

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

LIVING ENVIRONMENT

Wednesday, August 14, 2019 — 12:30 to 3:30 p.m., only

Student Name _____

School Name _____

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

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

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

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

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

Notice ...

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

DO NOT START THIS EXAMINATION UNTIL THE SIGNAL IS GIVEN.

4 Certain seaweeds contain a greater concentration of iodine inside their cells than there is in the seawater surrounding them. The energy required to maintain this concentration difference is most closely associated with the action of

- (1) ribosomes
- (2) mitochondria
- (3) vacuoles
- (4) nuclei

5 Doctors sometimes use a vaccine to prepare the body to defend itself against future infections. These vaccines most often contain

- (1) antibodies
- (2) antibiotics
- (3) white blood cells
- (4) weakened pathogens

6 Building large manufacturing facilities can affect ecosystems by increasing the

- (1) atmospheric quality
- (2) biodiversity in the area
- (3) demand for resources such as fossil fuels
- (4) availability of space and resources for organisms

7 An ameba is a single-celled organism. It uses its cell membrane to obtain food from its environment, digests the food with the help of organelles called lysosomes, and uses other organelles to process the digested food. From this, we can best infer that

- (1) all single-celled organisms have lysosomes to digest food
- (2) amebas are capable of digesting any type of food molecule
- (3) single-celled organisms are as complex as multicellular organisms
- (4) structures in amebas have functions similar to organs in multicellular organisms

8 White blood cells are most closely associated with which two body systems?

- (1) circulatory and digestive
- (2) immune and circulatory
- (3) digestive and excretory
- (4) excretory and immune

9 Carnivorous plants, such as pitcher plants and sundews, live in bogs where many other organisms cannot. Due to the high rate of decomposition occurring in bogs, the environment is acidic and contains very little oxygen and nutrients. The bogs only support certain types of organisms because

- (1) organisms in an environment are not limited by available energy and resources
- (2) the growth and survival of organisms depends upon specific physical conditions
- (3) favorable gene mutations only occur when organisms live in harsh environments
- (4) photosynthetic organisms can only inhabit environments that have a low acidity

10 Anhidrosis is the inability to sweat normally. If the human body cannot sweat properly, it cannot cool itself, which is potentially harmful. Anhidrosis most directly interferes with

- (1) a feedback mechanism that maintains homeostasis
- (2) an immune system response to harmless antigens
- (3) the synthesis of hormones in the circulatory system
- (4) the enzymatic breakdown of water in cells

11 The hair colors of the members of a family are listed below.

mother – brown hair
father – blond hair
older son – brown hair
younger son – blond hair

The hair colors of the sons are most likely a direct result of

- (1) natural selection in males
- (2) heredity
- (3) evolution
- (4) environmental influences

12 A sample of DNA from a human skin cell contains 32% cytosine (C) bases. Approximately what percentage of the bases in this sample will be thymine (T)?

- | | |
|--------|--------|
| (1) 18 | (3) 32 |
| (2) 24 | (4) 36 |

- 13 Carmine, a compound that comes from the cochineal beetle, shown below, is used as a food coloring.



Source: <https://alibi.com/events/256770/Cochineal-Empire-making-Insect.html>

The food coloring is not harmful to most people, but in a small number of individuals, it causes a reaction and affects their ability to breathe. This response to carmine is known as

- | | |
|----------------|-----------------------|
| (1) a stimulus | (3) natural selection |
| (2) an allergy | (4) an adaptation |

- 14 As a way to reduce the number of cases of malaria, a human tropical disease, a specific DNA sequence is inserted into the reproductive cells of *Anopheles* mosquitoes. Which process was most likely used to alter these mosquitoes?

- (1) cloning studies
- (2) genetic engineering
- (3) natural selection
- (4) random mutations

15 Which row in the chart below accurately identifies two causes of mutations and the cells that must be affected in order for the mutations to be passed on to offspring?

Row	Cause of Mutations	Cells Affected
(1)	infections and antigens	body cells
(2)	meiosis and mitosis	body cells
(3)	disease and differentiation	sex cells
(4)	chemicals and radiation	sex cells

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- 16 Many tiny plants can be seen developing asexually along the edge of the mother-of-thousands plant leaf, as shown in the photo below. The tiny plants eventually drop to the ground and grow into new plants of the same species.



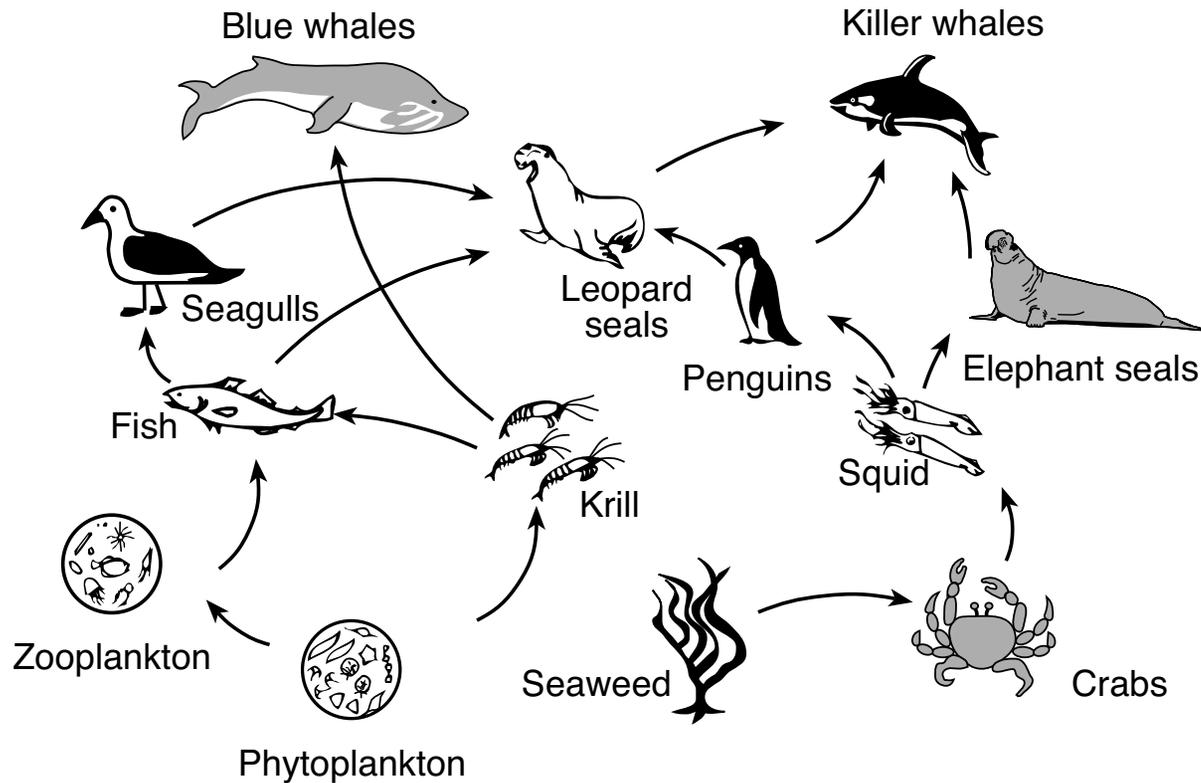
Source: http://www.plantamundo.com/produto_completo.asp?IDProduto=255

