

LIVING ENVIRONMENT

Friday, August 17, 2018 — 12:30 to 3:30 p.m., only

Student Name _____

School Name _____

The possession or use of any communications device is strictly prohibited when taking this examination. If you have or use any communications device, no matter how briefly, your examination will be invalidated and no score will be calculated for you.

Print your name and the name of your school on the lines above.

A separate answer sheet for multiple-choice questions in Parts A, B-1, B-2, and D has been provided to you. Follow the instructions from the proctor for completing the student information on your answer sheet.

You are to answer all questions in all parts of this examination. Record your answers for all multiple-choice questions, including those in Parts B-2 and D, on the separate answer sheet. Record your answers for all open-ended questions directly in this examination booklet. All answers in this examination booklet should be written in pen, except for graphs and drawings, which should be done in pencil. You may use scrap paper to work out the answers to the questions, but be sure to record all your answers on the answer sheet or in this examination booklet as directed.

When you have completed the examination, you must sign the declaration printed on your separate answer sheet, indicating that you had no unlawful knowledge of the questions or answers prior to the examination and that you have neither given nor received assistance in answering any of the questions during the examination. Your answer sheet cannot be accepted if you fail to sign this declaration.

Notice ...

A four-function or scientific calculator must be available for you to use while taking this examination.

DO NOT OPEN THIS EXAMINATION BOOKLET UNTIL THE SIGNAL IS GIVEN.

Part A

Answer all questions in this part. [30]

Directions (1–30): For *each* statement or question, record on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

1 Which human activity most directly causes a significant increase in the amount of carbon dioxide in the atmosphere?

- (1) growing corn for food
- (2) not using products containing plastics
- (3) driving cars long distances
- (4) planting large numbers of trees

2 An immune response is primarily due to the body's white blood cells recognizing

- (1) a hormone imbalance
- (2) abiotic organisms
- (3) foreign antigens
- (4) known antibiotics

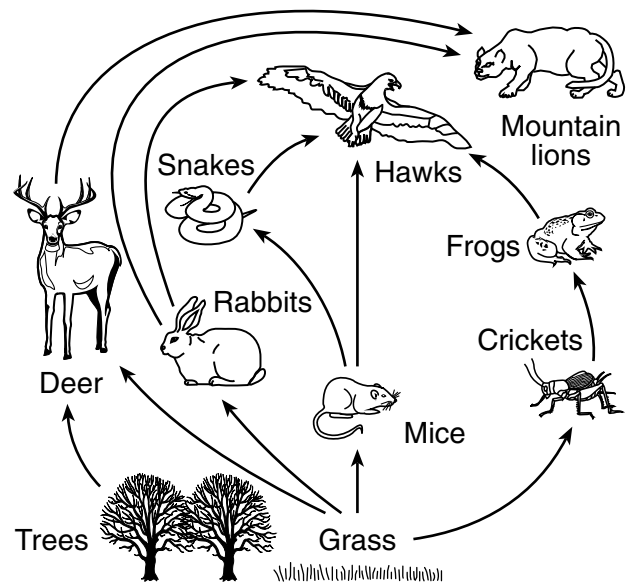
3 In an effort to reduce the number of deaths due to malaria, scientists have successfully introduced a gene into mosquitoes. The gene makes the mosquitoes unable to support the development of the parasite that causes malaria. The technique used to produce this new variety of mosquito is most likely

- (1) chromatography
- (2) genetic engineering
- (3) electrophoresis of genes
- (4) selective breeding

4 The organic compounds that scientists use to cut, copy, and move segments of DNA are

- (1) carbohydrates (3) hormones
- (2) enzymes (4) starches

Base your answers to questions 5 and 6 on the diagram below and on your knowledge of biology.



5 Which statement most accurately predicts the result of interfering with populations in the web?

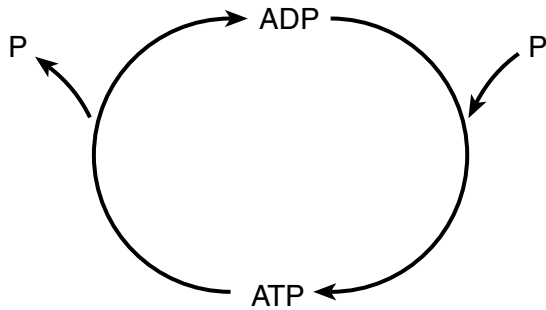
- (1) Removing the cricket population will have little effect on the balance of the food web.
- (2) Removing all the mountain lions from the food web will benefit the ecosystem.
- (3) Removing the cricket and rabbit populations would cause the number of trees to decrease.
- (4) Removing deer from the food web will affect the rabbit and grass populations.

6 A factor *not* shown in the diagram that provides energy for living organisms is

- (1) carbon dioxide (3) the Sun
- (2) water (4) oxygen

- 7 Scientists have found a gene that makes a protein called PKG that controls certain behaviors in many types of ants. The soldier ant will help collect food when it has a low level of PKG. When it has a high level of PKG, the soldier ant will protect and defend its colony. Soldier ants that are given PKG are more likely to ignore food sources and attack intruders. Which conclusion can best be made from this information?
- (1) PKG protein is synthesized only by the soldier ants.
 - (2) Genes control which type of amino acids a cell can make.
 - (3) Eating too much protein makes some organisms very aggressive.
 - (4) The behavior of soldier ants is controlled in part by the PKG protein.
- 8 Genetic researchers have discovered a number of different gene mutations that have led to the development of cancer. These mutations affect how frequently a cell reproduces. Which process would be directly influenced by these mutations?
- (1) differentiation of cells in an embryo
 - (2) meiotic cell division
 - (3) division of sperm and egg cells
 - (4) mitotic cell division
- 9 Lobsters are crustaceans related to crayfish, crabs, and shrimp. Most lobsters are a reddish-brown color, but on rare occasions, they can be orange, blue, or even multicolored. These color differences can be caused by
- (1) genetic variations
 - (2) different numbers of offspring
 - (3) overpopulation and excessive resources
 - (4) the instability of the ecosystem
- 10 Which two factors could lead to the evolution of a species over time?
- (1) overproduction of offspring and no variation
 - (2) changes in the genes of body cells and extinction
 - (3) struggle for survival and fossilization
 - (4) changes in the genes of sex cells and survival of the fittest
- 11 As human red blood cells mature, they lose their nuclei. As a result of this loss, which process would be impossible for mature red blood cells to carry out?
- (1) excretion
 - (2) respiration
 - (3) reproduction
 - (4) transport
- 12 To clone a mammal, a cloned embryo is often put into an adult female of the same species to continue internal development. The structure in which the embryo will develop is the
- (1) ovary
 - (2) placenta
 - (3) uterus
 - (4) egg
- 13 Nuclear power plants, which produce electrical energy, use large quantities of water for cooling. Often, small fish, larvae, and fish eggs are sucked in along with the cooling water and destroyed. This example illustrates how
- (1) industrialization can have positive and negative effects
 - (2) removal of these organisms has no effect on an ecosystem
 - (3) direct harvesting increases the natural fish population
 - (4) energy is generated without producing wastes
- 14 Acid rain is a major problem in the Adirondack Mountains. Evidence that acid rain *negatively* affected the Adirondack ecosystem is that
- (1) this rain has increased the amount of water in Adirondack lakes
 - (2) there has been a decrease in the variety of fish found in Adirondack lakes
 - (3) the amount of carbon dioxide in the air over the Adirondack Mountains has drastically decreased in recent years
 - (4) the number of heterotrophic organisms in Adirondack lakes has increased
- 15 Which system in a multicellular organism functions most like the cytoplasm in a single-celled organism?
- (1) immune
 - (2) reproductive
 - (3) nervous
 - (4) circulatory

