Practice Test 3

The Princeton Review®

1. YOUR NAME:

(Print)　　　　　Last　　　　　First　　　　　M.I.

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City　　　　　State　　　　　Zip Code

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

5. YOUR NAME

First 4 letters of last name				FIRST INIT	MID INIT

(A)(B)(C)(D)(E)(F)(G)(H)(I)(J)(K)(L)(M)(N)(O)(P)(Q)(R)(S)(T)(U)(V)(W)(X)(Y)(Z)

2. TEST FORM

_____

6. DATE OF BIRTH

Month	Day		Year	
◯ JAN				
◯ FEB				
◯ MAR	(0)	(0)	(0)	(0)
◯ APR	(1)	(1)	(1)	(1)
◯ MAY	(2)	(2)	(2)	(2)
◯ JUN	(3)	(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)

3. TEST CODE　　4. REGISTRATION NUMBER

Test Code column: (0)(A)(B)(C)(D)(E)(F)(G) with digits 0-9
Registration Number columns: 0-9

7. SEX

◯ MALE
◯ FEMALE

The Princeton Review®

1 (A)(B)(C)(D)	17 (A)(B)(C)(D)	33 (A)(B)(C)(D)	49 (A)(B)(C)(D)
2 (A)(B)(C)(D)	18 (A)(B)(C)(D)	34 (A)(B)(C)(D)	50 (A)(B)(C)(D)
3 (A)(B)(C)(D)	19 (A)(B)(C)(D)	35 (A)(B)(C)(D)	51 (A)(B)(C)(D)
4 (A)(B)(C)(D)	20 (A)(B)(C)(D)	36 (A)(B)(C)(D)	52 (A)(B)(C)(D)
5 (A)(B)(C)(D)	21 (A)(B)(C)(D)	37 (A)(B)(C)(D)	53 (A)(B)(C)(D)
6 (A)(B)(C)(D)	22 (A)(B)(C)(D)	38 (A)(B)(C)(D)	54 (A)(B)(C)(D)
7 (A)(B)(C)(D)	23 (A)(B)(C)(D)	39 (A)(B)(C)(D)	55 (A)(B)(C)(D)
8 (A)(B)(C)(D)	24 (A)(B)(C)(D)	40 (A)(B)(C)(D)	56 (A)(B)(C)(D)
9 (A)(B)(C)(D)	25 (A)(B)(C)(D)	41 (A)(B)(C)(D)	57 (A)(B)(C)(D)
10 (A)(B)(C)(D)	26 (A)(B)(C)(D)	42 (A)(B)(C)(D)	58 (A)(B)(C)(D)
11 (A)(B)(C)(D)	27 (A)(B)(C)(D)	43 (A)(B)(C)(D)	59 (A)(B)(C)(D)
12 (A)(B)(C)(D)	28 (A)(B)(C)(D)	44 (A)(B)(C)(D)	60 (A)(B)(C)(D)
13 (A)(B)(C)(D)	29 (A)(B)(C)(D)	45 (A)(B)(C)(D)	
14 (A)(B)(C)(D)	30 (A)(B)(C)(D)	46 (A)(B)(C)(D)	
15 (A)(B)(C)(D)	31 (A)(B)(C)(D)	47 (A)(B)(C)(D)	
16 (A)(B)(C)(D)	32 (A)(B)(C)(D)	48 (A)(B)(C)(D)	

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
60
Percent of Total Score
50%
Writing Instrument
Pencil required

Instructions

Section I of this examination contains 60 multiple-choice 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)   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

60 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?

(A)

(B)

(C)

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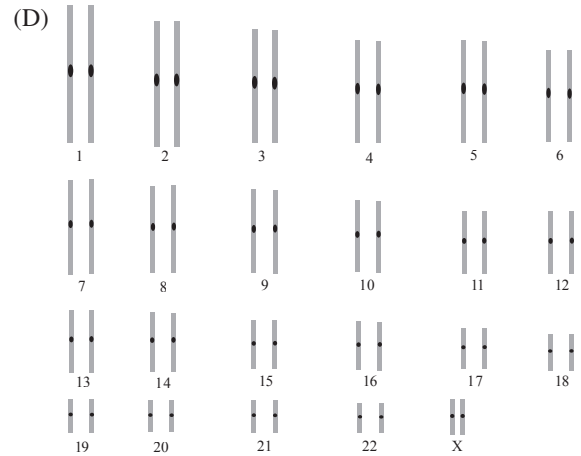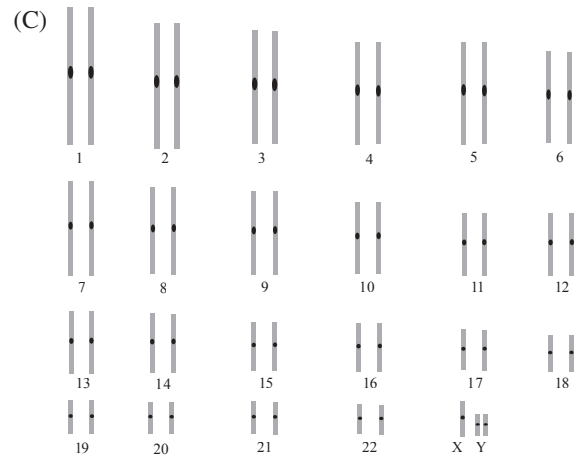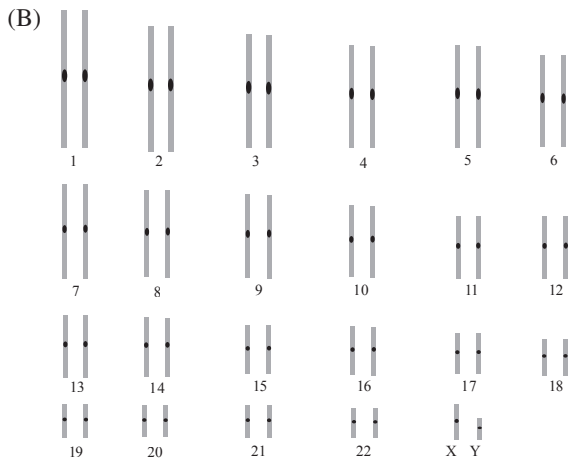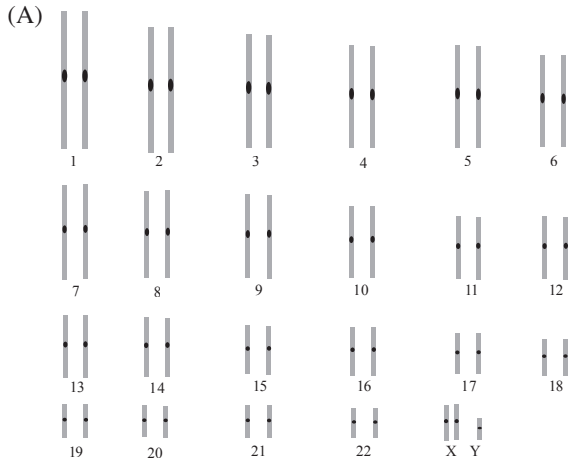
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2. The restriction enzyme BAMHI predictably cuts the following sequence at the locations designated by the stars.