One way this form of reproduction differs from sexual reproduction is

- (1) more genetic variations are seen in the offspring
- (2) there is a greater chance for mutations to occur
- (3) the offspring and the parents are genetically identical
- (4) the new plants possess the combined genes of both parents

17 A food web is represented in the diagram below.

Ocean Food Web



Adapted from: www.siyavula.com/gr7-9-websites/natural-sciences/gr8/gr8-11-02.html

If the fish population *decreases*, what is the most direct effect this will have on the aquatic ecosystem?

- (1) The leopard seals will all die from lack of food.
- (2) The krill population will only be consumed by seagulls.
- (3) The zooplankton population will increase in size.
- (4) The phytoplankton population will increase in size.

18 The chart below shows a sequence of events that was observed at an abandoned ski center over a period of years.

Changes in Plant Species Over Time

Year	Dominant Plant Species Observed
1985	grasses
1995	shrubs and bushes
2005	cherry, birch, and poplar trees

This sequence of changes is the result of

- (1) ecological succession
- (2) decreased biodiversity
- (3) biological evolution
- (4) environmental trade-offs

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19 Some salmon have been genetically modified to grow bigger and mature faster than wild salmon. They are kept in fish-farming facilities. Which statement regarding genetically modified salmon is correct?

- (1) Genetically modified salmon produce more of some proteins than wild salmon.
- (2) Genetically modified salmon and wild salmon would have identical DNA.
- (3) Wild salmon reproduce asexually while genetically modified salmon reproduce sexually.
- (4) Wild salmon have an altered protein sequence, but genetically modified salmon do not.

20 Which group of organisms in an ecosystem fills the niche of recycling organic matter back to the environment?

- (1) carnivores
- (2) decomposers
- (3) producers
- (4) predators

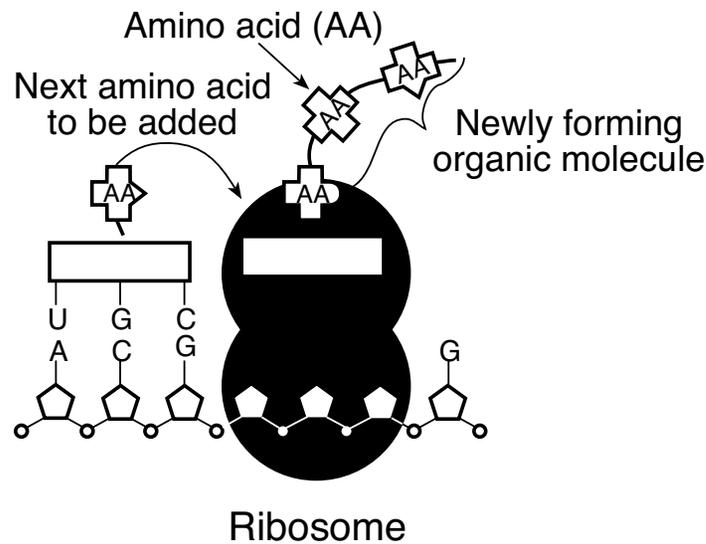
21 The use of solar panels has increased in the last ten years. A benefit of using solar energy would include

- (1) adding more carbon dioxide to the atmosphere
- (2) using less fossil fuel to meet energy needs
- (3) using a nonrenewable source of energy
- (4) releasing more gases for photosynthesis

22 In a sewage treatment facility, an optimal environment is maintained for the survival of naturally occurring species of microorganisms. These organisms can then break the sewage down into relatively harmless wastewater. For these microorganisms, the wastewater facility serves as

- (1) its carrying capacity
- (2) a food chain
- (3) an ecosystem
- (4) an energy pyramid

23 The diagram below represents a process taking place in a cell.



The type of organic molecule that is being synthesized is

- | | |
|------------|-------------|
| (1) DNA | (3) protein |
| (2) starch | (4) fat |

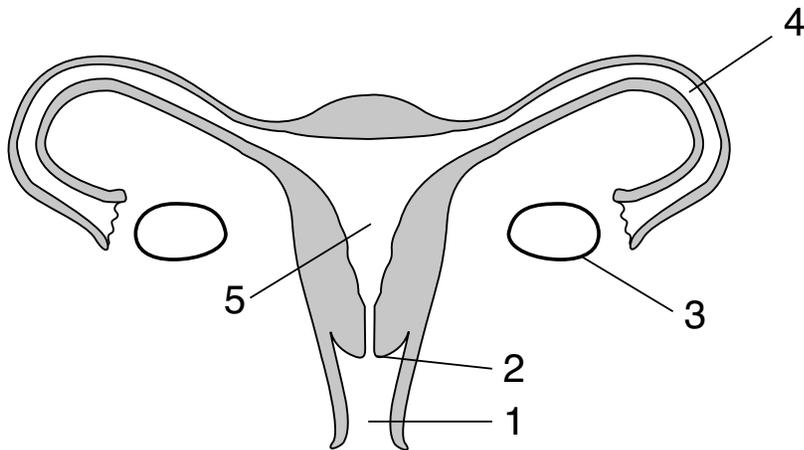
24 The governments of many countries have regulations that are designed to prevent the accidental introduction of nonnative insects into their countries. This is because, in these new habitats, the nonnative insects might

