The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

LIVING ENVIRONMENT

Tuesday, January 23, 2024 — 1:15 to 4:15 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 Homeostasis in single-celled organisms is maintained through the proper functioning of

(1) organelles
(2) estrogen
(3) guard cells
(4) antibodies

2 In a stable ecosystem, each niche is usually occupied by only one species. The species occupying a particular niche is able to continue to remain there as a direct result of

(1) ecological succession
(2) favorable adaptations
(3) a new mutation
(4) selective breeding

3 When exposed to ultraviolet (UV) light, human skin cells produce the protein melanin. This protein helps protect skin cells from damage caused by UV light. This is an example of

(1) a gene that cannot be passed on to offspring
(2) natural selection producing a new species
(3) sexual reproduction that will produce variation
(4) environmental factors affecting gene expression

4 The human pancreas contains cells that secrete insulin. Only these cells produce insulin because

(1) cells eliminate the parts of the genetic code they do not use
(2) all other cells lack the genes for insulin production
(3) different cells use different parts of the genetic information that they contain
(4) they are the only cells associated with the digestion of sugar

5 In humans, two organ systems work together to move oxygen throughout the body and deliver it to cells. Which system directly delivers oxygen to body cells?

(1) nervous
(2) digestive
(3) respiratory
(4) circulatory

6 Currently, turtle populations are decreasing. In September 2018, a scientist stated that turtles contribute to the health of many environments, and the decline of the turtles may lead to negative effects on other species.

Source:http://mdc.mo.gov/conmag/2018-08/three-toed-box-turtle

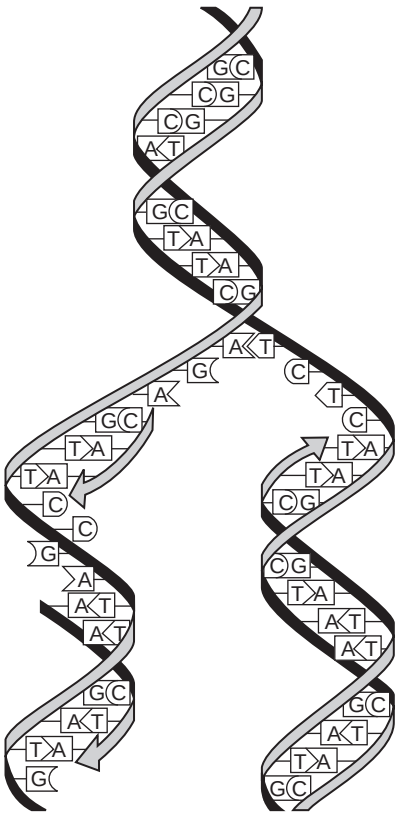
Which statement best summarizes the scientist's statement?

(1) Living organisms interact with and are dependent on their environment and each other.
(2) Turtles are very large animals and thus have a negative effect on their environment wherever they live.
(3) If organisms have a negative effect on their environment, there is probably a technological fix available.
(4) The decline of the turtles will not really matter because relatively few humans rely on them for food.

7 Which set of substances are molecular building blocks that directly form some of the complex organic molecules present in humans?

(1) water and oxygen
(2) starch and nitrogen
(3) carbon dioxide and proteins
(4) glucose and amino acids

8 The diagram below represents a process that occurs in many cells.



The main function of this process is to

(1) produce variations in cells before asexual reproduction
(2) synthesize antigens needed to combat immunity
(3) provide exact copies of the genetic code before cell division
(4) make proteins needed for cellular metabolism

9 Which interaction is an example of competition between two species?

(1) mice and chipmunks eating sunflower seeds at a bird feeder
(2) mold growing on a tree that has fallen in the forest
(3) a coyote feeding on the remains of a squirrel killed on the road
(4) a lion stalking, killing, and eating a zebra

10 One important reason that humans have such a significant effect on Earth's ecosystems is that humans

(1) remove large amounts of carbon dioxide from the air
(2) are able to increase the amount of finite resources
(3) can modify the environment through technology
(4) reproduce faster than other animal species

11 Mutations can be beneficial to a species because they

(1) can lead to some members of a species having favorable traits in a changing environment
(2) allow organisms to mate with other species
(3) will lead to the loss of traits that are helpful in a specific environment
(4) cause the reproductive rate of a species to decrease

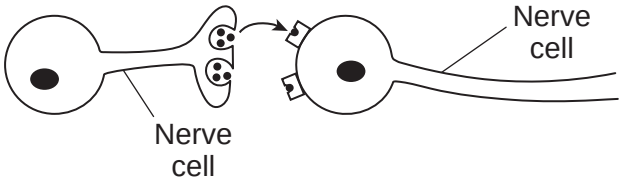
12 Within ten years after the introduction of a new mosquito spray, very few of the descendants of the targeted mosquito populations were killed by the usual dose of the spray. The best explanation for this is that

(1) ingesting the spray caused the mosquitoes to become resistant to it
(2) the spray polluted the water in which the mosquitoes deposited their eggs
(3) the spray killed organisms that caused diseases in mosquitoes
(4) existing variations in the mosquito population provided resistance to the spray

13 Once implanted into a recipient, bioengineered blood vessels made from a plastic-like material become covered with the recipient's own cells. An advantage of using these bioengineered vessels is that

(1) they contain antibodies that will block an immune response
(2) viruses and bacteria will not infect the cells on these blood vessels
(3) they do not trigger an immune response
(4) the engineered blood vessels can be inherited by future generations

14 Unlike telephone messages that pass over the telephone wires, messages between parts of the body are carried by a series of nerve cells that are not in direct contact with each other. Communication between two nerve cells is represented in the diagram below.



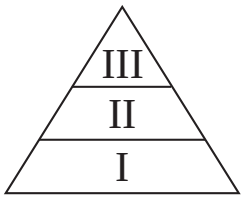
Which statement best explains how the message is delivered, even though these cells are *not* physically connected with each other?

(1) The cells communicate with the use of chemical messengers between them.
(2) The cells send messages by direct contact with other types of cells.
(3) Nutrients are the primary means of communication between cells.
(4) Ribosomes move out of one nerve cell into the other.

15 A saltwater aquarium contained a variety of saltwater fish and plants. Members of a species of small fish from a freshwater stream were accidentally added to the saltwater tank. Within an hour, all of the fish that were added were dead, while the saltwater fish were still healthy. The freshwater fish most likely died because they

(1) became severely dehydrated due to the process of diffusion
(2) swelled up and died due to taking in too much water
(3) had no freshwater organisms to eat in the saltwater tank, so they died of starvation
(4) ate all of the plants in the tank, so there was no longer oxygen in the water

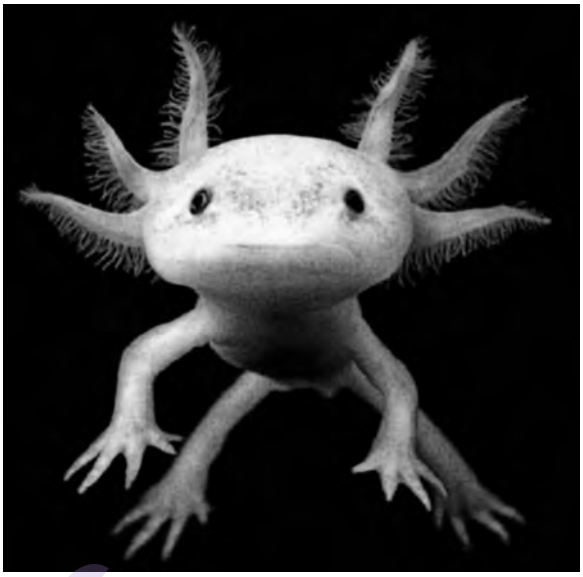
16 An energy pyramid containing green plants and other organisms from a food chain is represented below.



