

# AP Biology Practice Exam

## Section I: Multiple-Choice Questions

Complete one hundred multiple-choice questions in 80 minutes, worth 60 percent of the total score.

### BIOLOGY

#### SECTION I

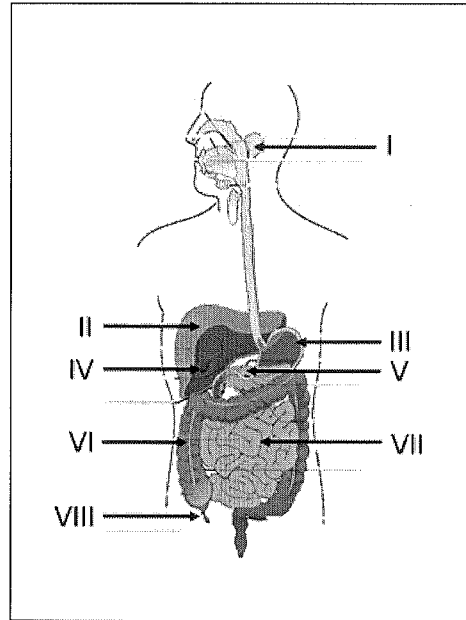
Time—80 minutes

100 Questions

**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.

1. During the evolutionary process, which of the following is the correct sequence of events?
  - A. Change in phenotype—change in genotype—speciation—selection
  - B. Speciation—change in genotype—selection—change in phenotype
  - C. Speciation—selection—change in phenotype—change in genotype
  - D. Change in genotype—change in phenotype—selection—speciation
  - E. Selection—speciation—change in phenotype—change in genotype
  
2. A lenticel is to a plant as a \_\_\_\_\_ is to an insect.
  - A. stoma
  - B. spiracle
  - C. trachea
  - D. mouth
  - E. siphon

Questions 3–6 refer to the following diagram.



3. Produce digestive enzymes.

- A. I, III, and V
- B. II, III, and V
- C. III, IV, V, and VIII
- D. I, III, V, and VII
- E. II, III, and IV

4. Produce(s) glucagon.

- A. II and IV
- B. III
- C. V
- D. VIII
- E. II and V

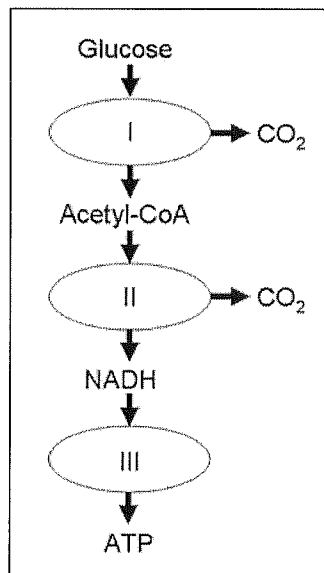
5. Absorbs lipids.
- A. III
  - B. VII
  - C. VI
  - D. IV
  - E. VIII
6. Produce(s) chyme.
- A. VIII
  - B. IV
  - C. VII and VIII
  - D. II and IV
  - E. III
7. A new biological structure has been discovered. It is larger than most bacteria. Although primarily composed of protein, it is covered with a lipid-based membrane. Its genetic material is double-stranded DNA, but the structure lacks RNA. The interior of the structure has ribosomes and a few enzymes. What is this?
- A. A virus
  - B. A protozoan
  - C. An alga
  - D. A bacterium
  - E. A prion

8. Dinitrophenol (DNP) is a compound that allows hydrogen ions to leak across a membrane. This leakage prevents the maintenance of an  $H^+$  gradient. How would this impact a cell?
- A. It would permit a greater growth rate, since the cell would no longer have to spend energy pumping  $H^+$  across the membrane.
  - B. It would permit a greater growth rate, because the equalization of  $H^+$  on both sides of a membrane would help the cell cope with an acidic environment.
  - C. If the cell were a neuron, it would have no impact, because the charge differential on the surface of the neuron membrane is based on  $Na^+$  and  $K^+$ , not on  $H^+$ .
  - D. The cell would lose the bulk of its energy production because of DNP's interference with chemiosmosis.
  - E. It would slow the growth rate slightly, but the cell would compensate by maintaining the function of proton pumps.
9. If you were to take 1.0 ml of a solution of HCl with a pH of 4.0 and add it to 9.0 ml of distilled water, what would be the pH of the final solution?
- A. The pH would remain unchanged.
  - B. The pH would rise to 5.5.
  - C. The pH would rise to 5.0.
  - D. The pH would be unmeasurable due to the amount of dilution.
  - E. The pH would rise to 7.0.
10. From where do the electrons used in photosynthesis originate?
- A. Glucose
  - B. NAD
  - C. Photons
  - D. Chlorophyll
  - E. Water

11. What distinguishes mammalian from plant cell membranes?
- A. Plant membranes contain chlorophyll, while mammalian membranes do not.
  - B. Mammalian membranes contain cholesterol, while plant membranes do not.
  - C. Plant membranes contain ion channels, while mammalian membranes do not.
  - D. Mammalian membranes are attached to a cytoskeleton, while plant cells are not.
  - E. Plant membranes contain cellulose, while mammalian cell membranes do not.
12. In fungi, sporangiospores are found in bag-like structures. Ascospores are also found in bag-like structures, but are always present in even numbers. Why are these spore types not the same?
- A. They are basically the same, but the sporangiospores are always larger.
  - B. Ascospores are formed as a result of meiosis, while sporangiospores are a result of mitosis.
  - C. Sporangiospores are produced by sexual recombination, while ascospores are produced asexually.
  - D. They are basically the same, but ascospores are always larger.
  - E. The structures are the same, but they were named differently before they were determined to have the same function.

13. One line of evidence for the evolutionary process is the identification of homologous structures. Of the following pairs of characteristics, which could be used in support of this mechanism?
- A. The wings of birds compared to the wings of insects
  - B. The eyes of insects compared to the eyes of humans
  - C. The cardiovascular system of animals compared to the vascular system of plants
  - D. The wings of birds compared to the legs of bats
  - E. The fins of whales compared to the hooves of horses
14. If a person contracts and survives an infectious disease such as measles, they tend not to get the disease again later in life. What cells are involved in this protective process?
- A. Platelets
  - B. Neurons
  - C. Lymphocytes
  - D. Neutrophils
  - E. Erythrocytes

Questions 15–17 refer to the following simplified diagram.