- (1) become food for birds
- (2) not survive a cold winter
- (3) not have natural predators
- (4) add to the biodiversity

25 The process of transferring energy during respiration occurs in a series of steps. This prevents too much heat from being released at one time. Maintaining an appropriate temperature is beneficial to an organism because

- (1) enzymes need a proper range of temperatures to catalyze vital reactions
- (2) cellular waste products can only be excreted in cooler temperatures
- (3) hormones can only produce antibodies if temperatures are not excessive
- (4) nutrients diffuse faster into cells when temperatures are lower

26 The diagram below represents some structures in the human female reproductive system.



The processes of meiosis and fertilization are essential in human reproduction. Which row in the chart correctly identifies where in the female reproductive system these two processes occur?

Row	Meiosis	Fertilization
(1)	1	3
(2)	2	5
(3)	3	4
(4)	4	5

27 Fruits and vegetables exposed to air begin to brown because of a chemical reaction in their cells. This may result in these foods being thrown out. Some people have found that adding lemon juice (citric acid) to apple slices keeps them from turning brown. The prevention of browning is likely the result of

- (1) increasing the concentration of enzymes
- (2) increasing the temperature
- (3) slowing the rate of enzyme action
- (4) maintaining the pH

28 Scientists monitoring frog populations have noticed that the ratio of male frogs to female frogs varies when certain chemicals are present in the environment. The influence of estrogen, for example, has a noticeable effect. In the presence of a higher amount of estrogen, it would be most likely that

- (1) fewer males would be found because they are much larger and fewer are produced
- (2) fewer females would be found because they are more sensitive to pesticides
- (3) more males would be found because estrogen promotes the development of male characteristics
- (4) more females would be found because estrogen promotes the development of female characteristics

29 Which action could humans take to slow the rate of global warming?

- (1) Cut down trees for more efficient land use.
- (2) Increase the consumption of petroleum products.
- (3) Use alternate sources of energy such as wind.
- (4) Reduce the use of fuel-efficient automobiles.

30 The role of antibodies in the human body is to

- (1) stimulate pathogen reproduction to produce additional white blood cells
- (2) increase the production of guard cells to defend against pathogens
- (3) promote the production of antigens to stimulate an immune response
- (4) recognize foreign antigens and mark them for destruction

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Part B-1

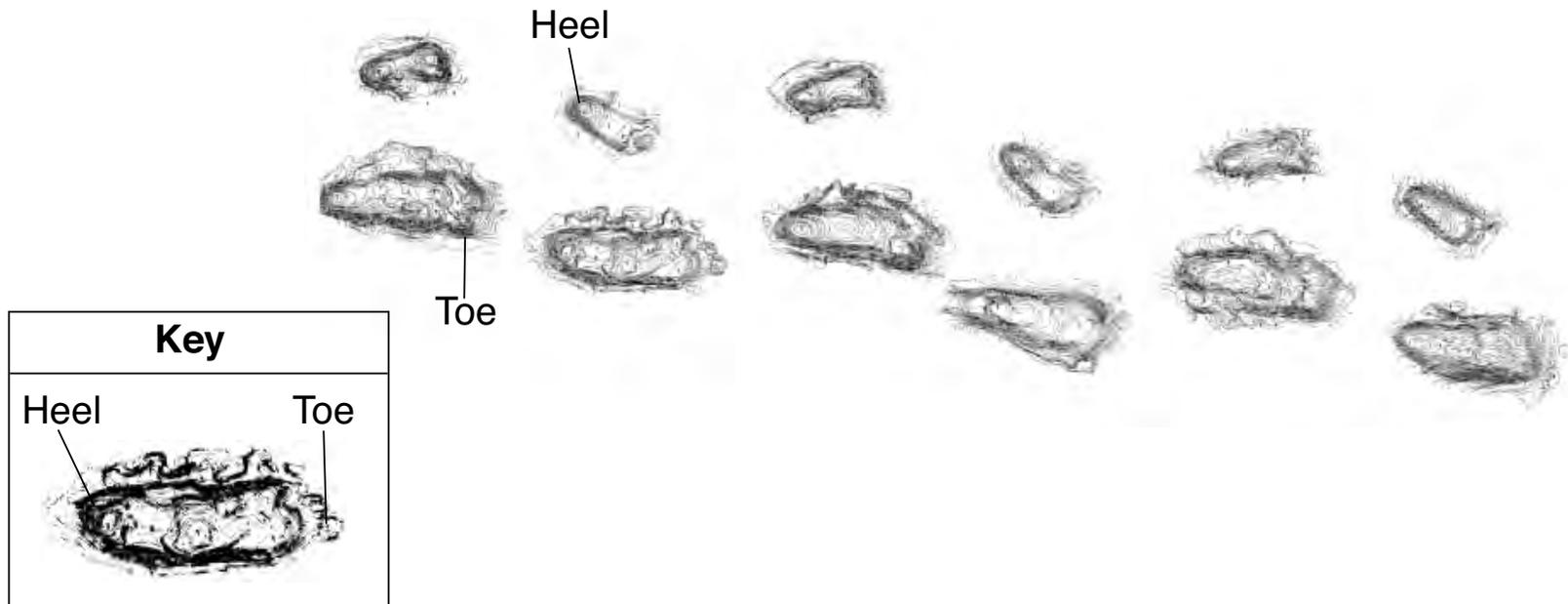
Answer all questions in this part. [13]

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

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

Fossil Footprints

Scientists examined a trail of fossil footprints left by early humans in soft, volcanic ash in Eastern Africa. A drawing of the trail of footprints is shown below. Each footprint is represented as a series of lines indicating the depth that different parts of the foot sank into the volcanic ash.



