

# LIVING ENVIRONMENT

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

# LIVING ENVIRONMENT

Tuesday, June 18, 2019 — 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 Which activity is an example of a decomposer recycling organic compounds back into the environment?

- (1) A tree synthesizes starch from simpler molecules.
- (2) A bacterial cell performs photosynthesis.
- (3) A bird digests proteins from its food.
- (4) A fungus breaks down the body of a dead animal.

2 Itching and other skin problems are signs that a cat or dog may have fleas. Fleas are parasites known for their biting and blood-sucking abilities. When they bite, flea saliva enters the pet's circulatory system, sometimes causing an allergic response commonly seen as a "hot spot" on the pet's neck or the base of its tail.



Source: <https://www.planetnatural.com/pest-problem-solver/household-pests/flea-control/>

These observations are best explained by the fact that

- (1) flea saliva may stimulate an immune response in cats and dogs
- (2) fleas are microbes whose bites cause a decreased blood flow
- (3) flea saliva is a toxic substance that is released when fleas prey on cats and dogs
- (4) fleas are host organisms whose saliva digests cat and dog fur, leaving "hot spots"

3 A German measles (rubella) epidemic during the years 1963 to 1965 resulted in approximately 30,000 babies being born with birth defects. The specific cause of these birth defects was most likely

- (1) the development of rubella virus infections in embryos
- (2) the failure of zygotes infected with rubella to develop
- (3) mutations in the nerve cells of pregnant females at the time of the rubella epidemic
- (4) an increase in the amount of time needed for healthy embryonic development

4 Placenta previa is a medical condition that occurs in some pregnant women. Women with this condition are often placed on bed rest, which prohibits them from any strenuous activity that may cause the blood vessels in the placenta to rupture. If not diagnosed, placenta previa can be a very dangerous condition because the placenta is

- (1) the primary source of oxygen for the mother
- (2) where the fetus obtains milk from the mother
- (3) where nutrients and wastes are exchanged
- (4) the primary source of estrogen and progesterone in the mother

5 Over time, a tree that once had a total mass of 300 g increased in mass to 3000 kg. This increase in mass comes mostly from

- (1) carbon dioxide that enters through the leaf openings
- (2) oxygen that enters through the leaf openings
- (3) soil that all plants need to grow
- (4) chloroplasts that enter the roots and move to the leaves

6 Recently, a type of genetically modified fish has been approved for sale for human consumption. The modified fish contain a growth hormone gene from a different fish species. As a result, the modified fish grow rapidly and are ready to sell in almost half the time it normally would take. The modified fish are able to produce the new growth hormone because

- (1) each of their cells contains the new gene to produce growth hormone
- (2) each gene contains the code to synthesize carbohydrates
- (3) the altered gene directs the mitochondria to synthesize the hormone
- (4) the modified body cells are able to reproduce by meiosis

7 Melanoma is a type of skin cancer that can spread to vital organs in the body. Doctors believe that exposure to ultraviolet (UV) radiation from the Sun is a leading cause of melanoma. One practical way governments can help prevent the harmful effects of UV radiation is to

- (1) require everyone to remain indoors during daylight hours
- (2) regulate the production and release of gases that damage the ozone shield
- (3) encourage the building of a greater number of cancer treatment centers
- (4) prohibit the use of solar panels on homes and businesses

8 Some birds have recently modified their migratory behavior. Instead of flying to warmer climates during the winter months, the birds are remaining in northern areas where they can consume discarded food that is abundant in landfills. As a result of this change in migratory behavior, many insect populations that the birds normally feed on in the warmer climate areas are now increasing. This is an example of human activity

- (1) interfering with ecological succession
- (2) increasing competition for infinite resources
- (3) disrupting the homeostasis of organisms
- (4) altering the equilibrium of ecosystems

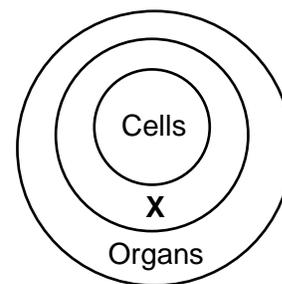
9 New York State charges consumers a fee when purchasing beverages sold in aluminum cans and plastic bottles. This money is returned to purchasers when they return these items for recycling. Programs such as these are an attempt to

- (1) encourage people to spend more money on their beverages
- (2) conserve the resources these containers are made from
- (3) reduce the amount of carbon dioxide produced by deforestation
- (4) totally eliminate the use of reusable containers

10 Recently, a human trachea (a respiratory organ) was produced by using a patient's own stem cells. The benefit of using the patient's own cells to produce a trachea instead of receiving one from a donor is that

- (1) there will be more enzymes produced to help maintain homeostasis in the trachea
- (2) there will be an increase in the quantity of antibodies that the patient produces in response to the new trachea
- (3) there is less of a chance that the patient's immune system will attack the trachea
- (4) there will be a greater response to any infectious agent that may enter the body

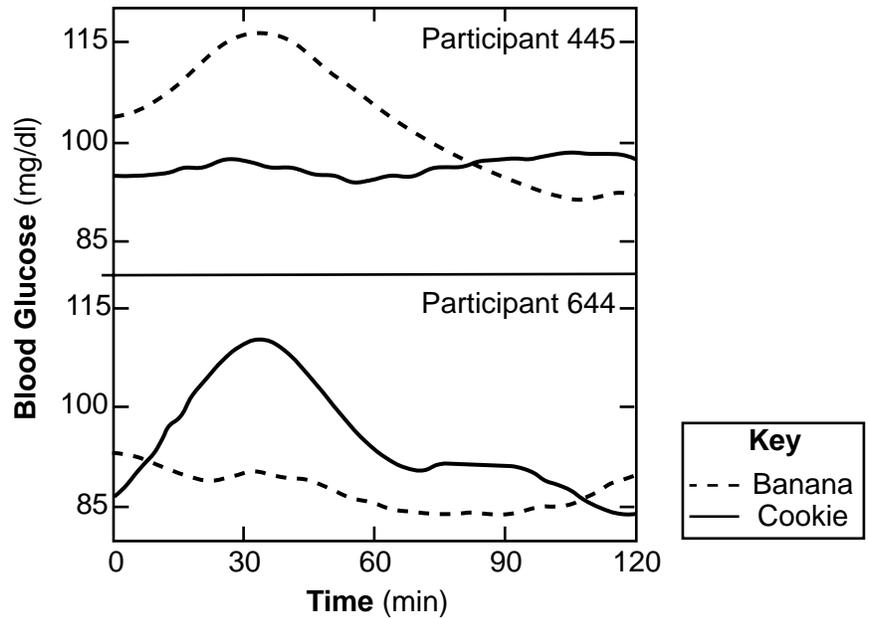
11 The diagram below represents the organization of structures within an organism.



Which term best indicates the structures represented by the circle labeled X?