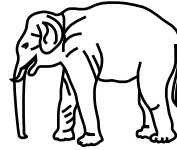
16 A common cycle in biology is represented below.



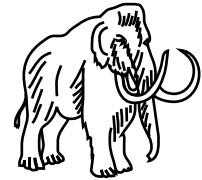
The ATP molecule above is commonly used to

- (1) actively transport molecules in an organism
 - (2) diffuse water across a membrane
 - (3) move molecules from a high to a low concentration
 - (4) balance the nutrients in an ecosystem
- 17 Fat molecules typically contain long chains of carbon atoms. Animals tend to store fats for use when food resources are scarce. This is an advantage to the animal because
- (1) much energy can be gained by breaking the bonds between atoms in the fats
 - (2) fats give off carbon dioxide that can be used by the muscles
 - (3) amino acids from fat synthesis are more easily digested than carbohydrates
 - (4) energy can only be created by digesting fats
- 18 While looking at the bottom surface of a leaf with a compound light microscope, a student notices pairs of cells with openings between them on the surface of the leaf. The main purpose of these openings and the cells that surround them is
- (1) removing excess sugars
 - (2) synthesis of carbon dioxide
 - (3) regulating gas exchange
 - (4) purification of water
- 19 An immune response to a usually harmless environmental substance is known as
- | | |
|-------------------|----------------|
| (1) an antigen | (3) an allergy |
| (2) a vaccination | (4) a mutation |

20 Scientists at Penn State have sequenced the DNA of the extinct woolly mammoth. The data suggested that the woolly mammoth was more closely related to present-day elephants than previously believed.



Elephant



Woolly mammoth

Which statement could account for the similarities between the woolly mammoth and present-day elephants?

- (1) Common gene mutations were caused by agents such as industrial chemicals and radiation.
 - (2) Present-day species developed from earlier, different species.
 - (3) Selective breeding results in offspring better able to survive.
 - (4) Both animals have identical genetic information.
- 21 Single-celled organisms are able to maintain homeostasis, even though they lack higher levels of organization such as organs and organ systems, because
- (1) single-celled organisms do not carry out the same life processes as multicellular organisms
 - (2) multicellular organisms do not rely on tissues or organs to carry out life processes
 - (3) cell structures work together to maintain homeostasis in single-celled organisms
 - (4) single-celled organisms are able to coordinate organ functions to maintain homeostasis
- 22 Sharks are often followed by smaller fish that eat some of the scraps from the organisms eaten by the shark. These smaller fish are acting as
- | | |
|-----------------|----------------|
| (1) decomposers | (3) producers |
| (2) scavengers | (4) herbivores |

- 23 The photographs below are side-by-side images of twins *A* and *B* with identical genetic information. Twin *A* is a nonsmoker, while twin *B* is a longtime smoker.



A

B

Source: <http://holykaw.alltop.com>

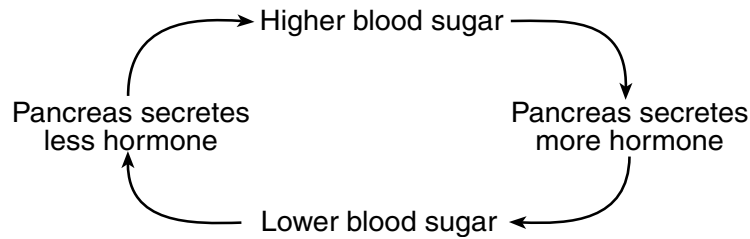
The best explanation for the differences in the appearance of the twins is that

- (1) twin *B* is older than twin *A*
 - (2) they each inherited half of their DNA from each parent
 - (3) the expression of genes is influenced by the environment
 - (4) one twin resembles the mother and the other resembles the father
- 24 Under the supervision of experts, certain areas in a nature preserve are regularly exposed to frequent, low-intensity fires. These controlled fires maintain specific populations of plants by directly
- (1) increasing the consumption of finite resources
 - (2) decreasing the carbon dioxide level in the atmosphere
 - (3) stopping the process of evolution
 - (4) interfering with the process of ecological succession

- 25 An invasive species, the spiny water flea, was recently found in a New York lake. These water fleas eat zooplankton, a food also consumed by native fishes. The fleas spread from lake to lake by attaching to fishing lines, anchor ropes, and boats. Which statement best describes the effect of the water flea on the lake?

- (1) It will not compete with animals in the local food chain.
 - (2) It will feed on organisms that are important to other species.
 - (3) The number of water fleas will decrease due to a lack of food.
 - (4) There will be no effect on native species in the lake.
- 26 A stable ecosystem can have high biodiversity because each species in that ecosystem
- (1) occupies a different niche
 - (2) inhabits a different environment
 - (3) is part of a different community
 - (4) lives in a different biosphere
- 27 Stability within an ecosystem is achieved partially by the presence of organisms that break down important molecules and make them available for other organisms to use. These organisms are
- | | |
|----------------|-----------------|
| (1) plants | (3) scavengers |
| (2) herbivores | (4) decomposers |

28 The diagram below represents a feedback mechanism.



The hormone referred to in this feedback mechanism is

- (1) estrogen
- (2) insulin
- (3) progesterone
- (4) testosterone

29 After a lake dried up during a severe drought, a section of undisturbed rock layers was exposed. The layers are represented below.