Source: <http://www.indiana.edu/~eniweb/lessons/foot-topo-10inch.pdf>

31 Which statement is an accurate observation that can be made based on this trail of footprints?

- (1) The individuals were running from a predator.
- (2) The volcano was about to erupt again.
- (3) One individual was much taller than the other.
- (4) One individual had larger feet than the other.

32 The type of information directly provided by these fossil footprints is useful because it

- (1) offers details about how these individuals changed during their lifetime
 - (2) offers data regarding their exposure to ultraviolet (UV) radiation
 - (3) is a record of information about what these individuals ate during their lifetime
 - (4) is a record of some similarities and differences they share with present-day species
-

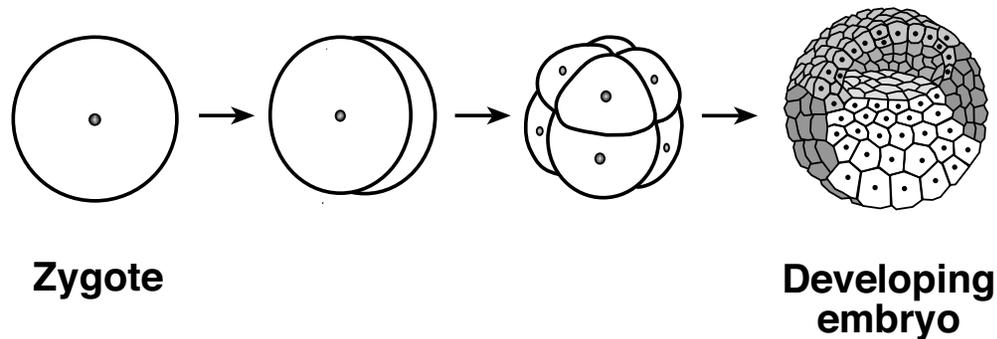
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33 Since the early 1990s, proton pump inhibitors (PPIs) have been widely used to treat acid reflux disease. Although clinical tests in the 1980s deemed PPIs to be safe for humans, in 2012 the FDA announced warnings that long-term use of PPIs could increase the risk of bone fractures, kidney disease, and some intestinal infections.

Which statement best explains why the safety of PPIs is now in question when clinical experiments in the 1980s provided evidence that they were safe?

- (1) Researchers have been able to collect more data than were available in the 1980s.
- (2) Fewer people had acid reflux in the 1980s compared to today.
- (3) The medication containing PPIs has changed since the 1980s when tests were done.
- (4) The original experiments in the 1980s used only test animals and did not use human subjects.

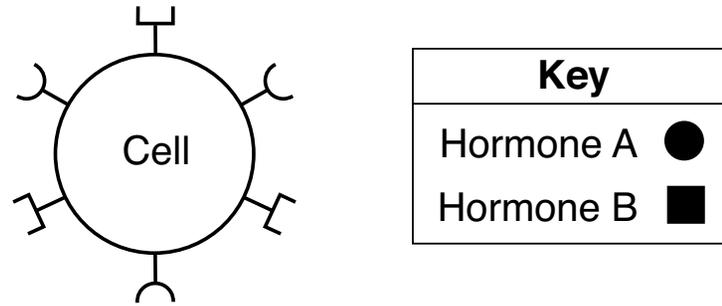
34 The process of embryonic development is represented in the diagram below.



The three arrows in the diagram each represent a process known as

- (1) mitotic cell division
- (2) meiotic cell division
- (3) fertilization of gamete cells
- (4) differentiation of tissues

35 A cell with receptors for two different hormones is represented below.



Which chemical would most likely interfere with the activity of hormone A, but *not* hormone B?



(1)



(2)



(3)



(4)

Base your answers to questions 36 through 39 on the information and photograph below and on your knowledge of biology.

Scientists Investigate Sex Determination in Alligators

The sex of some reptiles, including the American alligator, is determined by the temperature at which the eggs are incubated. For example, incubating them at 33°C produces mostly males, while incubation at 30°C produces mostly females.

Scientists recently discovered a thermosensor protein, TRPV4, that is associated with this process in American alligators. TRPV4 is activated by temperatures near the mid-30s, and increases the movement of calcium ions into certain cells involved with sex determination.

