



# Practice Test 1

Completely darken bubbles with a No. 2 pencil. If you make a mistake, be sure to erase mark completely. Erase all stray marks.

1. YOUR NAME: \_\_\_\_\_  
 (Print) Last First M.I.  
 SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_  
 HOME ADDRESS: \_\_\_\_\_  
 (Print) Number and Street  
 \_\_\_\_\_  
 City State Zip Code  
 PHONE NO. : \_\_\_\_\_  
 (Print)

5. YOUR NAME  
 First 4 letters of last name FIRST INIT MID INIT  

A	A	A	A	A	A
B	B	B	B	B	B
C	C	C	C	C	C
D	D	D	D	D	D
E	E	E	E	E	E
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G	G	G	G	G	G
H	H	H	H	H	H
I	I	I	I	I	I
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M	M	M	M	M	M
N	N	N	N	N	N
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Q	Q	Q	Q	Q	Q
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V	V	V	V	V	V
W	W	W	W	W	W
X	X	X	X	X	X
Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z

IMPORTANT: Please fill in these boxes exactly as shown on the back cover of your test book.

2. TEST FORM  
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3. TEST CODE 4. REGISTRATION NUMBER  

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6. DATE OF BIRTH  

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<input type="radio"/> DEC	<input type="radio"/> 9	<input type="radio"/> 9

7. SEX  
 MALE  
 FEMALE



**Section I** Start with number 1 for each new section. If a section has fewer questions than answer spaces, leave the extra answer spaces blank.

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# AP<sup>®</sup> Biology Exam

## SECTION I: Multiple-Choice Questions

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

### At a Glance

**Total Time**  
1 hour and 30 minutes  
**Number of Questions**  
69  
**Percent of Total Score**  
50%  
**Writing Instrument**  
Pencil required

### Instructions

Section I of this examination contains 69 multiple-choice questions. These are broken down into Part A (63 multiple-choice questions) and Part B (6 grid-in questions).

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. 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. Here is a sample question and answer.

#### Sample Question

#### Sample Answer

Chicago is a

(A)  (B)  (C)  (D)

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

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all the multiple-choice questions.

### About Guessing

Many candidates wonder whether or not to guess the answers to questions about which they are not certain. Multiple choice scores are based on the number of questions answered correctly. Points are not deducted for incorrect answers, and no points are awarded for unanswered questions. Because points are not deducted for incorrect answers, you are encouraged to answer all multiple-choice questions. On any questions you do not know the answer to, you should eliminate as many choices as you can, and then select the best answer among the remaining choices.

**BIOLOGY**  
**SECTION I**  
**69 Questions**  
**Time—90 minutes**

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

1. The resting membrane potential depends on which of the following?
  - I. Active transport
  - II. Selective permeability
  - III. Differential distribution of ions across the axonal membrane
  - (A) III only
  - (B) I and II only
  - (C) II and III only
  - (D) I, II, and III
2. The Krebs cycle in humans occurs in the
  - (A) mitochondrial matrix
  - (B) inner mitochondrial membrane
  - (C) outer mitochondrial membrane
  - (D) intermembrane space
3. A heterotroph
  - (A) obtains its energy from sunlight, harnessed by pigments
  - (B) obtains its energy by catabolizing organic molecules
  - (C) makes organic molecules from  $\text{CO}_2$
  - (D) obtains its energy by consuming exclusively autotrophs
4. Regarding meiosis and mitosis, one difference between the two forms of cellular reproduction is that in meiosis
  - (A) there is one round of cell division, whereas in mitosis there are two rounds of cell division
  - (B) separation of sister chromatids occurs during the second division, whereas in mitosis separation of sister chromatids occurs during the first division
  - (C) chromosomes are replicated during interphase, whereas in mitosis chromosomes are replicated during the first phase of mitosis
  - (D) spindle fibers form during prophase, whereas in mitosis the spindle fibers form during metaphase
5. A feature of amino acids that is NOT found in carbohydrates is the presence of
  - (A) carbon atoms
  - (B) oxygen atoms
  - (C) nitrogen atoms
  - (D) hydrogen atoms
6. Which of the following is NOT a characteristic of bacteria?
  - (A) Circular double-stranded DNA
  - (B) Membrane-bound cellular organelles
  - (C) Plasma membrane consisting of lipids and proteins
  - (D) Ribosomes that synthesize polypeptides
7. Which of the following best explains why a population is described as the evolutionary unit?
  - (A) Genetic changes can only occur at the population level.
  - (B) The gene pool in a population remains fixed over time.
  - (C) Natural selection affects individuals, not populations.
  - (D) Individuals cannot evolve, but populations can.
8. The endocrine system maintains homeostasis using many feedback mechanisms. Which of the following is an example of positive feedback?
  - (A) Infant suckling causes a mother's brain to release oxytocin, which in turn stimulates milk production.
  - (B) An enzyme is allosterically inhibited by the product of the reaction it catalyzes.
  - (C) When ATP is abundant the rate of glycolysis decreases.
  - (D) When blood sugar levels decrease to normal after a meal, insulin is no longer secreted.