Herbivores would most likely be located in

(1) level I, only
(2) level II, only
(3) level III, only
(4) level I and level II

17 The axolotl, also known as the Mexican walking fish, can regenerate parts of its body, such as a leg or a tail.



Source: https://futurism.com/meet-axolotl-mexican-walking-fish

The regeneration of these parts involves the process of

(1) biotechnology
(2) selective breeding
(3) mitotic cell division
(4) fertilization

18 Which would most likely control an insect pest and be the *least* harmful to the environment?

(1) eliminating the plants that the insect pest feeds on
(2) using traps baited with sex hormones that attract the insect pest
(3) releasing imported insects that prey on the insect pest
(4) spraying areas with insecticides that affect the insect pest

19 Which statement concerning the functioning of cells is correct?

(1) Mitochondria transfer energy from organic compounds to form ATP molecules.
(2) Vacuoles are the sites of DNA synthesis.
(3) The nucleus stores genes that will later be removed from the cell.
(4) The cell membrane prevents the diffusion of all poisons into a cell from its environment.

20 The photograph below shows the result of a deadly wildfire in California in 2018.

Source: Snopes.com

What is most likely expected to occur to this ecosystem in the future?

(1) The ecosystem will eventually restore itself, but will be very different from the original.
(2) The ecosystem will eventually restore itself and will be similar to the original.
(3) The ecosystem will be completely reestablished after six months.
(4) The ecosystem will be unable to reach a state of stability again.

21 The kittens shown below were born in the same litter.

Source: https://www.thesprucepets.com

Kittens in the same litter often have similar characteristics, such as fur texture and markings, because they

(1) were fed milk from the same mother
(2) developed in the same environment
(3) inherited similar genes
(4) were born at the same time

22 Damage to which structure would directly interfere with the nutritional needs of a developing embryo?

(1) ovary
(2) testes
(3) lungs
(4) placenta

23 The body's inability to regulate blood pH could affect

(1) enzymes that function within the circulatory system
(2) red blood cells' ability to fight infections
(3) white blood cells' ability to carry oxygen to the body
(4) DNA that controls starch digestion in the circulatory system

24 Test anxiety and stress can trigger many responses in the human body. It can stimulate increased heart and respiratory rates and increased sweating. These physical responses to increased stress are examples of

(1) competition
(2) infections
(3) gene manipulation
(4) feedback mechanisms

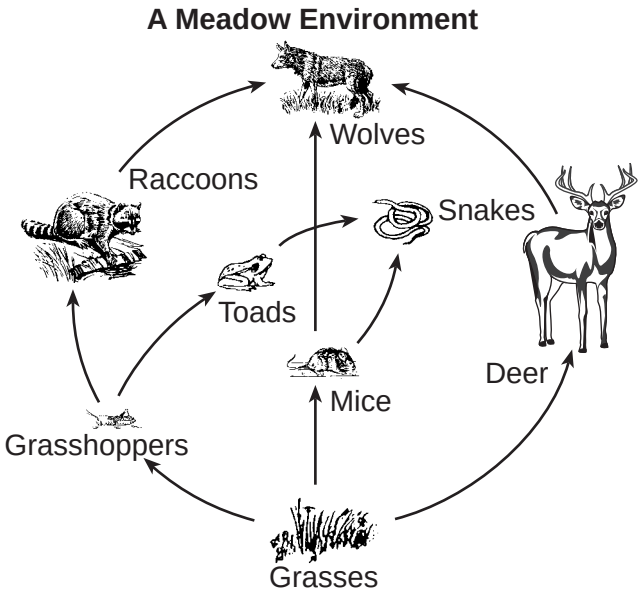
25 A self-sustaining ecosystem in a glass tank must include

(1) producers, decomposers, light, and water
(2) herbivores, consumers, decomposers, and water
(3) decomposers, heterotrophs, light, water, and carbon
(4) heterotrophs, water, and carbon dioxide

26 Scientists examined 39 tree species from warm and cold areas of Earth, and found that the trees were able to regulate their leaf temperatures, keeping them about 21°C. This meant that the leaves were able to be cooler than their environment in warm areas, but warmer than the environment in cool areas. This is an example of

(1) maintaining homeostasis by responding to environmental change
(2) controlling carbon dioxide release during daylight hours
(3) decreasing evaporation for cooling during evening hours
(4) failing to respond to environmental conditions

27 The diagram below represents a food web.



Two carnivores represented in this food web are

(1) deer and mice
(2) grasses and grasshoppers
(3) deer and wolves
(4) toads and snakes

28 A sea slug found along the eastern coast of North America is known to have an interesting relationship with algae. The sea slug incorporates part of the algae into its tissues. This allows the sea slug to directly use energy from the Sun. Which structures from the algae would the sea slug need to take in to accomplish this?

(1) nuclei
(2) mitochondria
(3) chloroplasts
(4) ribosomes

29 Which three processes usually result in the greatest variety of possible gene combinations?

(1) mutation, meiosis, and fertilization
(2) differentiation, mitosis, and fertilization
(3) cloning, meiosis, and fertilization
(4) differentiation, mutation, and fertilization

30 All the genetic information necessary for the growth and development in a sexually reproducing animal is present in

(1) egg cells, only
(2) sperm cells, only
(3) either sperm cells or egg cells
(4) zygotes

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.

31 Venus flytraps are plants that have specialized leaves that can capture insects. Researchers have discovered evidence that supports the claim that Venus flytraps do not capture the insects that usually pollinate them. The researchers studied the remains of captured insects in more than 200 plants. The remains did not contain any of the three most common pollinators of the plants.

Additional research showed that 87% of Venus flytrap pollinators can fly, and only 20% of the insects captured can fly. The flowers of the Venus flytrap are elevated above the leaves of the plant.

Source: https://images.app.goo.gl/pPDkkaXA4QWkj887

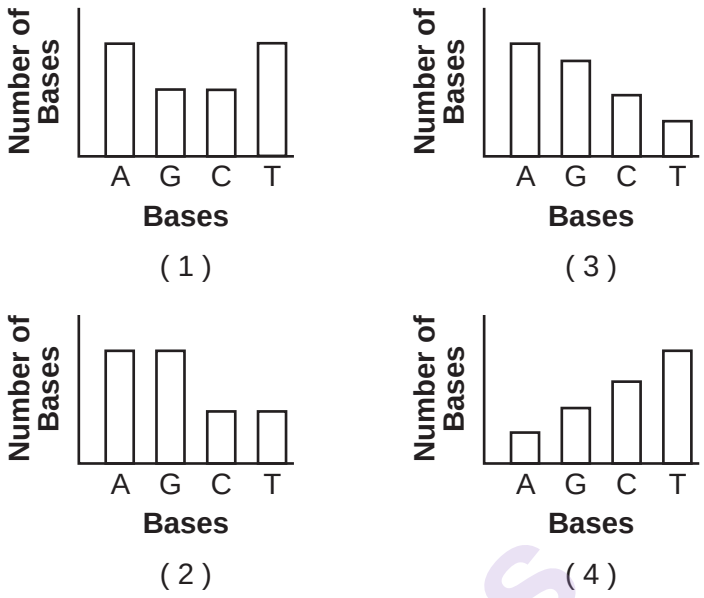
In order to support the claim that the pollinators of the Venus flytrap are mostly flying insects, the researchers would