- (1) organelles
- (2) chromosomes
- (3) organ systems
- (4) tissues

12 The chart below shows a comparison of the blood sugar levels for two individuals who took part in a scientific study.



Source: Science Daily 11/19/15

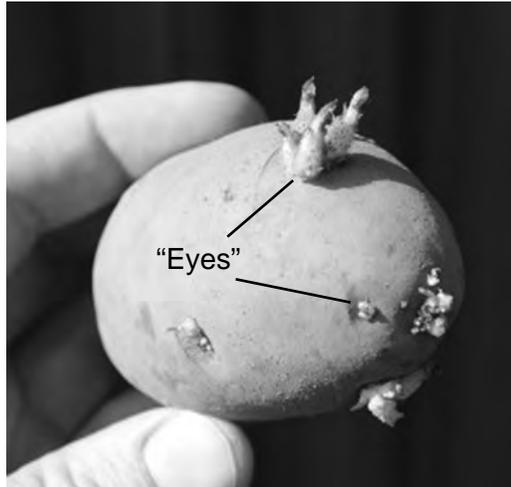
Scientists have observed that blood sugar levels rose by different amounts in the two individuals even though they were given identical portions of bananas and cookies. These results were obtained because

- (1) glucose is too large a molecule to be absorbed into the blood, so the researchers were only measuring the amount of glucose already present
- (2) participant 445 didn't like bananas, and his body absorbed more of the food that he likes
- (3) individuals have genetic differences that alter their responses to environmental factors
- (4) two different foods were used; the scientists should have had only one experimental variable

13 Which row in the chart below correctly matches the human activity with its effect?

Row	Human Activity	Effect
(1)	planting 20 acres of one crop	increases biodiversity
(2)	industrialization	decreases fossil fuel use
(3)	habitat destruction	decreases ecosystem stability
(4)	use of finite resources	increases resource renewal

14 Potatoes are an example of a crop that can be reproduced asexually. One potato will produce a number of “eyes,” which are sprouts that can grow into new plants. A potato with four eyes can be cut into four pieces, and each piece can be used to produce an individual potato plant.



Source: <https://www.quickcrop.ie/blog/2014/02/growing-potatoes/>

A gardener could produce a small crop of potatoes by planting the eyes from a single potato in her garden. Some of the potatoes grown in this way could be used to obtain eyes for the next season’s crop.

One likely *disadvantage* of growing potatoes cloned in this way, year after year, would be that

- (1) after a few years, the potatoes would stop producing eyes altogether, so no potatoes could be grown in the garden
- (2) the potatoes produced each succeeding year would get larger and larger, eventually being too big for use as food
- (3) the cost for growing your own potatoes in the garden would be greatly reduced
- (4) a potato plant could become infected with a disease, and it could easily spread to the entire crop, killing all of the plants

- 15 The back of the Namib Desert darkling beetle, shown in the photograph below, is covered in little bumps that collect water from the air. When it tilts forward, the water runs off its back into its mouth.

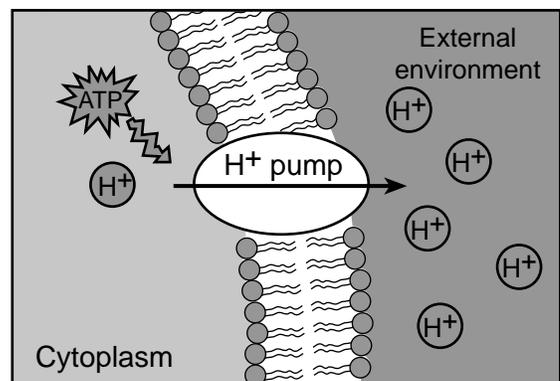


Source: <http://myinformatics.com>

These specialized structures on the beetle's back allow it to

- (1) locate food within the harsh desert environment
  - (2) obtain a substance that is required for survival
  - (3) reproduce asexually if mates are not available in the area
  - (4) increase the chances of survival by producing organic raw materials
- 16 An increase in human population puts a stress on resources that can be renewed, such as
- (1) trees and coal
  - (2) water and gasoline
  - (3) oil and natural gas
  - (4) water and trees
- 17 Mitochondria provide ribosomes with
- (1) ATP for protein synthesis
  - (2) amino acids for protein synthesis
  - (3) oxygen for respiration
  - (4) carbon dioxide for the production of sugars
- 18 Mutations are most directly caused by changes in the
- (1) cell organelles of tissues
  - (2) genes of chromosomes
  - (3) ribosomes in gametes
  - (4) receptors on membranes

- 19 Animals and green plants are similar in that they
- (1) both carry out heterotrophic nutrition
  - (2) all produce offspring by asexual reproduction
  - (3) both use DNA to transmit hereditary information to offspring
  - (4) all require oxygen to carry out photosynthesis
- 20 Two organisms of different species are *not* likely to compete for the same
- (1) food
  - (2) mate
  - (3) space
  - (4) water
- 21 Some salmon have been genetically modified to grow bigger and faster than wild salmon. They are grown in fish-farming facilities. These genetically modified fish should *not* be introduced into a natural habitat because
- (1) the salmon would recycle nutrients at a rapid rate
  - (2) their rapid growth rate could cause them to outcompete native salmon
  - (3) they would not have enough oxygen for survival
  - (4) they would reproduce asexually once they were released
- 22 The diagram below represents a portion of a cell membrane.



The arrow indicates that the cell membrane is carrying out the process of

- (1) respiration
- (2) cell recognition
- (3) diffusion
- (4) active transport

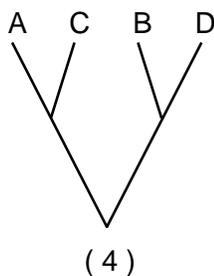
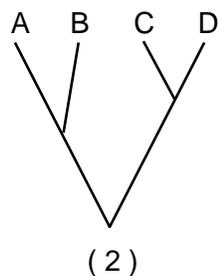
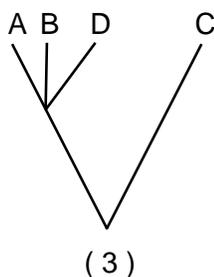
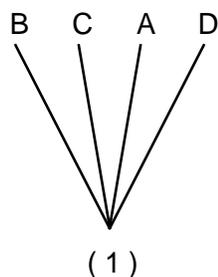
23 The expression of a trait is directly dependent on the

- (1) arrangement of amino acids in the protein synthesized
- (2) shape of the subunits in the DNA molecule
- (3) number of chromosomes present in the nucleus
- (4) sequence of bases coded for by the ribosome

24 Global warming is most closely associated with

- (1) increased use of solar panels
- (2) increased industrialization
- (3) reducing the rate of species extinction
- (4) removal of environmental wastes

25 Which diagram below indicates that species *D* is more closely related to *C* than it is to either *A* or *B*?



26 As climate changes, which type of reproduction would most likely result in a greater chance of survival for a species?