A baby alligator emerges from its egg shell during hatching



Source: <http://www.dailymail.co.uk/news/article-2190839/>

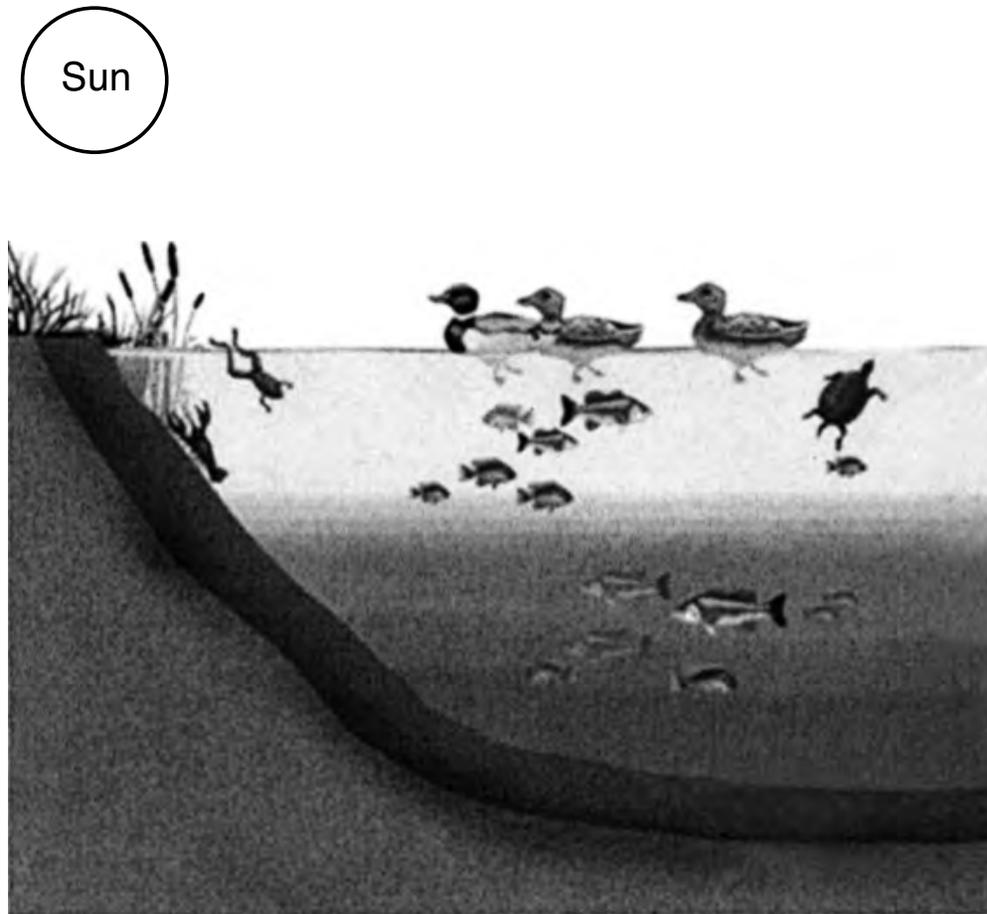
- 36 The results of this scientific investigation will most likely lead other scientists to hypothesize that
- (1) human sex cells also contain the TRPV4 protein
 - (2) other reptiles may have the TRPV4 protein in their eggs
 - (3) the TRPV4 protein affects the growth of plants
 - (4) the TRPV4 protein is present in all of the foods eaten by alligators
- 37 Which information was most essential in preparing to carry out this scientific investigation?
- (1) a knowledge of the variety of mutations found in American alligator populations
 - (2) the arrangement of the DNA bases found in the TRPV4 protein
 - (3) the effects of temperature on the incubation of alligator eggs
 - (4) a knowledge of previous cloning experiments conducted on alligators and other reptiles
- 38 The movement of the calcium ions into certain cells is most likely due to
- (1) the destruction of the TRPV4 when it contacts the cell membrane
 - (2) the action of TRPV4 proteins on the cells involved with sex determination
 - (3) the sex of the alligator embryo present in that particular egg
 - (4) the action of receptor proteins attached to the mitochondria in alligator sex cells
- 39 Environmental changes, such as global warming, could affect species such as the American alligator because even slight increases in environmental temperature could
- (1) lead to an overabundance of females and few, if any, males
 - (2) lead to an overabundance of males and few, if any, females
 - (3) cause the breakdown of the TRPV4 protein in female alligators
 - (4) increase the rate at which calcium ions exit the sex cells
-

40 Which human activity can have a *negative* impact on the stability of a mature ecosystem?

- (1) replanting trees in areas where forests have been cut down for lumber
- (2) building dams to control the flow of water in rivers, in order to produce electricity
- (3) preserving natural wetlands, such as swamps, to reduce flooding after heavy rainfalls
- (4) passing laws that limit the dumping of pollutants in forests

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Base your answer to question 41 on the diagram below and on your knowledge of biology. The diagram represents a pond ecosystem.



Source: freshwaterecosystemswebquest.wikispaces.com/ponds,+lakes,+and+inland+seas

41 Energy in this ecosystem passes directly from the Sun to

- | | |
|----------------|------------------|
| (1) herbivores | (3) heterotrophs |
| (2) consumers | (4) autotrophs |

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

Wild Horse Roundup



Source: <http://tuesdayshorse.wordpress.com/2012/10/31/outrage-over-advisory-board-proposal-to-sterilize-wild-mustangs/>

Wild horses called mustangs roam acres of federally owned land in the western United States. These horses have overgrazed the local vegetation to the extent that plants and soils are being lost entirely.

When the number of mustangs that roam the land exceeds the number of horses that the land can sustain, the government organizes helicopter-driven roundups. The horses are guided into a roped-off area and then are sold to the public or brought to pastures in the Midwest. About one percent of the horses captured die from injuries or accidents that occur during roundups.

- 42 The risk to the horses during the roundups compared to the entire loss of plants and soils is considered
- (1) selective breeding
 - (2) a technological fix
 - (3) direct harvesting
 - (4) a trade-off
- 43 The number of organisms that an area of land can sustain over a long period of time is known as
- (1) ecological succession
 - (2) its finite resources
 - (3) its carrying capacity
 - (4) evolutionary change
-

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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 48 on the information below, data table on the next page, and on your knowledge of biology.

White Nose Syndrome Found in Bats

White nose syndrome (WNS) is a disease found in bats. The disease, first detected in bats during the winter of 2006, is characterized by the appearance of a white fungus on the nose, skin, and wings of some bats, which live in and around caves and mines. It affects the cycle of hibernation and is responsible for the deaths of large numbers of bats of certain species. In some areas, 80-90% of bats have died. Not all bats in an area are affected, and certain bats that are susceptible in one area are not affected in other areas.

The roles of temperature and humidity in the environment of the bats are two of the many factors being investigated to help control the disease. Over the past few years, the Conserve Wildlife Foundation of New Jersey conducted summer bat counts of two bat species at 22 different sites, totaled the number, and reported the results. The approximate numbers of bats counted (to the nearest hundred) are listed in the table on the next page.

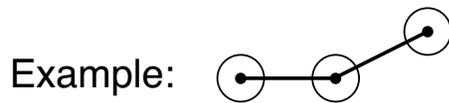
Summer Bat Count (Total Number of Bats)

Year	Big Brown Bats <i>(Eptesicus fuscus)</i>	Little Brown Bats <i>(Myotis lucifugus)</i>
2009	900	6100
2010	1000	1700
2011	1000	500
2012	1000	400
2013	1300	300

Directions (44–46): Using the information in the data table, construct a line graph on the grid on the next page, following the directions below.