(1) publish the study immediately and ask other researchers to support their claim
(2) expand the study to other Venus flytrap habitats and determine the number of flying and nonflying insect remains found in the plants there
(3) continue to study the insects found in the Venus flytraps in the research area, but only record the number of insects without wings
(4) compare the kinds of insect bodies with and without wings found in pitcher plants, a plant similar to the Venus flytrap, with the kinds of insects found in the original study

32 In an experiment using a particular frog species, nuclei were removed from the intestinal cells of tadpoles and transplanted into eggs whose nuclei had been removed. A small number of these eggs developed into normal frogs. This suggests that the nuclei of tadpole intestinal cells

(1) can undergo meiosis and form gametes
(2) contain all of the genetic information needed for frog development
(3) will undergo mitosis and form a new zygote
(4) fused with the frog genes already present in the zygotes

33 Which graph would most accurately represent the relationship between the four kinds of bases found in DNA?



34 The graph below shows the acid tolerance of nine species living in water at different pH values.

Acid Tolerance of Nine Animal Species

Acid Tolerance	pH 6.5	pH 6.0	pH 5.5	pH 5.0	pH 4.5	pH 4.0
Trout						
Bass						
Perch						
Frogs						
Salamanders						
Clams						
Crayfish						
Snails						
Mayfly larvae						

← Less acidic / More acidic →

Which statement best represents the information shown in the graph?

(1) Frogs tolerate more acidic conditions than the other organisms.
(2) All nine species survive equally well in the same habitat, regardless of acidity.
(3) Perch are more sensitive to acidic conditions than are snails.
(4) Mayfly larvae and trout are equally sensitive to acidity.

Base your answer to question 35 on the information below and on your knowledge of biology.

Source: https://animals.sandiegozoo.org/animals/camel

Desert camels have:

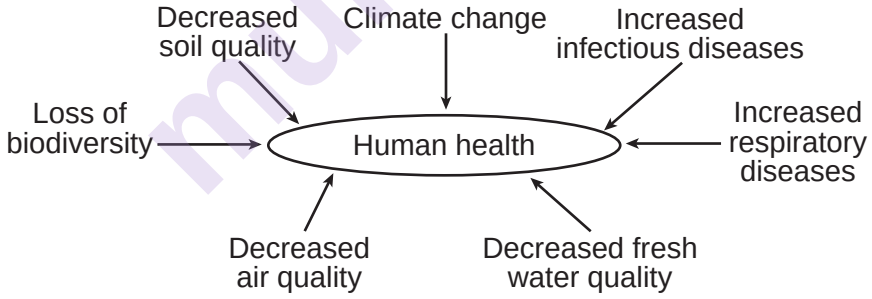
- large feet
- nostrils that can be closed
- fat stored in their humps
- a body temperature between 33.9°C and 41.7°C
- thick lips
- brown coat color
- hair-lined ears

35 Which statement best describes these camel characteristics?

(1) Natural selection favored other characteristics over the ones listed.
(2) The listed characteristics are the result of manipulating genes in female camels.
(3) These characteristics have adaptive value for the camel.
(4) Camels have these characteristics because they needed them.

Base your answers to questions 36 and 37 on the information below and on your knowledge of biology.

Humans rely on the stability of ecosystems for long-term health. Some of the current hazards to human health are represented in the diagram below.



36 Decreases in soil, air, and water quality can result from human activities that have

(1) negatively influenced these resources by removing pollutants
(2) modified natural cycles, increasing the quality of these resources
(3) resulted in an increase in the stability of these resources
(4) had a negative influence on the natural systems that maintain these resources

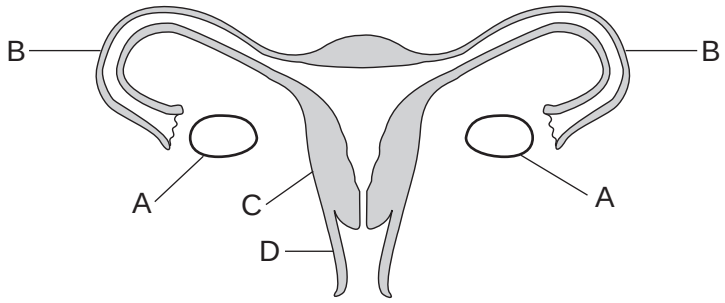
37 Current evidence has indicated that with an increase in global temperature, there will be more infectious and respiratory diseases. Worldwide efforts to slow down or halt the rise in temperature are being developed to

(1) increase the strain on the biosphere, resulting in the destruction of ecosystems
(2) introduce proposals that will limit the improvement of air, soil, and water quality
(3) protect resources for future generations
(4) increase the release of greenhouse gases into the atmosphere

38 Which sequence represents the correct interaction of organelles and processes for the synthesis of proteins?

(1) nucleus → amino acid bonding → ribosomes → gene codes
(2) ribosomes → nucleus → gene codes → amino acid bonding
(3) ribosomes → gene codes → amino acid bonding → nucleus
(4) nucleus → gene codes → ribosomes → amino acid bonding

Base your answers to questions 39 and 40 on the information below and on your knowledge of biology. The letters in the diagram indicate structures present in a human female.



39 What would occur if both structures labeled *B* were damaged or blocked?

(1) The egg would remain in the uterus and not travel to the ovary.
(2) The egg would not be able to unite with the sperm.
(3) The reproductive cycle in the female would stop.
(4) The process of mitosis would stop in the ovary.

40 Identify the structure that supports the development of the fetus and is also influenced by hormones.

(1) *A*
(2) *B*
(3) *C*
(4) *D*

Base your answer to question 41 on the data table below and on your knowledge of biology.

The data table shows an effect of secondhand smoke (SHS) on newborn babies of nonsmoking women.

Effect of Secondhand Smoke (SHS) on Newborns of Nonsmoking Women

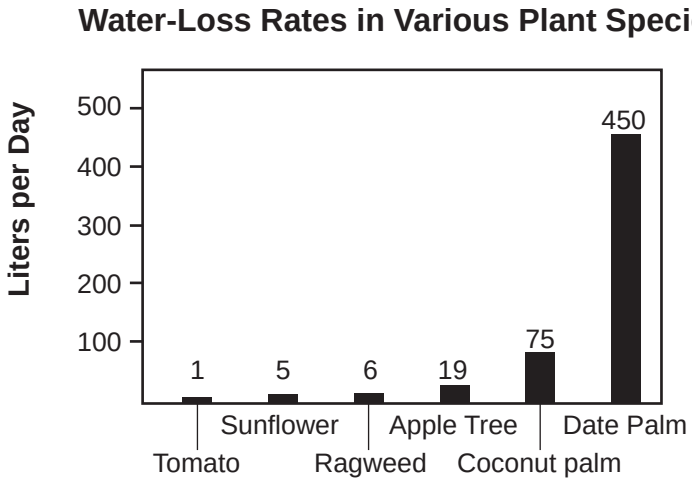
	Women Exposed to SHS	**Women Not Exposed to SHS**
Number of Newborns in Study	1085	2341
Birth Weight (mean)	3.15 Kg	3.21 Kg
Length (mean)	49.62 cm	49.87 cm
Head Circumference (mean)	34.05 cm	34.14 cm

Source: www.biomedcentral.com

41 Based on this and other similar studies involving newborns, medical professionals recommend that pregnant women avoid secondhand smoke because chemicals in the smoke