**GO ON TO THE NEXT PAGE.**

9. 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
- (A) bb bb  
(B) Bb Bb  
(C) Bb bb  
(D) BB Bb
10. 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. If weight is a highly heritable trait, which graph represents the change in population before and after the eruption?
- (A) A higher mean weight compared with their parents  
(B) A lower mean weight compared with their parents  
(C) The same mean weight as members of the original population  
(D) A higher mean weight compared with members of the original population
11. All of the following play a role in morphogenesis EXCEPT
- (A) apoptosis  
(B) homeotic genes  
(C) operons  
(D) inductive effects
12. During the period when life is believed to have begun, the atmosphere on primitive Earth contained abundant amounts of all the following gases EXCEPT
- (A) oxygen  
(B) hydrogen  
(C) ammonia  
(D) methane

Questions 13–14 refer to the following passage.

The digestive system in humans can be divided into two parts: the alimentary canal and the accessory organs. The canal is where the food actually passes during its transition into waste. The accessory organs are any organs that aid in the digestion by supplying the organs in the alimentary canal with digestive hormones and enzymes.

13. The small intestine is the main site of absorption. It can accomplish it so efficiently because of villi and microvilli that sculpt the membrane into hair-like projections. They likely aid in reabsorption by
- (A) increasing the surface area of the small intestine  
(B) decreasing the surface area of the small intestine  
(C) making the small intestine more hydrophilic  
(D) making the small intestine more hydrophobic
14. The pancreas is a major accessory organ in the digestive system. What is its likely function?
- (A) Moistening the food as it passes through  
(B) Removing the excess water from the food waste  
(C) Making enzymes that breakdown macromolecules  
(D) Preventing the food from entering the small intestine after it leaves the stomach
15. 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–secretory vesicle–rough ER  
(B) Ribosome–Golgi apparatus–rough ER–secretory vesicle–plasma membrane  
(C) Plasma membrane–Golgi apparatus–ribosome–secretory vesicle–rough ER  
(D) Ribosome–rough ER–Golgi apparatus–secretory vesicle–plasma membrane
16. 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) an individual with two identical alleles is said to be heterozygous with respect to that gene

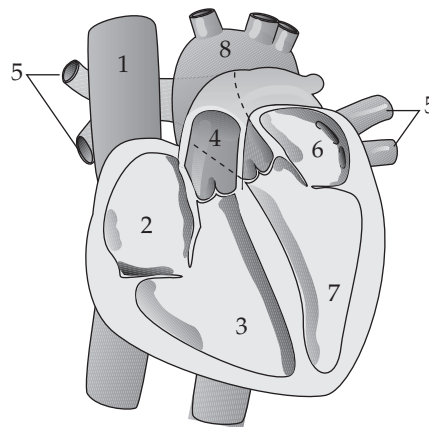
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17. Once specific genes, such as the gene coding for ampicillin, have been incorporated into a plasmid, the plasmid may be cloned by
- inserting it into a virus to generate multiple copies
  - treating it with a restriction enzyme in order to cut the molecule into small pieces
  - inserting it into a suitable bacterium in order to produce multiple copies
  - running it on a gel electrophoresis in order to determine the size of the gene of interest
18. Although mutations occur at a regular and predictable rate, which of the following statements is the **LEAST** likely reason the frequency of mutation often *appears* to be low?
- Some mutations produce alleles that are recessive and may not be expressed.
  - Some undesirable phenotypic traits may be prevented from reproducing.
  - Some mutations cause such drastic phenotypic changes that they are soon removed from the gene pool.
  - The predictable rate of mutation results in ongoing variability in a gene pool.
19. A scientist wants to test the effect of temperature on seed germination. Which of the following should be part of the experimental design?
- Use temperature as the dependent variable and alter the germination times
  - Use temperature as the independent variable and measure the rate of germination
  - Use temperature as the controlled variable and keep everything identical between groups
  - Use the variable natural outside temperature as a control group
20. Which of the following best accounts for the ability of legumes to grow well in nitrogen-poor soils?
- These plants make their own proteins.
  - These plants have a mutualistic relationship with nitrogen-fixing bacteria.
  - These plants are capable of directly converting nitrogen gas into nitrates.
  - These plants do not require nitrogen to make plant proteins.

