# Practice Test 3

# AP® 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) ● (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**

<u>Directions:</u> 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. Klinefelter's syndrome is a genetic condition in males that results in the creation of an extra X chromosome during the early stages of embryo development, which must be inactivated. Which of the following karyotypes represents a person with Klinefelter's?
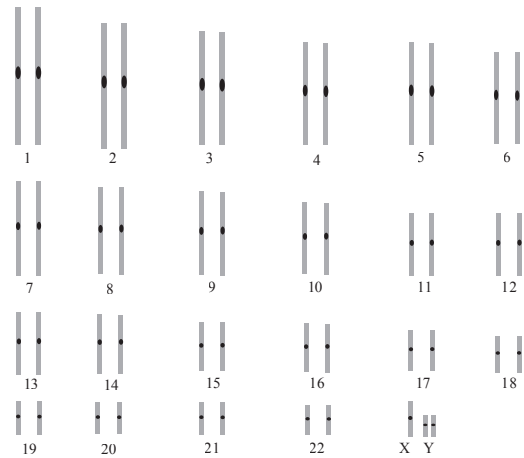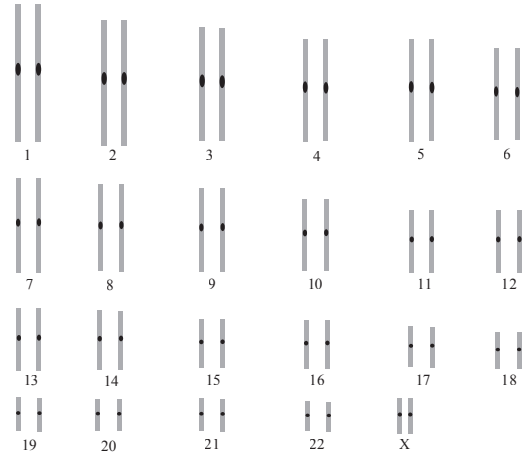
(A)



(B)



(C)



(D)
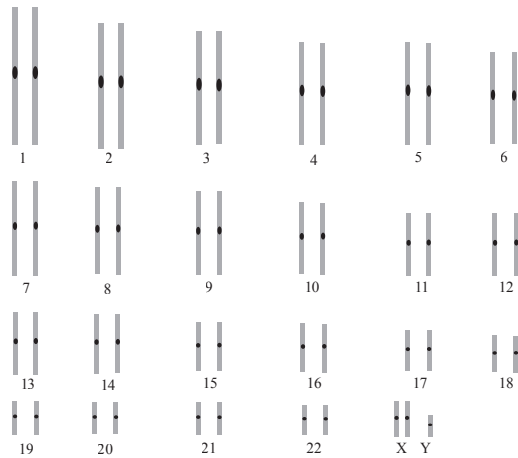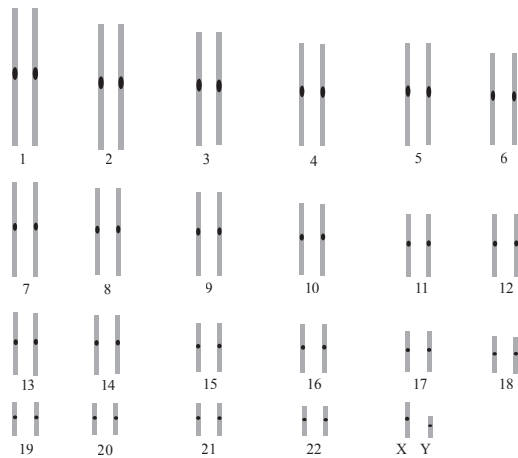
2. The restriction enzyme BAMHI predictably cuts the following sequence at the locations designated by the star.

   5′  G*GATCC  3′

   3′  CCTAG*G  5′

   Which of the following DNA helix sequences would be cut into 3 pieces by BAMHI?

   (A) 5′  GGATCC  3′
       3′  CCTAGG  5′
   (B) 5′  GGATCCGGATCCGGATCC  3′
       3′  CCTAGGCCTAGGCCTAGG  5′
   (C) 3′  GGATCC  5′
       5′  CCTAGG  3′
   (D) 5′  AAGGATCCGGATCCAA  3′
       3′  TTCCTAGGCCTAGGTT  5′

Questions 3–5 refer to the following passage.

   In a species of peas, green (G) peas are known to be classically dominant over yellow (g) peas. A true breeding green plant and a true breeding yellow plant are crossed. The resulting F1 generation is evaluated, and its phenotype distribution is shown in Table 1. Two green pea producing members of the F1 generation are then crossed, and the resulting F2 generation phenotype distribution is shown in Table 2.

   Table 1. F1 Generation

   | Type of Peas Produced | # of Plants |
   |---|---|
   | Green | 1,432 |
   | Yellow | 1 |

   Table 2. F2 Generation

   | Type of Peas Produced | # of Plants |
   |---|---|
   | Green | 1,196 |
   | Yellow | 374 |

3. You are given a green pea plant with an unknown genotype. You want to figure out the genotype by crossing it with another plant and looking at the offspring. Which of the following plants would be the most helpful in determining the genotype of the original plant?

   (A) Any green pea plant
   (B) A homozygous green plant
   (C) A yellow pea plant
   (D) None of the above

4. Which of the following best explains the single yellow pea producing plant in the F1 generation?

   (A) Crossing-over occurred in the parental pea plant to provide genetic variation.
   (B) The law of independent assortment: one homologous pair separated independently of the others during gamete production in the parental pea plant.
   (C) Nondisjunction in one of the parental pea plants caused an imbalance in chromosome distribution.
   (D) A DNA polymerase error occurred during DNA replication just prior to meiosis.

5. If a yellow plant from the F2 generation is crossed with a green plant from the F1 generation, what would be the green-to-yellow phenotype ratio?

   (A) 1:1
   (B) 3:1
   (C) 1:0
   (D) 1:3

6. According to the information in the figure, a sensory neuron would likely be oriented in which of the following ways?
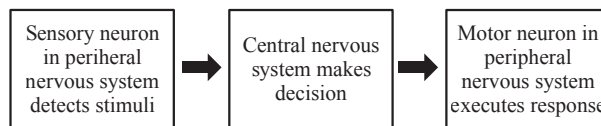


   (A) Dendrite connecting to the anterior pituitary in the brain and axon connecting to a skeletal muscle cell
   (B) Dendrite connecting to the photoreceptors in the eye and axon connecting to a smooth muscle cell
   (C) Dendrite connecting to the photoreceptors in the eye and axon connecting to the brain
   (D) Dendrite connecting to the anterior pituitary in the brain and axon connecting to the spinal cord

**GO ON TO THE NEXT PAGE.**

7. Compact bone contains rings of osteons, each of which contains a central canal housing the blood vessels, which can only be accessed by those osteocytes adjacent to it. Gap junctions, which are tunnels between neighboring cells, then allow the cells that are not adjacent to the central canal to exchange nutrients and wastes with the bloodstream. Which statement is true about the exchange of materials with the bloodstream?