(1) cause mutations in the cells of the ovaries
(2) affect the growth of the fetus
(3) are unable to pass through the placenta
(4) decrease digestion in the stomach of the fetus

42 The graph below shows the daily rates of water loss in various plant species.

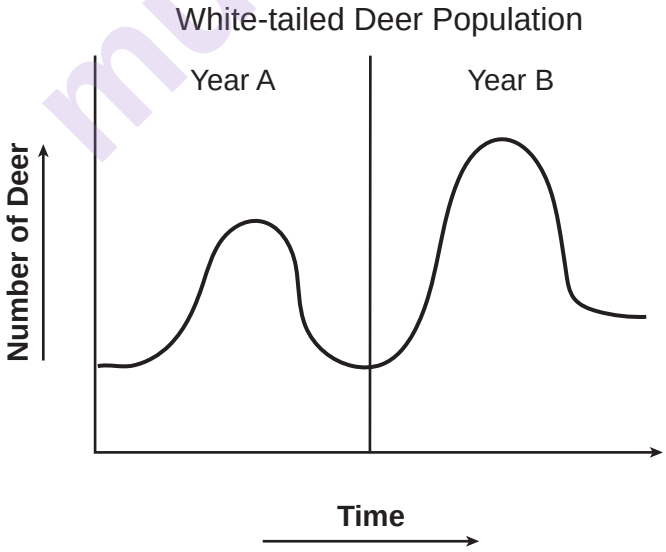


Source: Adapted from AP Biology Grid

Even though these plants grow in different environments, they most likely control water loss through

(1) the synthesis of proteins in their roots
(2) the functioning of the cell membranes in their flowers
(3) the actions of the guard cells in their leaves
(4) the storage of glucose in the vacuoles in their stems

43 The graph below represents the white-tailed deer population in a certain area of New York State during two different years (*A* and *B*).



One reason that the population of deer is greater during Year *B* than during Year *A* could be that, during Year *B*, there were fewer

(1) resources available
(2) decomposers adding nutrients to the soil
(3) white-tail deer predators present
(4) white-tail deer born

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 49 on the information and data table below and on your knowledge of biology.

Measles is a serious viral infection that can be fatal in small children. Before the measles vaccination program started in 1963, about 3 to 4 million people in the United States got measles each year.

The Centers for Disease Control (CDC) set a goal to eliminate measles from the United States through the widespread use of a highly effective measles vaccine, programs to encourage the vaccination of all children, and a public health system to respond to measles outbreaks.

In 2000, the CDC declared that measles was eliminated from the United States. However, measles remains present in many other countries and can be brought into the United States by unvaccinated travelers.

Number of Measles Cases in the United States per Year

Year	Number of Measles Cases
2010	63
2011	220
2012	55
2013	187
2014	667
2015	188
2016	86
2017	120
2018	372
2019*	839

* As of 5/10/19

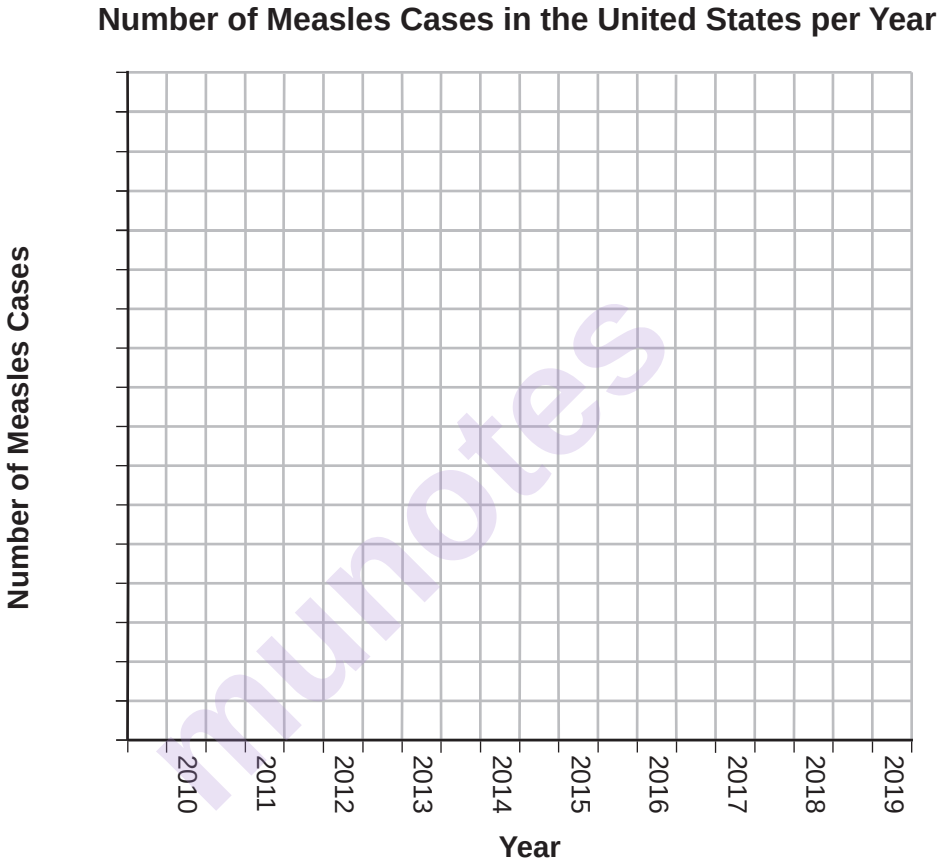
Source: https://www.cdc.gov/measles/cases

Directions (44–45): Using the information given in the data table, construct a bar graph on the grid provided, following the instructions below.

44 Mark an appropriate scale on the axis labeled "Number of Measles Cases." [1]

45 Construct vertical bars to represent the data recorded in the table. Shade in each bar. [1]

Example: ■



46 Children who receive the CDC's recommended two doses of the measles vaccine are considered to be protected from the measles virus for life. Explain why the protection provided by some vaccines can last a lifetime. [1]

47 Based on the data, students noticed that there was a large increase in the number of measles cases in 2014. Which statement best explains the research the students might do to state a claim about the cause of this increase?

(1) Determine if the outbreak that occurred in 2014 occurred in unvaccinated people.
(2) Check if the virus mutated, resulting in a decrease in the number of people infected with measles.
(3) Investigate the vaccine that children received in 2014 to see if it mutated.
(4) Test the measles virus to determine if it developed resistance to antibiotics.