21. Which of the following is most correct concerning cell differentiation in vertebrates?
- Cells in different tissues contain different sets of genes, leading to structural and functional differences.
  - Differences in the timing and expression levels of different genes lead to structural and functional differences.
  - Differences in the reading frame of mRNA lead to structural and functional differences.
  - Differences between tissues result from spontaneous morphogenesis.

Questions 22–23 refer to the following passage.

Pumping blood through the human heart must be carefully organized for maximal efficiency and to prevent backflow. In the figure below, the blood enters the heart through the vena cava, passes through the right atrium and right ventricle and then goes through the pulmonary artery towards the lungs. After the lungs, the blood returns through the pulmonary vein and then passes into the left atrium and the left ventricle before leaving the heart via the aorta.



22. Which of the following chambers or vessels carry deoxygenated blood in the human heart?
- 1 only
  - 2 and 3
  - 1, 2, 3, 4
  - 4 and 5
23. If a small amount of short-lived dye was injected into the left ventricle, which heart chambers would have dye 30 seconds later?
- All chambers of the heart
  - Only the ventricles
  - Only the left atrium and the left ventricle
  - Only the left ventricle

**GO ON TO THE NEXT PAGE.**

24. Some strains of viruses can change normal mammalian cells into cancer cells in vitro. This alteration of the mammalian cell is usually associated with the
- formation of a pilus between the mammalian cell and the virus
  - incorporation of the viral genome into the mammalian cell's nuclear DNA
  - conversion of the host's genome into the viral DNA
  - release of spores into the mammalian cell
25. All of the following correctly describe meiosis EXCEPT
- Meiosis produces four haploid gametes
  - Homologous chromosomes join during synapsis
  - Sister chromatids separate during meiosis I
  - Crossing over increases genetic variation in gametes
26. All of the following are examples of events that can prevent interspecies breeding EXCEPT
- the potential mates experience geographic isolation
  - the potential mates experience behavioral isolation
  - the potential mates have different courtship rituals
  - the potential mates have similar breeding seasons
27. Which of the following is NOT a characteristic of asexual reproduction in animals?
- Progeny cells have the same number of chromosomes as the parent cell.
  - Progeny cells are identical to the parent cell.
  - The parent cell produces diploid cells.
  - The progeny cells fuse to form a zygote.
28. Transpiration is a result of special properties of water. The special properties of water include all of the following EXCEPT
- cohesion
  - adhesion
  - capillary action
  - hydrophobicity

Questions 29–32 refer to the following passage.

An experiment was performed to assess the growth of two species of plants when they were grown in different pHs, given different volumes of water, and watered at different times of day over 6 weeks. Two plants were grown of each species and the average heights are shown in the table.