44 Mark an appropriate scale, without any breaks in the data, on the axis labeled “Number of Bats.” [1]

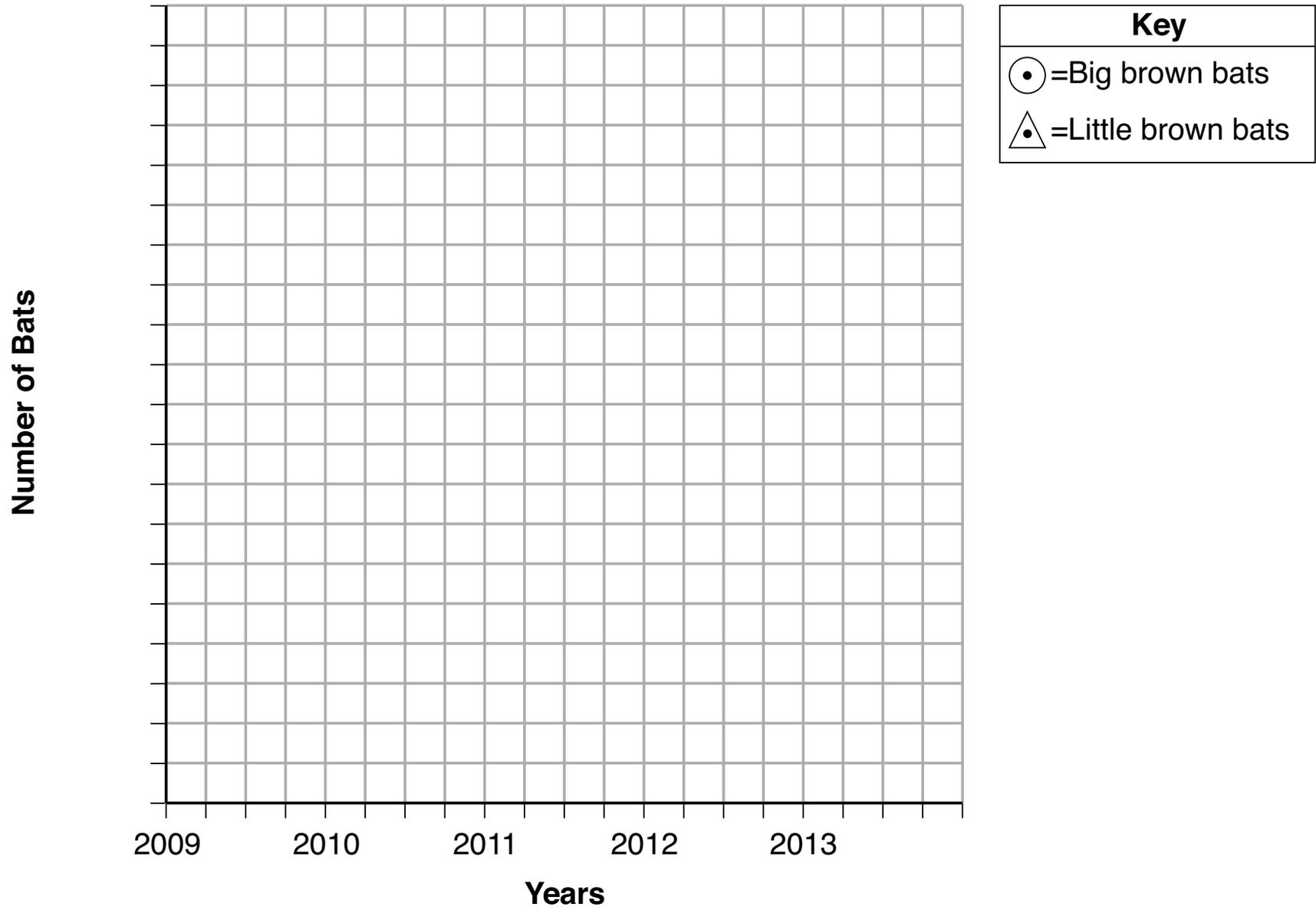
45 Plot the data for big brown bats on the grid, connect the points, and surround each point with a small circle. [1]



46 Plot the data for little brown bats on the grid, connect the points, and surround each point with a small triangle. [1]



Summer Brown Bat Count



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

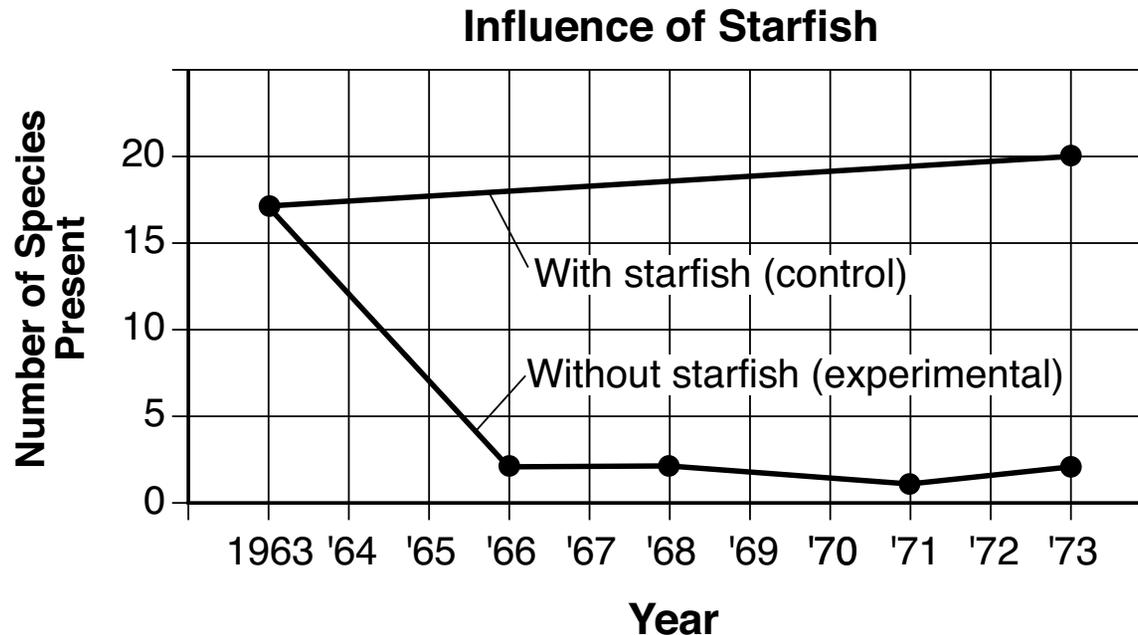
47 Biologists in New York and Vermont have noted that, in recent years, a higher percentage of the little brown bats are now surviving. Which statement best explains this increased survival rate?