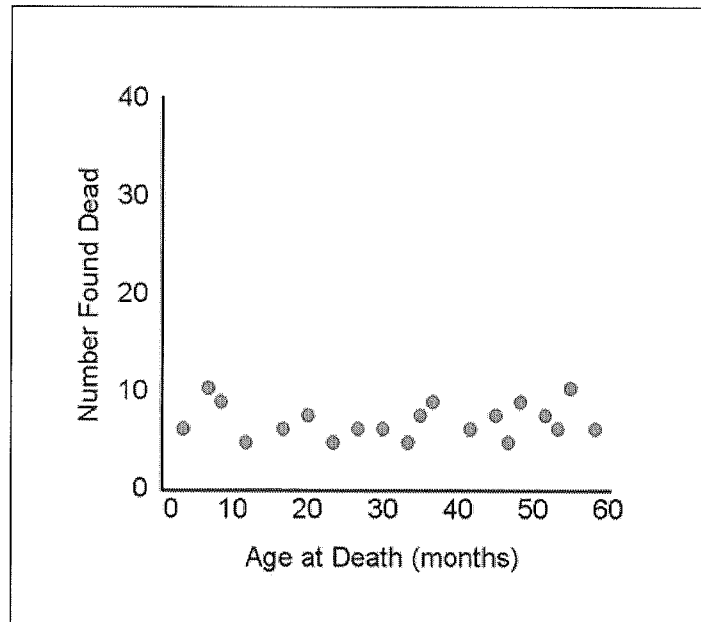


15. The diagram represents a central process of catabolism. Identify the process designated as (I).
- A. Electron-transport chain
  - B. Light-independent reactions
  - C. TCA cycle
  - D. Glycolysis
  - E. Transcription
16. What element or compound is needed for the process designated as (III) to occur?
- A. Chlorine
  - B. Nitrogen
  - C. Oxygen
  - D. Potassium
  - E. Sodium
17. Which combination of processes takes place entirely within a cellular organelle?
- A. I only
  - B. III only
  - C. I and II
  - D. II and III
  - E. I, II, and III

18. Animal phyla are broadly categorized into acoelomates, deuterostomates, protostomates, and pseudocoelomates. Identify the phyla that are classified as protostomates.
- A. Platyhelminthes and cnidarians
  - B. Echinodermatans and chordates
  - C. Molluscans and arthropods
  - D. Nematodes
  - E. Poriferans
19. Some dinosaur bones were discovered fairly recently that still contained significant amounts of the protein collagen in a non-fossilized form. Enough material was available to determine its amino-acid sequence. This allowed researchers to compare its sequence with the sequences of collagen from currently existing animals. What group of organisms did the dinosaur sequence most closely resemble?
- A. Birds
  - B. Lizards
  - C. Amphibians
  - D. Rodents
  - E. Fish
20. A cell is composed of thousands of molecules that range in size from very small to very large. Select the sequence of molecular size from the smallest to the largest.
- A. Carbon dioxide—phospholipid—DNA polymerase—ribosome
  - B. Phospholipid—DNA polymerase—ribosome—carbon dioxide
  - C. Phospholipid—carbon dioxide—ribosome—DNA polymerase
  - D. Carbon dioxide—DNA polymerase—phospholipid—ribosome
  - E. DNA polymerase—ribosome—carbon dioxide—phospholipid



Question 21 refers to the following graph.



21. A researcher was analyzing the life expectancy of a rodent found on an island off the coast of California. She was able to date its age based on the wear on its teeth. Her data is presented in the graph. What kind of survivorship curve would this data represent?
- A. A type I survivorship pattern
  - B. A blend of a type I and a type III survivorship pattern
  - C. A blend of a type II and a type III survivorship pattern
  - D. A type III survivorship pattern
  - E. A type II survivorship pattern

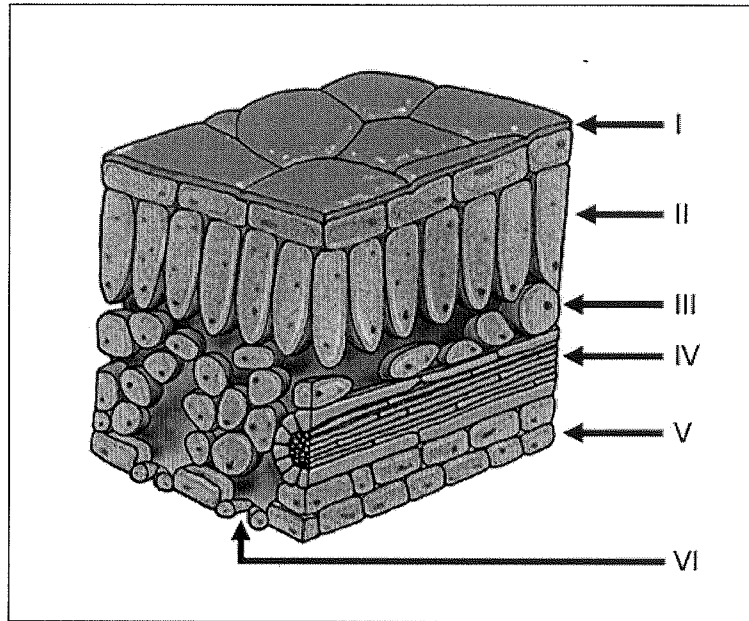
Questions 22 and 23 refer to the narrative below and the options that follow.

When restriction fragments produced from the same endonuclease are mixed under the proper conditions, they will spontaneously reanneal. However, they will not function properly within a cell until the nicks in the strands are repaired.

- A. *Taq* DNA polymerase
  - B. Reverse transcriptase
  - C. DNA-dependent RNA polymerase
  - D. DNA ligase
  - E. Eco RI
22. Identify a restriction endonuclease.
23. What enzyme is necessary to repair the nicks?
24. Which relationship presents a condition that could be identified as exploitative competition?
- A. A woodpecker and a wren
  - B. A sturgeon and a minnow
  - C. A mouse and a mole
  - D. A lichen and a rock
  - E. Mistletoe and a tree

25. Inside which portion of a cell does translation take place?
- A. The endoplasmic reticulum
  - B. The nucleus
  - C. The cytosol
  - D. The Golgi complex
  - E. The cell membrane
26. A woman has a colorblind father. Her son also has a colorblind father. Colorblindness is caused by an X-linked recessive gene. If only male offspring are considered in this case, what is the probability that her son will be colorblind?
- A. 100 percent
  - B. 50 percent
  - C. 0 percent
  - D. 25 percent
  - E. 75 percent
27. What is the best way to describe the steps involved in converting fatty acids to acetyl-CoA?
- A. They are catabolic, because the free energy increases as a result of the process.
  - B. They are metabolic, because the free energy increases as a result of the process.
  - C. They are anabolic, because the free energy decreases as a result of the process.
  - D. They are catabolic, because the free energy decreases as a result of the process.
  - E. They are anabolic, because the free energy increases as a result of the process.

Questions 28–30 refer to the diagram and the options that follow.