		Species A	Species B
pH	2	3.2	4.1
	4	37.6	20.6
	7	62.3	42.4
	10	48.4	31.5
	13	4.1	2.7
Volume (mL)	10	4.9	12.4
	20	19.2	38.9
	40	56.2	45.6
	80	65.1	21.5
	160	2.6	1.8
Time	12:00 am	62.3	20.3
	7:00 am	61.1	21.8
	12:00 pm	66.7	18.4
	7:00 pm	65.3	19.3

29. For which conditions do the species have different preferences?
- pH
  - volume
  - volume and watering time
  - pH and volume and watering time
30. What are the preferred growth conditions for Species B?
- pH 7, 40 mL, any time of day
  - pH 10, 40 mL, 7:00 A.M.
  - pH 7, 80 mL, any time of day
  - pH 10, 80 mL, 12:00 P.M.
31. Which pH and volume were likely used for the watering time experiment?
- pH 4 and 40 mL
  - pH 10 and 40 mL
  - pH 4 and 80 mL
  - pH 10 and 80 mL

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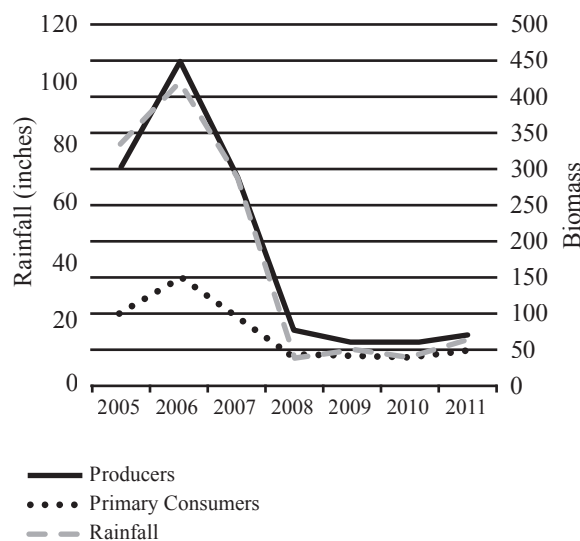
32. Which of the following would most improve the statistical significance of the results?
- Let the plants grow for a longer period of time
  - Add more conditions to test, such as amount of light and amount of soil
  - Test the same plants with more pHs and more volumes and times of day
  - Increase the number of plants in each group
33. A plant grows in the opposite direction of the gravitational force. This is an example of
- positive thigmotropism
  - negative phototropism
  - positive phototropism
  - negative gravitropism
34. In most ecosystems, net primary productivity is important because it represents the
- energy available to producers
  - total solar energy converted to chemical energy by producers
  - biomass of all producers
  - energy available to heterotrophs
35. Hawkmoths are insects that are similar in appearance and behavior to hummingbirds. Which of the following is LEAST valid?
- These organisms are examples of convergent evolution.
  - These organisms were subjected to similar environmental conditions.
  - These organisms are genetically related to each other.
  - These organisms have analogous structures.
36. Which of the following describes a mutualistic relationship?
- A tapeworm feeds off of its host's nutrients causing the host to lose large amounts of weight.
  - Certain plants grow on trees in order to gain access to sunlight, not affecting the tree.
  - Remora fish eat parasites off of sharks. The sharks stay free of parasites, and the remora fish are protected from predators.
  - Meerkats sound alarm calls to warn other meerkats of predators.

37. The pancreas is an organ that makes insulin and glucagon in its beta and alpha cells, respectively. Insulin is released when blood glucose is high and glucagon is released when blood glucose is low. Anti-beta cell antibodies will cause which of the following to occur?
- Glucagon secretion will stop, and blood glucose levels will not decrease.
  - 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 not decrease.

Questions 38–40 refer to the following passage.

The rainfall and biomass of several trophic levels in an ecosystem were measured over several years. The results are shown in the graph below.

**Rainfall and Biomass 2005–2011**



38. Which of the following concepts is best demonstrated by this experiment?
- Populations with higher genetic variation can withstand droughts better.
  - Meteorological impacts will affect the evolution of populations.
  - Environmental changes can affect all the levels of the ecosystem.
  - Unoccupied biological niches are dangerous because they attract invasive species.