   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 F_1 generation is evaluated, and its phenotype distribution is shown in Table 1. Two green pea producing members of the F_1 generation are then crossed, and the resulting F_2 generation phenotype distribution is shown in Table 2.

   Table 1. F_1 Generation

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

   Table 2. F_2 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 F_1 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 F_2 generation is crossed with a green plant from the F_1 generation, what would be the green-to-yellow phenotype ratio?

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

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Question 6 refers to the following experiment.

A group of *Daphnia,* small crustaceans known as water fleas, was placed in one of three culture jars of different sizes to determine their reproductive rate. There were 100 females in the jar. The graph below shows the average number of offspring produced per female each day in each jar of pond water.
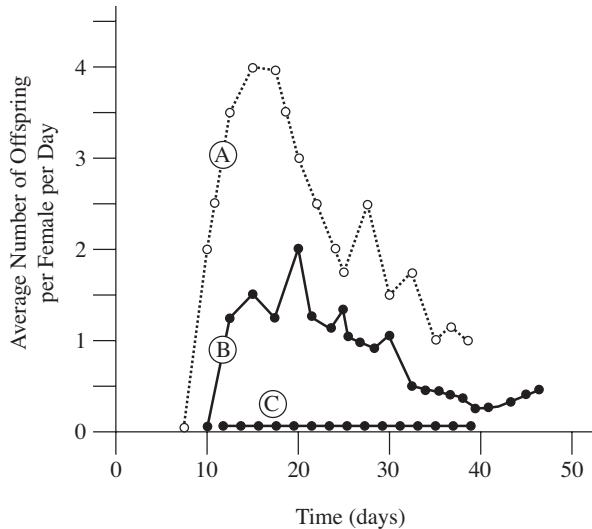
Key: (A) Water fleas in a 1-liter jar of pond water
     (B) Water fleas in a 0.5-liter jar of pond water
     (C) Water fleas in a 0.25-liter jar of pond water

6. The data in the figure above would best support which conclusion?

   (A) If you decreased the number of females, the container would have to remain constant.
   (B) The number of offspring produced scales proportionally with the container's size.
   (C) The number of offspring produced increases with time.
   (D) *Daphnia* prefer high-density conditions to have the most efficient reproductive rate.

7. Compact bone contains rings of osteons, each of which contains a central canal housing the blood vessels, which can be accessed only 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.
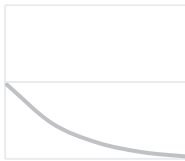
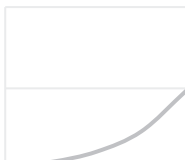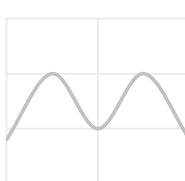8. How many chromosome segments are present in a somatic cell at the completion of mitosis?

   (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

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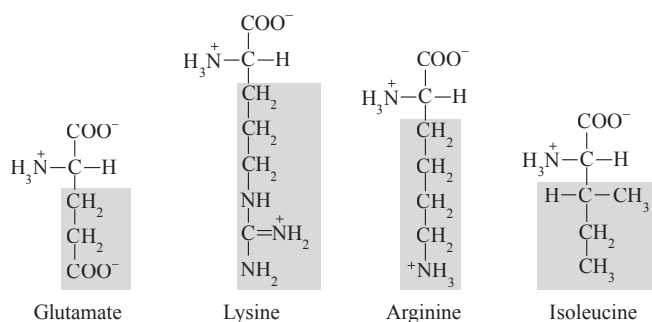
Questions 11–14 refer to the following passage.

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 in the figure below.

