



Practice Test 3

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: _____
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 SIGNATURE: _____ DATE: ____/____/____
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 City State Zip Code
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5. YOUR NAME
 First 4 letters of last name FIRST INIT MID INIT

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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

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7. SEX
 MALE
 FEMALE



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 FORM NO. 00001-PR

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[®] 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.

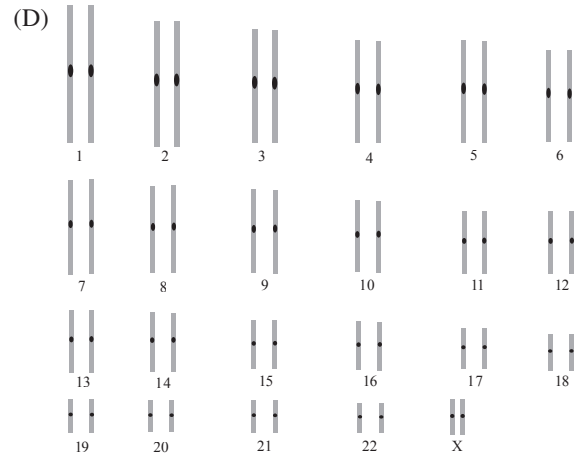
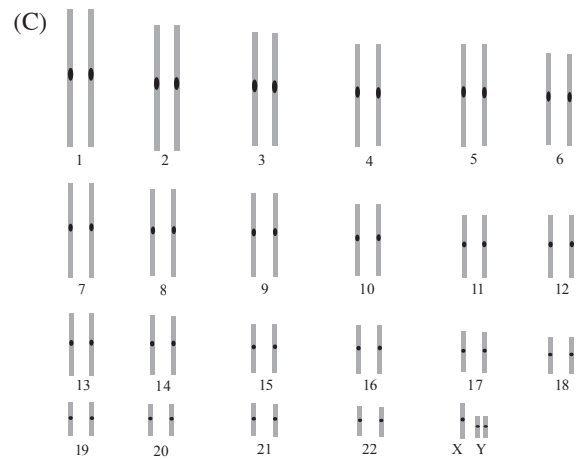
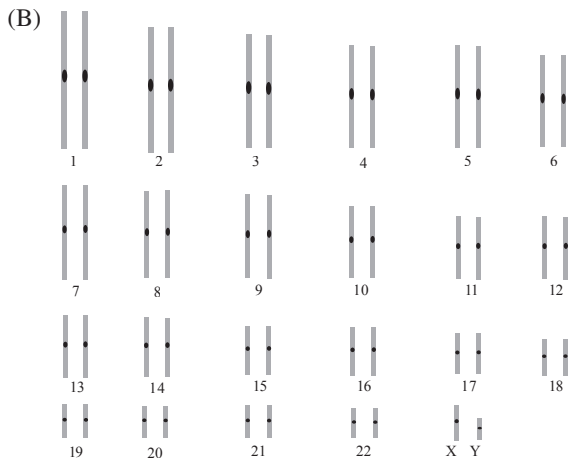
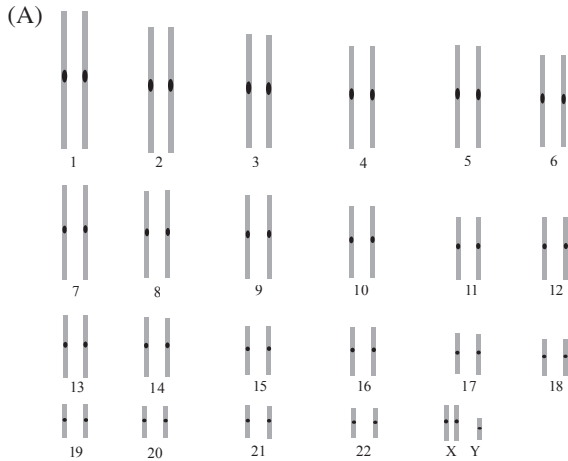
About Guessing

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. 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?



GO ON TO THE NEXT PAGE.