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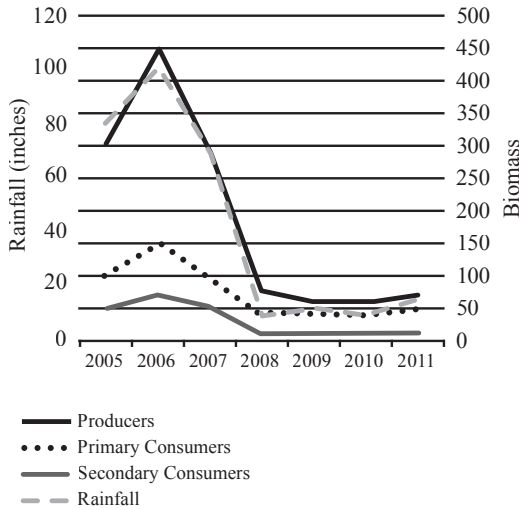


39. If it rained 120 inches, what would you project the primary consumer biomass to be?

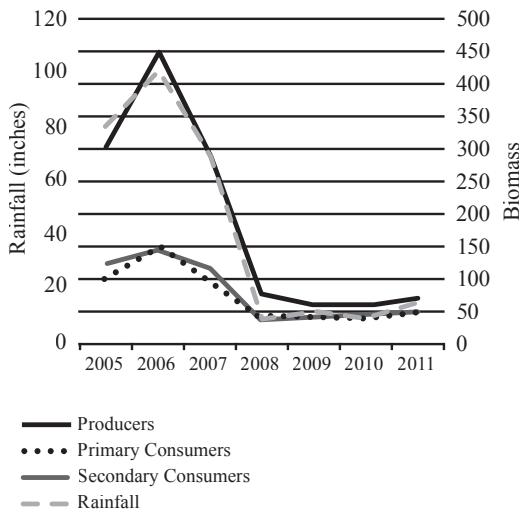
- (A) 150–200
- (B) 60
- (C) 45
- (D) 20

40. Which of the following graphs best depicts the projected biomass of secondary consumers if they were measured?

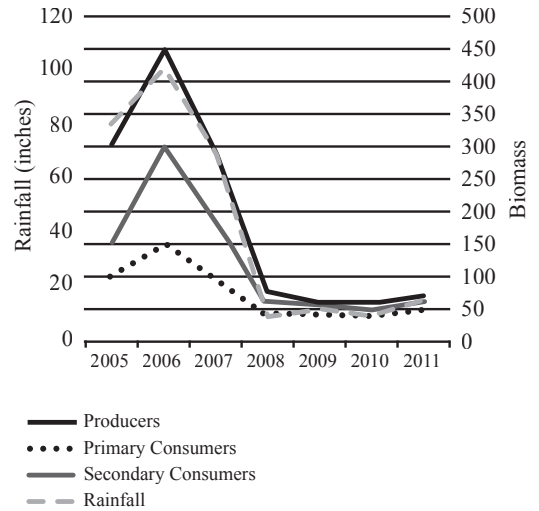
(A) Rainfall and Biomass 2005–2011



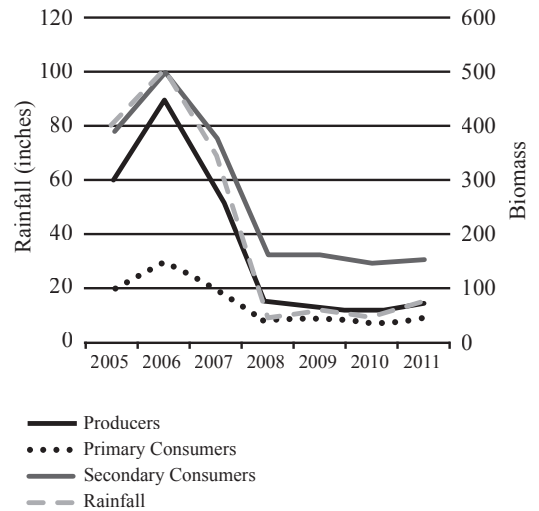
(B) Rainfall and Biomass 2005–2011



(C) Rainfall and Biomass 2005–2011



(D) Rainfall and Biomass 2005–2011



41. 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

- (A) parasitism
- (B) commensalism
- (C) mutualism
- (D) endosymbiosis

GO ON TO THE NEXT PAGE.