(A) Hydrophobic carbon dioxide waste must be passed via gap junctions from high concentration to low concentration.

(B) Hydrophilic $Ca^{2+}$ is passed via gap junctions from low concentration to high concentration.

(C) Hydrophobic carbon dioxide waste does not require the gap junctions to travel from high concentrations to low concentrations.

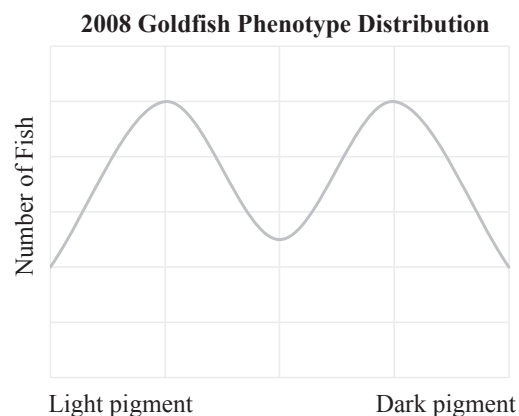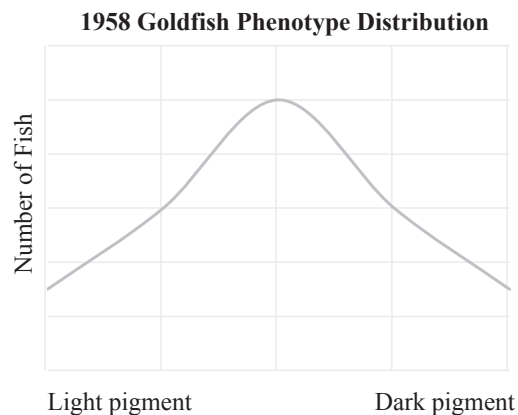(D) Hydrophilic $Ca^{2+}$ does not require gap junctions to travel from high concentration to low concentrations.

Questions 8–10 refer to the following passage.

The somatic cells in a newly identified sexually reproducing species are found to be octoploidy (8n), and each cell contains 32 chromosomes, slightly fewer than the 46 chromosomes in a somatic human cell. The cell cycle of this species is similar to ours, and gametes are made during meiosis. Two gametes will come together at fertilization to create octoploidy offspring.

8. How many chromosome segments are present in a somatic cell at the completion of mitosis?

(A) 64
(B) 32
(C) 16
(D) 8

9. How many unique, non-homologous chromosomes are present in this species?

(A) 4
(B) 8
(C) 16
(D) 32

10. How many chromosome segments will be in each gamete if you count each homologous member individually?

(A) 32
(B) 16
(C) 8
(D) 4

Questions 11–14 refer to the following passage.

A population of goldfish in a large, isolated pond were studied in 1958 and again in 2008. The fishes' pigment level varied from pale white-orange fish to dark brown-orange fish. The color of each of the fish was recorded and recorded in the figure below.

**1958 Goldfish Phenotype Distribution**



Light pigment          Dark pigment

**2008 Goldfish Phenotype Distribution**



Light pigment          Dark pigment

11. Which of the following best describes the fish population in the year 1958?

(A) All medium-orange in color
(B) Mostly medium-orange fish with some nearly white and some nearly brown
(C) Mostly white fish and brown fish with a few orange fish
(D) Equal numbers of orange fish, white fish, and brown fish

**GO ON TO THE NEXT PAGE.**

12. Which of the following theories is supported by the evidence?

    (A) The pigment trait in fish demonstrates incomplete dominance.
    (B) The pigment trait in fish demonstrates classical dominance.
    (C) The pigment trait in fish demonstrates codominance.
    (D) None of the above

13. If a dark-colored, poisonous fish and a bird that can see only light-colored fish are added to the ecosystem in 2008, what will the graph likely look like in 50 years?

    (A)

    (B)

    (C)

    (D)

14. Which addition to the pond did NOT likely contribute to the change between 1958 and 2008?

    (A) A poisonous fish with a medium orange pigment
    (B) Runoff from fields that makes the water dark and murky
    (C) A light-orange water grass that grows in the pond
    (D) Predatory birds that can easily see medium-orange pigment

Questions 15–16 refer to the following figure.
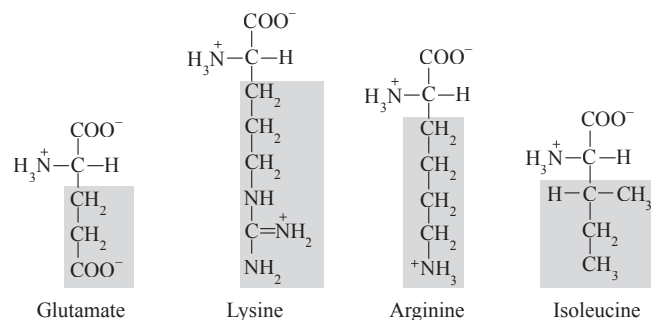


15. Which of the following amino acids would likely be found in the transmembrane domain?

    (A) Lysine
    (B) Arginine
    (C) Isoleucine
    (D) Glutamate

16. An enzyme's active site contains arginine residues. Which residues will likely be found on the corresponding substrate region?

    (A) Arginine
    (B) Lysine
    (C) Glutamate
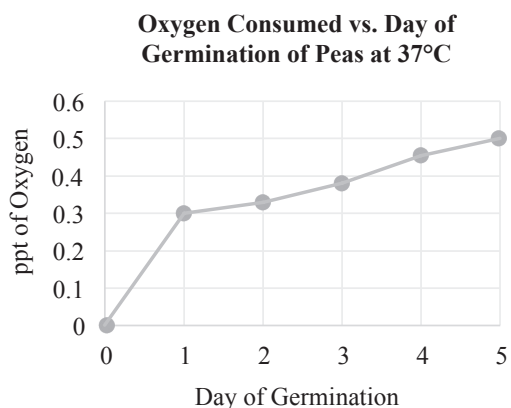    (D) Isoleucine

**GO ON TO THE NEXT PAGE.**

Questions 17–19 refer to the following passage.

The extracellular environment of the human body is typically abundant in sodium and calcium. In skeletal muscle cells, the sarcoplasmic reticulum is a specialized organelle that actively sequesters calcium from the cytosol. It stockpiles the calcium until a motor neuron triggers its release through an action potential, which opens voltage-gated calcium channels in the sarcoplasmic reticulum membrane. The calcium is necessary for the calcium-mediated functions of the protein troponin. In the presence of calcium, troponin removes tropomyosin from the myosin binding sites on actin filaments. This attachment is essential for sarcomere and muscle contraction.

17. Which of following statements best describes the uptake of calcium by skeletal muscles and the sarcoplasmic reticulum?
    (A) Calcium is passively taken from the extracellular environment and the cytosol.
    (B) Calcium is actively taken up from the extracellular environment and the cytosol.
    (C) Calcium is passively taken up from the extracellular environment and actively taken up from the cytosol.
    (D) Calcium is actively taken up from the extracellular environment and passively taken up from the cytosol.