- (1) sexual reproduction, with a short reproductive cycle
- (2) sexual reproduction, with a long reproductive cycle
- (3) asexual reproduction, with a short reproductive cycle
- (4) asexual reproduction, with a long reproductive cycle

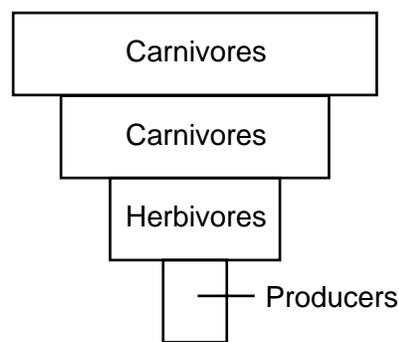
27 Adults of the *Aedes* mosquito genus are responsible for transmitting the viral diseases Zika and Dengue. Scientists have produced a modified form of male *Aedes* mosquitoes. The offspring of these male mosquitoes die before reaching adulthood. This method of reducing the spread of disease is dependent on

- (1) vaccines stimulating the immune system of infected people
- (2) providing medication to reduce the symptoms of disease
- (3) the use of natural selection to modify the viruses so they are no longer pathogenic
- (4) the use of genetic engineering to reduce the population of mosquitoes that carry the virus

28 Humans deplete the most resources when

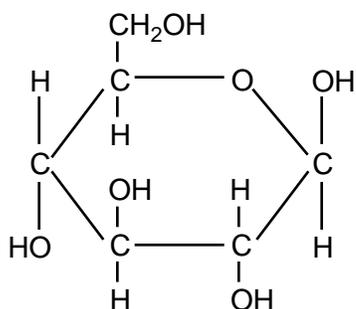
- (1) using wind energy as a power source
- (2) generating power by using fossil fuels
- (3) using water power to generate electricity
- (4) recycling glass and plastics

29 The diagram below does *not* represent a sustainable energy pyramid in an ecosystem because

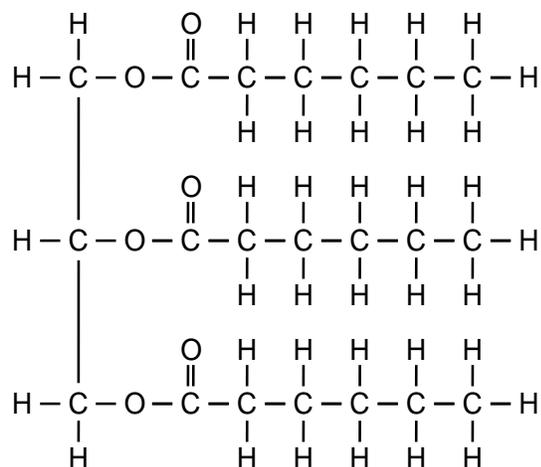


- (1) energy is never transferred between levels in ecosystems
- (2) ecosystems never have more than three levels of energy transfer
- (3) more energy must be available in the producer level than in the consumer levels
- (4) producers feed on herbivores in most ecosystems

30 The two diagrams below represent a sugar molecule and a fat molecule that are used by living organisms.



Sugar molecule



Fat molecule

Which statement best describes these two molecules?

- (1) Sugar molecules are inorganic and fat molecules are organic.
- (2) Sugar molecules are organic and fat molecules are inorganic.
- (3) Energy for life processes can be stored within the chemical bonds of both molecules.
- (4) Energy for life processes can be stored within the chemical bonds of sugar molecules, only.

**Part B-1**

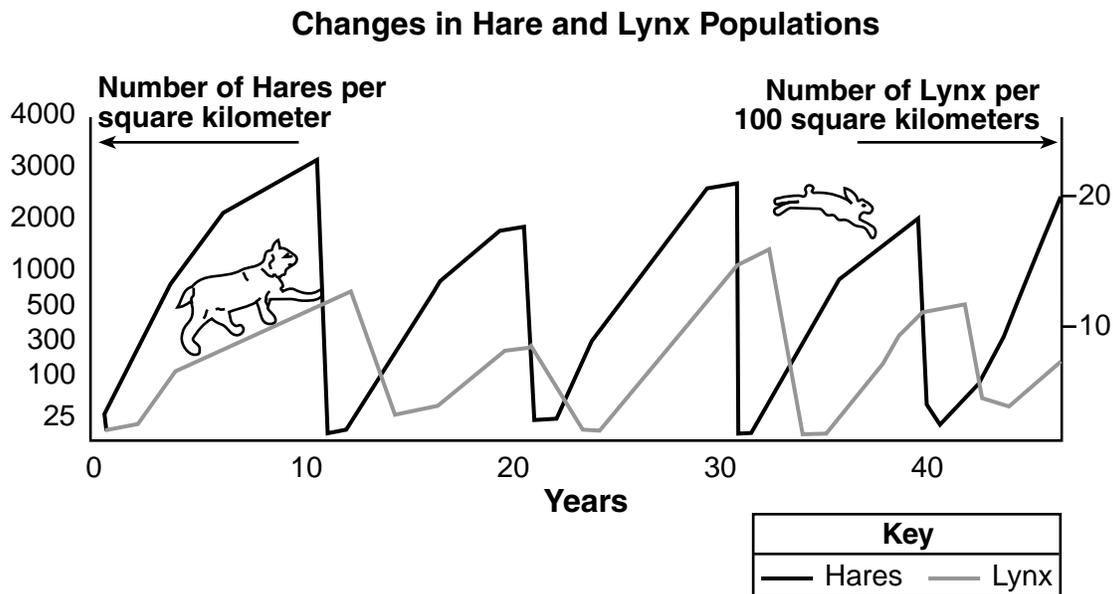
**Answer all questions in this part.** [13]

*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 A scientist analyzed a segment of DNA from a human chromosome and found that the percentage of thymine molecular bases (T) was 35%. Which row in the chart below contains the correct percentages of the other molecular bases in the DNA segment?

Row	Guanine (G)	Cytosine (C)	Adenine (A)
(1)	15%	25%	25%
(2)	25%	25%	15%
(3)	15%	15%	35%
(4)	35%	15%	15%

- 32 The graph below shows changes in the populations of hares and lynx in a Canadian ecosystem.

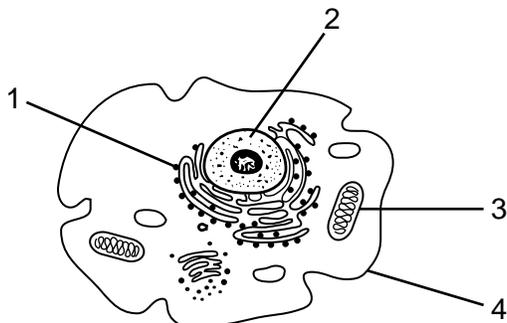


Source: Adapted from <http://lbyiene-jardin-wikispaces.com>

Which statement about the hares and lynx can be supported with information from the graph?