42. 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
43. 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
44. Trypsin is a digestive enzyme. It cleaves polypeptides after lysine and arginine amino acid residues. 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.
45. 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.
46. A change in a neuron membrane potential from +50 millivolts to -70 millivolts is considered
- depolarization
  - repolarization
  - hyperpolarization
  - an action potential
47. The energy given up by electrons as they move through the electron transport chain is used to
- break down glucose
  - make glucose
  - produce ATP
  - make NADH
48. If a plant undergoing the light-dependent reactions of photosynthesis began to release  $^{18}\text{O}_2$  instead of normal oxygen, one could most reasonably conclude that the plant had been supplied with
- $\text{H}_2\text{O}$  containing radioactive oxygen
  - $\text{CO}_2$  containing radioactive oxygen
  - $\text{C}_6\text{H}_{12}\text{O}_6$  containing radioactive oxygen
  - $\text{NO}_2$  containing radioactive oxygen
49. Chemical substances released by organisms that elicit a physiological or behavioral response in other members of the same species are known as
- auxins
  - hormones
  - pheromones
  - enzymes
50. Homologous structures are often cited as evidence for the process of natural selection. All of the following are examples of homologous structures EXCEPT
- the forearms of a cat and the wings of a bat
  - the flippers of a whale and the arms of a man
  - the pectoral fins of a porpoise and the flippers of a seal
  - the forelegs of an insect and the forelimbs of a dog
51. 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
- convergent evolution
  - divergent evolution
  - disruptive selection
  - stabilizing selection
52. Which of the following contributes the MOST to genetic variability in a population?
- Sporulation
  - Binary fission
  - Vegetative propagation
  - Mutation

Questions 53–55 refer to the following information and table.

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

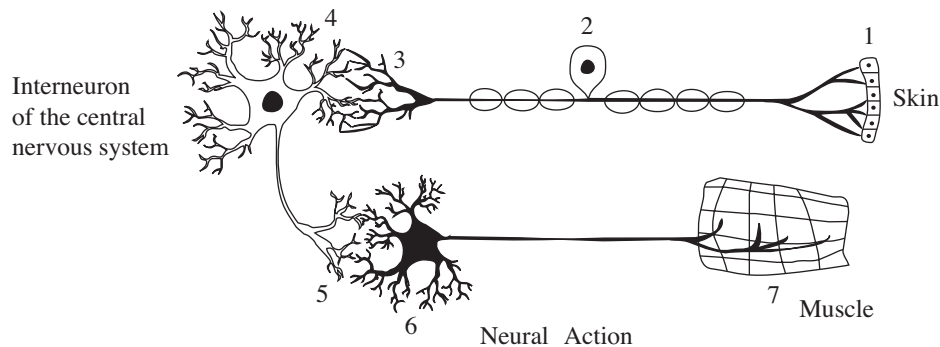
Type of Organism	Number of Organisms
Shark	2
Small crustaceans	400
Mackerel	20
Phytoplankton	1,000
Herring	100

53. Which of the following organisms in this population are secondary consumers?
- (A) Sharks
  - (B) Phytoplankton
  - (C) Herrings
  - (D) Small crustaceans
54. Which of the following organisms has the largest biomass in this food chain?
- (A) Phytoplanktons
  - (B) Mackerels
  - (C) Herrings
  - (D) Sharks

55. If the herring population is reduced by predation, which of the following would most likely be a secondary effect on the ecosystem?
- (A) The mackerels will be the largest predator in the ecosystem.
  - (B) The small crustacean population will be greatly reduced.
  - (C) The phytoplankton population will be reduced over the next year.
  - (D) The small crustaceans will become extinct.

Questions 56–58 refer to the following information and diagram.

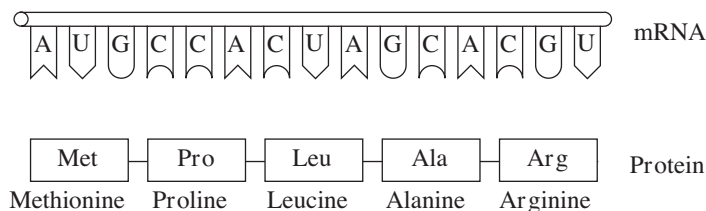
To understand the workings of neurons, an experiment was conducted to study the neural pathway of a reflex arc in frogs. A diagram of a reflex arc is given below.