18. Which statement best summarizes the role of calcium in skeletal muscle contraction?
    (A) It prevents muscle contractions during action potentials.
    (B) It changes the hypertonic nature of the cytosol to allow action potentials.
    (C) It amplifies the physical contraction of the sarcomere.
    (D) It connects the electrical neuronal signal to the actual physical contraction.

19. If a muscle cell fails to contract, which of the following could be a reason?
    (A) The cell is lacking tropomyosin.
    (B) Too much calcium is in the sarcoplasmic reticulum.
    (C) The cell is lacking troponin.
    (D) Too many action potentials are reaching the cell.

20. Dehydration synthesis is a key part of the creation of many macromolecules. It is best described as
    (A) loss of a water molecule in order to make something else
    (B) water rushing out of a cell during the process of osmosis
    (C) life moving out of the ocean and becoming complex
    (D) kidneys filtering hydrophilic compounds during urine formation

21. A person rings a small bell every time a dog is fed. Over time, the dog begins to associate the jingle of the bell with eating and begins to salivate at the sound of the bell even if no food has been presented. This is an example of classical conditioning, a type of learning.

    Imagine that you adopt a cat and discover that it has a strange fear of cotton balls. If this is a classically conditioned response, then which of the following could explain it?
    (A) The cat has eaten cotton balls and become sick before.
    (B) The cat sees cotton balls at the vet when it gets vaccinated.
    (C) The cotton balls resemble a type of toy it had as a kitten.
    (D) The cat is confused because it has never seen a cotton ball before.

22. A molecule of ADP is dephosphorylated once and then phosphorylated twice. What molecule will result?
    (A) AMP
    (B) ADP
    (C) ATP
    (D) AUP

**GO ON TO THE NEXT PAGE.**

Questions 23–25 refer to the following figure.

**Oxygen Consumed vs. Day of Germination of Peas at 37°C**



23. In the above figure, _____ is the dependent variable and _____ is the independent variable.

   (A)  ppt of oxygen consumed; day of germination
   (B)  ppt of oxygen consumed; 37°C
   (C)  day of germination; ppt of oxygen consumed
   (D)  37°C; day of germination

24. In the above figure, which process is likely occurring?

   (A)  Photosynthesis
   (B)  Cellular Respiration
   (C)  Fermentation
   (D)  All of the above

25. If the trend continues, what will be the oxygen consumed on day 7?

   (A)  0.55
   (B)  0.6
   (C)  0.75
   (D)  0.8

26. There are two broad categories of how a cell dies. The first is called apoptosis, which occurs when the cell chooses to die and carries out a programmed cell death. The cell carefully disposes of itself and implodes in a way that causes the least amount of problems for neighboring cells. The other form of death is called necrosis. Necrosis is a messy form of cell death that is not carefully controlled. The cell often ruptures and causes inflammation and danger to the surrounding cells. Which of the following situations does NOT likely end with apoptosis?

   (A)  An error occurs during DNA replication causing severe chromosome breakage.
   (B)  A killer T-cell identifies a cell infected with a virus.
   (C)  A virus-infected cell reaches the lytic phase.
   (D)  A cell undergoes uncontrolled mitosis.

27. A neuron experiences two refractory periods after firing an action potential. One is called an absolute refractory period, which means that a neuron cannot fire under any circumstances because the voltage-gated sodium channels are inactive. The second type is a relative refractory period, which means that the cell is experiencing a state of hyperpolarization, making it unlikely to reach action potential threshold.
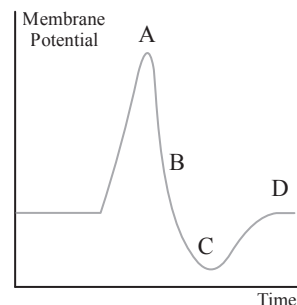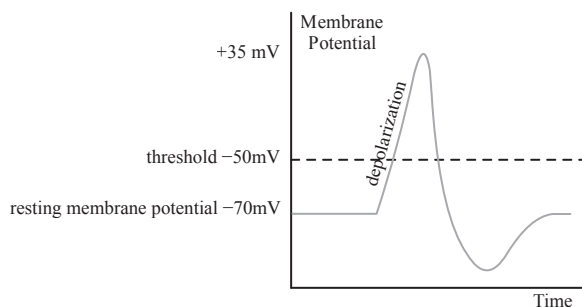


In the figure above, which of the following letters marks a relative refractory period?

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

**GO ON TO THE NEXT PAGE.**

28. During spermatogenesis, a single 2n spermatogonium undergoes meiosis to become

    (A) two spermatids with 1n chromosomes
    (B) four spermatids with 1n chromosomes
    (C) two spermatids with 2n chromosomes
    (D) four spermatids with 2n chromosomes

29. Which is NOT a true statement about acid rain?

    I. It increases the pH in the water and can harm aquatic plants.

    II. High levels of H+ can harm fish hatchlings.

    III. It can change the composition of the soil.

    (A) I only
    (B) I and II
    (C) II only
    (D) I and III

30. The Krebs cycle produces which of the following electron carriers?

    (A) NADPH
    (B) NADH
    (C) FADH
    (D) NAD$^+$

31. Plant cells are well-known for having a structural dependence upon their large central vacuole. As this is a water-dependent structure, plants have developed many strategies for maintaining a state of hydration. One of these is a thick, waxy skin called a cuticle, which prevents water escaping from the plant surface. If a plant is misted with an enzyme designed to eat away the waxy cuticle, all of the following would be predicted outcomes EXCEPT

    (A) the plant would not stand up as tall
    (B) the plant would dry out more quickly
    (C) the plant would grow more roots
    (D) the plant would transport sugars more quickly

Questions 32–33 refer to the following passage.

Radiometric dating is a scientific technique based on predictable radioactive decay. The age of a rock or other substance that contains trace amounts of radioactive isotopes can be estimated by measuring how much of the original radioactive isotope is present and how much of the decayed version is present. Because the rate of decay occurs in an even, predictable manner, the original creation date of the rock can be estimated.

32. Two fossils found right next to each other are determined by radiometric dating to have similar levels of decayed isotope in their surrounding rock. Which of the following conclusions can be made?

    (A) The two life forms had the same molecular DNA sequence.
    (B) The two life forms were the same trophic level in an ecosystem.
    (C) The two life forms were part of the same community.
    (D) They are common ancestors to modern day mammals.

33. Which of the following assumptions does radiometric dating NOT make?

    (A) The rock has not been in the presence of a strong magnetic field.
    (B) The rock formed at the same time that the radioactive isotope began decaying.
    (C) Neither the original isotope nor the decay product has escaped from the rock.
    (D) The rate of decay is predictable and has not greatly changed over time.