1958 Goldfish Phenotype Distribution

2008 Goldfish Phenotype Distribution
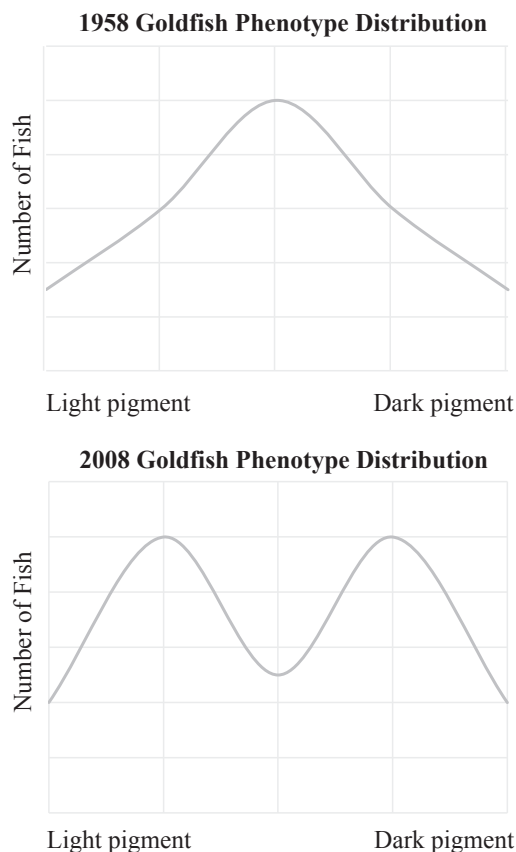
11. Which of the following best describes the fish population in the year 1958?

    (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

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

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Questions 15–16 refer to the following figure.

Glutamate   Lysine   Arginine   Isoleucine

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.

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

17. Which of the 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.

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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. When humans experience excessive heat loss, the nervous system sends random signals for skeletal muscles to contract resulting in shivering. This then raises the body temperature due to the production of heat. This physiological mechanism is most similar to which other process?

    (A) When a B-cell receptor binds to an infectious agent, signaling occurs to stimulate a larger immune response.
    (B) When blood sugar levels are sensed to be high in the body, insulin is released and blood sugar in the bloodstream drops.
    (C) When the uterus is stretched during contractions, this signals to the brain that oxytocin should be released that causes stronger contractions.
    (D) As fruit begins to ripen it releases ethylene that causes other fruit to ripen as as well.

22. A molecule of ADP is dephosphorylated once and then phosphorylated twice. What molecule will result?

    (A) AMP
    (B) ADP
    (C) ATP
    (D) AUP

Questions 23–25 refer to the following figure.

Oxygen Consumed vs. Day of Germination of Peas at 37°C
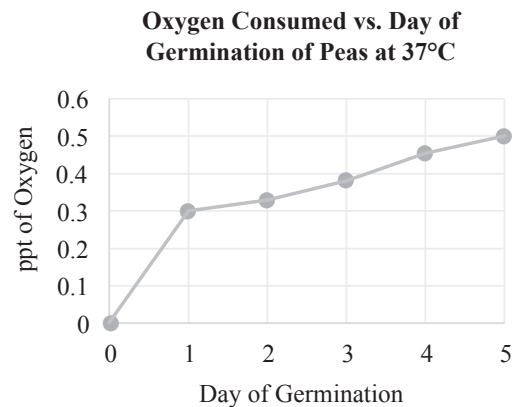
23. In the above figure, _____ is the dependent variable and _____ is the independent variable.

    (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

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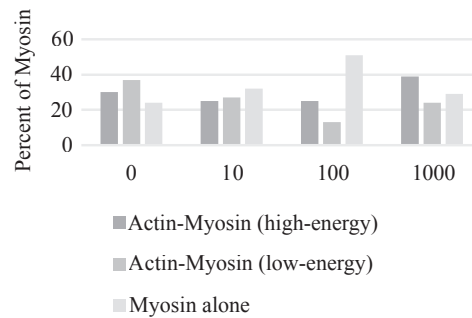
Questions 26–28 refer to the following passage.

The unit of contraction within skeletal muscle cells is called the sarcomere. A sarcomere contracts when the filamentous protein myosin stretches into a high-energy conformation and binds to the filamentous protein actin. When the myosin returns to its low-energy, relaxed conformation, actin is pulled, and the sarcomere contracts. The following steps relate ATP to each step of this process.

1—Myosin binds to actin (ADP is attached)
2—Myosin returns to low-energy conformation (ADP is released)
3—Myosin releases actin (ATP binds)
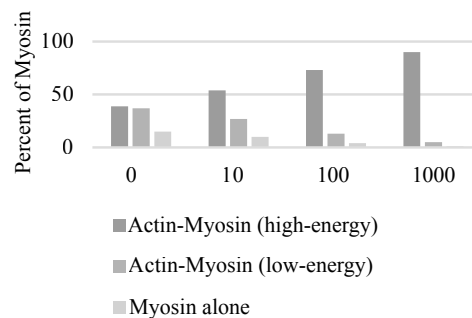4—Myosin stretches to high-energy conformation (ATP is hydrolyzed)

26. What is bound to myosin when it is in its high-energy conformation?

   I. Actin
  II. ATP
 III. ADP

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

27. If the cell runs out of ATP, what would be the state of the sarcomere?

   (A) Myosin is bound to actin in the high-energy conformation.
   (B) Myosin is alone in the high-energy conformation.
   (C) Myosin is bound to actin in the low-energy conformation.
   (D) Myosin is alone in the low-energy conformation.

28. A calcium ion is required for the binding of myosin to actin. If a calcium chelator, such as EDTA, is added to a muscle cell, which of the following graphs shows how it will affect muscle contraction?