- (1) The hare is the predator of the lynx because it is a larger animal.
- (2) The lynx population begins to drop after the hare population drops.
- (3) Both populations go through cycles due to the succession of plant species.
- (4) Both populations have a carrying capacity of 3000 per square kilometer.

33 The diagram below represents a cell in the human body.



Which statement concerning the structures within this cell is accurate?

- (1) Structure 1 is a chloroplast that carries out photosynthesis.
- (2) Structure 2 is a vacuole that contains DNA.
- (3) Structure 3 is a mitochondrion, where respiration takes place.
- (4) Structure 4 is the cell membrane, which provides rigid support for the cell.

Base your answers to questions 34 and 35 on the data table below and on your knowledge of biology. The table below indicates the amount of oxygen present at various water temperatures in a pond.

**Amount of Available Oxygen in Water at Various Temperatures**

Temperature (°F)	Dissolved Oxygen (ppm)
68.0	9.2
71.6	8.8
78.8	8.2
82.4	7.9
86.0	7.6

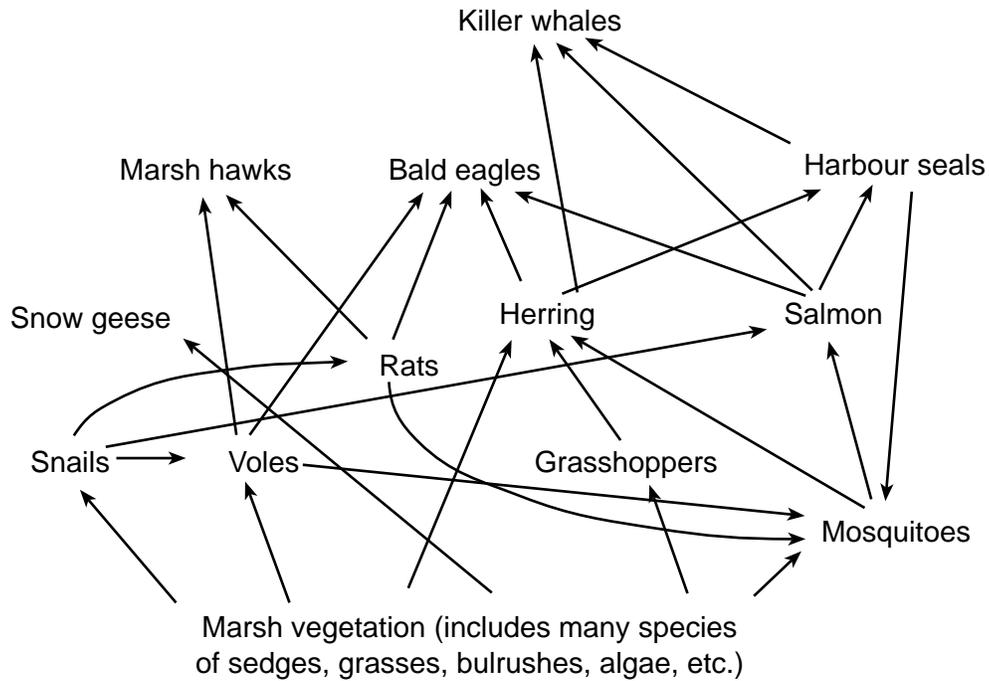
34 An aquatic ecosystem experiences an increase in temperature. Which row in the chart below shows the effect of this increased temperature on the available oxygen and ecosystem?

Row	Amount of Available Oxygen	Effect on Ecosystem
(1)	decreases	greater stability of the ecosystem
(2)	increases	lessens competition between predatory organisms
(3)	decreases	reduces carrying capacity for fish
(4)	increases	increases genetic mutations in bacteria

35 Which process performed by organisms produces oxygen for the aquatic ecosystem?

- (1) respiration
- (2) replication
- (3) active transport
- (4) autotrophic nutrition

Base your answers to questions 36 and 37 on the diagram below and on your knowledge of biology. The diagram represents a food web illustrating some relationships in a tidal marsh ecosystem.



Adapted from: <http://www.physicalgeography.net/fundamental/90.html>

36 Examples of autotrophs in this food web are

- |                               |                                 |
|-------------------------------|---------------------------------|
| (1) killer whales and grasses | (3) mosquitoes and grasshoppers |
| (2) sedges and bulrushes      | (4) snails and seals            |

37 In addition to grasshoppers, herring may also get energy from

- |                 |            |
|-----------------|------------|
| (1) algae       | (3) snails |
| (2) bald eagles | (4) voles  |

Base your answers to questions 38 and 39 on the information below and on your knowledge of biology.

Mercury is a toxic chemical that accumulates in the tissues of animals in a food chain. The chart below shows mercury levels found in various commercial fish and shellfish.

**Mercury Concentration**

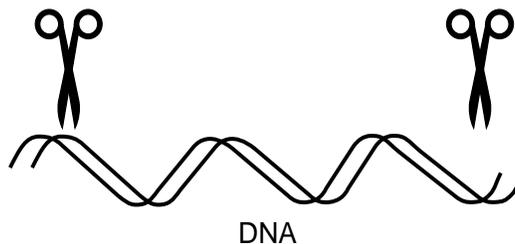
Species	Average Mercury Concentration (ppm)	Number of Samples
king mackerel	0.730	213
shark	0.979	356
swordfish	0.995	636
tilefish (Gulf of Mexico)	1.450	60
catfish	0.025	57
haddock	0.055	50
lobster (spiny)	0.093	13

Source: [www.fda.gov/food/foodborneillnesscontaminants/metals/ucm115644.html](http://www.fda.gov/food/foodborneillnesscontaminants/metals/ucm115644.html)

- 38 Each species listed is a predator. If the prey organisms that each predator consumes were tested, they would most likely contain
- (1) the same amount of mercury as the predator species
  - (2) less mercury than the predator species
  - (3) more mercury than the predator species
  - (4) no mercury, since the predators probably get it from the polluted water
- 39 Which statement is best supported by the data in the chart?
- (1) Any fish caught in the Gulf of Mexico would have low levels of mercury.
  - (2) Eating catfish or haddock would be most likely to cause deadly mercury poisoning.
  - (3) Spiny lobsters may have more or less mercury than indicated because only a few were sampled.
  - (4) Tilefish are the most nutritious of all the species listed.

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40 The diagram below represents a laboratory process.



The substance represented by the scissors shown cutting the DNA is

- (1) an enzyme
- (2) a starch molecule
- (3) a carbohydrate
- (4) a fat molecule

- 41 The human body has many cells that are deep inside the body. For this reason, the human body requires
- (1) a transport system and other organs
  - (2) carbon dioxide from the air
  - (3) the synthesis of many inorganic compounds
  - (4) the breakdown of glucose by the digestive system

Base your answers to questions 42 and 43 on the information below and on your knowledge of biology.