34. The membrane potential of cells is determined by the sodium-potassium pump, which

    (A) creates an intracellular space that is more negative than the extracellular space and possesses more potassium
    (B) creates an intracellular space that is more positive than the extracellular space and possesses more potassium
    (C) creates an intracellular space that is more negative than the extracellular space and possesses less potassium
    (D) creates an intracellular space that is more positive than the extracellular space and possesses less potassium

**GO ON TO THE NEXT PAGE.**

Questions 35–37 refer to the following passage.

Diabetes mellitus is a disease characterized by an inability of the cells to properly produce (type I) or respond (type II) to insulin, a hormone produced by the pancreas in response to high levels of blood glucose. Without insulin, glucose accumulates in the blood. In situations of low blood glucose, another pancreatic enzyme, glucagon, is released, which triggers the process of gluconeogenesis shown on the right side of the pathway below. The stimulators, activators, or inhibitors of each step are shown with + or – signs.
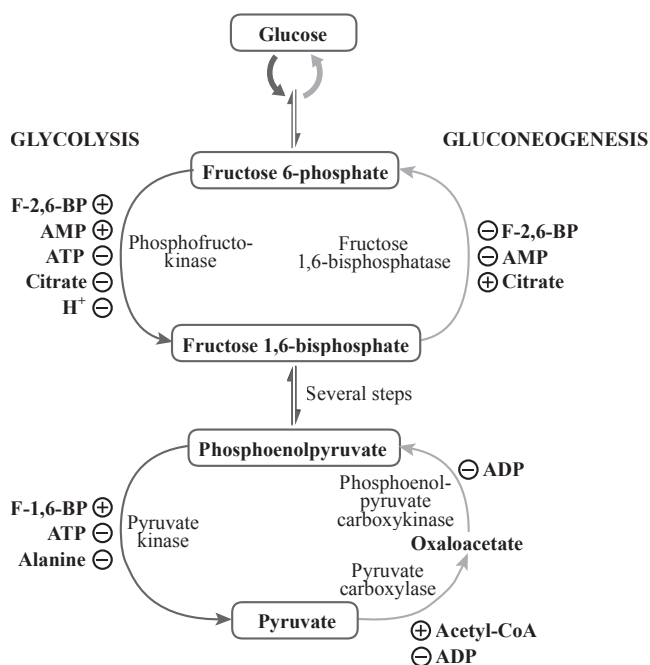


35. Which of the following conditions would lead to increased production of fructose 1,6-bisphosphate?

(A) High ATP and high citrate
(B) High AMP and high citrate
(C) High AMP and high F-2,6-BP
(D) High ATP and high F-2,6-BP

36. Patients with type I diabetes often require insulin injections. Which of the following situations would most require an insulin injection?

(A) After eating a stalk of celery
(B) After eating a cookie
(C) After skipping breakfast
(D) After drinking a lot of water

37. Which of the following situations likely stimulates gluconeogenesis?

(A) High levels of insulin
(B) High levels of F-2,6-BP
(C) High levels of glucagon
(D) High levels of ADP

**GO ON TO THE NEXT PAGE.**

Questions 38–39 refer to the following passage.

Embryogenesis is a carefully timed and well-organized process. As a single-celled zygote divides and grows into hundreds and thousands of cells, a process called differentiation occurs wherein certain areas of the embryo become specialized to become different types of tissue. As differentiation continues, the level of specificity increases, and the cell potency decreases until highly specialized unique tissues and organs develop. The figure below shows 12 stages of development of human embryos.
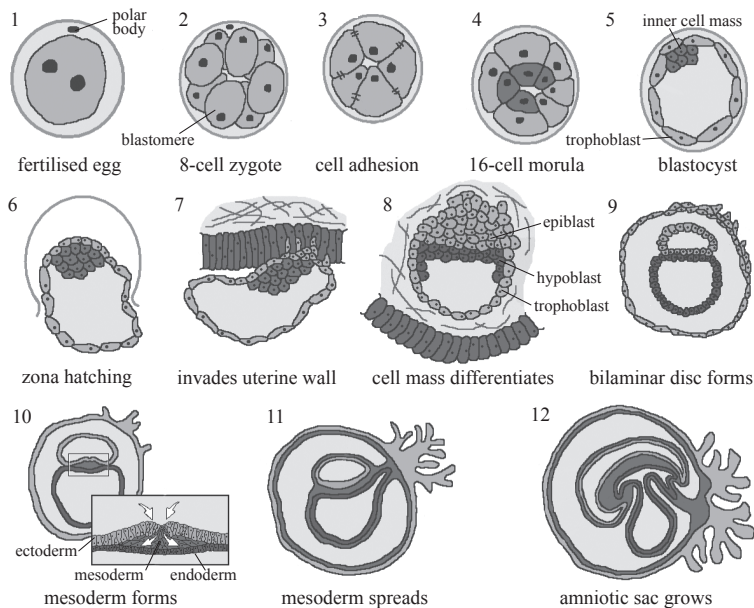


38. The inner cell mass is what eventually forms the embryo. During development, the embryo differentiates into various types of cell layers. Which of the following is NOT one of them?

(A) Mesoderm
(B) Hypoblast
(C) Blastomere
(D) Endoderm

39. A totipotent embryonic cell has the most cell potency. Which of the following is most likely to be totipotent?

(A) 8-cell zygote
(B) Inner cell mass
(C) Mesoderm
(D) Digestive tract

40. The following diagram demonstrates the ecological succession that occurs in an environment over time as it is colonized by different species.
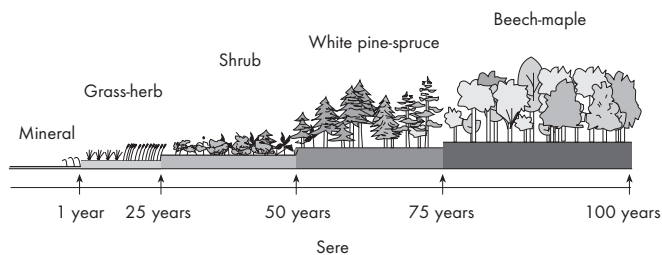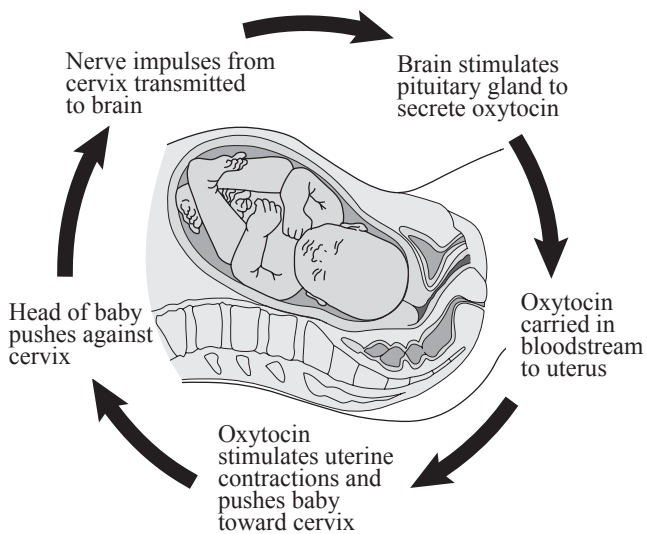


Why does it take 75 years for a beech-maple to occur in the figure above?