(A)

Confirmations of Myosin vs nM of EDTA

■ Actin-Myosin (high-energy)
■ Actin-Myosin (low-energy)
■ Myosin alone

(B)

Confirmations of Myosin vs nM of EDTA

■ Actin-Myosin (high-energy)
■ Actin-Myosin (low-energy)
■ Myosin alone

(C)

Confirmations of Myosin vs nM of EDTA

■ Actin-Myosin (high-energy)
■ Actin-Myosin (low-energy)
■ Myosin alone

(D)

Confirmations of Myosin vs nM of EDTA

■ Actin-Myosin (high-energy)
■ Actin-Myosin (low-energy)
■ Myosin alone
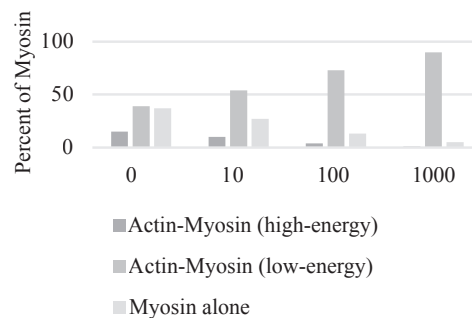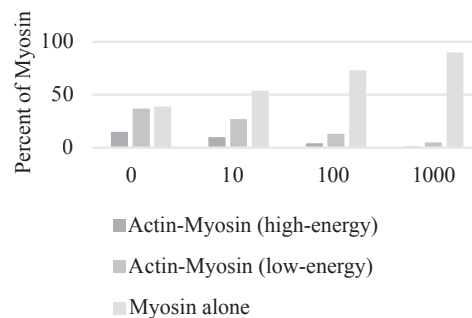
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29. Which is NOT a true statement about acid rain?

    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) The two life-forms 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

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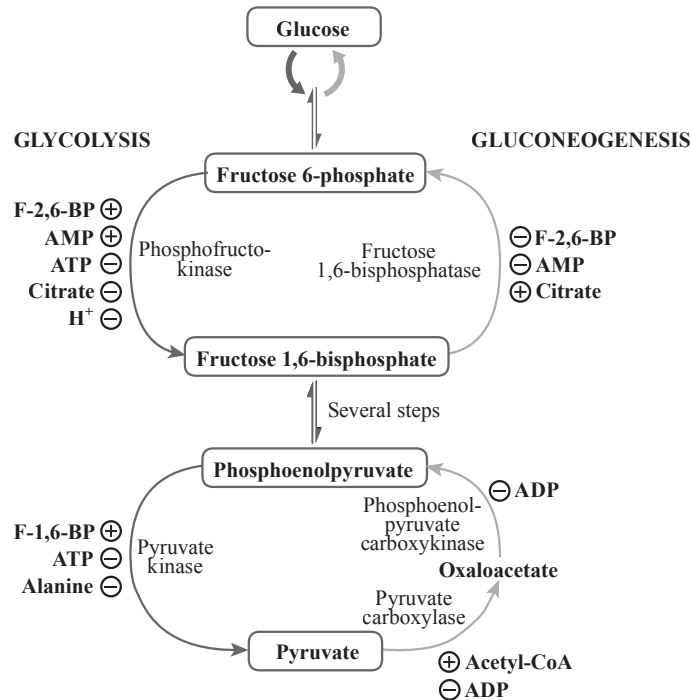
35. Which of the following conditions would lead to increased production of fructose 1,6-bisphosphate?

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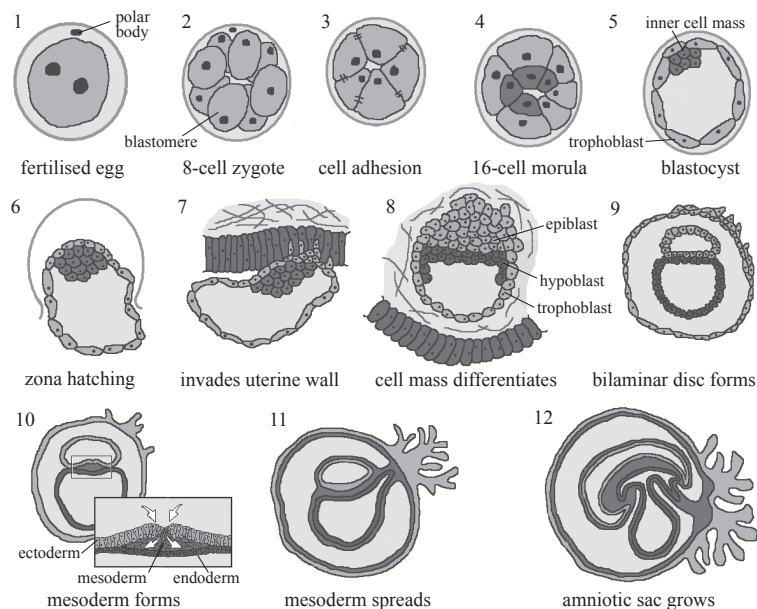
38. The inner cell mass is what eventually forms the embryo. During development, the embryo differentiates into various types of cell layers. Which of the following is NOT one of them?

    (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

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40. The following diagram demonstrates the ecological succession that occurs in an environment over time as it is colonized by different species.
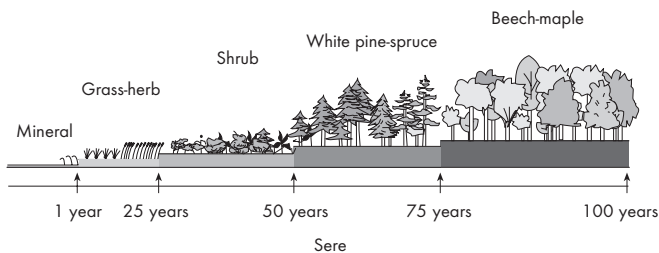
Why does it take 75 years for a beech-maple to occur in the figure above?