48 While measles was once declared eliminated in the United States, explain why the CDC continues to recommend that children receive the measles vaccine. [1]

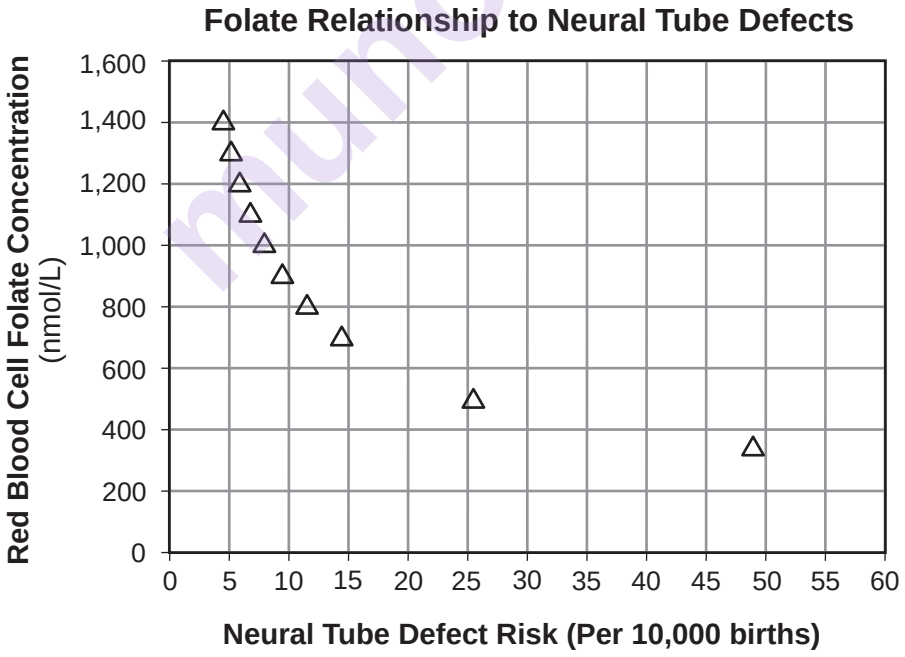
49 A person refuses to get the measles vaccine because they claim that the vaccination will cause them to develop the measles. This claim is unsupported because the measles vaccination contains only

(1) antibodies to fight the flu, not the actual flu virus
(2) the chicken pox virus, not the measles virus
(3) the active measles virus that stimulates the immune system to make measles antigens
(4) parts of the measles virus that triggers the immune system to fight the measles

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

One important vitamin that pregnant women should consume is folic acid. Folic acid is converted to folate in the body. It is well known that women who have a diet rich in folic acid show a decreased risk of having babies with neural tube (central nervous system) defects.

Scientists conducted a study to determine the optimal amount of folic acid needed in the mother's diet to prevent neural tube defects. The results are shown in the graph below.



Source: *British Medical Journal,* 29 July 2014

50 According to the graph, what is the *minimum* amount of folate needed to reduce the risk of neural tube defects to 10 or less per 10,000 births?

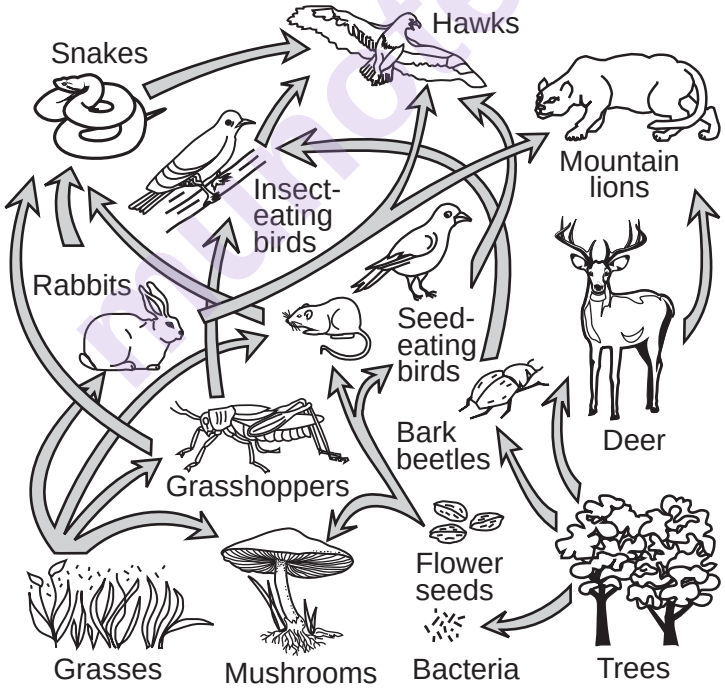
(1) 800 nmol/L
(2) 890 nmol/L
(3) 1000 nmol/L
(4) 1400 nmol/L

51 The table below shows some of the major milestones in fetal development.

Week	Milestones in Fetal Development
1	Embryo implants and continues to develop
3	Embryo has 3 distinct layers
4	Neural tube forms, limbs develop
5	Primitive lens, mouth and digits form
6	Primitive nose forms, neural tube closes, heartbeat can be detected
8	Internal organs can be distinguished
10	Lung buds appear

By what week should women have the optimal amount of folic acid in their diet? Support your answer. [1]

Base your answers to questions 52 and 53 on the diagram of a food web below and on your knowledge of biology.



52 Identify an organism in this food web that carries out autotrophic nutrition. [1]

53 Explain why a decrease in the population of mice would *not* necessarily result in an increase in rabbits. [1]

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

The Effect of Flooding on Crops

Flooding can have a negative effect on certain food crops. Damage occurs because, in flooded soils, the oxygen concentration drops to near zero within 24 hours. This is because the water replaces most of the air in the soil.

54 Whether or not the flooding occurs, plants need to take in water with their roots. Identify *one* specific process carried on by plants that requires relatively large amounts of water. Support your answer. [1]

55 Explain why a lack of oxygen in the soil would likely interfere with the ability of root cells to carry out active transport. [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 passage below and on your knowledge of biology.

Fish Farming

Approximately 44% of the world's fish produced for human consumption comes from aquaculture, which is the farming of fish and other aquatic organisms. This practice has increased the food supply and has also allowed over-fished wild populations to increase. As a result of genetic modifications, farm-raised fish usually grow faster and are typically larger than those in the wild.

However, there are some negative environmental effects associated with fish farming. Sea lice, a parasite of salmon, have spread quickly through some farms and have also been found in waters around the farms. Farm-raised fish sometimes escape through breaks in the sea cages. There is a concern that these escaped fish could negatively affect ocean ecosystems.

Researchers are studying methods that can be used to reduce the possible negative effects of fish farming. Improvements in engineering could make the sea cages where the farmed fish are raised more secure. Another suggestion involves raising farmed fish that have extra chromosomes. This would prevent them from reproducing with wild fish that have the normal number of chromosomes.

56 Describe *one* advantage of raising fish in a fish farm. [1]

57 Identify *one* concern that individuals might have as the number of fish farms increase. Support your answer. [1]

58 Researchers are studying environmental factors, such as temperature, that could be used to produce more and larger farm-raised fish. Explain why increasing or decreasing the temperature of the water in the fish farm could have negative effects on other organisms in the area of the farm. [1]

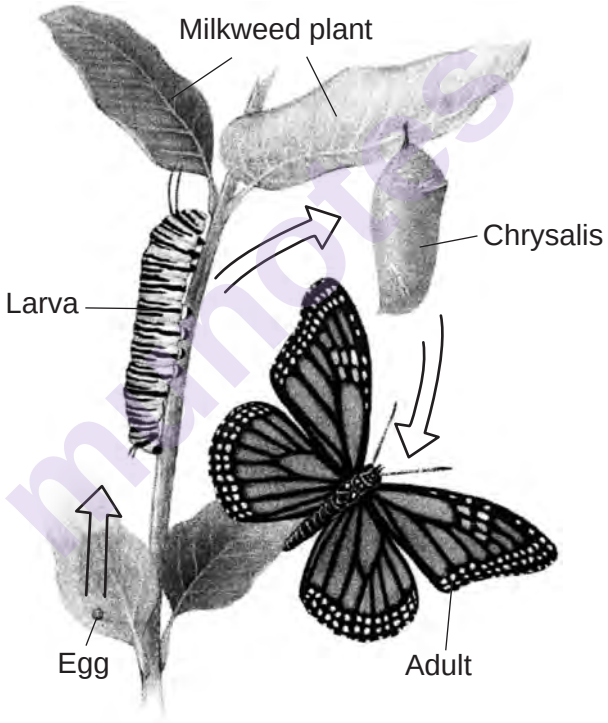
Base your answers to questions 59 through 61 on the information below and on your knowledge of biology.