(A) Beech seeds have a very long period of dormancy prior to germination.
(B) It takes an average of 75 years for conifer trees to become extinct.
(C) Agriculture was the predominant industry, and hardwood trees were removed.
(D) Maple trees grow better in a pine forest than they do in a grassland.

**GO ON TO THE NEXT PAGE.**

41. During labor, pressure on the cervix and oxytocin form a positive feedback loop as shown below.



Nerve impulses from cervix transmitted to brain

Brain stimulates pituitary gland to secrete oxytocin

Oxytocin carried in bloodstream to uterus

Head of baby pushes against cervix

Oxytocin stimulates uterine contractions and pushes baby toward cervix

Which of the following other pathways also demonstrate positive feedback?

(A) Glycolysis leads to the production of ATP. ATP, in turn, turns off the enzyme phosphofructokinase, which catalyzes a key phosphorylation step in glycolysis.

(B) The anterior pituitary gland in the brain releases adrenocorticotropic hormone (ACTH). ACTH then causes the adrenal cortex to release glucocorticoids. Glucocorticoids then prevent the pituitary from releasing more ACTH.

(C) Lutenizing hormone triggers ovulation and the formation of the corpus luteum, which is a hormone-producing structure formed during ovulation. The corpus luteum secretes progesterone, which inhibits LH. The drop in LH causes the degradation of the corpus luteum.

(D) When a tissue is injured, it releases chemicals that activate platelets. Activated platelets themselves then release chemicals that activate more platelets. These activated platelets then release chemicals to activate more platelets.

42. The figure below is a typical chemical synapse. The table below shows the measurements of 4 different synapses. The presynaptic membrane potential and the postsynaptic membrane potential are measured before the neurotransmitter is released and after the neurotransmitter is received.
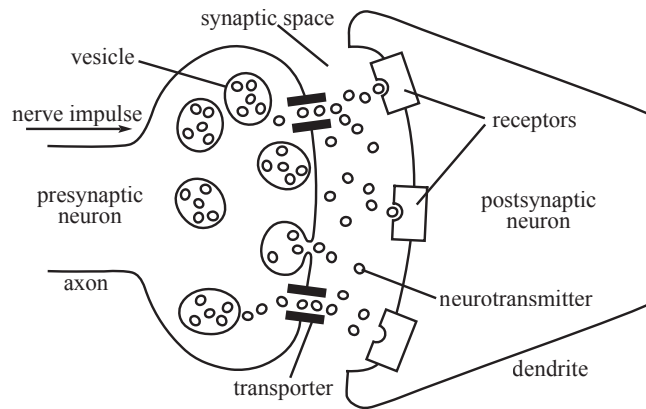


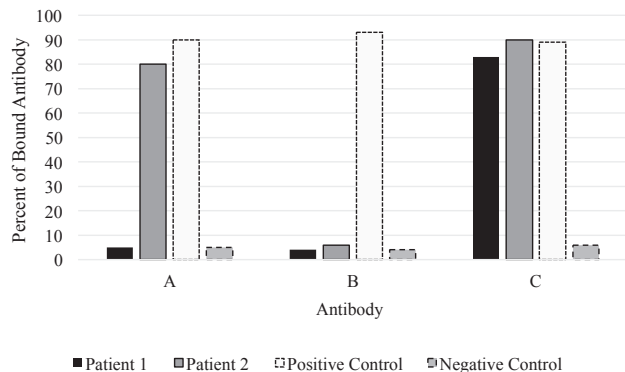| Synapse | Neurotrans-mitter Present | Pre-synaptic mem-brane potential | Post-synaptic mem-brane potential (initial) | Post-synaptic mem-brane potential (final) |
|---|---|---|---|---|
| Synapse 1 | Acetylcho-line | +35 mV | −70 mV | +35 mV |
| Synapse 2 | Acetylcho-line | +35 mV | −70 mV | −100 mV |
| Synapse 3 | Norepineph-rine | +35 mV | −70 mV | +35 mV |
| Synapse 4 | Norepineph-rine | +35 mV | −70 mV | +35 mV |

What is the best explanation for the varying behavior of acetylcholine on the postsynaptic membrane potential in synapse 1 and synapse 2?

(A) There might be acetylcholinesterase enzyme within synapse 1.

(B) The receptors on the postsynaptic cell determine the effect of the neurotransmitter.

(C) The action potential at the presynaptic cell is not always large enough to pass on.

(D) All of the above

**GO ON TO THE NEXT PAGE.**

Questions 43–46 refer to the following passage.

The blood of two patients is mixed independently with 3 different antibodies (A, B, and C) that are known to react to 3 diseases (1, 2, and 3 respectively). The results of the antibody binding are shown in the figure below.
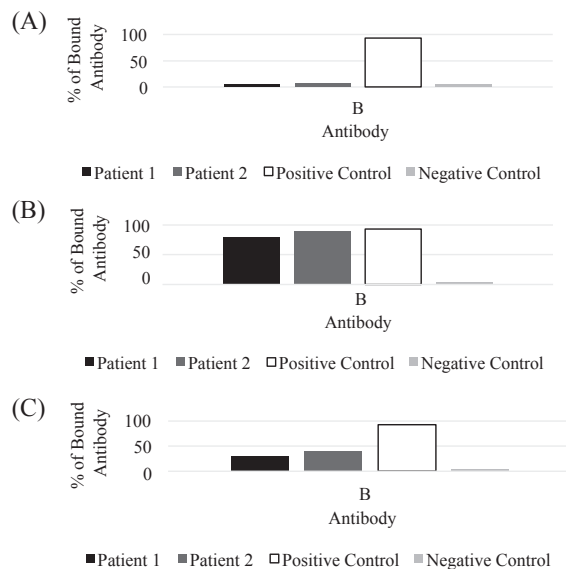


46. If this study was done a year from now, which graph would likely result for antibody B?

(A)



(B)



(C)



(D)  This is impossible to predict with the information given.

43. Which question is best answered by this experiment?

(A)  Has either patient 1 or 2 been infected in the past with disease 1, 2, or 3?
(B)  Do either of the patients have antibodies A, B, or C in their blood?
(C)  Is either patient 1 or patient 2 currently infected with disease 1, 2, or 3?
(D)  Has either patient 1 or patient 2 ever made antibodies A, B, or C in the past?