- A. I, II, III, V, and VI
- B. I, V, and VI
- C. VI
- D. II and III
- E. IV and VI

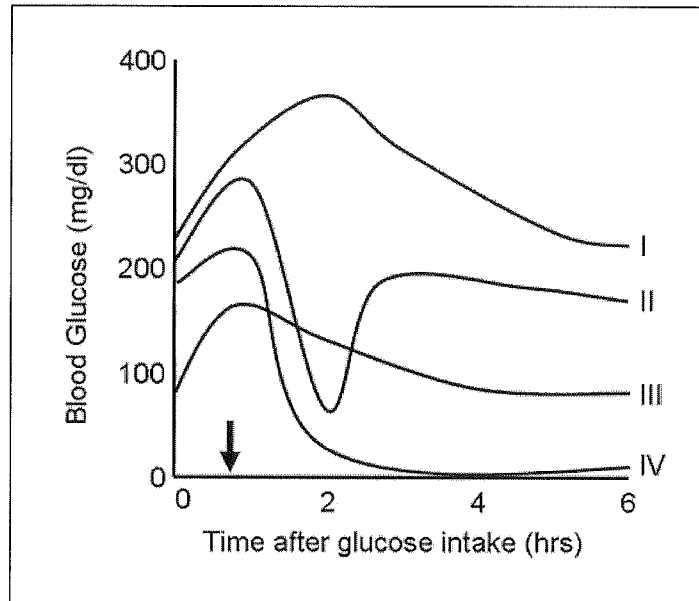
28. Require or utilize both oxygen and carbon dioxide.

29. Classified as dermal tissue or structures.

30. Closely associated with transpiration.

31. Mast cells are leukocytes contained in tissues. They are filled with granules that contain histamine. These cells are involved in allergies, including hay fever, for which antihistamines are used as therapy. What mechanism is the cause of the allergic reaction?
- A. When an allergen binds to specific receptors on a mast cell, it induces cellular degranulation and the release of histamine into the tissues.
  - B. Seasonal allergens irritate the nasal mucosa and cause cellular infiltration by mast cells.
  - C. Mast cells phagocytose allergens that induce cellular proliferation.
  - D. Mast cells rove through tissues removing both histamines and antihistamines that may be causing the allergy.
  - E. Antihistamines are antibodies that bind to histamine to produce a complex, which is then removed from the tissue by mast cells.
32. The genome of the rabies virus is negative-sense RNA. Negative sense means that the nucleic acid sequence is complementary to mRNA. What enzyme must be present in order for this virus to produce its viral proteins and replicate?
- A. DNA-dependent DNA polymerase
  - B. RNA-dependent RNA polymerase
  - C. DNA ligase
  - D. DNA-dependent RNA polymerase
  - E. Restriction endonuclease

Questions 33–36 refer to the graph and narrative that follow.



The options below apply only to questions 33 and 34. The normal blood glucose level is 70–150 mg/dl. The arrow indicates an injection of insulin only in someone who is diabetic.

- A. I and II
- B. III
- C. I, II, and IV
- D. IV
- E. II

33. Which curve(s) indicate(s) probable diabetes?

34. Which curve(s) indicate(s) diabetic shock?

35. To what do you attribute the drop, then rise, of blood glucose levels seen in curve II?
- A. Very poor monitoring of blood glucose levels
  - B. Flaws in the instrumentation or methods used to determine the blood glucose levels
  - C. Ingestion of additional glucose at about time 2 hours
  - D. A second injection of insulin at about time 2 hours
  - E. Sporadic release of insulin by the pancreas
36. The normal range is provided as 70–150 mg/dl. What would be the equivalent expressed as g/l?
- A. 0.7–1.5 g/l
  - B. 7.0–150 g/l
  - C. 0.007–0.015 g/l
  - D. 0.07–0.15 g/l
  - E. 0.0007–0.0015 g/l

Questions 37 and 38 refer to the following narrative.

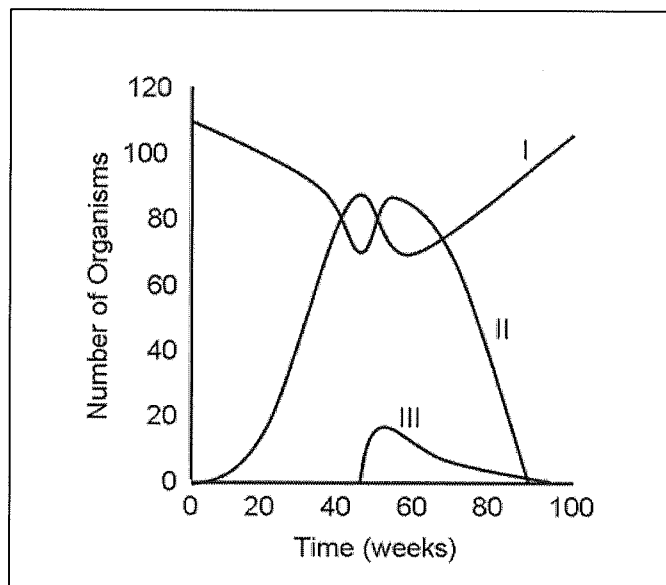
Erythroblastosis fetalis is a condition that affects a fetus *in utero* caused by an Rh incompatibility with the mother.

37. What is the mechanism that produces this condition?
- A. Antibodies from the fetus attack antibodies from the mother found in fetal circulation.
  - B. Antibodies from the fetus attach to the red blood cells within the maternal circulation.
  - C. Lymphocytes from the mother cross the placenta and attack the red blood cells of the fetus.
  - D. Lymphocytes from the fetus cross the placenta and attack the red blood cells in the mother.
  - E. Antibodies from the mother cross the placenta and attack the red blood cells of the fetus.
38. This problem is caused only when a(n) \_\_\_\_\_ mother has a child with phenotype \_\_\_\_\_.
- A. Unsensitized Rh<sup>+</sup>; Rh<sup>-</sup>
  - B. Sensitized Rh<sup>-</sup>; Rh<sup>-</sup>
  - C. Unsensitized Rh<sup>-</sup>; Rh<sup>+</sup>
  - D. Unsensitized Rh<sup>-</sup>; Rh<sup>-</sup>
  - E. Sensitized Rh<sup>-</sup>; Rh<sup>+</sup>



39. What is the relationship between glucose and sucrose?
- A. Glucose is sucrose with an extra  $-OH$  group at the 3' position.
  - B. Sucrose is composed of two glucose molecules joined by a glycoside bond.
  - C. A glucose molecule joined to a fructose molecule makes a molecule of sucrose.
  - D. Glucose is composed of two sucrose molecules joined by a glycoside bond.
  - E. Glucose is composed of a fructose and a sucrose molecule joined by a glycoside bond.

Questions 40–42 refer to the following diagram and narrative.