Fossils in Undisturbed Rock Layers

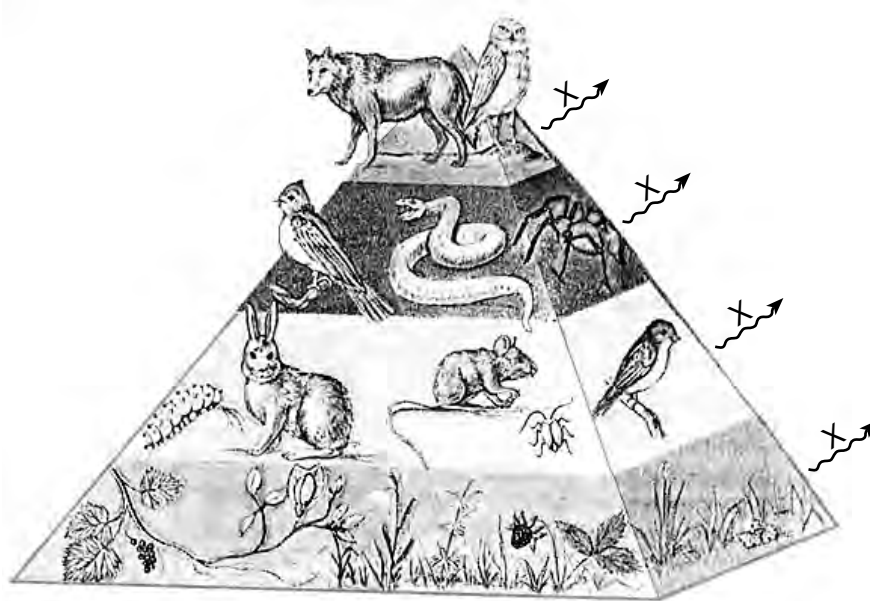


Source: <https://www.superteachertools.net>

This sequence of rock layers best illustrates the concept that

- (1) the living and nonliving environment both change over time
- (2) it is important to preserve the diversity of species and habitats
- (3) new inheritable characteristics can result from the recombining of genes
- (4) living organisms have the capacity to produce populations of unlimited size

30 Some organisms in an ecosystem are represented in the pyramid below.



Source: Sylvia Mader, *Human Biology* (McGraw-Hill, 1998), p.476.

In the pyramid, the arrows labeled X represent

- | | |
|--|--|
| (1) the loss of organisms due to predation | (3) the loss of energy in the form of heat |
| (2) a decrease in photosynthetic organisms | (4) a decrease in available oxygen |
-

Part B-1

Answer all questions in this part. [13]

Directions (31–43): For *each* statement or question, record on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

Base your answers to questions 31 and 32 on the information below and on your knowledge of biology.

A student designed an experiment to determine if air temperature had an effect on the rate of photosynthesis in corn plants.

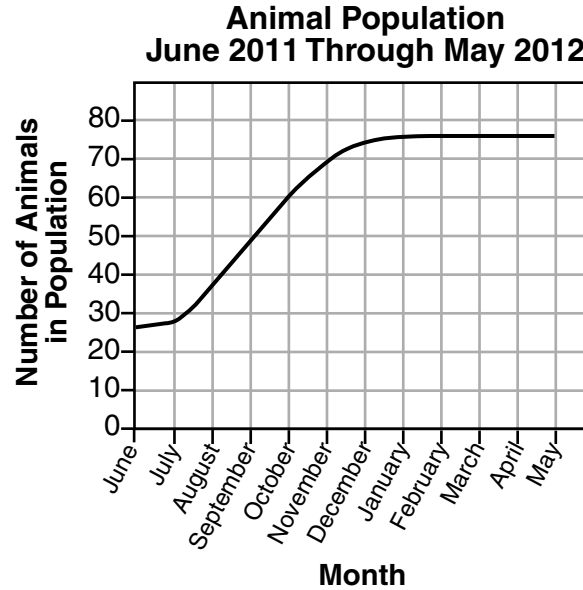
31 Which tool is correctly paired with a procedure that could be used during this experiment?

- (1) an electronic balance to measure the volume of soil in which each corn plant is grown
- (2) a graduated cylinder to measure 30 mL of water for each plant daily
- (3) a metric ruler to determine the mass of each plant each week
- (4) a Celsius thermometer to determine the pH of the soil

32 The independent variable in this experiment is the

- (1) air temperature at which the corn plants were grown
 - (2) amount of carbon dioxide used by the corn plants
 - (3) volume of oxygen produced by the corn plants
 - (4) number of corn plants used
-

Base your answers to questions 33 and 34 on the information and graph below and on your knowledge of biology. The graph shows the number of animals in a population throughout the course of a year. The population migrated into the area at the beginning of 2011.



33 The graph can best be used to illustrate

- (1) a food chain
- (2) ecological succession
- (3) natural selection
- (4) carrying capacity

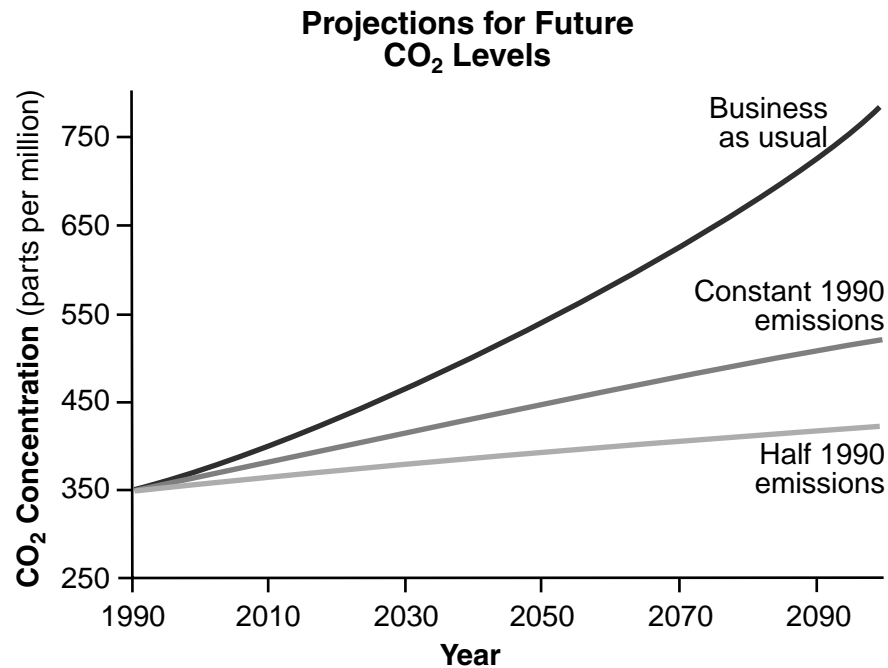
34 The approximate number of animals that were found in June 2012 was most likely