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

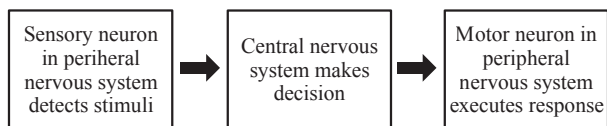
Type of Peas Produced	# of Plants
Green	1432
Yellow	1

Table 2. F2 Generation

Type of Peas Produced	# of Plants
Green	1196
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 connected 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

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7. Cells in the body are related to each other by many types of intercellular connections such as desmosomes, adherens junctions, tight junctions, and gap junctions. In the intestines, tight junctions are necessary because an absolute barrier must be maintained to separate the lumen of the gut from the rest of the body. Gap junctions are found in cardiac muscle where these direct connections from cell to cell allow action potentials to be passed. Adherens junctions and desmosomes are similar types of connections between cells that are flexible and mechanically pull on each other. Desmosomes attach to the intermediate filaments in the cytoskeleton.

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. What type of cell junctions would best help distant osteocytes exchange gases with the central canal?

- (A) Desmosomes
- (B) Gap junctions
- (C) Tight junctions
- (D) Adherens junctions

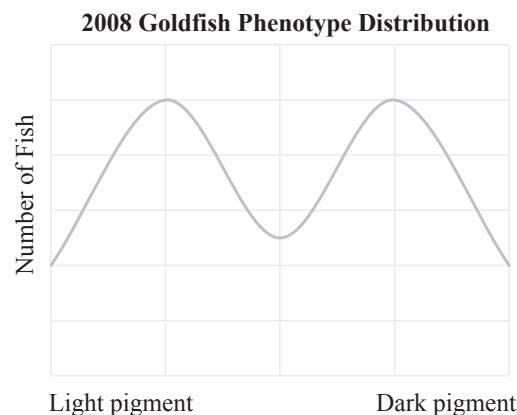
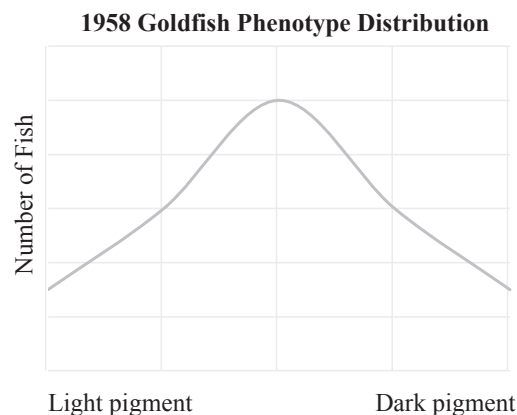
Questions 8–10 refer to the following passage.

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 during the G1 phase?
- (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.



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

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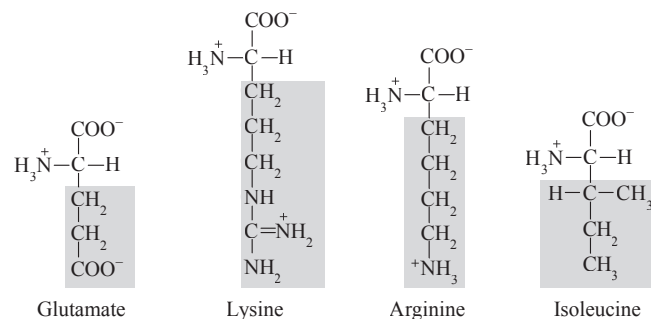
12. Which of the following theories is supported by the evidence?
- (A) The pigment trait in fish demonstrates incomplete dominance.
 (B) The pigment trait in fish demonstrates classical dominance.
 (C) The pigment trait in fish demonstrates codominance.
 (D) None of the above

13. If a dark colored, poisonous fish of similar appearance to these fish is added to the ecosystem in 2008, what will the graph likely look like in 50 years?