Monarch Butterfly Decline

Monarch butterfly populations have fallen by 90% in less than 20 years. Monarchs west of the Rocky Mountains overwinter on the central coast of California. Their numbers have dropped from 1.2 million to only 200,000. East of the Rocky Mountains, monarchs overwinter in Mexico. In 2002, their numbers were down by about 500 million.

One reason for the decrease in monarch numbers is the increased planting of corn, cotton, and soybeans that are genetically modified (GM) to be resistant to weed killers containing glyphosate. With the increased use of these GM plants, increased amounts of the weed killers are being sprayed on fields where these crops are grown. These weed killers do not kill monarchs and other insects. They kill only plants such as milkweed that do not contain the resistance gene.

Mature adult monarch butterflies lay their eggs on milkweed plants. The larvae (caterpillars) eat only milkweed. Adults seek out flower nectar from a variety of plants. Stages of the monarch life cycle are represented below.



Source: Adapted from http://www.knowledge-gallery.com/question.php?ID=111

59 Explain how the use of weed killers containing glyphosate is responsible for a decrease in the size of monarch populations, since monarchs do not feed on genetically modified corn or soybeans during any stage of their life cycle. [1]

60 When monarchs overwinter, they do not eat and do not reach sexual maturity until they begin the spring migration. Explain why large areas of flowering plants along their migratory pathways are important to their survival. [1]

Predators find both the larvae and adult monarchs toxic and bad-tasting due to the presence of stored chemicals larvae ingest from the milkweed plants. These chemicals do not affect the monarchs, but do affect the cardiovascular and other systems of their predators.

61 Explain how there can be large concentrations of the toxic chemicals from milkweed in adult monarch butterflies when they do *not* eat milkweed. [1]

Base your answers to questions 62 through 64 on the information and two graphs below and on your knowledge of biology. The graphs represent data published from Data Nuggets.

Restoration of the Saratoga Creek Salt Marsh

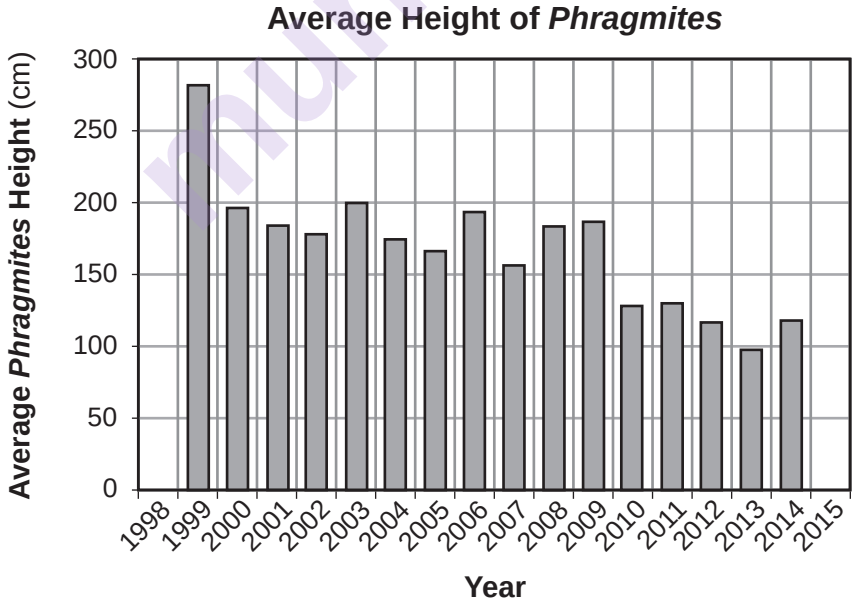
Since the 1990s, students in coastal Massachusetts have been working with Mass Audubon and scientist Liz Duff, collecting data from the Saratoga Creek salt marsh. They are studying an invasive species of tall grass called *Phragmites* that is spreading and crowding out native plants and animals.

Salt marshes are shoreline wetland habitats where salt-loving plants experience the highs and lows of the tidal action of seawater. *Phragmites* prefers water that is low in salt. When the amount of salt in the marsh is low, *Phragmites* does better than native plants, and when the amount of salt in the marsh water is high, close to the level of seawater, native grasses do better than *Phragmites*.

Evidence indicated that the storm drains built along the roads and homes near the shoreline added fresh water to the marsh, making it less salty, and altered sediment levels that reduced the salty ocean water coming into the marsh during high tide. The scientists thought that the presence of extra fresh water and sediments was the reason that *Phragmites* invaded the marsh.

In 1999, a restoration project to reverse the invasion of *Phragmites* began by digging a ditch along the road to reduce the freshwater runoff entering the marsh. A layer of sediment was also removed, allowing seawater to once again reach the marsh during high tide.

Scientists worked with students collecting data along the same sections of the marsh every year. They used the data to calculate the frequency (abundance) and average height of *Phragmites* plants. The graphs represent the average height and the frequency of the *Phragmites* in the Saratoga Creek salt marsh.

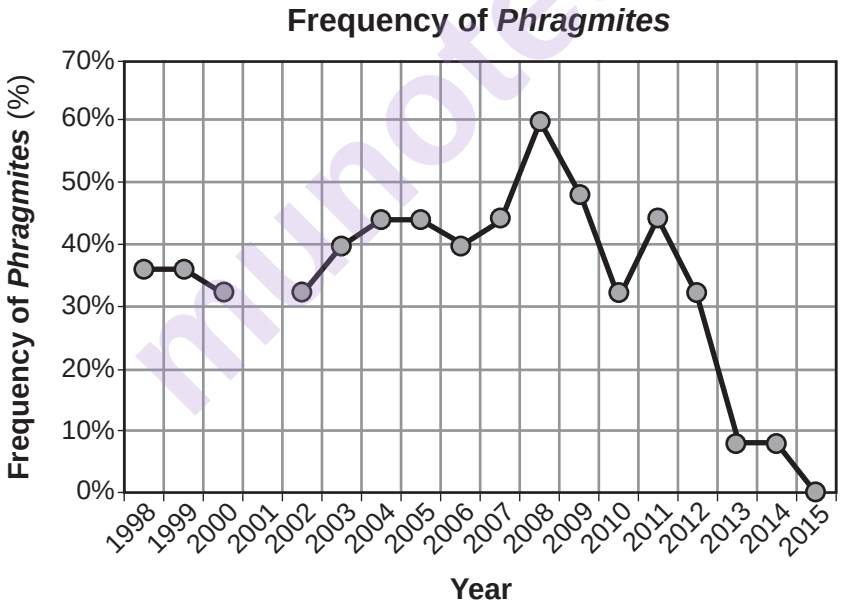


Source: http://datanuggets.org/wp-content/uploads/2015/08/Salt-marsh-recovery_StudentA.pdf

62 State *one* likely hypothesis that the scientists and students were testing in the studies of the Saratoga Creek marsh. [1]

63 Describe the pattern in the data of the Average Height of *Phragmites* and explain a cause for the pattern. Be sure to include numerical data from the chart to support your answer. [1]

64 The students claimed that the Saratoga Creek restoration that started in 1999 was successful at reducing the *Phragmites* population.