- (1) 16
- (2) 26
- (3) 76
- (4) 86

35 To prepare for an experiment, ten different sources of food were sterilized and kept in a sterile container. Bacteria of the same species were placed on each of the ten different food sources and kept at 26°C for two days. During this time, bacteria grew in nine of the containers. Based on this observation, the scientist could conclude that

- (1) all ten food sources used in the experiment are capable of supporting this species of bacteria
- (2) the temperature varied greatly in nine of the containers during this experiment
- (3) only the container that failed to grow any bacteria was prepared correctly
- (4) this species of bacteria synthesizes enzymes needed to digest the food in nine of the ten containers

36 The graph below shows three projections for future carbon dioxide (CO₂) levels.



Source: <http://www.yourclimateyourlife.org.uk>

- The “Business as usual” line shows CO₂ levels if emissions remain at current levels.
- The “Constant 1990 emissions” line shows CO₂ levels if emissions are cut to the same level that they were in 1990.
- The “Half 1990 emissions” line shows CO₂ levels if emissions are cut to half of the level that they were in 1990.

Which statement is supported by the graph?

- (1) Climate change will result in the melting of polar ice caps.
- (2) The increase in carbon dioxide levels will cause a decrease in global average temperature.
- (3) Human activities have no effect on atmospheric carbon dioxide levels.
- (4) Future generations can be affected by the choices of current generations.

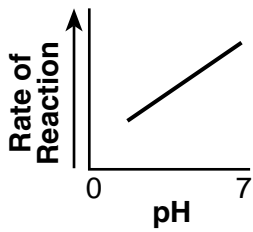
Base your answers to questions 37 through 39 on the information below and on your knowledge of biology.

Hydrogen peroxide (H_2O_2) is a toxic compound that is produced by plant and animal cells. These cells also produce the enzyme catalase, which converts H_2O_2 into water and oxygen gas, preventing the buildup of H_2O_2 .

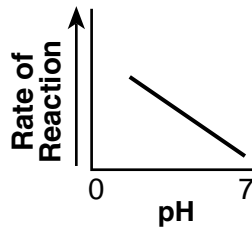
A student designed an experiment to test the effect of an acidic pH on the rate of the reaction of H_2O_2 with catalase. The data below summarize the outcome of the experiment.

pH Level	7 (neutral)	6	5	3
Reaction Rate (mL of oxygen/minute)	1.5	1.3	1.0	.55

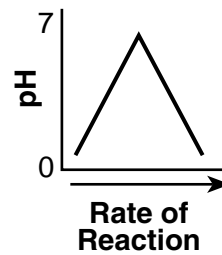
37 Which graph most accurately represents the results obtained by this student?



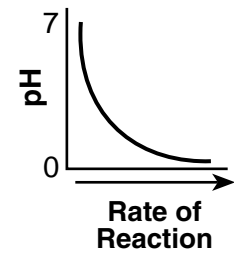
(1)



(2)



(3)



(4)

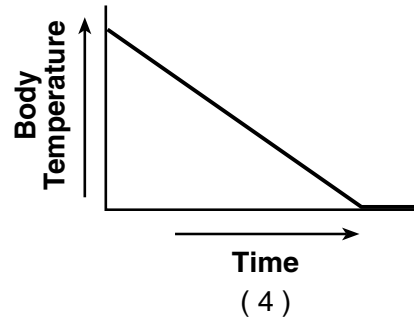
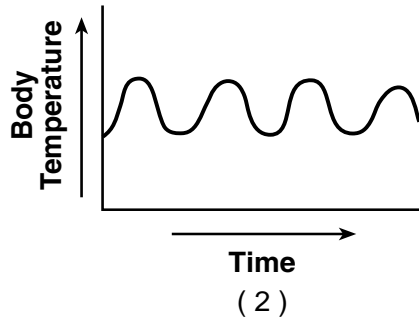
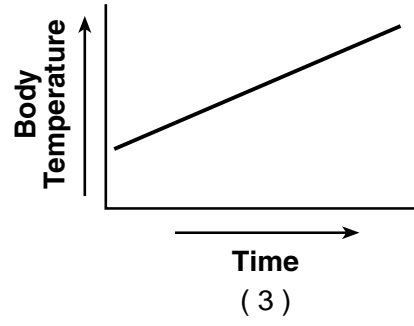
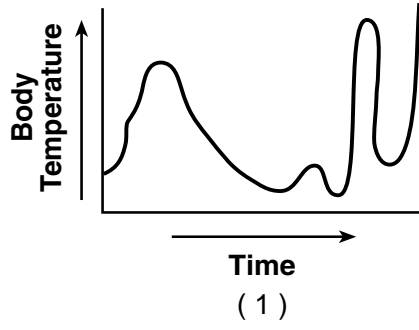
38 Which conclusion is valid based upon the data collected by the student?

- (1) The change in pH prevents catalase from breaking down water.
- (2) Catalase has the greatest activity at a pH of 7.
- (3) Oxygen production will increase if more water is added to the reaction.
- (4) Catalase caused the greatest production of oxygen at a pH of 3.

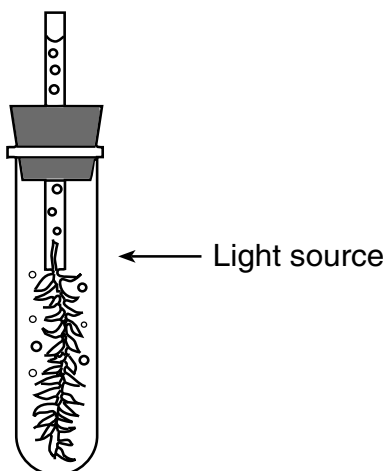
39 The best explanation for the change in catalase activity as the pH changed from 7 to 3 is that

- (1) strong acid digests the catalase, causing the reaction rate to increase
- (2) the student most likely cooled the H_2O_2 solution, causing the reaction rate to increase
- (3) in acidic solutions, the shape of catalase changes, causing the reaction rate to decrease
- (4) decreased oxygen production causes catalase to increase the rate of reaction

40 Which graph best illustrates the body temperature in an individual maintaining dynamic equilibrium?



43 A student placed a test tube containing elodea (an aquatic plant) and pond water 10 cm from a light source. He observed that the plant gave off bubbles of a gas and counted how many bubbles were released in one minute. He moved the plant farther away from the light source to see if distance from the source made a difference. The data table below shows his results.