### **Bird Flu**

Researchers are not sure when the H7N9 virus, referred to as bird flu, hit the China poultry markets. In February of 2012, the virus was found to have spread from birds to humans. All cases resulted from direct contact with infected poultry.

The bird flu can cause severe respiratory illness in humans. Since flu viruses constantly mutate, it would be difficult to develop a vaccine ahead of time. Scientists are worried that the virus could spread easily among people, causing a worldwide outbreak of the disease.

- 42 Based on the information, one danger of the new Bird Flu H7N9 strain is that it
- (1) causes death in over 75% of the individuals who become infected
  - (2) is transferred to humans through consuming cooked poultry
  - (3) can spread from humans to birds, such as crows and pigeons
  - (4) mutates rapidly, making it hard to produce an effective vaccine
- 43 The fact that the H7N9 virus has only recently infected humans helps explain why
- (1) it is highly transmissible through both the air and water
  - (2) it is found only in the U.S.
  - (3) humans have little or no immunity to the virus
  - (4) the human population has formed antibodies against the virus
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## 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 47 on the information below and on your knowledge of biology.

As part of an experiment, a bacterial culture was grown in a lab for two days. No additional nutrients were added to the culture after the initial set-up. As the bacteria reproduced asexually, the population of the culture was measured every six hours. Some of the data related to the bacterial growth are shown in the data table below.

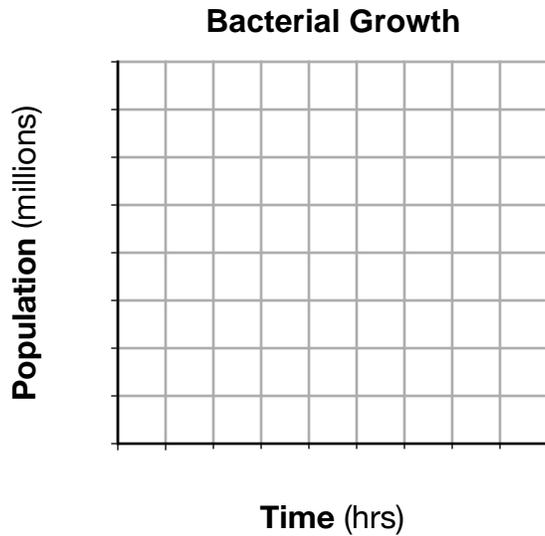
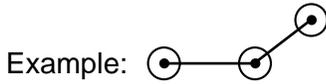
**Bacterial Growth**

<b>Time (hrs)</b>	<b>Population (millions)</b>
0	2.0
6	4.5
18	16.0
30	28.0
48	37.0

*Directions (44–45):* Using the information in the data table, construct a line graph on the grid below, 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 provided. Connect the points and surround each point with a small circle. [1]



46 If data for the growth of this bacterial population continued to be recorded, would the data point at 60 hours be above or below 37 million? Support your answer. [1]

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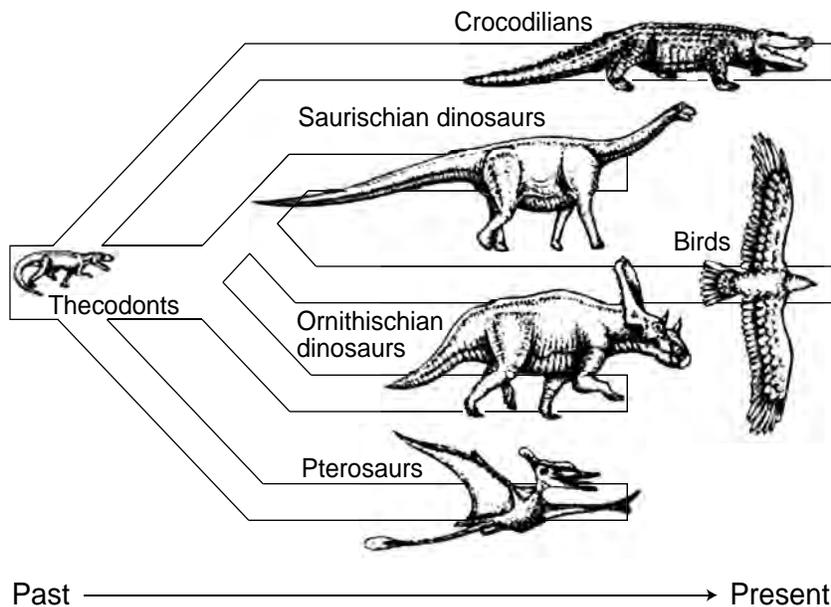
**Note: The answer to question 47 should be recorded on your separate answer sheet.**

- 47 One likely reason bacteria would be grown in laboratory cultures would be to
- (1) increase the number of antibiotics produced by human cells
  - (2) eliminate the cloning of cells that can fight disease
  - (3) increase the production of specialized proteins by using genetic engineering
  - (4) decrease the amount of bacteria naturally present in organisms

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Base your answers to questions 48 and 49 on the information and diagram below and on your knowledge of biology. The diagram represents a biological process.

Fossil evidence has demonstrated that birds evolved from a group of small carnivorous dinosaurs. Scientists have hypothesized that some evolved into birds as they filled available niches.



48 Identify *two* groups of organisms from the diagram that still exist on Earth today. Describe how they may have been able to survive to the present. [1]

Organisms: \_\_\_\_\_ and \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

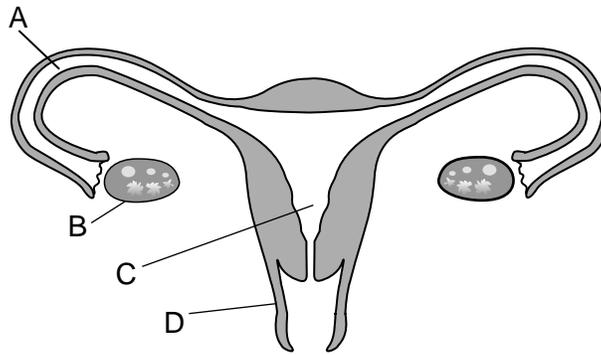
\_\_\_\_\_

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

49 The most recent fossil discoveries have filled in many of the gaps in the evolution of birds from dinosaurs. Before the latest fossils were found, there were some scientists who questioned this idea that birds evolved from dinosaurs. In general, scientists constantly work to

- (1) clarify scientific explanations so they can be made into a law that never changes
- (2) develop theories based on the data and evidence from a few experiments with inconclusive results
- (3) provide enough evidence and accurate predictions to allow for widespread acceptance
- (4) develop explanations that are permanent and do not change over time

Base your answers to questions 50 through 52 on the diagram below and on your knowledge of biology. The diagram indicates some parts of the human female reproductive system.