14. Which addition to the pond is NOT a likely contributor 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

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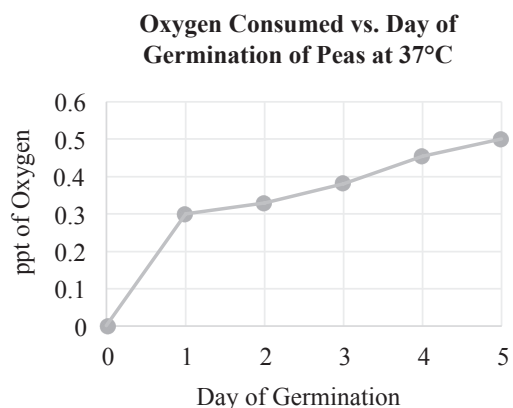
Questions 17–19 refer to the following passage.

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 the following statements best describes the uptake of calcium by skeletal muscles and the sarcoplasmic reticulum?
- Calcium is passively taken from the extracellular environment and the cytosol.
 - Calcium is actively taken up from the extracellular environment and the cytosol.
 - Calcium is passively taken up from the extracellular environment and actively taken up from the cytosol.
 - 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?
- It prevents muscle contractions during action potentials.
 - It changes the hypertonic nature of the cytosol to allow action potentials.
 - It amplifies the physical contraction of the sarcomere.
 - 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?
- The cell is lacking tropomyosin
 - Too much calcium in the sarcoplasmic reticulum
 - The cell is lacking troponin
 - Too many action potentials reaching the cell
20. Dehydration synthesis is a key part of the creation of many macromolecules. It is best described as:
- Loss of a water molecule in order to make something else
 - Water rushing out of a cell during the process of osmosis
 - Life moving out of the ocean and becoming complex
 - 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?
- The cat has eaten cotton balls and become sick before.
 - The cat sees cotton balls at the vet when it gets vaccinated.
 - The cotton balls resemble a type of toy it had as a kitten.
 - 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?
- AMP
 - ADP
 - ATP
 - AUP

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Questions 23–25 refer to the following figure.



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

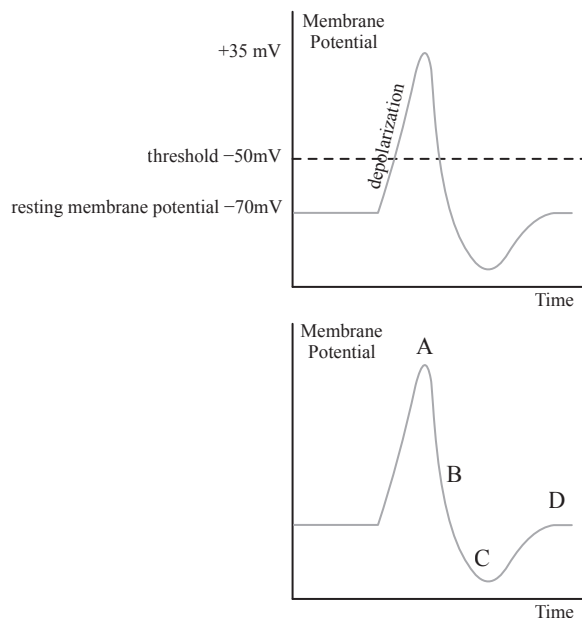
25. If the trend continues, what will be the oxygen consumed on day 7?

- (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

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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 32–34 refer to the following passage.

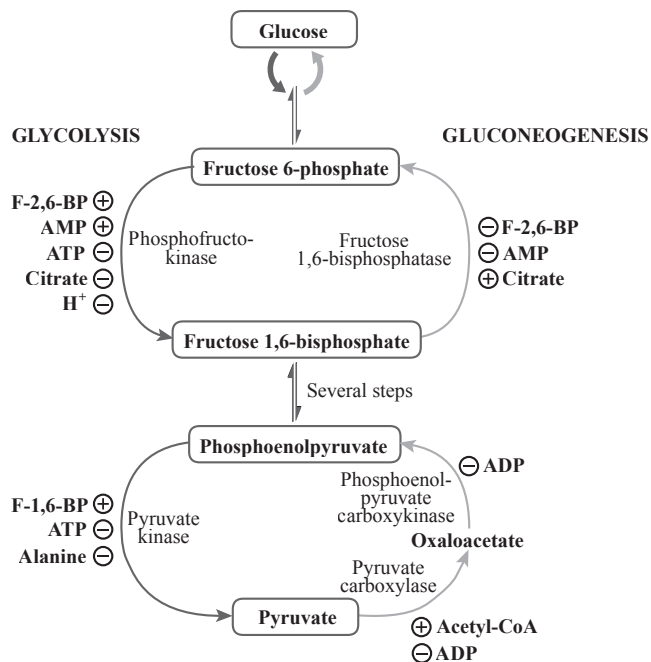
Radiometric dating is a scientific technique based on predictable radioactive decay. The age of a rock or other substance that contains trace amounts of radioactive isotopes can be estimated by measuring how much of the original radioactive isotope is present and how much of the decayed version is present.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