Gas Production

Distance from Light (cm)	Bubbles Produced per Minute
10	40
20	30
30	7
40	4

The gas that was being produced was most likely

- (1) carbon dioxide as a product of the process of respiration
- (2) carbon dioxide as a product of the process of photosynthesis
- (3) oxygen as a product of the process of respiration
- (4) oxygen as a product of the process of photosynthesis

Part B-2

Answer all questions in this part. [12]

Directions (44-55): For those questions that are multiple choice, record on the separate answer sheet the *number* of the choice that, of those given, best completes each statement or answers each question. For all other questions in this part, follow the directions given and record your answers in the spaces provided in this examination booklet.

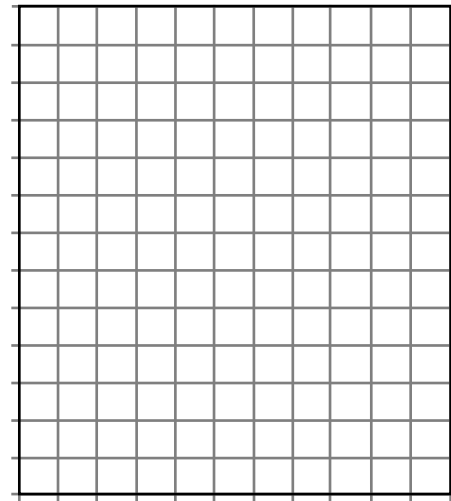
Base your answers to questions 44 through 46 on the data table below and on your knowledge of biology. The data table shows the estimated number of species extinctions from 1960 to 2010.

Number of Estimated Species Extinctions

Year	Estimated Number of Species Extinctions
1960	5000
1970	10,000
1980	15,000
1990	25,000
2000	35,000
2010	50,000

Number of Estimated Species Extinctions

Estimated Number of Species Extinctions

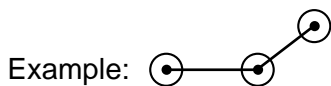


Year

Directions (44-45): Using the information in the data table, construct a line graph on the grid above, following the directions below.

44 Mark an appropriate scale, without any breaks in the data, on each labeled axis. [1]

45 Plot the data on the grid, connect the points and surround each point with a small circle. [1]



46 State *one* possible cause for the increase in the number of species extinctions from 1960-2010. [1]

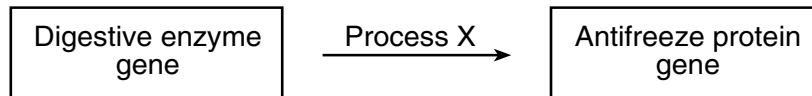
Base your answers to questions 47 through 49 on the information and diagram below and on your knowledge of biology.

Icefish Evolution

Over the last 50 million years, icefish evolved many adaptations that contributed to their success in surviving the decreasing water temperatures of the ocean surrounding Antarctica. For example, they have the ability to produce an antifreeze protein that prevents their blood from freezing in waters that are now below the normal freezing point of fresh water.

Note: The answer to question 47 should be recorded on your separate answer sheet.

47 Scientists have analyzed the icefish DNA and documented genetic changes that gave rise to the antifreeze gene. Their findings are represented in the diagram below.



Process X is referred to as

- (1) mitosis
- (2) mutation
- (3) differentiation
- (4) meiosis

48 Explain how the process of natural selection can account for the increase in frequency of the antifreeze protein gene in the icefish population. [1]

Note: The answer to question 49 should be recorded on your separate answer sheet.

49 In addition to the appearance of the antifreeze gene, icefish have also been found to have DNA sequences similar to the DNA sequences in hemoglobin genes of other fish species. However, these DNA sequences are not complete and therefore not functional in icefish. This evidence makes it likely that

- (1) icefish ancestors had hemoglobin
- (2) icefish will soon produce offspring with hemoglobin
- (3) hemoglobin is a molecule made by some fish that do not have genes for it
- (4) soon all fish will stop producing hemoglobin

Base your answers to questions 50 and 51 on the passage below and on your knowledge of biology.

Green sea slugs are animals that live in water and have developed the ability to produce their own chlorophyll. These creatures can also pass this ability to make chlorophyll to their offspring. Once the offspring have one meal of algae, they are able to make food using sunlight. This one meal provides the baby slugs with the chloroplasts needed to make use of the chlorophyll, and they are able to produce their own food in the future.

Note: The answer to question 50 should be recorded on your separate answer sheet.

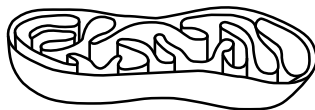
50 The best explanation for why sea slugs are able to pass on this ability to make food to their offspring is that

- (1) the gene for making algae is in all their body cells
- (2) making food is beneficial, so the slugs needed to mutate
- (3) the environment causes the slugs to become green
- (4) the gene for chlorophyll production is part of their DNA

51 Explain how green sea slugs can be considered both a producer and a consumer. [1]

52 State why fossil fuels are considered a finite resource. [1]

53 The diagram below represents an organelle.



Identify the process that occurs in this organelle, and explain the importance of this process to the survival of organisms. [1]

Process: _____

Importance: _____

Base your answers to questions 54 and 55 on the information below and on your knowledge of biology.

The testes of a human male produce gametes. The process that produces these gametes differs from the process that produces new skin cells in the same individual.

54 Identify the type of cell division involved in each process. [1]

Skin cells: _____

Gametes: _____

55 How does the genetic makeup of the skin cells differ from the genetic makeup of the gametes? [1]

Part C

Answer all questions in this part. [17]

Directions (56–72): Record your answers in the spaces provided in this examination booklet.

Base your answers to questions 56 through 58 on the information below and on your knowledge of biology.

Placental mammals – as opposed to the kind that lay eggs, such as the platypus, or carry young in pouches, such as the kangaroo – are an extraordinarily diverse group of animals with more than 5000 species today. They [placental mammals] include examples that fly, swim, and run, and range in weight from a couple of grams to hundreds of tons. ...

Source: "Earliest Placental Mammal Ancestor Pinpointed," BBC News, February 7, 2013.