56. 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
57. 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.  
 (C) All behaviors in frogs are primarily reflex responses.  
 (D) This reflex action does not require the brain.
58. 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.

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Questions 59–61 refer to the figure and chart below.



Formation of a Protein

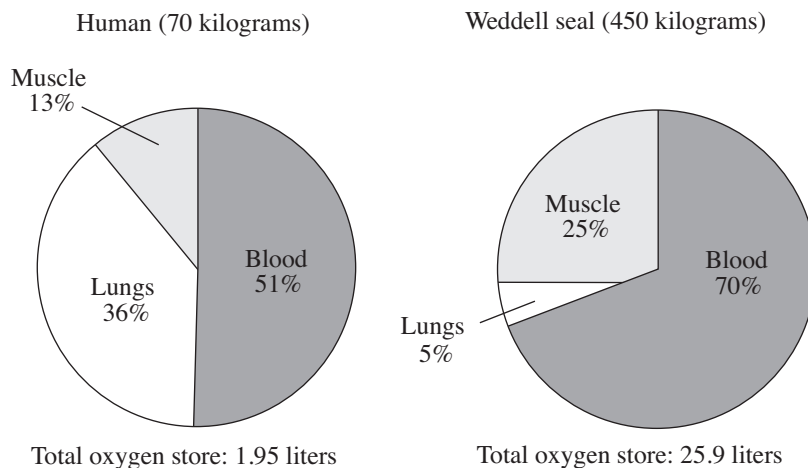
The Genetic Code: Codons of mRNA that Specify a Given Amino Acid					
First Position (5' end)	Second Position	Third Position (3' end)			
		U	C	A	G
U	U	UUU	UUC	UUA	UUG
		Phenylalanine		Leucine	
	C	UCU	UCC	UCA	UCG
		Serine			
A	U	UAU	UAC	UAA	UAG
		Tyrosine			
G	U	UGU	UGC	UGA	UGG
		Cysteine			Tryptophan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

59. Which of the following DNA strands is the template strand that led to the amino acid sequence shown above?
- (A) 3'-ATGCGACCAGCACGT-5'  
 (B) 3'-AUGCCACUAGCACGU-5'  
 (C) 3'-TACGGTGATCGTGCA-5'  
 (D) 3'-UACGGUGAUCGUGCA-5'
60. Immediately after the translation of methionine, a chemical is added which deletes all remaining uracil nucleotides in the mRNA, 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
61. 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

**GO ON TO THE NEXT PAGE.**

Questions 62 and 63 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.

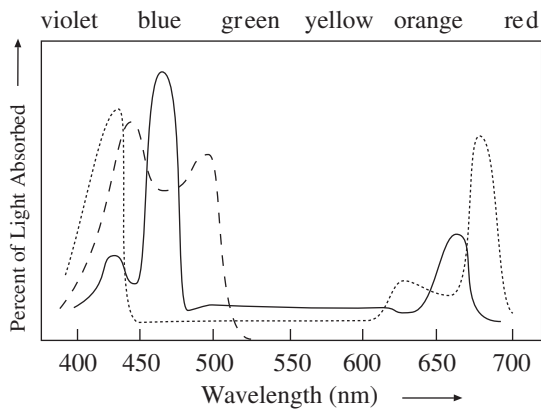


62. Compared with humans, approximately how many liters of oxygen does the Weddell seal store per kilogram of body weight?
- (A) The same amount of oxygen  
 (B) Twice the amount of oxygen  
 (C) Three times the amount of oxygen  
 (D) Five times the amount of oxygen
63. During a dive, a Weddell seal's 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

**GO ON TO THE NEXT PAGE.**

Directions: Part B consists of questions requiring numeric answers. Calculate the correct answer for each question.