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

50 The structure in which fertilization normally takes place is

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

51 State *one* function of organ B. [1]

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52 State *one* advantage of internal development for the human embryo. [1]

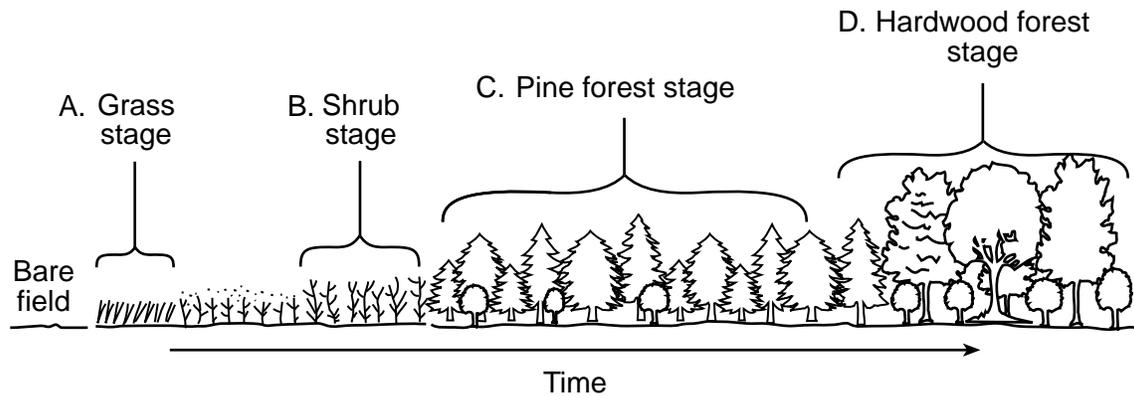
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Base your answers to questions 53 through 55 on the information below and on your knowledge of biology. The diagram represents an ecological process that occurs in New York State over a long period of time.



53 Identify the ecological process that is represented from stage A through stage D, and explain why each stage is important to the stage that follows it. [1]

Process: \_\_\_\_\_

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54 Identify *two* abiotic factors that can determine which types of organisms can inhabit an ecosystem. [1]

\_\_\_\_\_ and \_\_\_\_\_

55 Identify the short-term effect that a forest fire during stage D would have on the biodiversity of the area. [1]

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**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 and 57 on the information below and on your knowledge of biology.

**Turtle Cells and Human Skin**

New research has demonstrated that turtles and humans may have had a common ancestor 310 million years ago. A recent study looked at the genes responsible for the skin layers of turtle shells compared to the genes for human skin. The findings of the study suggest that about 250 million years ago, when turtle evolution split from other reptiles, a mutation in a specific group of genes occurred. The basic organization of this group of genes is similar in turtles and humans, and they produce the important skin proteins that produce shells in turtles and protect against infection in the skin of humans.

56 Identify the molecule that contains the hereditary material and the organelle in which it is found in turtle cells. [1]

Molecule: \_\_\_\_\_

Organelle in turtle cells: \_\_\_\_\_

57 Describe how the mutation in the genes of a turtle ancestor turned out to be a beneficial evolutionary adaptation. [1]

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Base your answers to questions 58 through 60 on the illustration and information below and on your knowledge of biology.

### The Little Brown Bat



Source: <http://knatolee.blogspot.com/2011/09/not-ducklings.html>

The illustration is of a species commonly called the little brown bat. It has 38 teeth and usually lives near bodies of water. The animal is considered beneficial by many people because it eats mosquitoes and many types of garden pests. They feed at night, detecting their prey by echolocation—a form of sonar similar to what is used on ships. They can determine the location and size of their prey by listening to the return echo.

58 The little brown bat eats mainly mosquitoes and night-flying insects. State *one* way in which the animal is adapted to prey on these organisms. [1]

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59 If a mutation occurs in some of these bats, it may result in a new inheritable trait that makes them better able to catch insects than other bats in the population. Describe what will most likely happen to the frequency of the *original* trait in the population. Support your answer. [1]

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60 Coevolution occurs when the evolution of an adaptation by one species affects the evolution of an adaptation in a second species. Some species of moths have evolved the ability to emit high frequency sounds that can block the little brown bat's echolocation. Based on the information provided, explain how this relationship between moths and bats is an example of coevolution. [1]

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Base your answers to questions 61 through 64 on the information below and on your knowledge of biology.

### **Kaolin as a Spray to Control a Bean Pest**

Spraying kaolin, a clay-like material, on the leaves of plants has been effective in reducing insect damage to plants that grow in temperate regions, but has not been tried in tropical areas.

Researchers in the tropical Andean region of South America have recently conducted experiments to see if kaolin can be used there to control the greenhouse whitefly, a significant pest of the region's bean crops.

In the study, four groups of bean plants were used with the following treatments:

<b>Group</b>	<b>Treatment</b>	<b>Whiteflies Killed (%)</b>
1 (control)	No insecticide or other substance applied to the plants	0
2	Synthetic chemical insecticide applied to leaves	90
3	Leaves treated with 2.5% concentration of kaolin spray	80
4*	Leaves treated with 5% concentration of kaolin spray	80

\* Note: In group 4 the plants lost 40% less water and showed a 45% increase in chlorophyll content in the leaves.

61 State *one* likely effect of the whiteflies on the bean plants in the control group (group 1) by the end of the study. Support your answer. [1]

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62 Should the group 3 kaolin treatments be considered as an acceptable alternative control method to the group 2 insecticide treatment for whiteflies? Support your answer with data from the chart. [1]

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63 Based on the results of groups 3 and 4, identify the kaolin treatment that would be best for bean plants grown in areas where low rainfall is a common occurrence. Support your answer. [1]

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64 State *one* reason why the scientists are interested in reducing whitefly populations in the Andean region. [1]

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Base your answers to questions 65 through 68 on the passage below and on your knowledge of biology.

### Medical Mystery

Recently, an elderly man went to a hospital. He felt tired and was coughing and dehydrated. At first, the doctor thought he had pneumonia, but an x ray showed a spot on his lung. Because the man was a smoker, the doctor expected to find a tumor.

Instead, the surgeon discovered a pea seed growing inside the man's lung. When the pea seedling was removed, the patient quickly regained his health.

65 When he first arrived at the hospital, the man reported feeling unusually tired. Explain why damage to the man's lung caused fatigue. [1]

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66 In this case, the pea seed entered into the man's lung, but the immune system was not able to defend against it. Describe *one* specific way the cells of the immune system usually protect the body against certain molecules or microbes that are breathed into the lungs. [1]

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67 Identify *two* environmental factors inside a human lung that would help the pea begin to germinate. [1]

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68 State whether the pea seedling could have continued to grow and develop in the lung over a long period of time. Support your answer. [1]

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

### Scientists Reprogram Plants for Drought Tolerance



Source: Lancaster Farming 2/21/15/AAAS

*Arabidopsis* plants respond to drought conditions by producing a stress hormone called ABA. This hormone slows down plant growth and leads to a decrease in the plant's use of water.