- (1) A few of the bats possessed an immunity to the WNS disease and produced offspring that were immune.
- (2) The bats needed to reproduce in greater numbers, otherwise they would have died out completely.
- (3) The people that performed the recent counts did not identify the bats correctly and were counting bats of a different species.
- (4) The original decline in the bat population due to WNS was a natural occurrence and is part of a natural cycle.

48 Conservation groups have promoted the building and placing of bat houses in areas thought to be most suitable for bat populations. Explain why this might have a positive effect on the control of WNS in bats. [1]

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

49 In the coastal waters off western North America, there is a starfish species that feeds primarily on mussels, another marine organism. In an experimental area, the starfish were removed from the waters. The effect of this removal is shown in the graph below.



Source: *Biology, 8th Ed.*, Campbell, Reese, et al. Pearson, San Francisco, CA, 2009, p. 1208.

What conclusion can be made regarding the role of the starfish in this ecosystem?

- (1) The biodiversity of this ecosystem increased within ten years as organisms adjusted to the loss of the starfish.
- (2) The starfish is important in maintaining the biodiversity of this ecosystem.
- (3) When the starfish were removed, the ecosystem decreased in stability and increased in biodiversity.
- (4) Biodiversity in this ecosystem is not dependent on the presence of starfish.

Base your answers to questions 50 through 52 on the information below and on your knowledge of biology.

Biomass Energy

Biomass is the term for all living, or recently living, materials coming from plants and animals that can be used as a source of energy. Biomass can be burned to produce heat and used to make electricity. The most common materials used for biomass energy are wood, plants, decaying materials, and wastes, including garbage and food waste. Burning the wood and plant matter does produce some air pollutants. Biomass contains energy that originally came from the Sun. Some biomass can be converted into liquid biofuels. These biofuels can be used to power cars and machinery.

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

- 50 In a community, before biomass is widely used as an energy source, several experts, including an ecologist, are hired to provide specific information. The ecologist would most likely be asked about
- (1) the cost of producing the fuel compared with the profit when the fuel is sold
 - (2) whether the fuel will be widely accepted by consumers
 - (3) what effect the production of the fuel will have on the environment
 - (4) the time it will take to produce large amounts of the fuel
- 51 Explain why biomass is considered a renewable energy source. [1]

52 State *one* specific advantage and *one* specific disadvantage of the use of biofuels as an energy source. [1]

Advantage: _____

Disadvantage: _____

Base your answers to questions 53 and 54 on the information below and on your knowledge of biology.

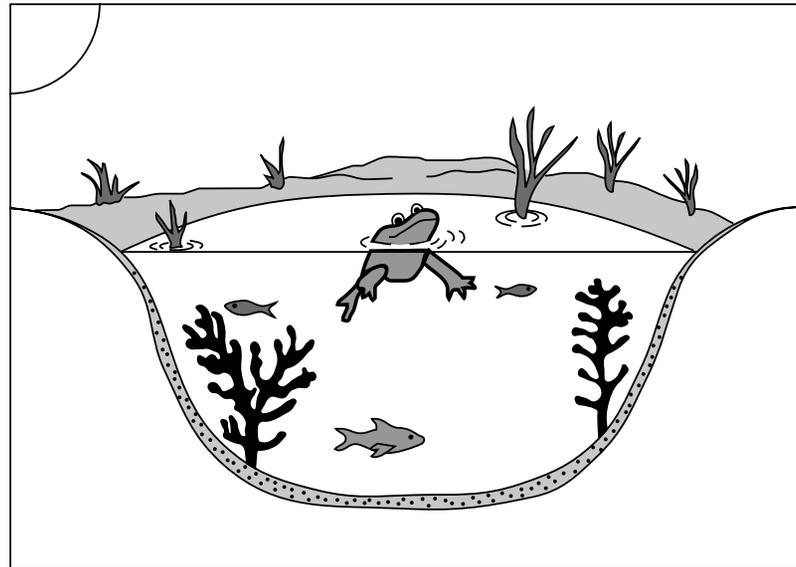
Photosynthesis is a process that is important to the survival of many organisms on Earth.

53 Identify *two* raw materials necessary for photosynthesis. [1]

_____ and _____

54 State *one* reason why photosynthesis is necessary for animals to survive. [1]

55 The diagram below represents a pond ecosystem.



Identify *one* abiotic factor present in the pond ecosystem and explain how this abiotic factor would affect the frogs in the pond. [1]

Abiotic factor: _____

Part C

Answer all questions in this part. [17]

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

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

Bye – Bye Bananas?

The world's most popular type of banana is facing a major health crisis. According to a new study, a disease caused by a powerful fungus is killing the Cavendish banana, which accounts for 99% of the banana market around the globe. The disease, called tropical race 4 (TR4), has affected banana crops in southeast Asia for decades. In recent years, it has spread to the Middle East and the African nation of Mozambique. Now experts fear the disease will show up in Latin America, where the majority of the world's bananas are grown. ...

...Once a banana plant is infected with TR4, it cannot get nourishment from water and nutrients, and basically dies of thirst. TR4 lives in soil, and can easily end up on a person's boots. If the contaminated boots are then worn on a field where Cavendish bananas are grown, the disease could be transferred. "Once a field has been contaminated with the disease, you can't grow Cavendish bananas there anymore," Randy Ploetz [scientist] says. "The disease lasts a long time in the soil." ...

...But Cavendish [banana] is also particularly vulnerable to TR4. The banana is grown in what is called monoculture. "You see a big field of bananas and each one is genetically identical to its neighbor" Ploetz says. "And they are all uniformly susceptible to this disease. So once one plant gets infected, it just runs like wildfire throughout that entire plantation." ...

Source: <http://www.timeforkids.com/new/bye-bye-bananas/3311666>

56 State how the TR4 fungus threatens homeostasis within the banana plant. [1]

57 Explain why the entire Cavendish banana crop worldwide is particularly vulnerable to the TR4 fungus. [1]

58 If the fungus cannot be stopped by chemical treatment of the soil, describe *one* other possible way that the growers may be able to combat the disease. [1]

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

Lead Poisoning

Two pathways by which lead can enter the human body are ingestion and inhalation. Once in the bloodstream, lead is distributed to parts of the body including the brain, bones, and teeth.