The lines represent three species within a single isolated ecosystem as observed by a team of qualified researchers.

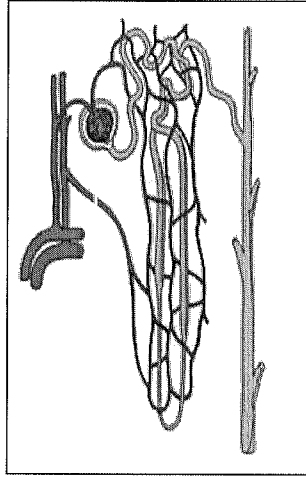
40. What relationship between two populations can you reasonably deduce when comparing curves I and II?
- A. The relationship is neutral.
  - B. There is strong evidence of competition but with resource partitioning.
  - C. The population designated II appears to be an invasive species that outcompetes the other.
  - D. The population designated I appears to be an invasive species that could not survive in a new niche.
  - E. The population designated II appears to be a parasitic species that uses the other as its host.
41. What relationship does the population designated as III reasonably have with the other two populations?
- A. The population designated III is a competitor of both of the other populations.
  - B. The population designated III is a predator of population II but not I.
  - C. The population designated III is a predator of population I but not II.
  - D. The population designated III has a neutral relationship with both of the other populations.
  - E. The population designated III is a predator of both populations II and I.

42. To what might you reasonably attribute the loss of population III within the ecosystem?
- A. Population III was a prey of population I, which completely consumed all its members within the ecosystem.
  - B. Population III was a prey of population II, which completely consumed all its members within the ecosystem.
  - C. Population III was a predator of population II, but it could not survive in the ecosystem.
  - D. Populations II and III both used population III as their prey, completely consuming all its members within the ecosystem.
  - E. Population III was a predator of population I but it could not survive in the ecosystem.
43. What differences are there between the cell membranes of eukaryotes and prokaryotes?
- A. Prokaryotic cell membranes are thinner and contain more proteins.
  - B. Eukaryotic cell membranes contain more proteins and larger phospholipids.
  - C. Gases and water pass through a prokaryotic cell membrane at greater rates than through those of eukaryotes.
  - D. Many functions that are compartmentalized within organelles of eukaryotes are associated with the cell membranes of prokaryotes.
  - E. There are no significant differences in the structure or function of the cell membranes.

44. Which of the following best explains the origin of the predation ability of Venus flytraps?
- A. Only those plants with the ability to supplement the poor nutrient content of their soils could survive.
  - B. Predation allowed the Venus flytrap to outcompete other species because of its ability to move rapidly.
  - C. As consumers instead of producers, Venus flytraps have greater access to better nutrients.
  - D. Predation allowed the Venus flytrap to collect a wider variation of preformed organic materials.
  - E. Better nutrients allowed the Venus flytrap to grow faster than other plants.
45. A type of fungus exists that lives symbiotically with plants. What is that fungus?
- A. Mycorrhizae
  - B. Lichens
  - C. Mushrooms
  - D. Morels
  - E. Truffles
46. Which of the following experiments first ascertained that the nucleus possessed the ability to control phenotype?
- A. Experiments with radiolabelled phages
  - B. Experiments with bacteria that identified DNA polymerase
  - C. Transformation experiments with *Streptococcus pneumoniae*
  - D. Identification of restriction endonucleases
  - E. Grafting experiments with *Acetabularia*

47. A father with type B blood and mother with type A blood have a child. Their child, while in a biology lab at school, tests her blood and discovers she has type O blood. Does she have any concerns about her parentage?
- A. Yes, because she should have type AB blood if they are her true biological parents.
  - B. No, because type O blood is possible if her parents both had genotypes AB.
  - C. No, because both of her parents could be heterozygous.
  - D. Yes, because both of her parents might be heterozygous.
  - E. No, because blood types A and B are codominant.
48. The HIV genome is roughly 10,000 nucleotides in size, while the human genome compares at about 3,000,000,000 base pairs. Reverse transcriptase has an error rate of about 1 in 20,000 bases. What does this imply about the evolution of the virus?
- A. The evolutionary rate is rather slow, because it is unlikely that any one virus will contain a mutation.
  - B. The rate of evolution is extremely high, because every infected cell will produce viruses with mutations.
  - C. The rate of evolution is rather slow, because the genome is so small.
  - D. The rate of evolution is extremely high, because the human genome is so comparatively large.
  - E. The evolutionary rate is slow, because the vast majority of HIV mutations will prevent the virus from binding to human cell receptors.

Questions 49–51 refer to the diagram



49. Which organ or tissue contains this structure?
- A. Liver
  - B. Ovary
  - C. Lung
  - D. Kidney
  - E. CNS
50. Vasopressin affects the functioning of this structure. Which of the following secretes this substance?
- A. Posterior pituitary
  - B. Liver
  - C. Hypothalamus
  - D. Anterior pituitary
  - E. Adrenal glands

51. What product or process is this structure known for?
- A. Production of urine
  - B. Production of LH and FSH
  - C. Feedback control of the autonomic nervous system
  - D. Gas exchange
  - E. Production of bile
52. "Human cells contain DNA sequences that match the sequences found in bacterial 16S rDNA." What is your response to this statement?
- A. The statement is untrue, because healthy human cells should contain no bacterial DNA.
  - B. The statement is true, because mitochondria contain bacterial DNA sequences.
  - C. The statement is untrue, because there is no such thing as rDNA, only rRNA.
  - D. The statement is true, because the 16S sequences are part of the human 18S sequences.
  - E. The statement is true, because there are many human sequences that match 16S sequences.
53. The  $\text{Na}^+/\text{K}^+$  pump uses a form of \_\_\_\_\_ known as \_\_\_\_\_.
- A. passive transport; uniport
  - B. facilitated diffusion; antiport
  - C. active transport; symport
  - D. facilitated diffusion; uniport
  - E. active transport; antiport

54. Many mammalian cell membrane receptors associated with the immune system contain repetitive structures known as the immunoglobulin fold. Receptors containing even one of these folds are considered members of the immunoglobulin superfamily. How would you explain this common feature in so many molecules?
- A. All of the genes that produce these proteins used to be part of a much larger gene that fragmented in the past.
  - B. All of the genes in question are retrotransposons.
  - C. Most of the genes in question are introns that experienced mutations that removed the splice sequence.
  - D. The fold was so successful as a signaling molecule that it encouraged its propagation.
  - E. The fold is repetitive because of gene duplication.

Questions 55 and 56 refer to the following narrative.

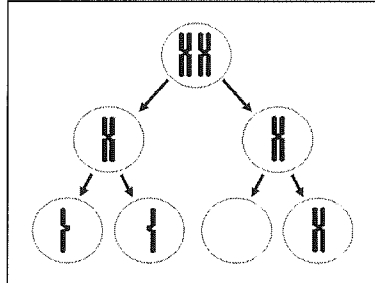
Assume you had a 10 m<sup>2</sup> pond to study. You measured the amount of light energy bathing the water surface at 1,000 kcal.