ABA binds to specific receptors in the plant that cause the guard cells on the leaf surfaces to close the stomatal openings through which water vapor can normally pass. This reduces water loss during the drought conditions.

Although it has been suggested that spraying plants with ABA during a drought could be beneficial, it is not practical. The chemical is expensive to produce and quickly loses its ability to bind to cell receptors in the plant cells.

Recently, however, scientists have found a way to modify the ABA receptors in *Arabidopsis* plants so they can be activated by another chemical that is both stable and inexpensive.

69 Describe how the shape of molecules, such as the hormone ABA, is critical to their function in the *Arabidopsis* plant. [1]

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70 Explain how the response of the guard cells to a drought is part of a feedback mechanism. [1]

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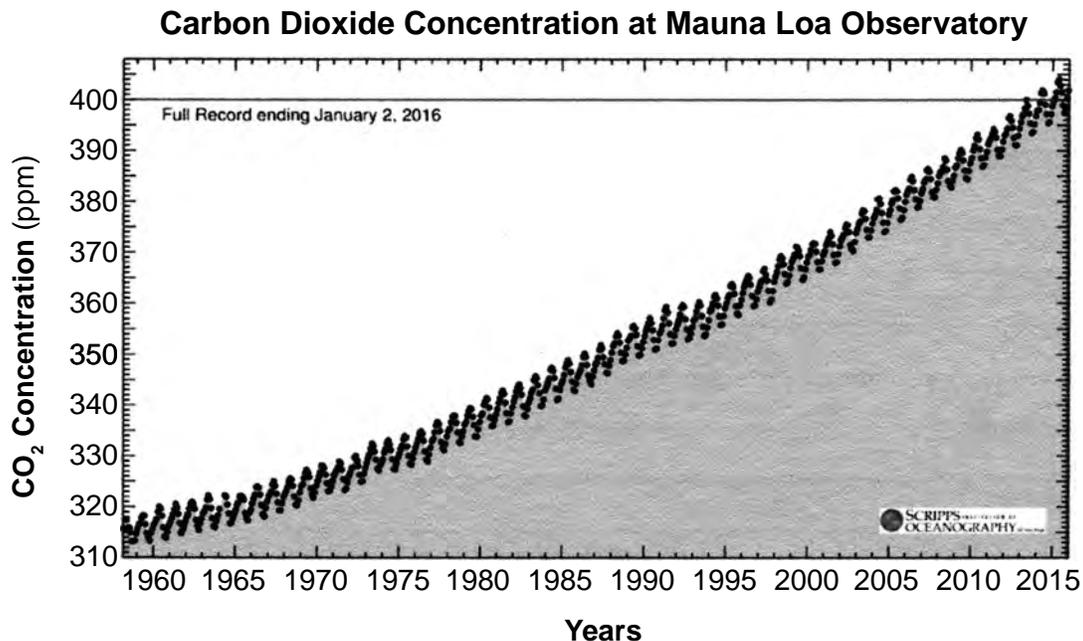
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Base your answers to questions 71 and 72 on the passage and graph below and on your knowledge of biology.

### Atmospheric Carbon Dioxide

Records from polar ice cores show that the natural range of atmospheric carbon dioxide (CO<sub>2</sub>) over the past 800,000 years was 170 to 300 parts per million (ppm) by volume. In the early 20th century, scientists began to suspect that CO<sub>2</sub> in the atmosphere might be increasing beyond this range due to human activities, but there were no clear measurements of this trend. In 1958, Charles David Keeling began measuring atmospheric CO<sub>2</sub> at the Mauna Loa observatory on the big island of Hawaii.



71 Record the approximate concentration of carbon dioxide at the start of the study and describe how it compares to the concentration in 2015. [1]

\_\_\_\_\_ ppm CO<sub>2</sub>

Description: \_\_\_\_\_  
\_\_\_\_\_

72 Identify *one* likely reason for the overall change in CO<sub>2</sub> concentration observed between 1958 and 2015. [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 Which group of materials would be most useful to a student planning to separate a mixture of leaf pigments using paper chromatography?
- (1) filter paper, dropper, solvent, beaker
  - (2) enzymes, beaker, goggles, compound microscope
  - (3) compound microscope, filter paper, coverslip, glass slide
  - (4) meterstick, thermometer, solvent, enzymes

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

- 74 In many parts of the world, plants are used as a source of medicine. Many of these plants are in danger of becoming extinct. It is therefore important for researchers to
- (1) collect and dry all the medicinal plants to preserve them for future use
  - (2) search for other plant species that could be used as a new source of that medicine
  - (3) use the plants now while we still have them
  - (4) apply fertilizer to reduce the numbers of the plants that grow in the wild

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

- 75 In the lab activity *Making Connections*, an experiment was designed to test the effect of exercise on the ability to squeeze a clothespin. The number of times the clothespin was squeezed served as the
- |                          |                |
|--------------------------|----------------|
| (1) independent variable | (3) hypothesis |
| (2) dependent variable   | (4) control    |

Base your answer to question 76 on the Universal Genetic Code Chart below and on your knowledge of biology.

**Universal Genetic Code Chart**

		SECOND BASE				
		U	C	A	G	
FIRST BASE	U	UUU } PHE UUC } UUA } LEU UUG }	UCU } UCC } SER UCA } UCG }	UAU } TYR UAC } UAA } STOP UAG }	UGU } CYS UGC } UGA } STOP UGG } TRP	U C A G
	C	CUU } LEU CUC } CUA } CUG }	CCU } CCC } PRO CCA } CCG }	CAU } HIS CAC } CAA } GLN CAG }	CGU } ARG CGC } CGA } CGG }	U C A G
	A	AUU } ILE AUC } AUA } AUG } MET or START	ACU } ACC } THR ACA } ACG }	AAU } ASN AAC } AAA } LYS AAG }	AGU } SER AGC } AGA } ARG AGG }	U C A G
	G	GUU } VAL GUC } GUA } GUG }	GCU } GCC } ALA GCA } GCG }	GAU } ASP GAC } GAA } GLU GAG }	GGU } GGC } GLY GGA } GGG }	U C A G

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

- 76 When provided with a sequence of bases in one segment of mRNA, the Universal Genetic Code Chart is used to
- (1) directly identify the DNA from an animal cell
  - (2) determine the sequence of amino acids in a protein
  - (3) change the RNA sequence of a protein into DNA
  - (4) identify the specific mutations in the genetic material in a cell

77 A student was setting up beakers that contained different solutions in order to conduct a laboratory investigation, but the next day he could not tell which beaker contained the starch and water mixture. In order to find out which beaker contained starch, he took a small sample from each of the beakers and conducted a test for starch on each of them.

