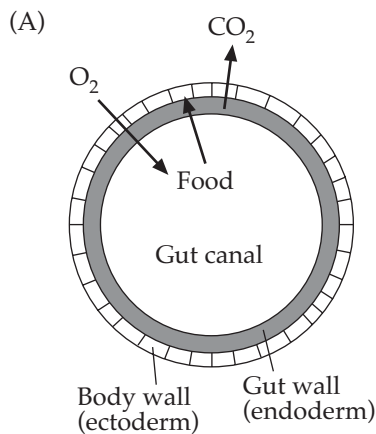
Questions 70–73 refer to different biologically important organic molecules

- (A) Nucleic acid
- (B) Protein
- (C) Cellulose
- (D) Triglyceride
- (E) Glycogen

70. Lipid that consists of three fatty acids covalently bonded to glycerol
71. The stored form of sugar in humans
72. A macromolecule that consists of a polymer of amino acids
73. A substance that cannot be broken down by cows

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Questions 74–77 refer to different circulatory systems



- 74. The circulatory system in birds
- 75. The circulatory system in hydras
- 76. The circulatory system in fish
- 77. The circulatory system in amphibians

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Questions 78–81 refer to different vertebrate classes

- (A) Class Crustacea
- (B) Class Reptilia
- (C) Class Pisces
- (D) Class Aves
- (E) Class Amphibia

78. Cold-blooded animals with dry, scaly bodies
79. Homeotherms with hollow, air-filled bones
80. Cold-blooded animals which lay eggs with leathery shells
81. Animals that respire through their gills, lungs, and moist, soft skin

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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 82–84 refer to the following information and graph.

A marine ecosystem was sampled in order to determine its food chain. The results of the study are shown below.

Type of Organism	Number of Organisms
Shark	2
Small crustaceans	400
Mackerel	20
Plankton	1000
Herring	100

82. Which of the following organisms in this population are secondary consumers?

- (A) Sharks
- (B) Mackerels
- (C) Herrings
- (D) Shrimp
- (E) Phytoplanktons

83. Which of the following organisms has the largest biomass in this food chain?

- (A) Phytoplanktons
- (B) Mackerels
- (C) Herrings
- (D) Shrimp
- (E) Sharks

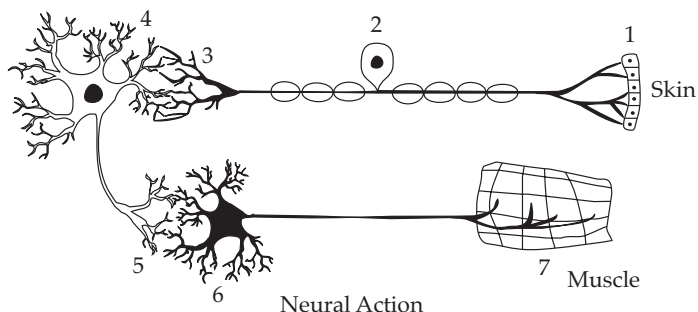
84. If the herring population is reduced by predation, which of the following is most likely to occur in this aquatic ecosystem?

- (A) The mackerels will be the largest predator in the ecosystem.
- (B) The shrimp population will be greatly reduced.
- (C) The plankton population will be reduced over the next year.
- (D) The shrimp will become extinct.
- (E) There will be no change in the number of sharks in the ecosystem.

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Questions 85–87 refer to the following information and diagram.

To understand the workings of neurons, an experiment was conducted to study the neural pathway of a reflex arc in frogs. A diagram of a reflex arc is given below.



85. Which of the following represents the correct pathway taken by a nerve impulse as it travels from the spinal cord to effector cells?

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

86. The brain of the frog is destroyed. A piece of acid-soaked paper is applied to the frog's skin. Every time the piece of paper is placed on its skin, one leg moves upward. Which of the following conclusions is best supported by the experiment?

- (A) Reflex actions are not automatic.
- (B) Some reflex actions can be inhibited or facilitated.
- (C) All behaviors in frogs are primarily reflex responses.
- (D) This reflex action bypasses the brain.
- (E) Reflex responses account for the total behavior in frogs.