(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.

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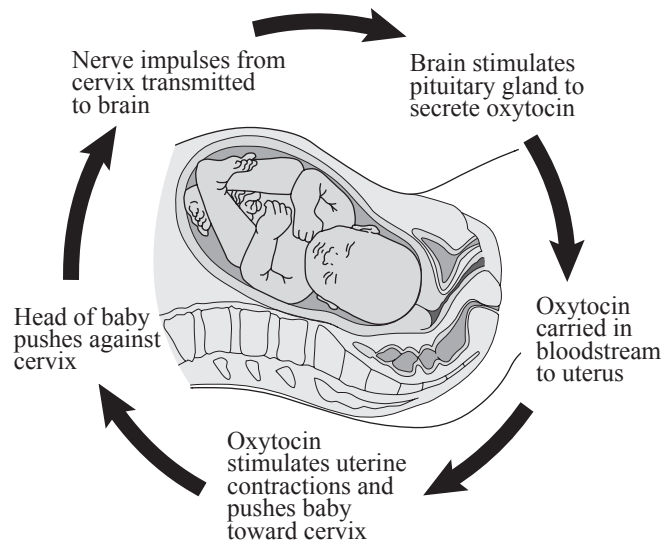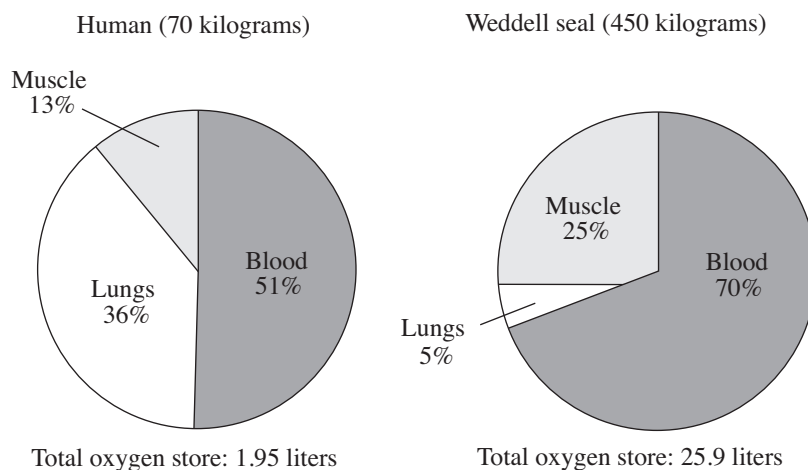

Which of the following other pathways also demonstrate positive feedback?

(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 activated platelets then release chemicals to activate more platelets.

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<u>Questions 42 and 43</u> 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.

Human (70 kilograms)   Weddell seal (450 kilograms)

Muscle
13%

Blood
51%

Lungs
36%

Muscle
25%

Blood
70%

Lungs
5%

Total oxygen store: 1.95 liters   Total oxygen store: 25.9 liters

42. 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

43. 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

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Questions 44–46 refer to the following synthetic pathway of nRNA pyrimidine, cytidine 5′ triphosphate, CTP. This pathway begins with the condensation of two small molecules by the enzyme aspartate transcarbamylase (ATCase).
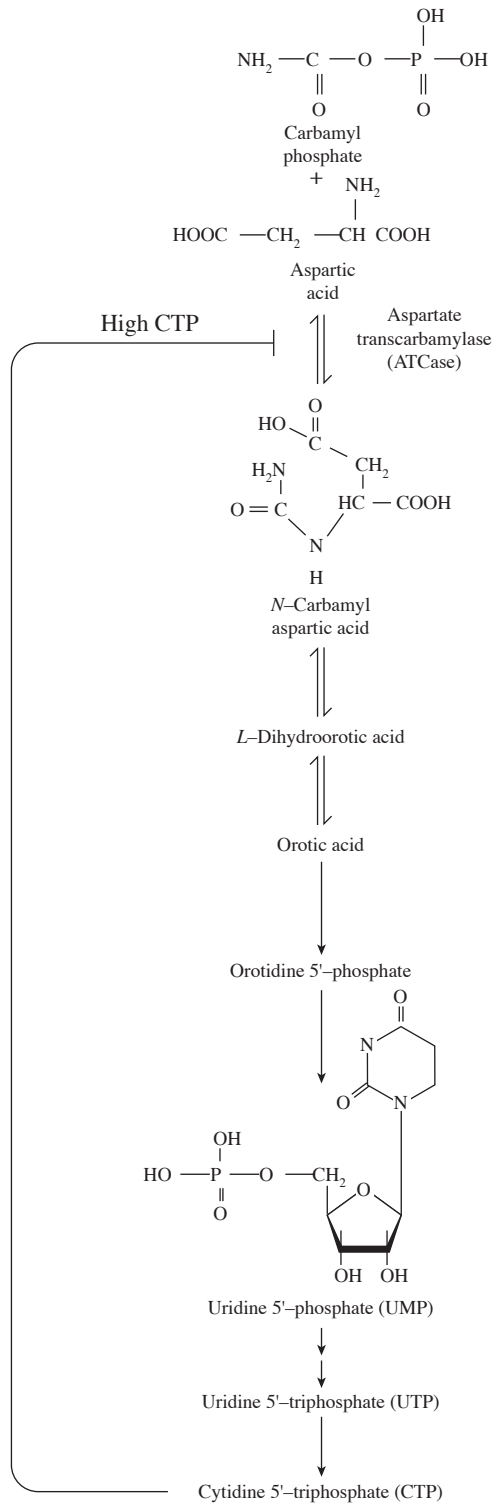
Regulation of CTP biosynthesis

44. Which of the following is true when the level of CTP is low in a cell?

 (A) CTP is converted to ATCase.
 (B) The metabolic traffic down the pathway increases.
 (C) ATCase is inhibited, which slows down CTP synthesis.
 (D) The final product of the pathway is reduced.