Describe the test for starch that the student should use and the result that would indicate the presence of starch. [1]

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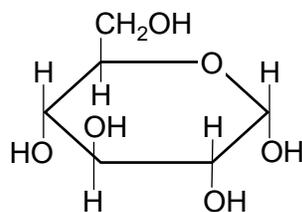
78 In order to survive in its environment, a single-celled organism uses a contractile vacuole to remove excess water that diffuses into its cell. Another species, a hydra, also excretes excess water. Both processes involve the use of energy.

Based on this information, state whether these two organisms live in fresh water or salt water. Support your answer. [1]

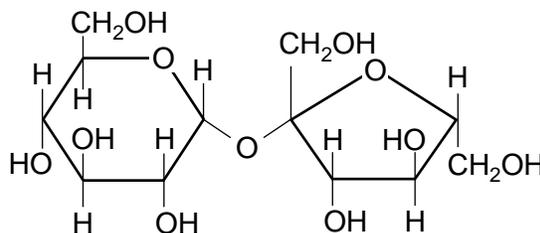
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79 The diagram below represents two types of carbohydrate molecules, glucose and sucrose.



**Glucose**



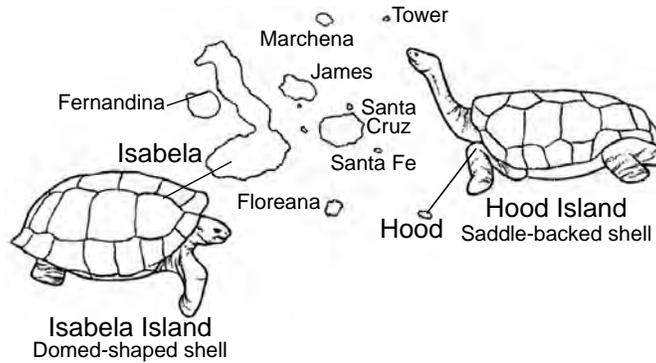
**Sucrose**

State *one* reason why a glucose molecule is more likely than a sucrose molecule to diffuse through an artificial membrane. [1].

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Base your answers to questions 80 through 82 on the information below and on your knowledge of biology. The diagram represents some of the various types of giant tortoises that live on the Galapagos Islands. The chart provides information about some individual island environments.

### Giant Tortoises of the Galapagos Islands



Source: Adapted from <http://slideplayer.com/slide/7372273>

### Environmental Conditions on Certain Galapagos Islands

Galapagos Island	Island Characteristics
Hood Island	sparse vegetation located high off of the ground; hot, dry, arid
Isabela Island	rich variety of vegetation located low to the ground; much rainfall; humid

80 Explain why specific Galapagos tortoise species are able to live only on certain islands. [1]

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

81 The role that the environment plays in determining which species survive is referred to as

- (1) a trade-off
- (2) a gene mutation
- (3) an ecological niche
- (4) a selecting agent

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

82 Over the years, human activity introduced organisms such as goats and other herbivores to the Galapagos Islands. The addition of these invasive organisms caused the tortoise species to be threatened because there was

- (1) an increase in competition for food sources
  - (2) a decrease in ecological succession
  - (3) an increase in the availability of vegetation
  - (4) a decrease in direct harvesting
- 

83 As fish are frozen for storage, the water in the cells expands as it cools from 4°C to 0°C and may cause cells to burst. This lowers the quality of the fish. Explain how soaking the fish briefly in salt water before freezing them might prevent this damage to the cells. [1]

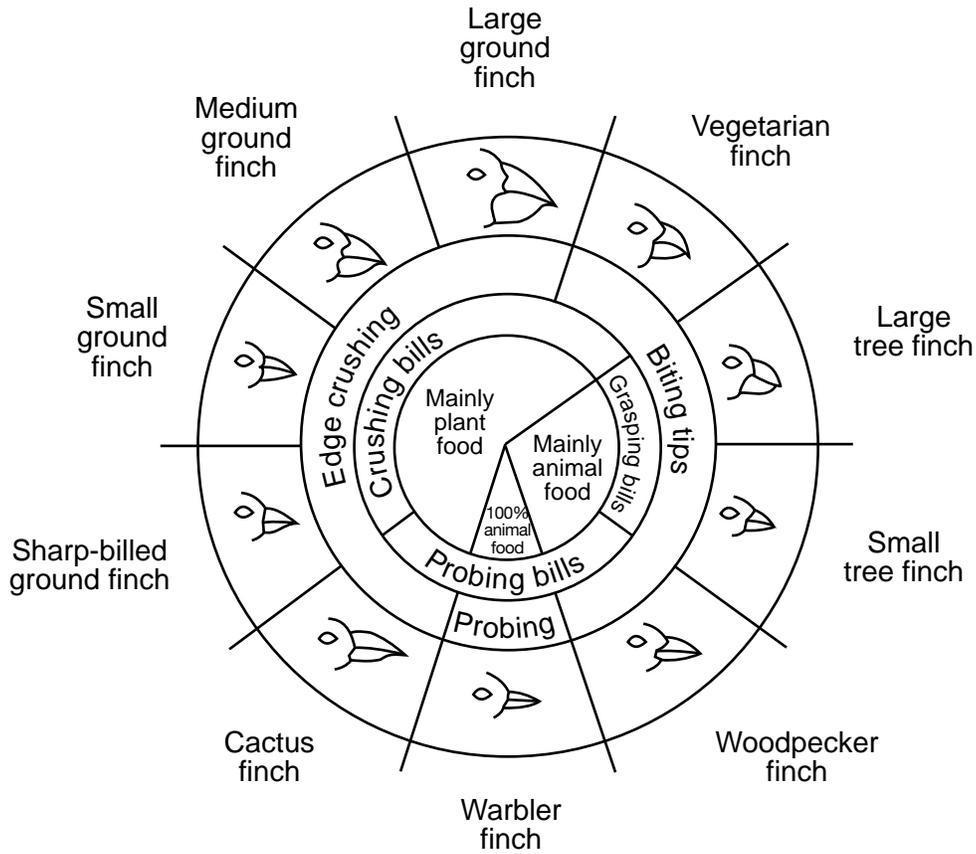
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Base your answers to questions 84 and 85 on the diagram below and on your knowledge of biology.

### Variations in Beaks of Galapagos Islands Finches



Source: *Galapagos: A Natural History Guide*

84 Identify *one* finch population that would be *negatively* affected if the birth rate of small tree finches increased significantly. Support your answer. [1]

Finch: \_\_\_\_\_

Support: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

85 A student completed two trials of the *Beaks of Finches* lab, each time picking up eleven seeds, as shown in the table below. If the student needs to collect an average of thirteen seeds to survive, how many seeds must he pick up in round 3? Record your answer in the space provided in the table below. [1]

<b>Trial Number</b>	<b>Seeds Picked Up</b>
1	11
2	11
3	_____
Average	13

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# LIVING ENVIRONMENT