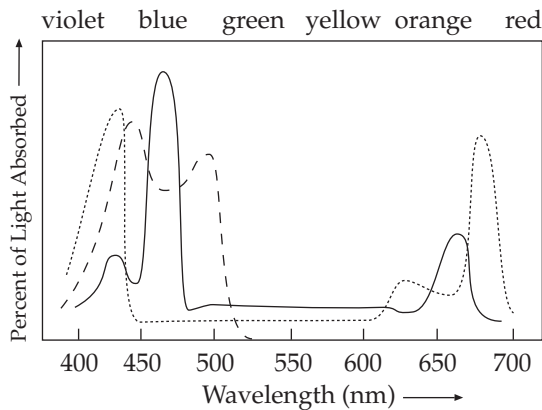
87. A nerve impulse requires the release of neurotransmitters at the axonal bulb of a presynaptic neuron. Which of the following best explains the purpose of neurotransmitters, such as acetylcholine?

- (A) They speed up the nerve conduction in a neuron.
- (B) They open the sodium channels in the axonal membrane.
- (C) They excite or inhibit the postsynaptic neuron.
- (D) They open the potassium channels in the axonal membrane.
- (E) They force potassium ions to move against the concentration gradient within the axonal membrane.

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Questions 88–90 refer to the following graph and information.

An experiment was conducted to observe the light-absorbing properties of chlorophylls and carotenoids using a spectrophotometer. The pigments were first extracted and dissolved in a solution. They were then illuminated with pure light of different wavelengths to detect which wavelengths were absorbed by the solution. The results are presented in the absorption spectrum below.



Absorption Spectrum for Green Plants

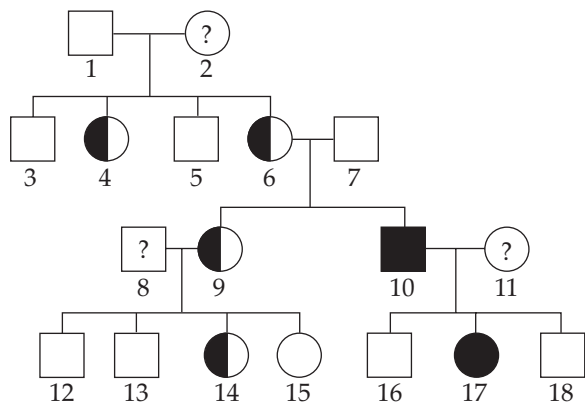
- Chlorophyll *a*
- Chlorophyll *b*
- - - - Carotenoids

88. At approximately what wavelength does chlorophyll *a* maximally absorb light?
- (A) 425 nm
 - (B) 450 nm
 - (C) 575 nm
 - (D) 640 nm
 - (E) 680 nm

89. Which of the following color ranges were strongly absorbed by the chlorophyll pigments?
- (A) Yellow–green and orange–red
 - (B) Violet–blue and orange–red
 - (C) Blue–green and yellow–orange
 - (D) Blue–green and orange–red
 - (E) Orange–red and yellow–green
90. Which of the following conclusions can be drawn from the experiment?
- (A) Light reflected by the pigments is involved in photosynthesis.
 - (B) All wavelengths of light that reach the leaf can be utilized for photosynthesis.
 - (C) Photosynthetic pigments selectively absorb various wavelengths of light.
 - (D) All wavelengths of visible light are absorbed and used by the plant.
 - (E) The light reflected from leaves consists mainly of violet–blue light.

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Questions 91–92 refer to the following graph. A pedigree was established to trace the colorblindness allele through four generations.

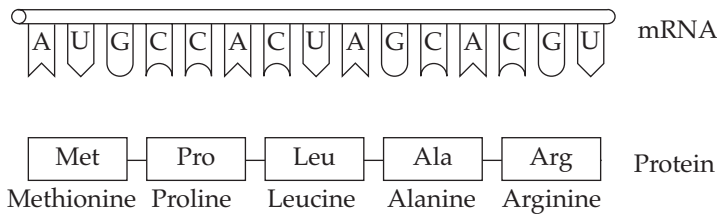


Family Tree for Color Blindness

91. Based on the pedigree above, what is the probability that a male child born to individuals 6 and 7 will be color-blind?
- (A) 0
 (B) $\frac{1}{4}$
 (C) $\frac{1}{2}$
 (D) $\frac{3}{4}$
 (E) 1
92. In this family tree, individual 2 can best be classified as a
- (A) normal male
 (B) normal noncarrier female
 (C) color-blind male
 (D) carrier female
 (E) color-blind female

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Questions 93–95 refer to the figure and chart below.