Source: http://datanuggets.org/wp-content/uploads/2015/08/Salt-marsh-recovery_StudentA.pdf

Identify evidence from the Frequency of *Phragmites* data that justified their claim. [1]

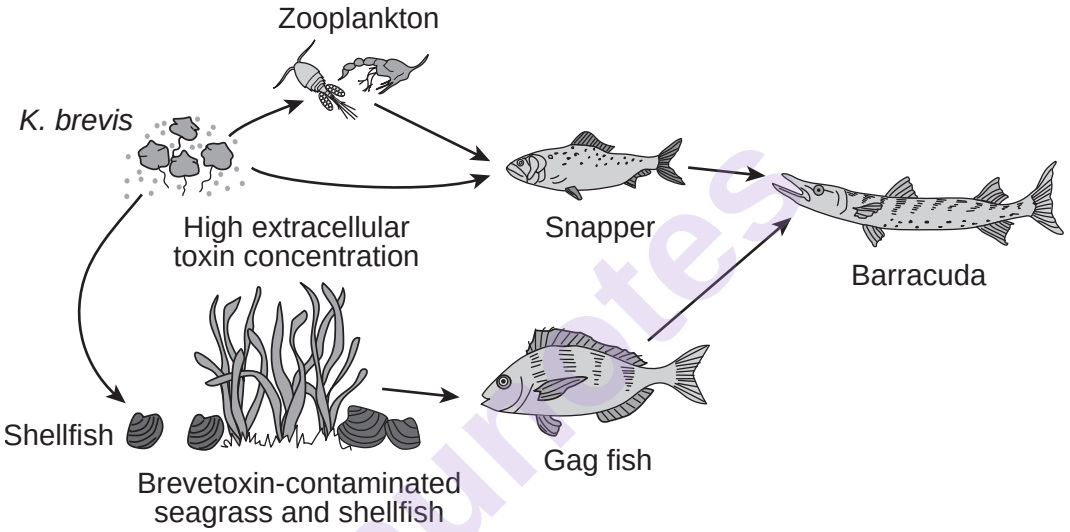
Base your answers to questions 65 through 67 on the information below and on your knowledge of biology.

Gulf Coast Suffers from Red Tide

Florida residents have been experiencing the consequences of "red tides," excessive growth of the algae *Karenia brevis* (*K. brevis*). This species of algae is a single-celled organism that releases brevetoxin, a dangerous nerve toxin that can be fatal to animals. Even though shellfish, which can eat *K. brevis*, are not affected by this algae, many fish and other marine organisms, such as dolphins and manatees, are paralyzed by the toxin. This toxin prevents the organisms from carrying out the process of cellular respiration.

The red tides usually appear in late summer or early fall. Researchers are not sure what causes red tides. A variety of factors seem to be associated with their occurrence. These factors include warmer ocean temperatures, heavy rainfall, and pollution from fertilizers.

The model below represents a typical food web present in Gulf Coast waters.



Source: Adapted from Toxicon. 2007 Oct; 50 (5):707-72.

65 Identify *one* abiotic factor mentioned in the passage that could be causing the red tides in Florida, and describe how this factor may be leading to an increase in the algae population. [1]

66 Explain how an increase in these *K. brevis* populations could affect human health. [1]

67 Explain how the fact that *K. brevis* does not kill shellfish could be a factor in the damage caused by the red tide. [1]

Base your answers to questions 68 and 69 on the information and illustration below and on your knowledge of biology.

Some Moths Are Not Easy For Bats to Detect

The cabbage tree emperor moth does not have ears that might alert them to approaching predators, such as bats. Instead, they all have wings with scales and hair-like structures called fur, suited to absorbing the ultrasonic sound frequencies used by bats hunting for food. This absorption reduces the echoes that bounce back to the bats, allowing these moths to avoid detection. Since they are not detected, they don't need to quickly fly away and use more energy.

Scientists have observed that other moth species have developed different defense mechanisms. Some moth species have ears and can hear their predators approaching and quickly swerve out of the way. Other moth species fly in a slow zigzag pattern that imitates bees and wasps, which are not desirable prey to bats.

Source: https://upload.wikimedia.org/wikipedia/commons/thumb/c/ca/Bunaea_alcinae

68 Describe *one* advantage of having sound-absorbing fur and scales compared to a different defense mechanism. [1]

69 Predict how the frequency of the trait for sound-absorbing wings might be expected to change over time. Support your answer. [1]

Base your answers to questions 70 through 72 on the information and photograph below and on your knowledge of biology.

Northern Quolls vs the Cane Toads

Poisonous South American cane toads were introduced into Australia in 1935 in an attempt to control a beetle that was eating sugar cane crops. However, the toads did not control the beetles and, instead, they caused an environmental disaster. Today, the toad population is estimated to be greater than 200 million.

As the invasive toads spread westward across northern Australia, many native species were negatively affected. For example, in the years since the toads' introduction, scientists have observed that the entire population of the northern quoll, a small squirrel-sized carnivore, has declined more than 75%.

The decline is due to the fact that the quolls mistake the poisonous toads for something that they can safely eat. When they eat the toads, they die from the poison that the toads produce. The northern quolls may soon become extinct if something cannot be done to save them.

Recently, some quolls were found to have a genetic trait that makes them uninterested in preying on the toads. Scientists have now discovered that these quolls with "toad-smart genes" can pass them on to their offspring. The scientists plan to release quolls that avoid eating the toads into native populations, hoping that they will breed and produce offspring that also avoid eating the toads, thus saving the species from extinction.

Source:http://theinvasionofcanetoads inaustralia.blogspot.com

70 Explain how the northern quoll extinction would affect the other organisms in the ecosystems where they once lived. [1]

71 It is hoped that northern quolls can be saved from extinction. If this proves to be true, will saving the quolls help solve the problems associated with the spread of the cane toads? Support your answer. [1]

72 A scientist suggests using genetic engineering to alter the fertilized eggs of a quoll to include "toad-smart genes." Would the offspring coming from the fertilized eggs be able to mate and produce offspring that would *not* try to eat the cane toads? Support your answer. [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.

73 Five students measured their pulse rates, then exercised by running up and down the stairs five times, then measured their pulse rates again. In the investigation, the independent variable is the

(1) time to run up and down the stairs
(2) pulse rate
(3) five students who participated
(4) exercise that was done

74 The chart below shows some characteristics of different species of finches.

Characteristics Chart

Large Ground Finch  Beak: crushing Food: mainly large seeds	Warbler Finch  Beak: probing Food: 100% animal
Small Ground Finch  Beak: crushing Food: mainly plant	Cactus Finch  Beak: probing Food: cactus

According to the information in the chart, which finch species is best adapted to feed on insects that live under the bark of trees?