45. This enzymatic phenomenon is an example of

 (A) transcription
 (B) feedback inhibition
 (C) dehydration synthesis
 (D) photosynthesis

46. The biosynthesis of cytidine 5′-triphosphate requires

 (A) a ribose sugar, a phosphate group, and a nitrogen base
 (B) a deoxyribose sugar, a phosphate group, and a nitrogen base
 (C) a ribose sugar, phosphate groups, and a nitrogen base
 (D) a deoxyribose sugar, phosphate groups, and a nitrogen base

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47. The following graph demonstrates 3 different strategies for survival.
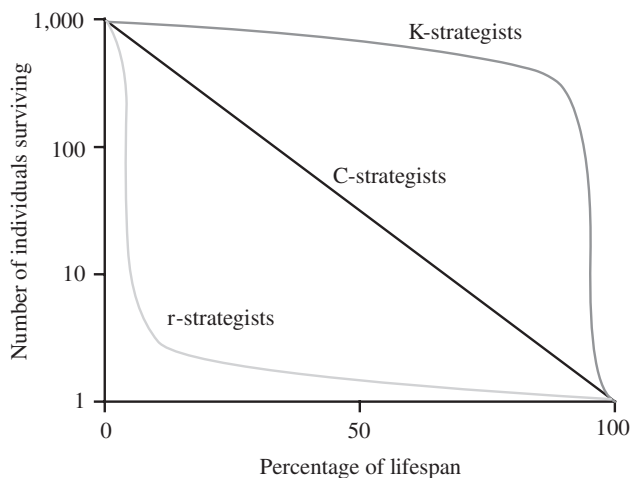
Which of the following are true statements according to the figure?

  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

Questions 48–49 refer to the following figure.

Phylogenetic Tree of Life
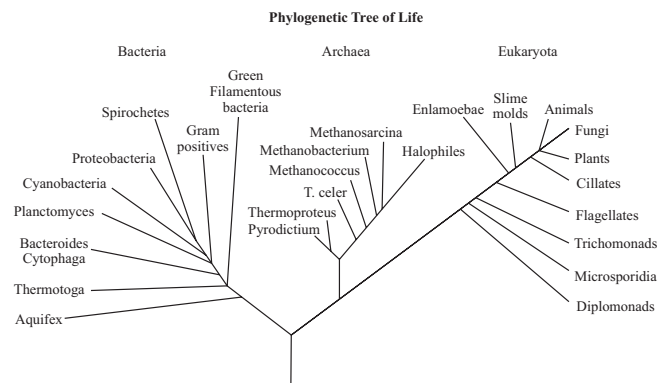
48. Which of the following are the most closely related?

(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.

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50. Which of the following would make the Calvin Benson 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. In the following cladogram, a common ancestor (*) and species derived from it are illustrated. How many species have four or more common ancestors with Iguanodon?

                                    Hypsilophodon
                                    Tenontosaurus
                                    Zalmoxes
                                    Dryosaurus
                                    Camptosaurus
    Iguanodontia   Iguanodon
                                    Ouranosaurus
    Iguanodontoidea   Altirhinus
                                    Probactrosaurus
                                    Hadrosauridae
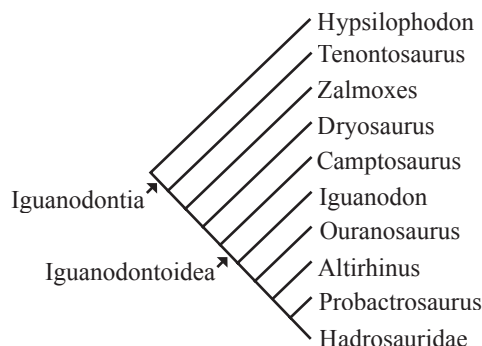
    (A) 1
    (B) 2
    (C) 4
    (D) 6

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

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

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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. In a closed population, squirrel teeth can be either long or short. The long teeth allele is classically dominant. If there are 320 squirrels with long teeth and 40 squirrels with short teeth, what is the frequency of heterozygotes? Round to 2 decimal places.

(A) 0.11
(B) 0.33
(C) 0.44
(D) 0.67

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 vessels, 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 59–60 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
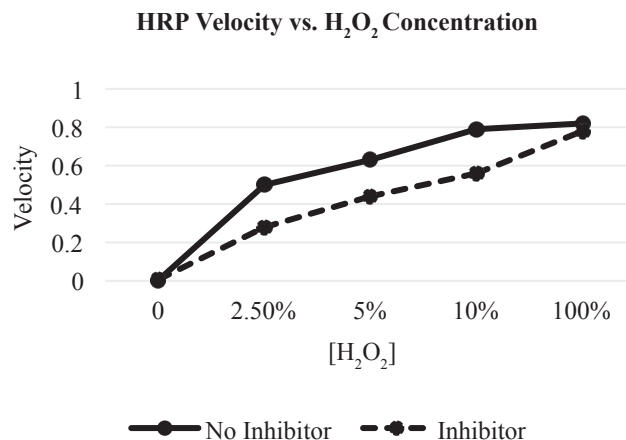
59 What is the substrate in this reaction?

(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.

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

6 Questions
Writing Time—90 minutes

Directions: Questions 1 and 2 are long free-response questions that should require about 25 minutes each to answer and are worth 8–10 points each. Questions 3 through 6 are short free-response questions that should require about 10 minutes each to answer and are worth 4 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 unless specifically requested.