32. How does carbon-14 differ from the typical carbon, carbon-12?
- (A) It formed a long time ago.
 - (B) It has shared electrons.
 - (C) It has more neutrons.
 - (D) It has half the atomic mass.
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. Which of the following research questions could NOT be answered using radiometric dating?
- (A) How many years ago did the planet Venus form?
 - (B) When did the last large dinosaurs go extinct?
 - (C) How old is the deepest layer in the Grand Canyon?
 - (D) How long have mastodon bones been buried in the permafrost?

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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

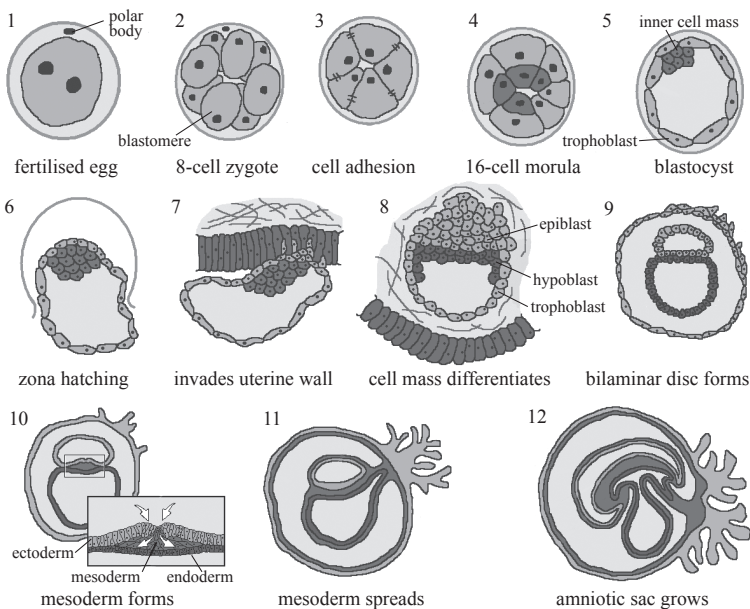
37. Which of the following situations likely stimulates gluconeogenesis?

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

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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.



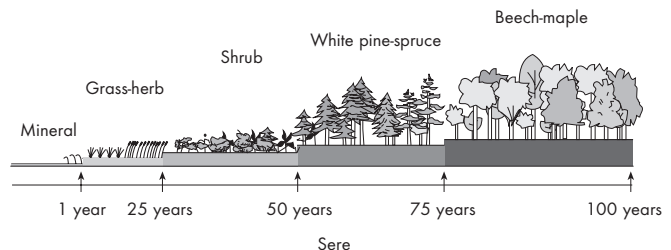
38. The inner cell mass is what eventually forms the embryo. During development, the embryo differentiates into various types of cell layers. Which of the following is not one of them?

- (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.