56 Describe *one* function of the placenta during the internal development of an offspring. [1]

57 Describe *one* advantage for an offspring to develop internally as opposed to developing externally. [1]

58 Identify *one* factor, besides genetics, that could influence the development of human offspring. [1]

Base your answers to questions 59 through 61 on the information below and on your knowledge of biology.

Birds Are Evolving Rapidly–Today

Many people think that evolutionary change occurs so slowly, we cannot observe it directly. Not so!

For example today in the U.S., house finches are evolving rapidly and visibly. In 1941, some captive house finches from California escaped near New York City. They spread rapidly and are now found across most of the United States and in southern Canada. Many of these areas have cold, snowy winters, during which many birds die. The finches have evolved, because those that survive differ from their parents. Size is one example.

Male house finches in recently established populations in Michigan and Montana are larger than the males that escaped. Large males outcompete small males for food, so are more likely to survive the winter. They also pair more successfully with females early in the spring.

Smaller females survive better than larger females as nestlings. Also, because they need less food to maintain their own bodies, they can breed earlier in spring. Females that breed earlier raise more young than those that start breeding later.

Rapid evolution of house finches reminds us that evolutionary changes are occurring visibly all around us.

Source: birdnote.org/show/birds-are-evolving-rapidly-today

59 Explain why it is an advantage for female finches to be small. [1]

60 Explain why the population of large male house finches in Michigan and Montana continues to increase. [1]

61 Predict what both the male and female finch populations might be like 10 years in the future, based on what is currently happening with the finch populations. [1]

Male: _____

Female: _____

Base your answers to questions 62 through 64 on the information below and on your knowledge of biology.

New Threat to Endangered Sea Turtles



Endangered sea turtles in tropical areas are facing a new threat in the form of changing beach temperatures caused by climate change. The sex of sea turtle hatchlings is determined by the temperature inside the nest. Embryos develop into males when the temperature is approximately 28°C (82°F), whereas female embryos develop at approximately 31°C (88°F). If the temperature inside the nest is between these values, then both male and female turtles are produced.

If these endangered sea turtles are going to survive in the long term, we need to protect their nesting habitat, ensure that the potential nest sites have adequate amounts of shade-producing vegetation (such as palm trees) nearby, and ensure that they are not affected by tourist activities in the area.

- 62 Temperatures at beaches where these turtles nest are expected to slowly increase with global climate change. State *one* specific effect that a continuous rise in temperature could have on the sex ratio of the hatchling populations of these sea turtles. [1]

- 63 Explain how having adequate amounts of shade-producing vegetation nearby, such as palm trees, can affect the nesting success of endangered sea turtles. [1]

- 64 State *one* way that tourist activities in areas where turtles make their nests could have a *negative* impact on the nesting success of the turtles. [1]

Base your answers to questions 65 through 68 on the information and photograph below and on your knowledge of biology. The photograph shows a grasshopper mouse howling after eating a scorpion.



Source: Michael and Patricia Fogden/Minden/NGS

Grasshopper Mice

In the Sonoran Desert in the southwestern United States, the grasshopper mouse is active at night, searching for crickets, rodents, tarantulas, and even scorpions. The mouse ignores the venom of the scorpion, kills it, and consumes its flesh. The ability of the mouse to ignore the pain normally associated with the venom of the scorpion is due to the presence of a mutated protein. This protein prevents the pain signal from reaching the brain.

These mice are born killers, capable of taking down prey that are much larger than themselves. They are also aggressive neighbors and take over nests by displacing other desert inhabitants rather than making their own. Under difficult environmental conditions, they may even eat members of their own species.

65 State the role of the population of grasshopper mice in the Sonoran Desert food web. [1]

66 State *one* advantage grasshopper mice have over the other local populations when competing for resources. [1]

67 Identify *one* advantage to grasshopper mice of being active during the night rather than daylight. [1]

68 Explain how research on the mutated protein identified in the grasshopper mouse could benefit humans suffering from chronic pain. [1]

Base your answers to questions 69 and 70 on the information below and on your knowledge of biology.

To attend public school in New York State, children need to be vaccinated against various diseases. The list below shows some required vaccinations.

Required Vaccinations

Polio

Tetanus

Pertussis

Measles

Mumps

Rubella

Diphtheria

69 Explain how vaccinations protect against diseases. [1]

70 The flu is a disease caused by a virus that can undergo frequent genetic changes. A different flu vaccination is needed each year. Explain why a single vaccination is *not* effective against all flu viruses. [1]

Base your answers to question 71–72 on the information below and on your knowledge of biology.

Survey Finds Invasive Snail in St. Lawrence River That Could Threaten Waterfowl

New research has found a larger presence of faucet snails in the Great Lakes than previously recognized, including the northern parts of Lake Ontario and the St. Lawrence River. The invasive species can carry three types of intestinal parasites that can injure and kill waterfowl such as ducks. ...

...When the waterfowl eat the snails, the parasites attack internal organs, causing lesions [sores] and hemorrhage [uncontrolled bleeding]. Birds affected by the snail will fly and dive erratically before their eventual death. The university said that the snails are about 12 to 15 millimeters in height at full size, brown to black with a distinctive whorl of concentric circles on the shell opening cover that looks like tree rings. ...

...Mr. Kosnicki [an ecologist] said the spread of snails, along with other invasive species, shows the need for increased awareness of possible contaminants coming from boats and in runoff from land. ...

Source: Watertown Daily Times, Monday, January 19, 2015, by Gordon Block

71–72 Discuss how invasive species can harm an ecosystem. In your answer, be sure to:

- explain *one* negative effect that faucet snails have on the lake ecosystem [1]
- describe *one* human activity that can slow the spread of the faucet snail [1]

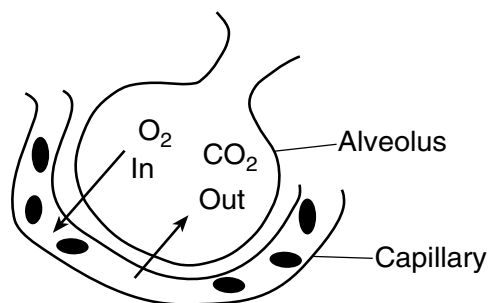
Part D

Answer all questions in this part. [13]

Directions (73–85): For those questions that are multiple choice, record on the separate answer sheet the *number* of the choice that, of those given, best completes each statement or answers each question. For all other questions in this part, follow the directions given and record your answers in the spaces provided in this examination booklet.

Note: The answer to question 73 should be recorded on your separate answer sheet.