55. About how much of that available energy would be expected to be converted into producer biomass?
- A. 100 kcal
  - B. 1,000 kcal
  - C. 2,000 kcal
  - D. 10 kcal
  - E. 200 kcal



56. Based on the energy captured above, about what percentage of that would be transferred to higher trophic levels?
- A. 1.65 percent
  - B. 16.5 percent
  - C. 33 percent
  - D. 3.3 percent
  - E. 66 percent
57. If a woman who suffers from rheumatoid arthritis becomes pregnant, the arthritis symptoms often subside temporarily during her pregnancy. Not coincidentally, a woman who has once had genital warts caused by the human papillomavirus (HPV) will find they return temporarily during her pregnancy. What do these two observations have in common?
- A. Both effects are caused by the production of FSH and LH during pregnancy.
  - B. Both effects are caused by the reduction of progesterone and estrogen during pregnancy.
  - C. Both are caused by the partial suppression of the immune system during pregnancy.
  - D. Both effects are caused by the production of progesterone and estrogen, and the drop in  $\beta$ -HCG levels, during pregnancy.
  - E. Both effects are caused by the production of oxytocin during pregnancy.

Questions 58 and 59 refer to the following diagram.



58. The diagram indicates an error in some process. What is that process?

- A. Meiosis
- B. Crossing over
- C. Pleiotropy
- D. Misogyny
- E. Mitosis

59. Which of the following is true about the process as indicated?

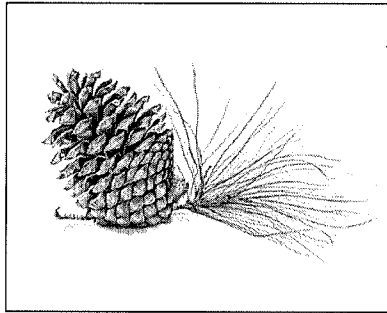
- A. It is the cause of sickle cell anemia.
- B. It is the failure to get equal distribution of chromosomes during mitosis.
- C. It is associated with susceptibility to HIV infection.
- D. It is an important part of the double-fertilization process.
- E. It is the cause of the “superfemale” syndrome (XXX).

60. What do these two conditions have in common: webbed fingers and toes in humans and the development of cancer cells?

- A. Both are caused by excessive cell growth.
- B. Both are caused by a loss of apoptosis.
- C. Both are a result of exposure to carcinogenic compounds.
- D. Both are caused by excessive fat-soluble vitamin levels.
- E. Both are caused by infections from cancer-associated viruses.

61. Tobacco mosaic virus (TMV) is very common in the environment and is frequently isolated from tobacco products. What health implication does this present?
- A. TMV is a cause of lung cancer.
  - B. TMV is associated with immune suppression.
  - C. TMV is associated with skin tumors.
  - D. There are no health implications; TMV cannot infect human cells.
  - E. TMV is associated with genetic abnormalities within any cell exposed to secondhand smoke.

Question 62 refers to the following image.

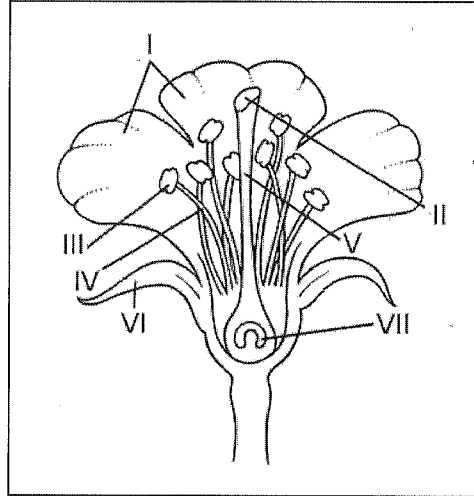


62. Which has the most phylogenetic relatedness to what is seen here?
- A. Lycophytes
  - B. Monocots
  - C. Gingkos
  - D. Mosses
  - E. Ferns

63. In addition to enzymes, at least one other organic molecule is known to be capable of catalysis. What is that molecule?
- A. DNA
  - B. Fatty acids
  - C. Cellulose
  - D. RNA
  - E. ATP
64. What is the primary source of the electrons used in the mitochondria?
- A. Water
  - B. Glucose
  - C. ATP
  - D. Cellulose
  - E. Oxygen
65. Large populations of organisms are centered on deep sea hydrothermal vents. Which of the following is true about these populations?
- A. The energy captured by these organisms is thermal in nature and allows them to thrive in mixed populations.
  - B. Only a single species is found at any one vent, although the species varies from vent to vent.
  - C. The species found at each site are usually evenly mixed between producer plants and consumer microorganisms and animals.
  - D. Fungi and protozoans are usually not represented in these populations.
  - E. Energy from mineral ions feed producers, which in turn feed varieties of consumers.

66. A certain species of bird has two feather variations displayed by males: a dull-colored one that blends into their preferred habitat and a brightly colored one that is very obvious. The adult females are dull colored. The predation rate for brightly colored adults is three times higher than for the dull-colored adults. In spite of this, the brightly colored plumage persists in the population. How would you explain this?
- A. Females prefer the brighter plumage and so mate with this phenotype more often.
  - B. The dull plumage provides a selection advantage over the bright plumage.
  - C. The adults with dull plumage require less energy investment to ensure their survival.
  - D. Those brightly colored birds that do survive have more highly developed survival skills than those that do not survive.
  - E. Dull-colored adult males are more lethargic than the brightly colored birds.

Questions 67–69 refer to the diagram below and the options that follow.



- A. VII
  - B. I and VI
  - C. II, III, IV, and V
  - D. II, V, and VII
  - E. III and VII
67. Meiosis takes place in which structure(s)?
68. If this flower relied on wind pollination, then this/these structure(s) would be a lot more pronounced.
69. Aggregate fruit are produced from a single flower with multiple numbers of these structures.

70. As has occurred innumerable times in the past, the global mean temperature appears to be rising, at least in the short term. Which of the following is an inevitable result of this change?
- A. First frost dates will be delayed.
  - B. Birds will migrate shorter distances.
  - C. Oxygen levels in the oceans will rise.
  - D. Available fertile lands will decrease as desertification increases.
  - E. Animal life will be reduced worldwide.
71. The damming of the Nile River near Aswan in the 1960s introduced a new disease to the area. While the water once flowed freely, stopping its flow allowed new organisms to thrive in newly opened niches. One of these new organisms causes a disease called schistosomiasis, which infects humans as part of its life cycle. What is the taxonomic classification of this organism?
- A. Arachnid
  - B. Helminth
  - C. Cephalopod
  - D. Bacterium
  - E. Cladoceran
72. Antigen-presenting cells communicate with effector cells of the immune system. Which of the following mechanisms account for this?
- A. Direct cell membrane-to-membrane contact
  - B. Quorum sensing
  - C. Release of highly specific steroidal hormones
  - D. Release of neurotransmitter-like substances
  - E. Induction of rapid ion flow through the membrane

Questions 73–75 refer to the following narrative.