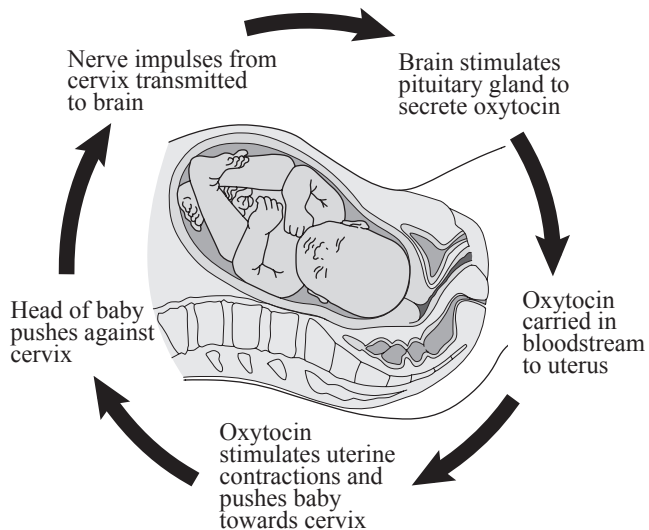


Why does it take 75 years for a beech-maple to occur in the figure above?

- (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.

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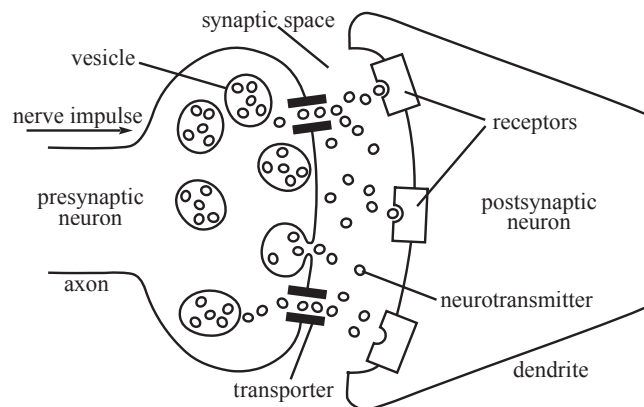
41. During labor, pressure on the cervix and oxytocin form a positive feedback loop as shown below.



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 activate 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	Neurotransmitter Present	Pre-synaptic membrane potential	Post-synaptic membrane potential (initial)	Post-synaptic membrane potential (final)
Synapse 1	Acetylcholine	+35mV	-70mV	+35mV
Synapse 2	Acetylcholine	+35mV	-70mV	-100mV
Synapse 3	Norepinephrine	+35mV	-70mV	+35mV
Synapse 4	Norepinephrine	+35mV	-70mV	+35mV

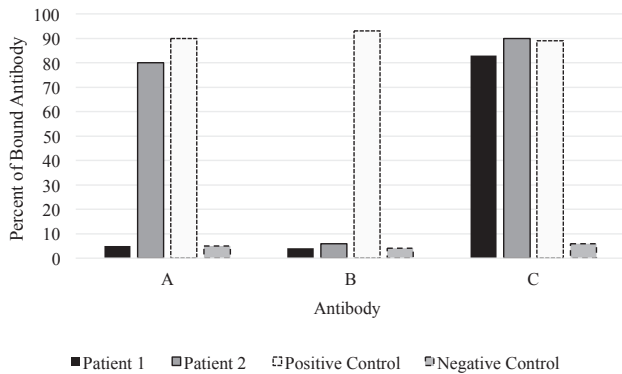
What is the best explanation for the varying behavior of acetylcholine on the postsynaptic membrane potential in synapse 1 and synapse 2?

- (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

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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.



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) Are 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?

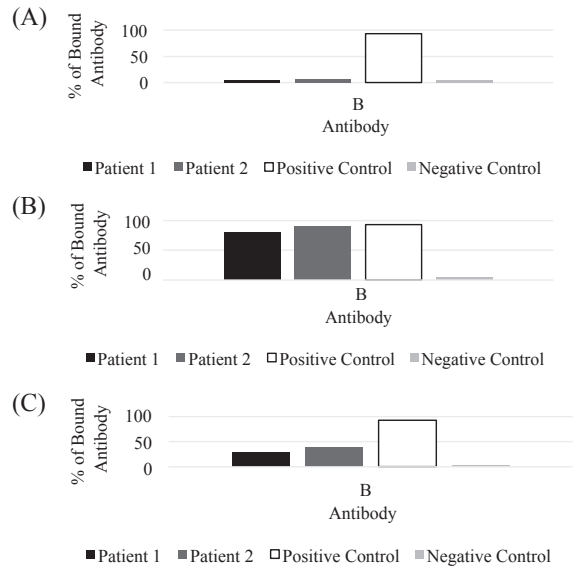
44. The low bars for antibody B represent each of the following EXCEPT:

- (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?