1. A group of researchers wished to gain information about a type of bacteria that was known to actively uptake glucose across its cell membrane by use of a sodium-glucose cotransport mechanism whereby sodium and glucose enter the cell together. The researchers conducted an experiment in which bacterial cells with a relatively low intracellular sodium concentration were placed in glucose-rich media that had a relatively high sodium ion concentration. At regular intervals, the medium was analyzed for glucose and sodium concentrations.
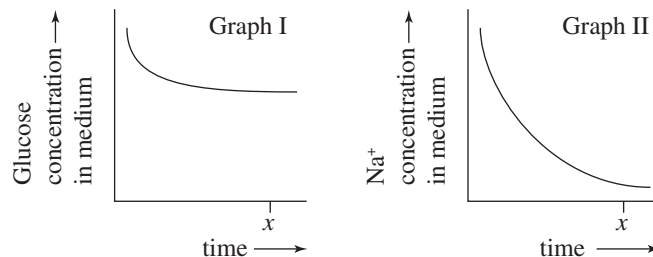

Figure 1. Glucose and Na+ concentrations in medium (no ATP in medium)

(a) **Describe** why a cell membrane is semipermeable. Include examples of molecules that can/cannot pass through.

(b) Bacterial cells contain a Na^+/K^+ ATPase pump that helps them maintain an osmotic balance with their surroundings. In the experimental cells, glycolysis was inhibited to prevent sodium from being pumped out of the cell. **Explain** how the inhibition of glycolysis likely achieves this.

(c) **Analyze** the data and **explain** how the levels of glucose and sodium inside the cell change throughout the experiment.

(d) **Predict** what would happen if the level of sodium inside the cell was not relatively low at the onset of the experiment.

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2. Basking sharks, which can grow up to 10 m in length, have been recorded jumping out of the water as high and as fast as great white sharks. Marine biologists are unsure why they do this but have pointed to this phenomenon as evidence of how much we still have to learn about marine life. The sharks are speculated to jump out of the water only off the shores of Scotland, where they have been observed previously. A team of scientists wanted to determine if basking sharks in other areas of northern Europe can jump to similar heights. The following data were obtained by that team.

Location	Scotland	Ireland	Isle of Man	Cornwall
Jump Height Mean (m)	1.3175	1.1	0.2	1.5625
Confidence Intervals	0.058	0.125	0.091	0.024

(a) Basking sharks filter feed on plankton, tiny ocean organisms. **Describe** an adaptation and **explain** how that adaptation could increase a shark's fitness.

(b) **Construct** a graph plotting the mean jump height and confidence intervals represented by error bars.

(c) **Identify** which of the locations showed statistical differences in jump height compared to the Scotland sharks. **Explain** how you know this.

(d) Basking sharks are endotherms like most other sharks. **Predict** how the environment may differ between the Cornwall sampling site and the Isle of Man site. **Justify** your prediction.

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3. Photosynthesis is the process plants use to derive energy from sunlight and is associated with a cell's chloroplasts. The energy is used to produce carbohydrates from carbon dioxide and water. Photosynthesis involves light and dark phases. Figure 1 represents two initial steps associated with the light phase.

The light phase supplies the dark phase with NADPH and a high-energy substrate.

A researcher attempted to produce a photosynthetic system outside the living organism according to the following protocols:

- Chloroplasts were extracted from green leaves and ruptured, and their membranes were thereby exposed, then a solution of hexachloroplatinate ions carrying a charge of –2 was added.

- The structure of the composite was analyzed, and the amount of oxygen produced by the system was measured.

The researcher concluded that the ions were bound to the membrane's Photosystem 1 site by the attraction of opposite charges. The resulting composite is shown in Figure 2. It was found that the hexachloroplatinate-membrane composite was photosynthetically active.
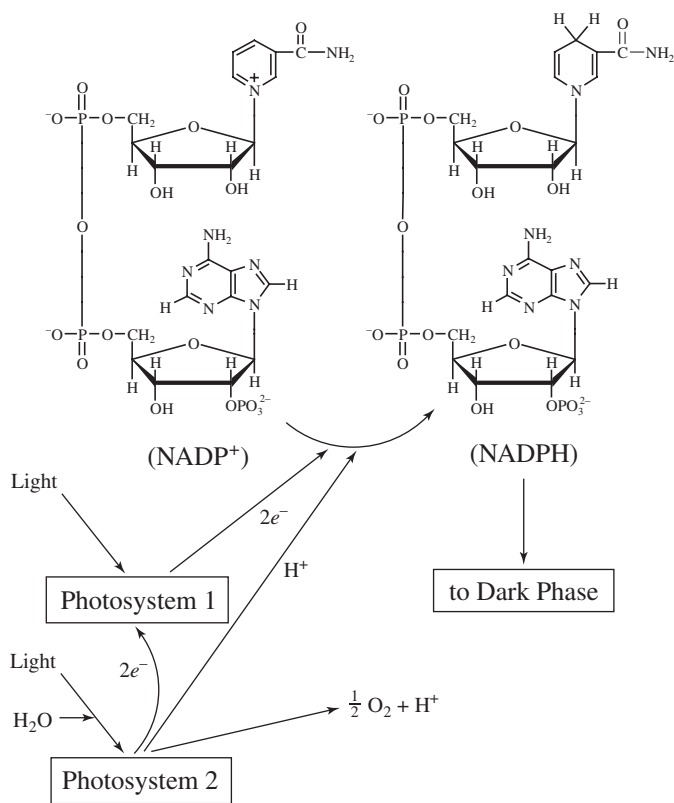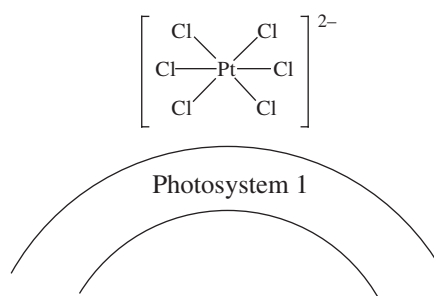

Figure 1

Figure 2

(a) **Describe** how photosynthesis is different from the energy-producing reactions of aerobic respiration.
(b) **Identify** the hypothesis the researcher was testing.
(c) **Predict** how the dark phases of photosynthesis were affected during this experiment.
(d) **Justify** your prediction.