*Shigella* is a bacterium that is very closely related to *E. coli* but is incapable of fermenting lactose (lactose negative). A gene for resistance to the antibiotic ampicillin (*ampR*) was inserted in between two of the structural genes of the *lac* operon and then inserted into *Shigella*.

73. What would be the effect of this insertion?
- A. The cell would immediately be resistant to ampicillin.
  - B. The cell would be resistant to ampicillin only in the presence of tryptophan.
  - C. The cell would produce the enzyme  $\beta$ -lactamase as soon as it started to grow exponentially.
  - D. The cell would spontaneously utilize DNA-editing enzymes to restore the original genotype.
  - E. The cell would be resistant to ampicillin only in the presence of lactose.
74. If *Shigella* is normally lactose negative, from where did the *lac* operon originate?
- A. The bacterial genome was removed, the *lac* operon was added, and then the genome was inserted back into the original cell.
  - B. The *lac* operon was present on a plasmid which was inserted into the cell by transformation.
  - C. The bacterial genome was removed and replaced by a plasmid containing the *lac* operon.
  - D. The *lac* operon developed in the cell by random mutation and strong selection pressures.
  - E. The *lac* operon was derived from mutations of the tryptophan operon which is normally present in *Shigella*.



75. What enzyme regularly used by genetic engineers would be vital for the successful completion of this exercise?
- A. DNA polymerase
  - B. Reverse transcriptase
  - C. *Taq* polymerase
  - D.  $\beta$ -galactosidase
  - E. Restriction endonuclease
76. Assume that you have been hired to work in a lab that tests plant hormones for increasing crop yield. Your job today is to test spray a large plot with a selected hormone to determine its effect in hybrid vigor. Which of the following would you want to avoid using?
- A. 2,4-D
  - B. IAA
  - C. Gibberellin
  - D. Cytokinin
  - E. Abscisic acid
77. Place the following vessels or tissues in the proper sequence from containing the highest concentration of  $\text{CO}_2$  to the lowest.
- A. Pulmonary veins—left atrium—tissues—right ventricle—pulmonary arteries
  - B. Left atrium—tissues—right ventricle—pulmonary veins—pulmonary arteries
  - C. Pulmonary arteries—right ventricle—tissues—left atrium—pulmonary veins
  - D. Right ventricle—pulmonary arteries—pulmonary veins—left atrium—tissues
  - E. Tissues—pulmonary veins—pulmonary arteries—left atrium—right ventricle

78. Individuals born with a condition known as phenylketonuria must control their intake of phenylalanine or suffer developmental problems. Because of this they must avoid foods rich in what?
- A. Proteins and lipids
  - B. Fats and oils
  - C. Proteins
  - D. Simple sugars
  - E. Complex carbohydrates and oils

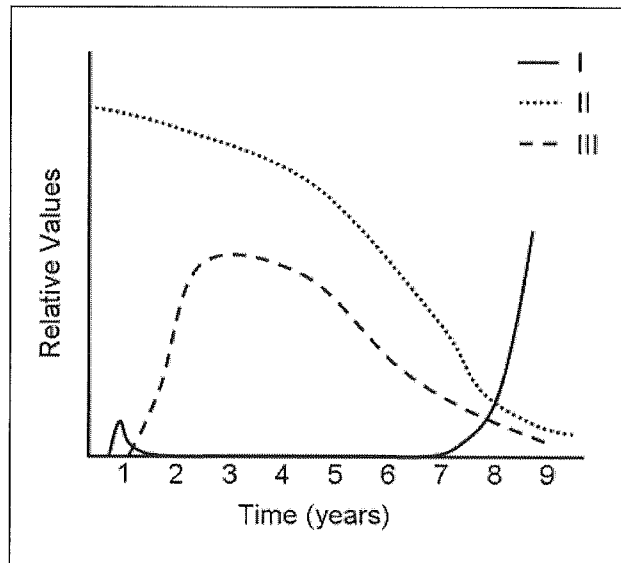
Questions 79–80 refer to the following table and narrative.

ID	HLA-A	HLA-B	HLA-C	HLA-DR
1	A1, A3	B5, B7	C3, Cw19	DR3, DR9
2	A1, A6	B2, B6	C2, C16	DR4, DR13
3	A1, -	B2, B5	C2, C3	DR4, DR9

The genes that code for the human leukocyte antigen (HLA) antigens, also known as the major histocompatibility complex (MHC) genes, are all located on human chromosome 6. Two brothers and a sister participated in a bone marrow donor registration, and their HLA typing results are given above.

79. What is the probability that, if they had a fourth sibling, that sibling would match one of the three above?
- A. 25 percent
  - B. 100 percent
  - C. 0 percent
  - D. 50 percent
  - E. 75 percent
80. What is your explanation for the single HLA-A result for sibling 3?
- A. A gene-deletion event occurred during crossing over.
  - B. Nondisjunction occurred during meiosis.
  - C. A laboratory error caused the lost data; it should have a second result.
  - D. A metabolic error prevented the synthesis of the second antigen.
  - E. Both parents were heterozygous for HLA-A1.

Question 81 refers to the following graph.



81. Based on this monitoring of an individual infected with HIV at six months, who was untreated during the time period indicated, how would you identify what the three curves signify?
- A. I = viral antigen in the blood; II = anti-HIV antibodies in the blood; III = CD4<sup>+</sup> cells in the blood
  - B. I = viral antigen in the blood; II = CD4<sup>+</sup> cells in the blood; III = anti-HIV antibodies in the blood
  - C. I = CD4<sup>+</sup> cells in the blood; II = anti-HIV antibodies in the blood; III = viral antigen in the blood
  - D. I = anti-HIV antibodies in the blood; II = viral antigen in the blood; III = CD4<sup>+</sup> cells in the blood
  - E. I = CD4<sup>+</sup> cells in the blood, II = viral antigen in the blood; III = anti-HIV antibodies in the blood

82. Where in a plant cell is a water molecule broken down to release oxygen gas, electrons, and hydrogen ions?
- A. In the inner matrix of the mitochondrion
  - B. In the outer membrane of the chloroplast
  - C. In the intermembrane space of the mitochondrion
  - D. In the thylakoid space of the chloroplast
  - E. In the intermembrane space of the chloroplast
83. What is the best measuring stick to use to determine the degree of fitness in evolutionary selection?
- A. The increase in lifespan resulting from selection
  - B. The increase in chromosomal number within the nucleus
  - C. Reproductive success
  - D. The number of available alleles for any one gene
  - E. The increase in geographical territory for any one species
84. Identify the general relative sizes of the listed structures from the smallest to the largest.