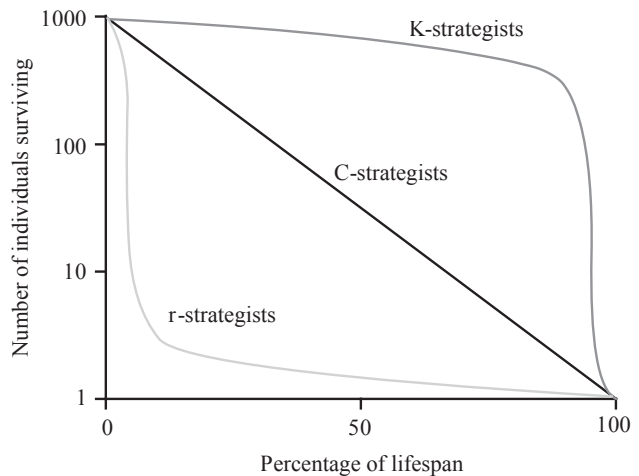
- (A) Blood containing diseases 1, 2, and 3
- (B) Blood containing antibodies A, B, and C
- (C) Blood without disease 1, 2, and 3
- (D) Blood without antibodies A, B, and C

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



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

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

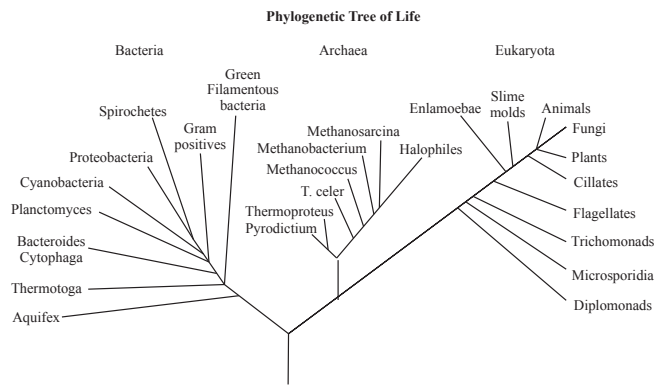


Which of the following are examples of r-strategists?

- I. Human
 - II. Spider
 - III. Beluga whale
- (A) I only
 - (B) II only
 - (C) I and III
 - (D) I, II, and III

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Questions 48–49 refer to the following figure.



48. Which of the following are the most closely related?
- Aquifex and diplomonads
 - Animals and fungi
 - Halophiles and entamoebae
 - There is not enough information given.
49. A planctomyces is dividing by budding, which of the following will occur?
- A mitotic spindle will pull chromosome segments to opposite ends of the cell.
 - Enzymes will unwind the helix and copy the entire bacterial genome.
 - The nuclear envelope will break down and then reform after DNA replication.
 - The mitochondria will replicate and be divided between the two cells.
50. Which of the following would make the Calvin cycle unnecessary?
- If the light-dependent reactions made sugar and ATP
 - If plants could make ATP in their electron transport chain
 - If plants could use ATP to power cellular processes
 - If NADPH could be created by photosystem I
51. Without phototropism how would plant growth be affected?
- Plants would never point towards the sun.
 - Plants would not be able to change direction of growth.
 - Plants would not be able to perform photosynthesis.
 - The direction of plant growth would not be related to the sun.
52. Which of the following does NOT affect higher order protein structure?
- Ester linkages between amino acids
 - Amino acid sequence order
 - Hydrogen bonding between R groups on the same polypeptide
 - Hydrophobic interactions between side groups on different polypeptides

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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 where 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	2760
Control side	2240

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'