64. 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

At approximately what wavelength does chlorophyll *a* maximally absorb light?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

65. 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?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

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66. The trophic level efficiency of large herbivores such as elk is frequently only about 5 percent. In tons, what volume of plants would be required to maintain 24,000 lbs of elk?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

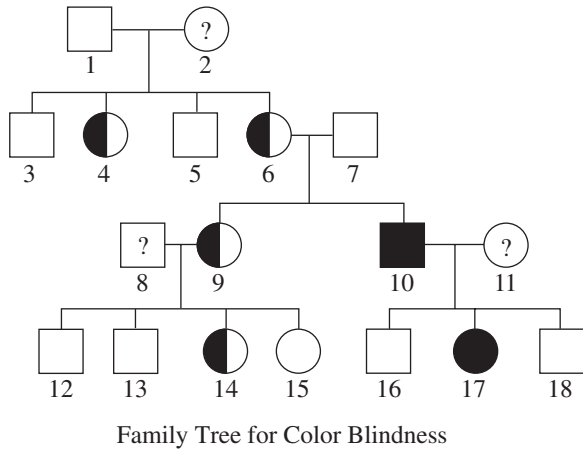
67. If the genotype frequencies of an insect population are  $AA = 0.49$ ,  $Aa = 0.42$ , and  $aa = 0.09$ , what is the gene frequency of the recessive allele?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

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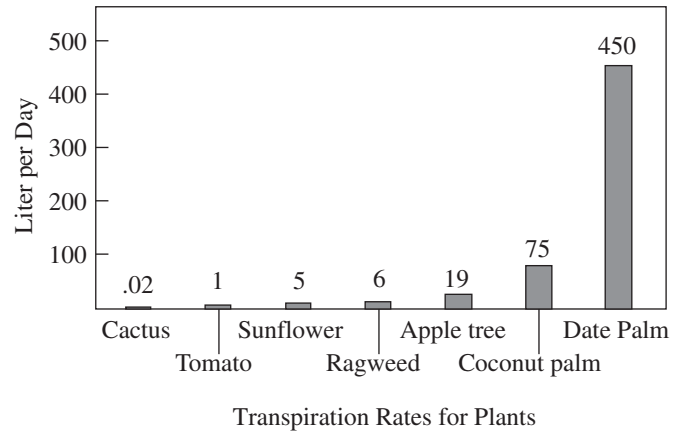
Question 68 refers to the diagram below.



68. Based on the pedigree above, what is the probability that a male child born to individuals 6 and 7 will be color-blind?

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

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



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

	/	/	/	
.	.	.	.	.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

STOP

END OF SECTION I

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION. DO NOT GO ON TO SECTION II UNTIL YOU ARE TOLD TO DO SO.

**BIOLOGY**  
**SECTION II****8 Questions****Planning Time—10 minutes****Writing Time—80 minutes**

**Directions:** Questions 1 and 2 are long free-response questions that should require about 22 minutes each to answer and are worth 10 points each. Questions 3 through 8 are short free-response questions that should require about 6 minutes each to answer. Questions 3 through 5 are worth 4 points each, and questions 6 through 8 are worth 3 points each.

Read each question carefully and completely. Write your response in the space provided following each question. Only material written in the space provided will be scored. Answers must be written out in paragraph form. Outlines, bulleted lists, or diagrams alone are not acceptable.

- The cell membrane is an important structural feature of a nerve cell.
  - Describe** the role of the sodium potassium pump in maintaining the resting membrane potential.
  - Discuss** ion flow during an action potential.
  - Predict** the outcome on action potentials if a cell could not make voltage-gated sodium channels.
  - Explain** how myelin affects the speed of an action potential.
- 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.
  - Discuss** the process by which mutation occurs in base substitution.
  - 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.
  - 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.
- Cell size is limited by the surface area-to-volume ratio of the cell membrane.
  - Discuss** why cell size is limited by this ratio.
  - Describe** two adaptations that increase surface area in organisms.
  - Describe** the difference in how small polar and small nonpolar molecules cross cell membranes
- Discuss** the Krebs cycle and the electron transport chain, and chemiosmosis.
  - Explain** why these steps are considered aerobic processes.
  - Discuss** the location at which **each** stage occurs.

**GO ON TO THE NEXT PAGE.**

5. **Describe** three main differences between meiosis and mitosis.
6. **Define** homologous structures and give an example. **Describe** how they are different from analogous structures.
7. **Describe** the three ways that genetic information is transmitted laterally between bacteria.
8. **Describe** why viruses are typically not considered to be alive.

**STOP**

**END OF EXAM**

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