I = bacterium

II = enzyme

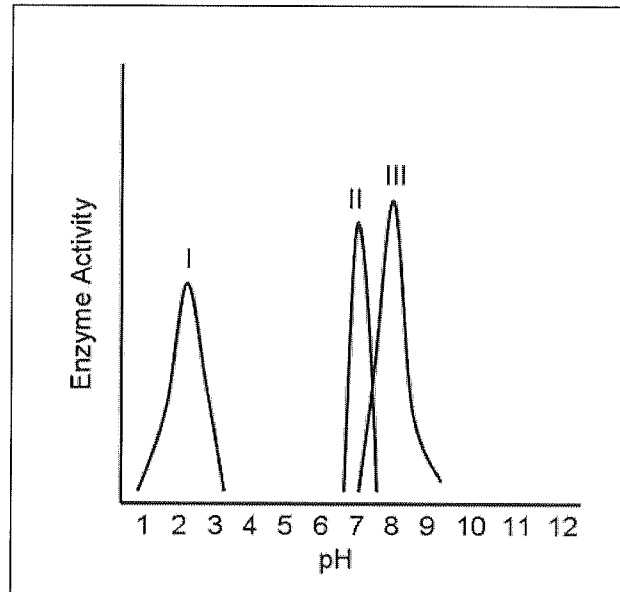
III = nucleus

IV = chromosome

V = molecule of water

- A. V—II—I—IV—III
- B. II—V—IV—I—III
- C. V—I—II—III—IV
- D. II—V—I—IV—III
- E. II—V—IV—III

Question 85 refers to the following graph.



85. The graph displays the activity curves for three human enzymes. Identify the curve designation with the enzyme.
- A. I = pepsin; II = chymotrypsin; III = fibrin
  - B. I = chymotrypsin; II = fibrin; III = pepsin
  - C. I = fibrin; II = pepsin; III = chymotrypsin
  - D. I = pepsin; II = fibrin; III = chymotrypsin
  - E. I = fibrin; II = chymotrypsin; III = pepsin

86. Why do toadstools form fairy rings after a rain?
- A. The ring reflects a pH gradient which is highest in the center of the circle and diffuses outward. The size of the ring varies with the alkalinity at the center.
  - B. The ring appears around the remnants of a tree stump that provides nutrients at the perimeter of the buried wood.
  - C. The ring usually appears at the periphery of large buried boulders or other dense material.
  - D. In actuality, the appearance of a fairy ring is usually just the mind's attempt to make a pattern out of random placements of toadstools.
  - E. The ring indicates the intersection of a colony of subsurface fungal hyphae expanding into a surrounding colony with a different mating type.

Questions 87 and 88 refer to the following narrative.

Hemophilia is a genetic disorder caused by an X-linked recessive allele. It is of historical interest because of the extensive familial intermarriages of the royal houses of Europe during the seventeenth to nineteenth centuries AD.

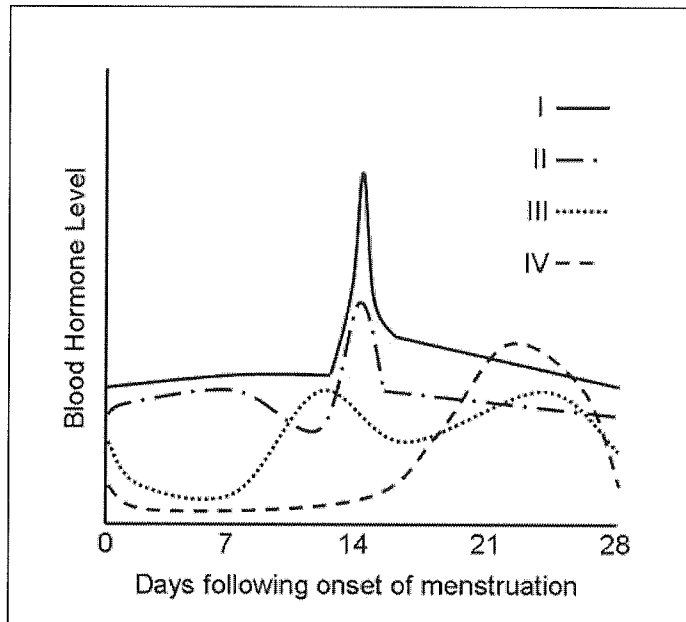
87. In evolutionary terms, why has this lethal allele continued to be passed on?
- A. Because of the founder effect
  - B. Because, while producing a bleeding disorder, it increases longevity
  - C. Because it only affects female carriers of the trait
  - D. Because the recessive allele provides a selection advantage
  - E. Because of disruptive selection

88. Which of the following best describes this form of hemophilia?
- A. This disorder is caused by reduced production of thrombocytes in the bone marrow.
  - B. This disorder is caused by an increased production of antithrombin.
  - C. This disorder is caused by an absence of factor VIII in the blood.
  - D. This disorder is caused by a loss of the clotting ability of thrombocytes, which are present in normal numbers in the blood.
  - E. This disorder is caused by an increased level of anticoagulants in circulation and in the tissues.
89. Numerous animals, notably reptiles, are capable of reproduction and maintaining numbers when populations are composed of only single sex members, even in isolated areas. How do you explain this statement?
- A. It is not possible and the statement is false.
  - B. When only females are present, hormonal signals will cause the dominant female to develop male characteristics and engage in sexual reproduction with the other females.
  - C. Meiosis within unfertilized eggs will arrest at a diploid stage and undergo normal fetal development in an all-female population.
  - D. When only males are present, random males will become hermaphroditic and lay eggs fertilized internally.
  - E. The sperm from males can be stored for years within a female, allowing normal clutches of eggs to hatch years after males have disappeared from a population.



90. An experiment is set up with a culture of algae undergoing normal photosynthesis. A pulse of radioactive carbon, in the form of  $^{14}\text{CO}_2$ , is inserted into the culture at time zero. At five-second intervals, some of the cells are removed by dropping them into boiling water to halt metabolic processes. What is the first organic material that would be identified as being radioactive during this process?
- A. ATP
  - B. PGA
  - C. ADP
  - D. Glucose
  - E. Acetyl-CoA
91. *Hydrilla* is a vascular invasive plant species that grows under the surface of lakes at a very high density during the summer but dies back to its buried rhizomes during the winter. It has been linked to oxygen depletion of the waters in which it is found, in spite of the fact that it is photosynthetic. How can you account for this seeming contradiction?
- A. While photosynthetic, *Hydrilla* consumes oxygen at a faster rate than it releases it because of its very high rate of growth.
  - B. *Hydrilla*'s nutrient density is so great that fish that feed upon it proliferate beyond the carrying capacity of the lakes in which it is found.
  - C. Because *Hydrilla* is vascular, it binds up large quantities of oxygen in its biomass.
  - D. As an aquatic plant, *Hydrilla* requires large quantities of oxygen to fill its air bladders.
  - E. When the vegetative structures die off in the winter, decomposing bacteria consume the oxygen during their rapid growth.