Formation of a Protein

The Genetic Code: Condons of mRNA that Specify a Given Amino Acid					
First Position (5' end)	Second Position	Third Position (3' end)			
		U	C	A	G
U	U	UUU	UUC	UUA	UUG
		Phenylalanine		Leucine	
	C	UCU	UCC	UCA	UCG
		Serine			
A	UAU	UAC	UAA	UAG	
	Tyrosine				
G	UGU	UGC	UGA	UGG	
	Cysteine			Tryptophan	
C	U	CUU	CUC	CUA	CUG
		Leucine			
	C	CCU	CCC	CCA	CCG
		Proline			
A	CAU	CAC	CAA	CAG	
	Histidine		Glutamine		
G	CGU	CGC	CGA	CGG	
	Arginine				
A	U	AUU	AUC	AUA	AUG
		Isoleucine			
	C	ACU	ACC	ACA	ACG
		Threonine			
A	AAU	AAC	AAA	AAG	
	Asparagine		Lysine		
G	AGU	AGC	AGA	AGG	
	Serine		Arginine		
G	U	GUU	GUC	GUA	GUG
		Valine			
	C	GCU	GCC	GCA	GCG
A	GAU	GAC	GAA	GAG	
	Aspartic Acid		Glutamic acid		
G	GGU	GGC	GGA	GGG	
	Glycine				

93. Which of the following DNA strands would serve as a template for the amino acid sequence shown above?

- (A) 3' -ATGCGACCAGCACGT- 5'
- (B) 3' -AUGCCACUAGCACGU- 5'
- (C) 3' -TACGGTGATCGTGCA- 5'
- (D) 3' -UACGGUGAUCGUGCA- 5'
- (E) 3' -TGCACGATCACCGTA- 5'

94. If a mutation occurs in which uracil is deleted from the messenger RNA after methionine is translated, which of the following represents the resulting amino acid sequence?

- (A) serine–histidine–serine–threonine
- (B) methionine–proline–glutamine–histidine
- (C) methionine–proline–leucine–alanine–arginine
- (D) methionine–proline–alanine–arginine–arginine
- (E) serine–proline–leucine–alanine–arginine

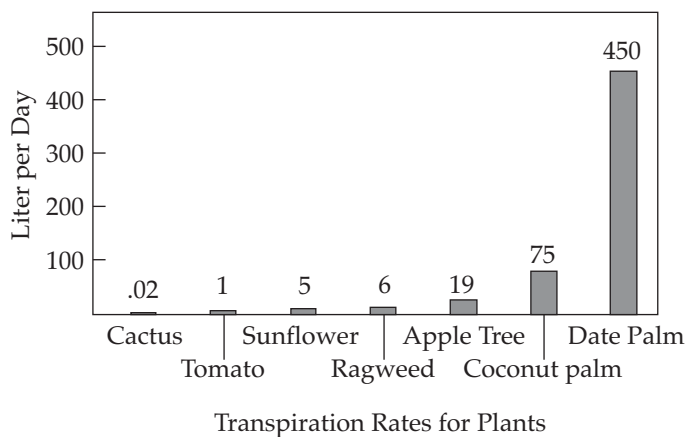
95. The mRNA above was found to be much smaller than the original mRNA synthesized in the nucleus. This is due to the

- (A) addition of a poly(A) tail to the mRNA molecule
- (B) addition of a cap to the mRNA molecule
- (C) excision of exons from the mRNA molecule
- (D) excision of introns from the mRNA molecule
- (E) translation of the mRNA molecule

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Questions 96–98 refer to the following chart.

The loss of water by evaporation from the leaf openings is known as transpiration. The transpiration rates of various plants are shown below.



96. How many liters of water per week are lost by a coconut palm?

- (A) 19
- (B) 25
- (C) 75
- (D) 450
- (E) 525

97. During transpiration, water passes from the soil to the leaves via

- (A) tracheids
- (B) sieve-tube cells
- (C) lenticels
- (D) companion cells
- (E) spongy cells