44. The low bars for antibody B represent each of the following EXCEPT

(A)  neither patient currently has disease 2 in their blood
(B)  a low level of non-specific binding occurs by antibody B
(C)  neither patient currently has antibody B in their blood
(D)  antibody B did not specifically bind to the patient's blood

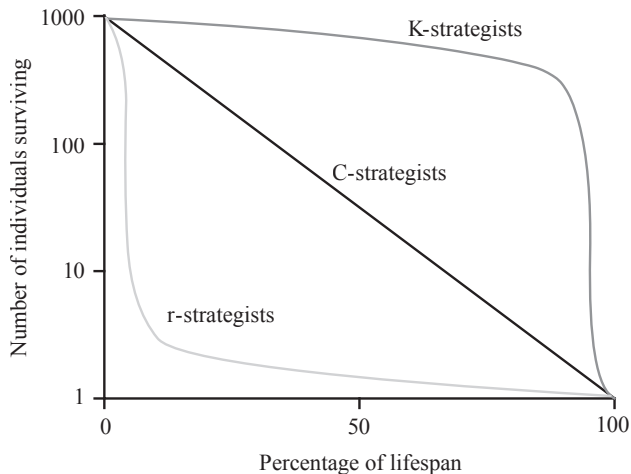45. What is likely in the positive control?

(A)  Blood containing diseases 1, 2, and 3
(B)  Blood containing antibodies A, B, and C
(C)  Blood without diseases 1, 2, and 3
(D)  Blood without antibodies A, B, and C

47. The following graph demonstrates 3 different strategies for survival.



Which of the following are true statements according to the figure?

 I. r-strategists are unlikely to die young.

 II. The death rate for a c-strategist is constant.

III. Humans are an example of a K-stategist.

(A)  I only
(B)  II only
(C)  II and III
(D)  I, II, and III

**GO ON TO THE NEXT PAGE.**

Questions 48–49 refer to the following figure.

**Phylogenetic Tree of Life**
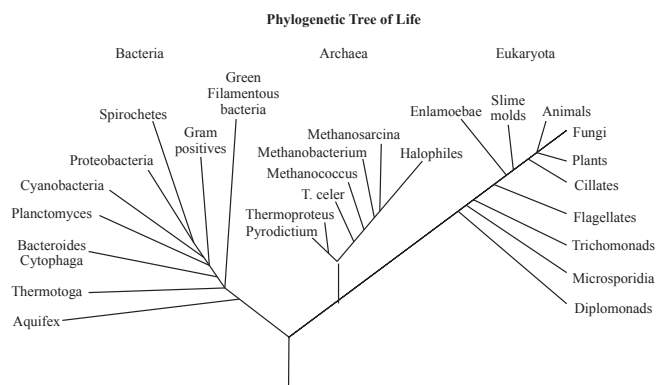


48. Which of the following are the most closely related?

    (A) Aquifex and diplomonads
    (B) Animals and fungi
    (C) Halophiles and entamoebae
    (D) There is not enough information given.

49. If a planctomyces is dividing by budding, which of the following will occur?

    (A) A mitotic spindle will pull chromosome segments to opposite ends of the cell.
    (B) Enzymes will unwind the helix and copy the entire bacterial genome.
    (C) The nuclear envelope will break down and then reform after DNA replication.
    (D) The mitochondria will replicate and be divided between the two cells.

50. Which of the following would make the Calvin cycle unnecessary?

    (A) If the light-dependent reactions made sugar and ATP
    (B) If plants could make ATP in their electron transport chain
    (C) If plants could use ATP to power cellular processes
    (D) If NADPH could be created by photosystem I

51. Without phototropism how would plant growth be affected?

    (A) Plants would never point towards the sun.
    (B) Plants would not be able to change direction of growth.
    (C) Plants would not be able to perform photosynthesis.
    (D) The direction of plant growth would not be related to the sun.

52. Which of the following does NOT affect higher order protein structure?

    (A) Ester linkages between amino acids
    (B) Amino acid sequence order
    (C) Hydrogen bonding between R groups on the same polypeptide
    (D) Hydrophobic interactions between side groups on different polypeptides

**GO ON TO THE NEXT PAGE.**

Questions 53–54 refer to the following passage.

The following study was carried out to examine sexual selection of beetles. Chemicals believed to be pheromones were isolated from males of certain species of butterfly. An environment was created in which a pheromone-containing droplet was applied to one side of the box and a control drop was applied to the other side. Female butterflies were introduced to the center of the box and given the opportunity to go to either side. The results are shown in the table below.

| Preferred Side | # of Butterflies |
|---|---|
| Male chemical side | 2,760 |
| Control side | 2,240 |

53. What is the best testable null hypothesis for the above experiment?

(A) Female butterflies prefer the scent of chemicals produced by males of their own species over the control chemicals.
(B) Female butterflies prefer the scent of the control chemicals over chemicals produced by males of their own species.
(C) Female butterflies cannot sense the chemicals produced by males of their own species.
(D) Female butterflies have no preference for either of the chemicals.

54. A chi-squared analysis would be performed in this experiment to make which of the following conclusions?

(A) To calculate that there is 1 degree of freedom
(B) To determine if the null hypothesis can be rejected
(C) To determine the standard deviation between two samples
(D) To prove that the working hypothesis is correct

Questions 55–56 refer to the following passage.

Two DNA sequences are shown below.

Sequence 1

5′ GATTCCTACATCAG 3′
3′ CTAAGGATGTAGTC 5′

Sequence 2

5′ CGGCGAGACGCGGC 3′
3′ GCCGCTCTGCGCCG 5′

55. If the mRNA sequence transcribed from one of the above sequences is 5′ GAUUCCUACAUCAG 3′, what is the sequence of the coding strand of DNA?

(A) 3′ CTAAGGATGTAGTC 5′
(B) 5′ GACTACATCCTTAG 3′
(C) 5′ GATTCCTACATCAG 3′
(D) 3′ CTGATGTAGGAATC 5′

56. Which of the following best describes the relationship between sequence 1 and sequence 2?

(A) Sequence 1 is less likely to be a coding sequence.
(B) Sequence 2 is more likely to degrade over time.
(C) Sequence 1 has more hydrogen bonds between base pairs.
(D) Sequence 2 has a higher melting temperature.

57. Microvilli provide what benefit to organisms?

(A) Aiding in locomotion in unicellular organisms
(B) Increasing surface area, which increases absorption efficiency
(C) Secreting hormones necessary to maintain homeostasis
(D) Clearing dust and pathogens from mucus membranes

58. Blood pressure is determined by the volume of the blood and the peripheral resistance of the blood vessels. Blood volume is dependent upon hydration level and osmotic pressure within the blood. Peripheral resistance refers to the volume of blood vessel, which is dependent upon constriction and dilation of arteries as blood flow is maximized and minimized in response to the body's needs.

Which of the following would BOTH help to raise blood pressure?

(A) Constriction of blood vessels and decreasing salt intake
(B) Dilation of blood vessels and decreasing salt intake
(C) Constriction of blood vessels and increasing salt intake
(D) Dilation of blood vessels and increasing salt intake

**GO ON TO THE NEXT PAGE.**

Questions 59–61 refer to the following passage.

Hydrogen peroxide ($H_2O_2$) is broken down into oxygen and water by the enzyme horseradish peroxidase (HRP). This reaction can be measured with an oxygen-sensitive color indicator, and the color change can be measured on a spectrophotometer. The rate of oxygen formation is measured with a constant HRP concentration and 5 different concentrations of $H_2O_2$ at room temperature. A follow-up experiment adds a known inhibitor of HRP (sodium azide). The results of both studies are shown in Figure 1.