Questions 92–94 refer to the following graph.



92. Given that the curve designated II is FSH, identify the other three.
- I = LH; III = progesterone; IV = estrogen
  - I = estrogen; III = LH; IV = progesterone
  - I = progesterone; III = LH; IV = estrogen
  - I = LH; III = estrogen; IV = progesterone
  - I = estrogen; III = progesterone; IV = LH
93. Identify the sources of the hormones.
- Ovary = I and II; pituitary = III; hypothalamus = IV
  - Ovary = III and IV; pituitary = I and II
  - Ovary = I and II; pituitary = III and IV
  - Hypothalamus = I and II; pituitary = III and IV
  - Ovary = I and II; pituitary = IV; hypothalamus = III

94. Identify the day of follicle rupture.
- A. About day 14
  - B. About day 10
  - C. About day 0
  - D. About day 21
  - E. About day 25
95. Which of the following observations support the fluid mosaic model of membrane structure?
- A. The capping of fluorescent antibodies specific for cell-surface receptors
  - B. The presence of the cytoskeleton underneath the surface of the membrane
  - C. The measurement of ions flowing through ion-gated channel proteins by patch clamps
  - D. The pseudopodial movement of amoebas
  - E. The scaffolding and kinetic proteins associated with the movement of cilia
96. Broca's area, the portion of the brain associated with the motor control of speech, is localized in which portion of the brain?
- A. The parietal lobe
  - B. The cerebellum
  - C. The occipital lobe
  - D. The frontal lobe
  - E. The lateral sulcus

97. Which of the following means of reproduction is the most ancient?
- A. Viviparity
  - B. Oviparity
  - C. Ovoviviparity
  - D. Placental viviparity
  - E. Viviparous matrotrophy
98. When carbohydrate monomers are joined together, the process is identified as \_\_\_\_\_, and when they are broken apart again it is called \_\_\_\_\_.
- A. hydrolytic bonding; degradation
  - B. hydrogen bonding; depletion
  - C. condensation synthesis; hydrolysis
  - D. polar synthesis; hydrolysis
  - E. condensation synthesis; anabolism
99. Some plants have the ability to twine around objects. What is this ability to respond to physical contact with a growth response called?
- A. Seismonastic movement
  - B. Phototropism
  - C. Thigmotropism
  - D. Somnambulism
  - E. Gravitropism

100. Many organisms have been used in research to help elucidate biological processes. Which of the following is used exclusively in developmental biology?
- A. *Drosophila melanogaster*
  - B. *Caenorhabditis elegans*
  - C. *Pisum sativum*
  - D. *Escherichia coli*
  - E. *Daphnia pulex*

END OF SECTION I

## Section II: Free-Response Questions

Complete four essay questions, with ten minutes of reading and planning time and an hour and a half of writing time. Each question is worth 10 percent of the total exam score.

### BIOLOGY

#### SECTION II

Reading and planning time—10 minutes

Writing time—1 hour and 30 minutes

**Directions:** Answer all questions.

Your answers must be in essay form. Neither outlines alone nor diagrams alone are sufficient. It is important that you read and understand each question before you begin to write.

1. Cellular homeostasis must be maintained to sustain life and life processes. In order to accomplish this, the cell must possess the ability to operate with both positive and negative control mechanisms.
  - A. **Identify and explain** ONE positive and ONE negative control mechanism involved in gene expression.
  - B. **Identify and explain** ONE positive and ONE negative control mechanism involved in enzyme kinetics.
  
2. Organismal homeostasis must be maintained to sustain life and insure the continuation of the species. In mammals, this maintenance is often controlled by both neural and hormonal mechanisms.
  - A. **Discuss** the neural mechanism of the control of blood pressure.
  - B. **Discuss** the kidney's role in maintenance of blood pressure.
  - C. **Identify** TWO disease processes caused by failure to control blood pressure.

3. Speciation results from the application of selective pressures until two non-interbreeding populations develop.
  - A. **Identify and explain** TWO prezygotic isolating mechanisms.
  - B. **Identify and explain** TWO postzygotic isolating mechanisms.
  
4. Plants maintain homeostasis but lack the pumps and muscles that animals have in order to do so.
  - A. **Identify** the elements associated with fluid flow within vascular plants. **Describe** the mechanisms that produce the flow.
  - B. In order to maintain fluid flow, the vascular structure must be protected. **Explain** TWO such protective mechanisms.

**END OF EXAM**

## Answers to the AP Biology Practice Exam

## Section I: Multiple-choice questions

## ANSWER KEY

- |       |       |
|-------|-------|
| 1. D  | 25. C |
| 2. B  | 26. B |
| 3. A  | 27. D |
| 4. C  | 28. D |
| 5. B  | 29. B |
| 6. E  | 30. E |
| 7. A  | 31. A |
| 8. D  | 32. B |
| 9. C  | 33. C |
| 10. E | 34. D |
| 11. B | 35. C |
| 12. B | 36. A |
| 13. E | 37. E |
| 14. C | 38. E |
| 15. D | 39. C |
| 16. C | 40. C |
| 17. D | 41. B |
| 18. C | 42. C |
| 19. A | 43. D |
| 20. A | 44. A |
| 21. E | 45. A |
| 22. E | 46. E |
| 23. D | 47. C |
| 24. A | 48. B |



- |       |        |
|-------|--------|
| 49. D | 75. E  |
| 50. A | 76. A  |
| 51. A | 77. C  |
| 52. B | 78. C  |
| 53. E | 79. E  |
| 54. E | 80. E  |
| 55. D | 81. B  |
| 56. B | 82. D  |
| 57. C | 83. C  |
| 58. A | 84. A  |
| 59. E | 85. D  |
| 60. B | 86. E  |
| 61. D | 87. A  |
| 62. C | 88. C  |
| 63. D | 89. C  |
| 64. B | 90. B  |
| 65. E | 91. E  |
| 66. A | 92. D  |
| 67. E | 93. B  |
| 68. C | 94. A  |
| 69. D | 95. A  |
| 70. A | 96. D  |
| 71. B | 97. B  |
| 72. A | 98. C  |
| 73. E | 99. C  |
| 74. B | 100. B |