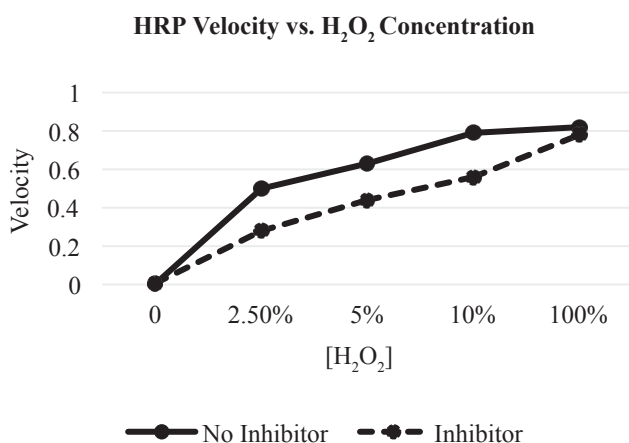
3' GCCGCTCTGCGCCG 5'

55. If the mRNA sequence transcribed from one of the above sequences is 5' GAUCCUACAUCAG 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

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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.



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

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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 1 decimal place.

	/	/	/	
.
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

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?

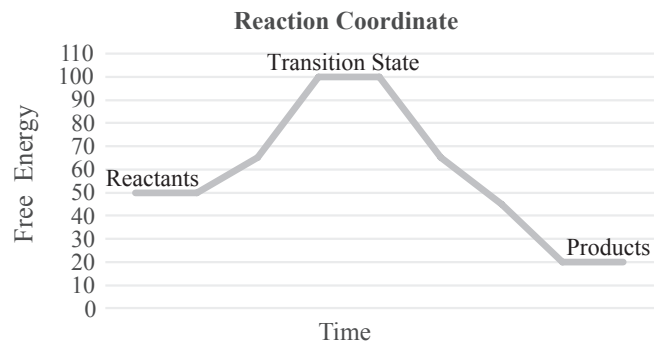
	/	/	/	
.
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

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

5' UAACGAUCAUAUAUGACGCGUAUCUAG 3'

	/	/	/	
.
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

Questions 67–68 refer to the following figure.



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

	/	/	/	
.
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

68. What is the activation energy for the equation?

	/	/	/	
.
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. To determine whether pillbugs prefer wet or dry conditions, you create a choice chamber that measures 400 cm². 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 how many pillbugs are on each side. After 3 trials, you find that an average of 8.8 pill bugs choose the wet side and an average of 1.2 pill bugs choose dry side.

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

	/	/	/	
.
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.

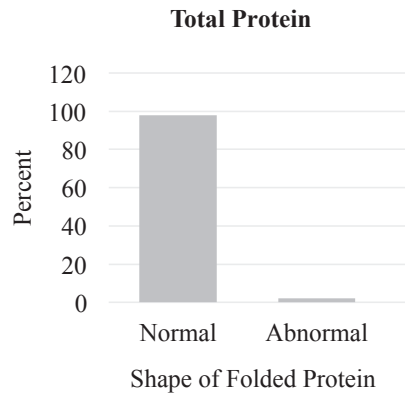
1. A bacterial transformation is a way to introduce new DNA into bacteria. Using special equipment, the bacteria are made permeable and will uptake plasmid DNA from their surroundings. This plasmid DNA can be expressed within them in the same way as their own bacterial chromosome.

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 (PTH) 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 each 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.

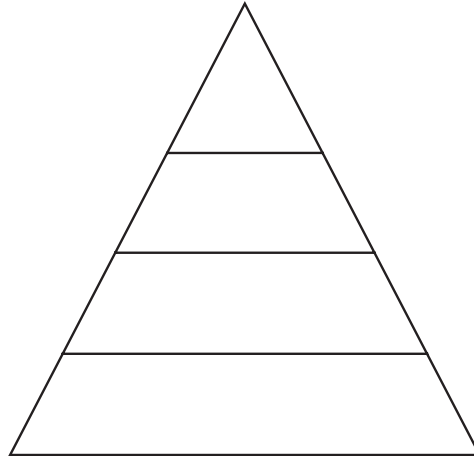
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5. **Explain** why a universal energy molecule is essential in cells. Give examples of energetically unfavorable reactions/processes and **explain** how they can be powered.
6. The following graph shows the shapes of a certain protein found in the cytosol.



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