(1) large ground finch
(2) small ground finch
(3) warbler finch
(4) cactus finch

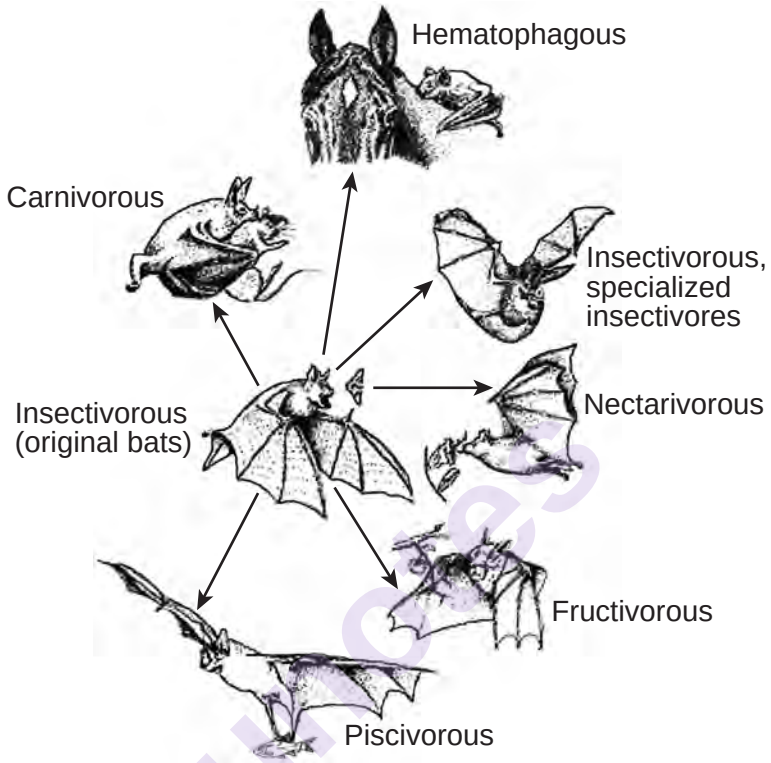
75 Students in a biology class wanted to determine the effect of exercise on heart rate. In order to reach a more reliable conclusion, the students should collect data from a

(1) small number of students, then multiply the heart rates together
(2) small number of students, then average the heart rates
(3) large number of students, then average the heart rates
(4) large number of students, then add the heart rates together

Base your answers to questions 76 and 77 on the information below and on your knowledge of biology.

The existing species of South American bats depend upon a wide variety of food sources, yet they have evolved from a single population of insect eating bats. The diagram below summarizes the feeding habits of some species of South American bats.

South American Bats



Adapted from: http://www.press.uchicago.edu/Misc/Chicago/468283.html

76 The adaptations shown by each species of bat will most likely cause the total number of bats to

(1) increase due to decreased competition
(2) decrease due to increased breeding
(3) increase due to a greater chance of mutation
(4) decrease due to a decrease in pathogens

77 Describe how the evolutionary pattern shown in these South American bats resembles the evolutionary pattern seen in the Galapagos finches. [1]

Base your answers to questions 78 and 79 on the information below and on your knowledge of biology.

Four model cells were prepared by using dialysis tubing and filling each of them with the same solution. Each of the model cells originally weighed 20 grams. Next, each model cell was placed in a beaker. Each of the four beakers contained a different concentration of water. After 24 hours, the mass of each model cell was measured and recorded in the data table below.

Model Cells

Percentage of Concentration of Water in Beaker	**Mass of Model Cell After 24 Hours** (in grams)
100	22
90	21
80	20
70	19

78 Explain why the model cell placed in 100% water increased in mass. [1]

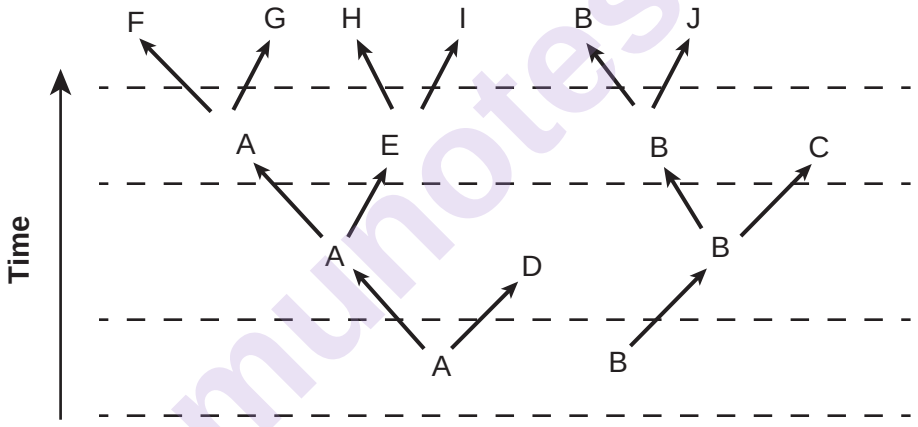
79 What was the concentration of water in the four cells at the start of the experiment? Use data from the table to support your answer. [1]

80 Explain how an increased pulse rate during exercise helps to maintain homeostasis in an organism. [1]

81 DNA normally contains four different molecular bases. Long strands consisting of only the molecular base cytosine (C) are placed in a beaker under conditions that allow for protein synthesis. After a period of time, the contents of the beaker are analyzed, and the proteins present are composed entirely of the amino acid proline. This finding best supports the claim that

(1) most proteins are composed of only one type of amino acid
(2) the amino acid proline is composed only of the molecular base cytosine
(3) a mutation occurred in the test tube during this experiment
(4) CCC codes for the amino acid proline

Base your answer to question 82 on the diagram below and on your knowledge of biology. The diagram represents evolutionary relationships between different species.

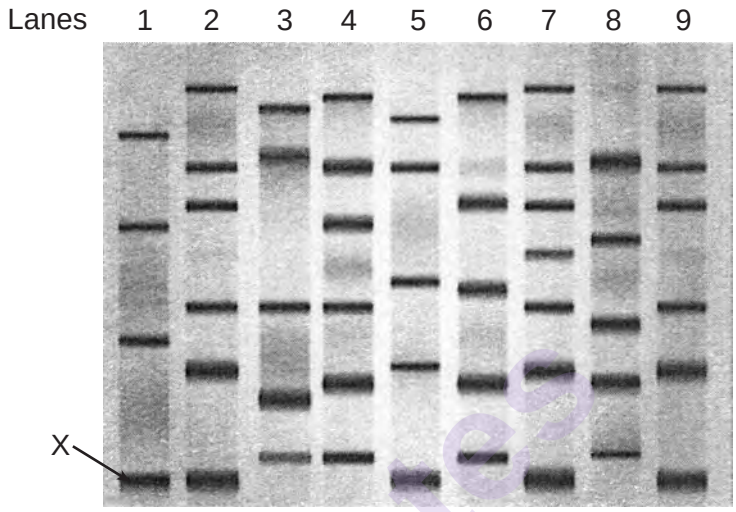


82 Which species would *least* likely have a protein similar to species *H*?

(1) *A*
(2) *B*
(3) *E*
(4) *D*

Base your answers to questions 83 and 84 on the information below and on your knowledge of biology.

The band labeled **X** on the image of the gel below represents a segment of DNA associated with the production of a unique protein. The protein is being tested to determine if it might be useful in treating a disease found in horses. DNA from one of eight different plants, each thought to be from a different species, was injected into each of eight lanes of the gel. It was then compared to the plant in the first lane, which is known to produce this unique protein.



Source: Adapted from https://www.shutterstock.com/search/gel+electrophoresis

83 In addition to the plant represented in the first lane, how many other plants most likely produce this unique protein? Support your answer by using evidence from the gel. [1]

84 When this research was peer-reviewed, several scientists pointed out that there might have been an error in the original experiment. The reviewers claimed that they compared only seven plant species to the plant in the first lane, rather than eight.

Examine the gel and, based on your analysis, provide evidence to support the claim that only seven different plant species had been compared to the species in lane 1. [1]

Base your answer to question 85 on the information below and on your knowledge of biology.

During exercise pulse rate may change. The pulse rate indicates the rate at which the heart is beating.

85 State how the level of a waste product in the blood would be expected to change if pulse rate increased. Support your answer. [1]

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