- 73 The diagram below represents one of many microscopic air sacs in a human lung. The alveolus (air sac) is the place where oxygen (O_2) and carbon dioxide (CO_2) move into or out of the blood, as represented in the diagram.



Which statement best explains why these gases are able to move in the directions shown in the diagram?

- (1) The CO_2 moves out of the capillary and into the alveolus to make more room for the blood to carry O_2 .
- (2) The O_2 is needed by the cells, so it is actively transported into the blood. The CO_2 , which is not needed, is actively transported out of the blood.
- (3) The blood coming to the lungs is low in CO_2 and high in O_2 , so the gases each diffuse from a lower to a higher concentration in this area.
- (4) The blood coming to the lungs is high in CO_2 and low in O_2 , so the gases each diffuse from a higher to a lower concentration in this area.

Note: The answer to question 74 should be recorded on your separate answer sheet.

- 74 During the process of chromosome replication, a genetic error occurs. As a result, a sequence of events occurs as described below.

Event A: a protein with a new sequence of amino acids is produced

Event B: a DNA strand with an altered base sequence is formed

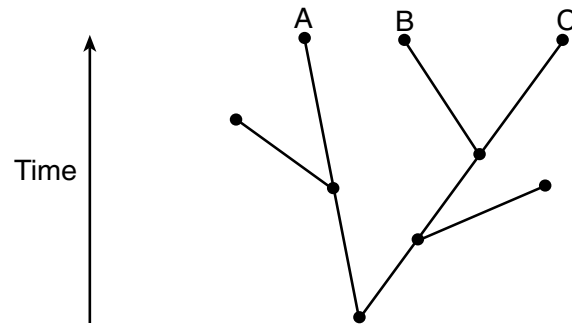
Event C: a new inheritable trait is expressed in an organism

Event D: an mRNA strand with a new sequence of bases is synthesized

The usual order in which these events would occur is

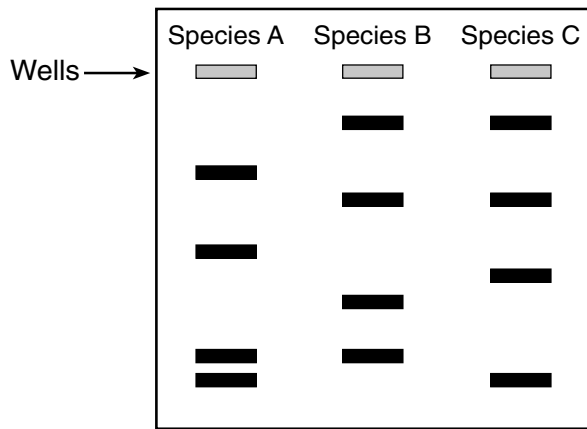
- (1) B — D — A — C
- (2) B — D — C — A
- (3) D — A — B — C
- (4) D — C — B — A

Base your answers to questions 75 through 77 on the information below and on your knowledge of biology. The evolutionary tree below represents possible relationships between several species of plants.

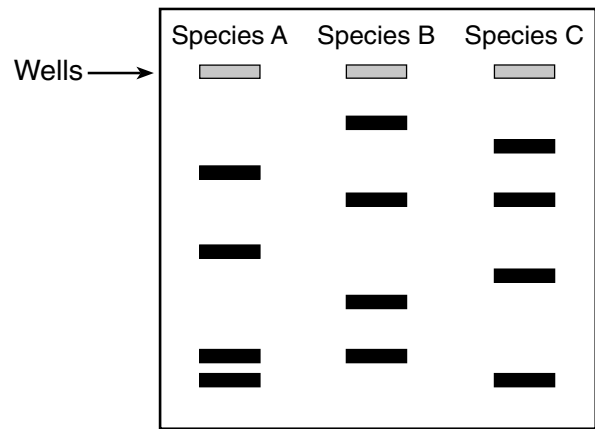


Note: The answer to question 75 should be recorded on your separate answer sheet.

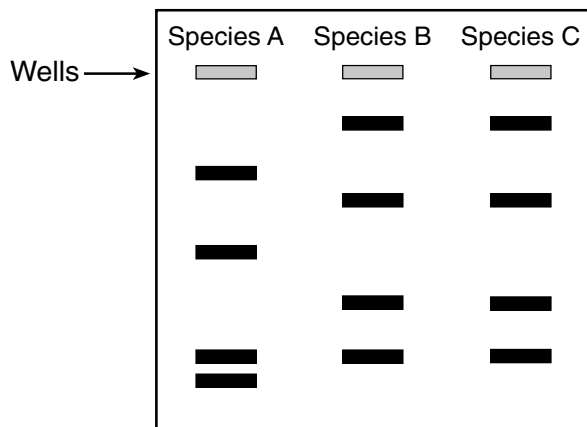
75 According to the tree, species *B* and *C* are more closely related to each other than to species *A*. Which gel electrophoresis diagram would best support this statement?



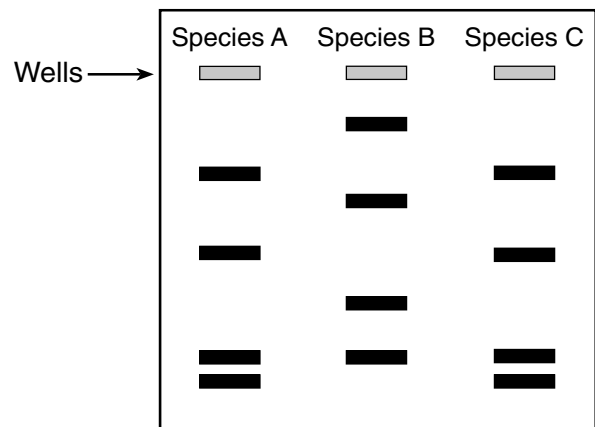
(1)



(3)



(2)



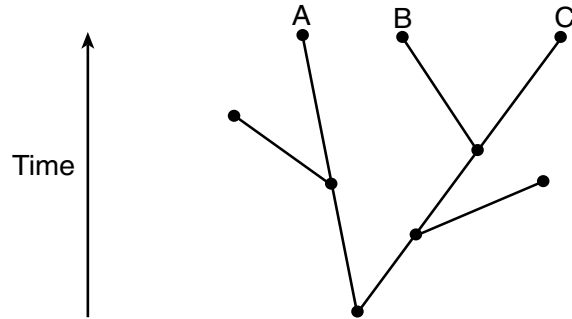
(4)

Note: The answer to question 76 should be recorded on your separate answer sheet.