**HRP Velocity vs. $H_2O_2$ Concentration**
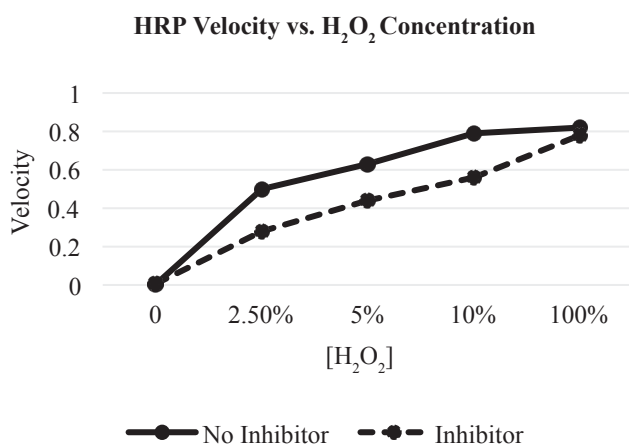


59   What is the substrate in this reaction?

(A)  $H_2O_2$
(B)  HRP
(C)  Water
(D)  Oxygen

60. Which of the following hypotheses about why the no-inhibitor graph plateaus after 10% $H_2O_2$ is supported?

(A)  Water begins to act as an inhibitor.
(B)  All the HRP is fully engaged.
(C)  There is no more $H_2O_2$ available.
(D)  The temperature is no longer optimal.

61. Which statement about sodium azide is supported by the data?

(A)  It performs best at room temperature.
(B)  It binds to the active site on HRP.
(C)  It binds to an allosteric site on HRP.
(D)  It has no effect on the reaction.

Questions 62–63 refer to the following passage.

Interactions between biotic and abiotic factors are what makes an ecosystem stable. Some interactions are obvious, but others occur underground beyond our sight. Mycorrhizae are a type of symbiotic relationship between fungi and plant roots. Special growth patterns allow the two species to easily share water, nutrients, and sugars. The plant is better at making sugar than the fungi, and the fungi have lots of tiny little strands, which provide the plant a huge surface area.

62. How might the fungi be helping the plant?

(A)  Preventing the plant from touching the soil
(B)  Giving it more capacity to suck up water
(C)  Decreasing the osmotic pressure in the root
(D)  Assisting in the light-independent reactions of photosynthesis

63. If the plant devised a way to block sugar transport to the fungi, the relationship could best be described as

(A)  mutualistic
(B)  parasitic
(C)  commensal
(D)  individual

**GO ON TO THE NEXT PAGE.**

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

64. A species of butterfly comes in two colors: blue (B) and white (b). In a population of 500 butterflies at Hardy-Weinberg equilibrium, there are 300 blue butterflies. What is the frequency of the recessive allele? Answers should be rounded to 2 decimal places.

66. A homozygous, dominant male and a homozygous, recessive female are crossed. One of the male offspring is backcrossed to the female. What percentage of their offspring will be heterozygous?

65. In the following mRNA, what is the length of the 5′ untranslated region in bases?

5′ UAACGAUCAUAUAUGACGCGUAUCUAG 3′

Questions 67–68 refer to the following figure.
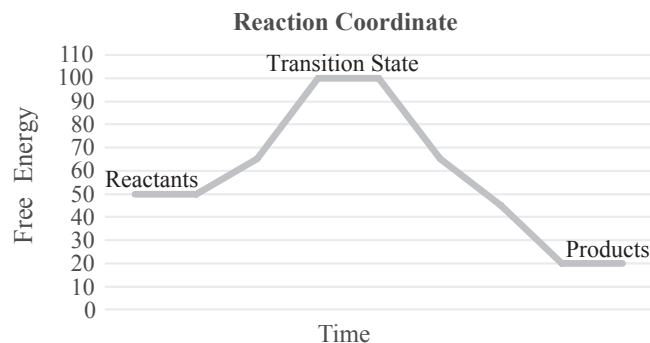
**Reaction Coordinate**

67. What is the change in Gibbs free energy for the reaction?

68. What is the activation energy for the equation?

69. To determine whether pillbugs prefer wet or dry conditions, you create a choice chamber that measures 400 cm$^2$. Half of the chamber is covered with wet soil and half of the chamber is covered in dry soil. You place 10 pillbugs at the center line of the choice chamber. After 15 minutes, you count the number of pillbugs on each side. After 3 trials, you find that an average of 8.8 pillbugs choose the wet side and an average of 1.2 pillbugs choose dry side.

What is the chi-square value for this experiment (round to one decimal place)?

**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.

1. A bacterial transformation is a way to introduce new DNA into bacteria. Using special equipment, the bacteria are made permeable and will uptake plasmid DNA from their surroundings. This plasmid DNA can be expressed within them in the same way as their own bacterial chromosome.

   You are given three types of bacteria (A, B, and C), unlimited plates of agar, the antibiotics tetracycline and ampicillin, and plasmids with either the tetracycline or ampicillin genes for antibiotic resistance. Assume that you also have the proper equipment to grow bacteria and carry out bacterial transformations.

   (a) **Design** an experiment to determine the antibiotic resistance of each type of bacteria. Be sure to use proper controls.

   - **Describe** your methods.
   - **Show** mock data in a graph or table.
   - **Justify** your conclusion using the data as a reference.

   (b) **Design** a follow-up experiment to test if antibiotic resistance can be genetically transferred.
   - **Describe** your methods.
   - **Show** mock data in a graph or table.
   - **Justify** your conclusion using the data as a reference.

2. Homeostasis is the steady state that the human body strives to maintain.

   (a) **Explain** why homeostasis is important in the body and include at least THREE physiological variables that must be maintained.

   (b) **Contrast** homeostasis in a unicellular organism with homeostasis in a complex organism.

   (c) Calcium is a very important ion in the body. The hormones parathyroid hormone (PTC) and calcitonin are released when calcium levels are low and high, respectively, to help the body return to its homeostatic state. **Describe** the likely effects of both PTH and calcitonin in the body with respect to:

   - intestinal absorption rates (collection of calcium from the diet)
   - kidney reabsorption rates (retaining calcium in the blood during blood filtration instead of excreting it in urine)
   - the production of osteoblasts (bone builders) and osteoclasts (bone destroyers)

3. **Describe** the general process of photosynthesis, including reactants, products, and the different objectives of the light-dependent and the light-independent reactions.

4. The vertebrate immune system consists of two parts: innate immune response and cell-mediated specific immune response. Briefly **explain** how each of them would work together to combat a first-time exposure infection.

**GO ON TO THE NEXT PAGE.**

5. **Explain** why a universal energy molecule is essential in cells. Give examples of energetically unfavorable reactions/processes and **explain** how they can be powered.