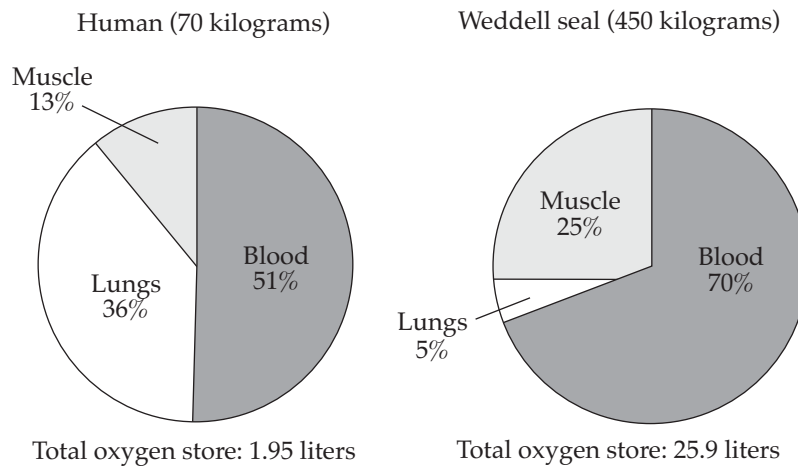
98. Transpiration aids in the transport of water by doing all of the following EXCEPT

- (A) directing the upward movement of water to leaves
- (B) keeping the air spaces of leaves moist
- (C) increasing water pressure in the roots
- (D) contributing to the cooling of the plant through exudation
- (E) increasing the amount of food absorbed by the plant

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Questions 99–100 refer to the following information.

A scientist studies the storage and distribution of oxygen in humans and Weddell seals to examine the physiological adaptations that permit seals to descend to great depths and stay submerged for extended periods. The figure below depicts the oxygen storage in both organisms.



99. Compared with humans, approximately how many liters of oxygen does the Weddell seal store per kilogram of body weight?
- (A) The same amount of oxygen
 - (B) Twice the amount of oxygen
 - (C) Three times the amount of oxygen
 - (D) Five times the amount of oxygen
 - (E) Thirteen times the amount of oxygen
100. During a dive, a Weddell seal's blood flow to the abdominal organs is shut off and oxygen-rich blood is diverted to the eyes, brain, and spinal cord. Which of the following is the most likely reason for this adaptation?
- (A) To increase the number of red blood cells in the nervous system
 - (B) To increase the amount of oxygen reaching the skeletomuscular system
 - (C) To increase the amount of oxygen reaching the central nervous system
 - (D) To increase the oxygen concentration in the lungs
 - (E) To decrease the extreme pressure on the diving seal

STOP

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.

BIOLOGY
SECTION II

Planning time—10 minutes

Writing time—1 hour and 30 minutes

You will have 10 minutes to read the exam questions. Spend this time reading through all of the questions, noting possible problem-solving approaches and otherwise planning your answers. It's fine to make notes on the green question insert, but be sure to write your answers and anything else that might be worth partial credit in the pink answer booklet—the graders will not see the green insert. After 10 minutes you will be told to break the seal on the pink Free-Response booklet and begin writing your answers in that booklet.

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. The cell membrane is an important structural feature of a nerve cell.
 - a. **Describe** how the cell membrane of a neuron is similar to the cell membrane of other cells in the transport of materials across a membrane.
 - b. **Discuss** what ions and concentration are associated with the resting state of a neuron.
 - c. **Describe** the role of membranes in the conduction of a nerve impulse.
2. Before plants could survive on land, several adaptational problems had to be solved.
 - a. **Describe** the problems associated with plant survival on land.
 - b. **Discuss two** structural adaptations that kept plants supplied with water.
 - c. **Describe two** other structures that contributed to their success in a terrestrial environment.
3. Sickle-cell anemia is a genetic disorder caused by the abnormal gene for hemoglobin S. A single substitution occurs in which glutamic acid is substituted for valine in the sixth position of the hemoglobin molecule. This change reduces hemoglobin's ability to carry oxygen.
 - a. **Discuss** the process by which mutation occurs in base substitution.
 - b. Biologists used gel electrophoresis to initially identify the mutant gene. **Explain** how gel electrophoresis could be applied to the identification of the gene mutation. **Discuss** the use of restriction enzymes.
 - c. Hemoglobin S is transmitted as a simple Mendelian allele. **Describe** the outcome if a female who does not carry the abnormal allele mates with a male homozygous for the disease. **Include** a Punnett square and phenotypic and genotypic ratios.
4. **Discuss** the Krebs cycle, the electron transport chain, and oxidative phosphorylation.
 - a. **Explain** why these steps are considered aerobic processes.
 - b. **Discuss** the location at which **each** stage occurs.
 - c. **Discuss** the role of NADH and FADH₂ in aerobic respiration.

END OF EXAMINATION