76 In addition to analyzing DNA, what other evidence could be used to best support the evolutionary relationship between species *B* and *C*?

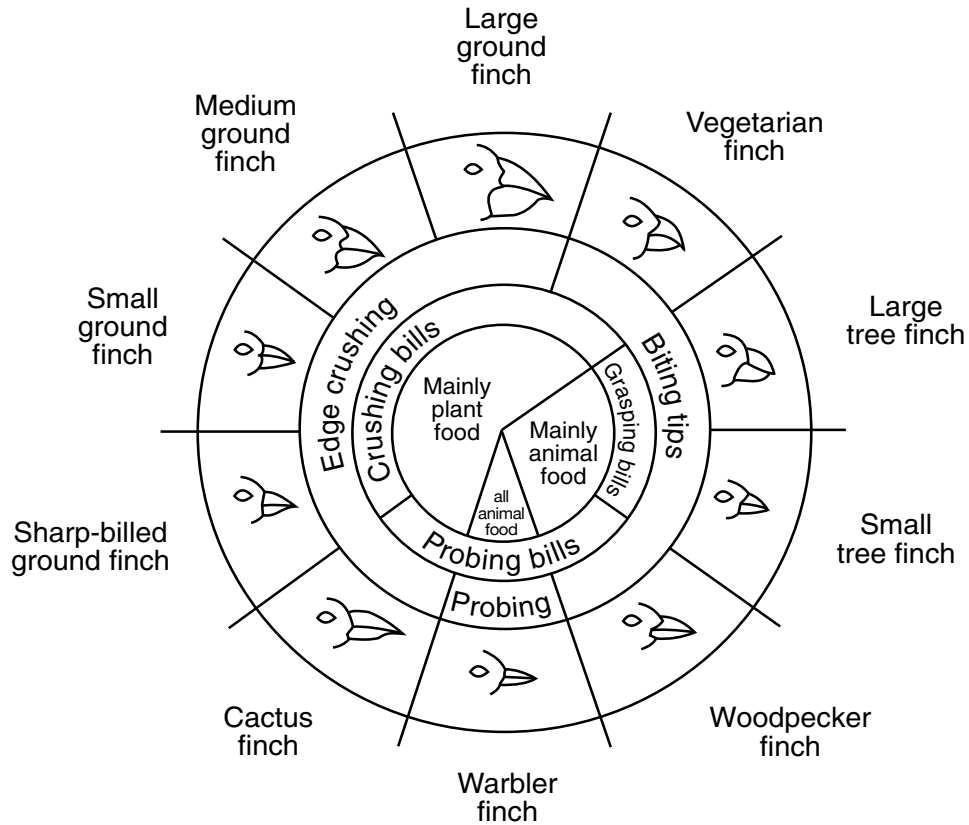
- (1) Species *B* and *C* live in the same ecosystem.
- (2) Species *B* and *C* require the same amount of sunlight.
- (3) Species *B* and *C* possess many of the same enzymes.
- (4) Species *B* and *C* grow to the same maximum height as species *A*.

77 On the diagram below, circle the dot that best represents the common ancestor of species *A*, *B*, and *C*. [1]



Base your answers to questions 78 and 79 on the information and chart below and on your knowledge of biology. The chart below shows variations in the beaks of finches in the Galapagos Islands.

Variations in Beaks of Galapagos Islands Finches



Source: *Galapagos: A Natural History Guide*

78 Explain *one* way that sharp-billed ground finches and small tree finches could possibly compete with each other if they lived on the same island. [1]

79 A small tree finch and a large tree finch inhabit the same island. Describe a situation that would allow both populations to live on the same island even though they both feed on animal food. [1]

Base your answers to questions 80 and 81 on the information below and on your knowledge of biology.

In his journey to the Galapagos Islands, Charles Darwin was amazed by the variation in the characteristics of plants and animals he encountered. In any habitat, food can be limited and the types of foods available may vary.

One year, there was no rain on these islands. Many plants failed to bloom and produced no new seeds. This left mostly large, tough seeds for the finches to eat.

80 Describe *one* change in beak characteristics that would most likely occur in the finch population after many generations if this change in seed size became permanent. [1]

Note: The answer to question 81 should be recorded on your separate answer sheet.

81 The different tools (such as spoons, chopsticks, or pliers) used during *The Beaks of Finches* laboratory activity represented variations in

- | | |
|-------------------------|-----------------------|
| (1) feeding adaptations | (3) finch migration |
| (2) seed size | (4) island ecosystems |

Base your answers to questions 82 through 84 on the information below and on your knowledge of biology.

Respiratory Rates

A student completed a lab activity that demonstrated the connection between pulse rate, heart rate, and flow of blood during exercise. She left her class wondering if there is a connection between breathing rate and exercise. With the help of her track coach, she conducted an investigation to try and find an answer to her question.

In the investigation, the respiratory rates of thirty athletes were measured before any exercise. To measure their rates, they counted the number of times they took a breath in one minute. Then, they ran one lap around the track, and their respiratory rates were determined again. Finally, they ran two laps around the track and checked their respiratory rates one last time. All of their data were recorded, and the averages were calculated. The data table shows the information obtained in this investigation.

The Effect of Exercise on the Respiratory Rates of Thirty Athletes

Type of Activity	Average Respiratory Rates (breaths per minute)
At rest	13
After one lap	30
After two laps	38

Note: The answer to question 82 should be recorded on your separate answer sheet.

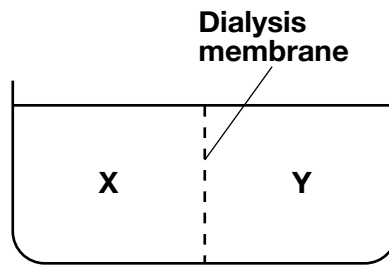
82 During this activity, what was the purpose of finding the respiratory rates of the students at rest?

- (1) to determine if the students were healthy
- (2) to practice using the timer
- (3) to use as a comparison
- (4) to use as the variable

83 State *one* likely hypothesis that the student was testing in this investigation. [1]

84 When determining the respiratory rates of the students at rest, the student found that the rates ranged from 10 to 20 breaths per minute. State *one* reason why students would have a range of respiratory rates. [1]

85 The diagram below represents a container of water divided by a dialysis membrane into two areas, X and Y.



Starch solution was added to the water on side X. One hour later, amber-colored starch indicator solution was added to both sides. Identify the colors that could be observed at X and at Y after the addition of the starch indicator. [1]

Final color of X: _____

Final color of Y: _____

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