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4. A species of sunflower was studied in the 1980s by Professor Telly of Calicat Research Labs. Native to California, the *C. harriehazelet* sunflower blooms in late June and the blooms often draw photographers to the coast for the gorgeous fields of yellow flowers following the Sun. Professor Telly was interested in the preferences in soil moisture for the sunflower since California has often suffered extreme drought conditions spurring wildfires. The sunflower population at nine different moisture levels is shown in Figure 1.
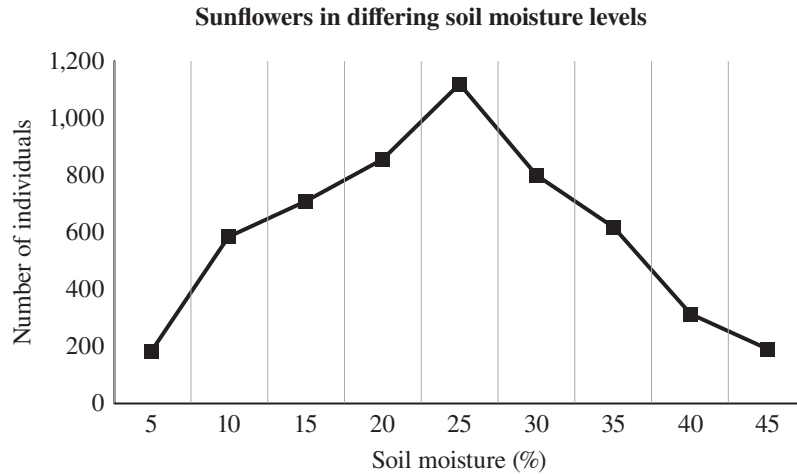
Sunflowers in differing soil moisture levels

Figure 1. Sunflower populations vs. moisture levels 1987

After 40 years, Professor Telly decided to revisit the sunflower blooms and measure the soil moisture content at different sites again. It was discovered that sunflower species were primarily found at 2 tiers of moisture levels: 50–60% and 5–10%.

(a) Soil moisture and temperature are important for plant survival. **Explain** how plants react to environmental stimuli to maintain homeostasis.

(b) **Explain** how harsh environmental condition can change the phenotypes of a population over many generations.

(c) **Predict** what might have led to the change in water preference for the sunflower population.

(d) **Justify** your prediction.

5.
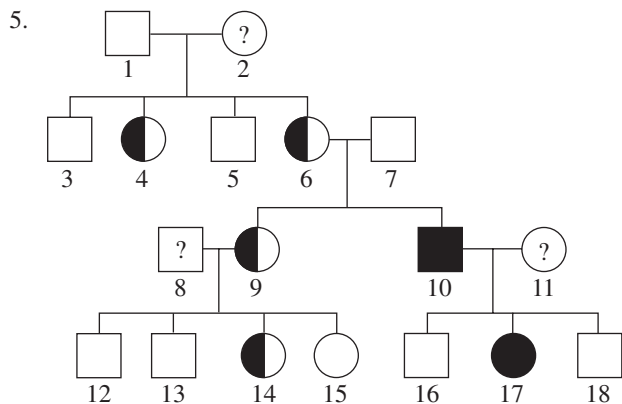
Family Tree for Color Blindness, an X-linked Recessive Disease: squares represent males and circles represent females. Shading in a shape represents the allele for color blindness. Each half of a shape represents one of the two copies of the gene.

(a) **Explain** the importance of diploid and haploid cells in sexual reproduction.
(b) **Explain** what the genotype of an individual with no shading would be. If you use abbreviations, be sure to indicate what they represent.
(c) Of the individuals with a "?", **identify** which of them is heterozygous.
(d) It is possible for a mother to pass on either of her two copies of a gene. **Explain** why this is helpful to prepare populations for selective pressures.

6. Regulation of genes prior to transcription is essential. The covalent modification of methylation is one such way that gene control occurs in eukaryotes, and it has been implicated in several diseases. DNA methylation turns off eukaryotic gene expression by physically blocking transcriptional proteins and by recruiting chromatin remodeling proteins that change the packing of DNA around histones.

An experiment was performed to assess the relative amount of transcription and the impact of a sequence-specific regulatory factor and the amount that DNA is packaged. The results are shown in Table 1.

	Sequence-Specific Factor	DNA	Relative Amount of Transcription
1.	None	unpackaged	0.74
2.	None	packaged	0.07
3.	Present	unpackaged	1.0
4.	Present	packaged	0.59

Table 1

(a) **Identify** the positive control in the data table.
(b) **Calculate** the percentage decrease in transcription with packaged DNA and no transcription factor.
(c) **Determine** which independent variable plays more of a role in regulating transcription.
(d) **Explain** how an epigenetic change can lead to a phenotype different from what is expected from the genotype.

STOP

END OF EXAM