6. The following graph shows the shapes of a certain protein found in the cytosol.

**Total Protein**
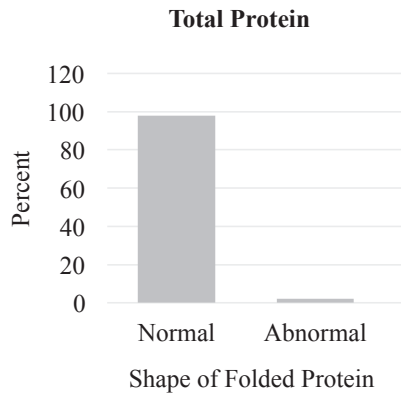


**Explain** how two shape outcomes can be possible. Be sure to mention DNA replication, transcription, and translation in your response.

7. **Describe** the process of natural selection and give an example. **Explain** how genetic drift differs from natural selection.

8. Draw a food energy pyramid and **explain** why 90% is estimated to be lost at each ascending level.



**STOP**

**END OF EXAM**

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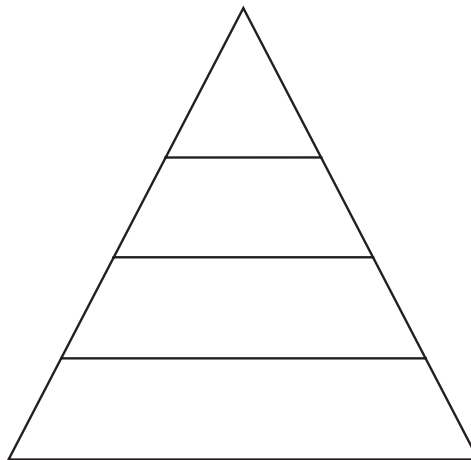
Completely darken bubbles with a No. 2 pencil.  If you make a mistake, be sure to erase mark completely.  Erase all stray marks.

## 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)
(F) (F) (F) (F)   (F) (F)
(G) (G) (G) (G)   (G) (G)
(H) (H) (H) (H)   (H) (H)
(I) (I) (I) (I)   (I) (I)
(J) (J) (J) (J)   (J) (J)
(K) (K) (K) (K)   (K) (K)
(L) (L) (L) (L)   (L) (L)
(M) (M) (M) (M)   (M) (M)
(N) (N) (N) (N)   (N) (N)
(O) (O) (O) (O)   (O) (O)
(P) (P) (P) (P)   (P) (P)
(Q) (Q) (Q) (Q)   (Q) (Q)
(R) (R) (R) (R)   (R) (R)
(S) (S) (S) (S)   (S) (S)
(T) (T) (T) (T)   (T) (T)
(U) (U) (U) (U)   (U) (U)
(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

## 3. TEST CODE

## 4. REGISTRATION NUMBER

(0) (A) (0) (0) (0)   (0) (0) (0) (0) (0) (0)
(1) (B) (1) (1) (1)   (1) (1) (1) (1) (1) (1)
(2) (C) (2) (2) (2)   (2) (2) (2) (2) (2) (2)
(3) (D) (3) (3) (3)   (3) (3) (3) (3) (3) (3)
(4) (E) (4) (4) (4)   (4) (4) (4) (4) (4) (4)
(5) (F) (5) (5) (5)   (5) (5) (5) (5) (5) (5)
(6) (G) (6) (6) (6)   (6) (6) (6) (6) (6) (6)
(7)     (7) (7) (7)   (7) (7) (7) (7) (7) (7)
(8)     (8) (8) (8)   (8) (8) (8) (8) (8) (8)
(9)     (9) (9) (9)   (9) (9) (9) (9) (9) (9)

## 6. DATE OF BIRTH

| Month | Day | Year |
|---|---|---|
| ◯ JAN | | |
| ◯ FEB | | |
| ◯ MAR | (0) | (0) (0) |
| ◯ APR | (1) | (1) (1) |
| ◯ MAY | (2) | (2) (2) |
| ◯ JUN | (3) | (3) (3) |
| ◯ JUL | (4) | (4) (4) |
| ◯ AUG | (5) | (5) (5) |
| ◯ SEP | (6) | (6) (6) |
| ◯ OCT | (7) | (7) (7) |
| ◯ NOV | (8) | (8) (8) |
| ◯ DEC | (9) | (9) (9) |

(Day column also has (0)(1)(2)(3) and Year columns (0)(1)(2)(3)(4)(5)(6)(7)(8)(9))

## 7. SEX

◯ MALE
◯ FEMALE

# The Princeton Review®

1   (A) (B) (C) (D)
2   (A) (B) (C) (D)
3   (A) (B) (C) (D)
4   (A) (B) (C) (D)
5   (A) (B) (C) (D)
6   (A) (B) (C) (D)
7   (A) (B) (C) (D)
8   (A) (B) (C) (D)
9   (A) (B) (C) (D)
10  (A) (B) (C) (D)
11  (A) (B) (C) (D)
12  (A) (B) (C) (D)
13  (A) (B) (C) (D)
14  (A) (B) (C) (D)
15  (A) (B) (C) (D)
16  (A) (B) (C) (D)

17  (A) (B) (C) (D)
18  (A) (B) (C) (D)
19  (A) (B) (C) (D)
20  (A) (B) (C) (D)
21  (A) (B) (C) (D)
22  (A) (B) (C) (D)
23  (A) (B) (C) (D)
24  (A) (B) (C) (D)
25  (A) (B) (C) (D)
26  (A) (B) (C) (D)
27  (A) (B) (C) (D)
28  (A) (B) (C) (D)
29  (A) (B) (C) (D)
30  (A) (B) (C) (D)
31  (A) (B) (C) (D)
32  (A) (B) (C) (D)

33  (A) (B) (C) (D)
34  (A) (B) (C) (D)
35  (A) (B) (C) (D)
36  (A) (B) (C) (D)
37  (A) (B) (C) (D)
38  (A) (B) (C) (D)
39  (A) (B) (C) (D)
40  (A) (B) (C) (D)
41  (A) (B) (C) (D)
42  (A) (B) (C) (D)
43  (A) (B) (C) (D)
44  (A) (B) (C) (D)
45  (A) (B) (C) (D)
46  (A) (B) (C) (D)
47  (A) (B) (C) (D)
48  (A) (B) (C) (D)

49  (A) (B) (C) (D)
50  (A) (B) (C) (D)
51  (A) (B) (C) (D)
52  (A) (B) (C) (D)
53  (A) (B) (C) (D)
54  (A) (B) (C) (D)
55  (A) (B) (C) (D)
56  (A) (B) (C) (D)
57  (A) (B) (C) (D)
58  (A) (B) (C) (D)
59  (A) (B) (C) (D)
60  (A) (B) (C) (D)
61  (A) (B) (C) (D)
62  (A) (B) (C) (D)
63  (A) (B) (C) (D)

64   65   66   67   68   69

(Grid-in response boxes numbered 64–69, each with a minus sign, slash, and decimal point options and bubbles 0–9 in each column)