One reason that lead is toxic is that it interferes with the functioning of a variety of enzymes. It acts like metals such as calcium and iron and replaces them, changing the molecular structure of these enzymes. In the case of calcium, lead is absorbed through the same cell membrane channels that take in calcium.

Lead affects children and adults in different ways. Even low lead levels in children can cause many different problems, including nervous system damage, learning disabilities, decreased intelligence, poor bone growth, and death. In adults, high levels of lead can cause hearing problems, memory and concentration problems, muscle and joint pain, brain damage, and death. It wasn't until 1971 that steps were taken against the use of lead with the passage of the Lead Poisoning Prevention Act. However, lead is still a public health risk today.

- 59 It is recommended that children eat foods high in calcium and iron as a way to reduce the accumulation of lead in their cells and enzymes. Explain why this is a scientifically valid recommendation. [1]

60 Describe how the presence of lead in body cells could interfere with the ability of enzymes to function. [1]

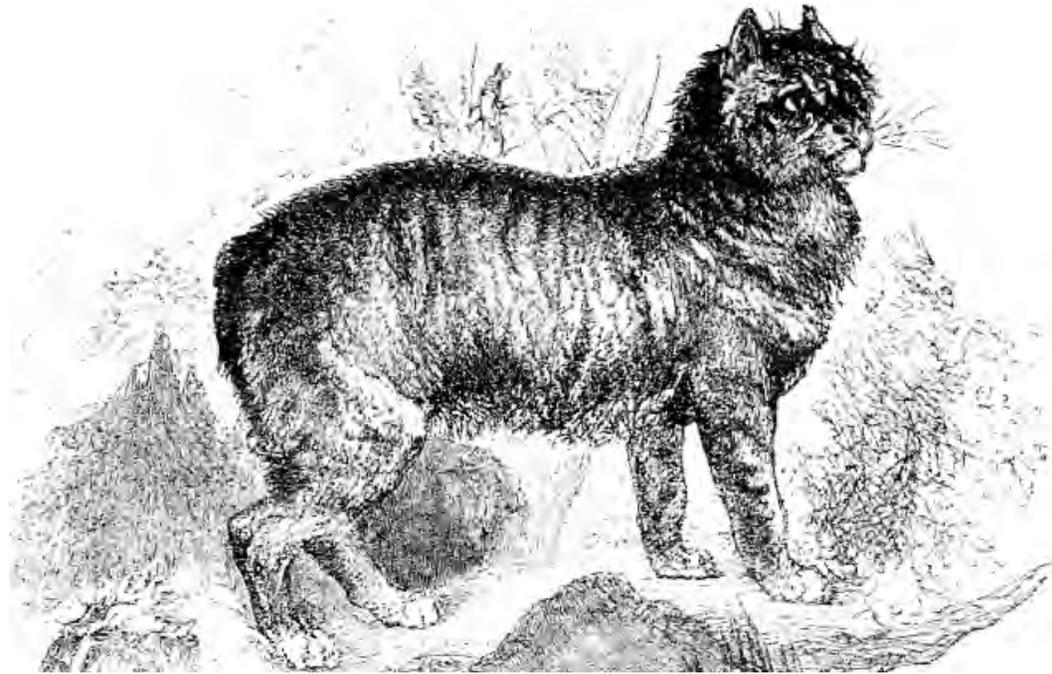
61 Based on the parts of the body that are most affected by lead intake, identify *one* type of cell that would be expected to have numerous calcium channels. Support your answer. [1]

Type of cell: _____

Support: _____

Base your answers to questions 62 and 63 on the illustration and passage below and on your knowledge of biology.

The Telltale DNA of Manx Cats



Source: [http://commons.wikimedia.org/wiki/File:Manx cat \(stylizes\) 1885.jpg](http://commons.wikimedia.org/wiki/File:Manx_cat_(stylizes)_1885.jpg)

A few breeds of cat have no tails. Manx cats have extremely short tails and may even appear to have no tail at all. Manx cats were first discovered several hundred years ago.

Scientists have determined that a certain mutation in a group of genes (called T-box genes) interferes with the development of the spine in the cat embryo. Mutations in these T-box genes can cause abnormalities in the number, shape, and/or size of bones in the spines of Manx cats, which results in smaller spines and shorter tails.

If a Manx cat inherits one copy of the mutated T-box gene and one copy of the normal gene, it will have a very short tail or no tail at all.

If the cat embryo inherits two copies of these mutated genes, it will stop developing and die. Therefore, all surviving Manx cats have only one copy of the mutated gene.

62 State *one* reason why the mutation in Manx cat embryos causes them to have such very short tails. [1]

63 Two Manx cats have several litters of offspring. Explain how the genes that the kittens inherit determine whether they will have a normal tail or a short tail. [1]

Base your answer to question 64–66 on the passage below and on your knowledge of biology.

Hummingbirds Are Sugar Junkies



Source: <http://bug-bird.com/hummingbirds-large-images/>

Most humans enjoy candy, cake, and ice cream. As a result of evolutionary history, we have a wide variety of tastes. This is not true of all animals. Cats do not seek sweets. Over the course of their evolutionary history, the cat family tree lost a gene to detect sweet flavors. Most birds also lack this gene, with a few exceptions. Hummingbirds are sugar junkies.

Hummingbirds evolved from an insect-eating ancestor. The genes that detect the savory flavor of insects underwent changes, making hummingbirds more sensitive to sugars. These new sweet-sensing genes give hummingbirds a preference for high-calorie flower nectar. Hummingbirds actually reject certain flowers whose nectar is not sweet enough!

Base your answers to questions 67 through 70 on the information below and on your knowledge of biology.

Folic acid is a type of vitamin that is essential for the normal growth and development of cells in the body. If a woman consumes folic acid in her diet before and during the earliest stages of pregnancy, it can help to reduce her baby's risk for developing a type of birth defect called a neural tube defect. Early in pregnancy, the neural tube forms the brain and spinal cord. If the neural tube does not form properly, serious birth defects may result.

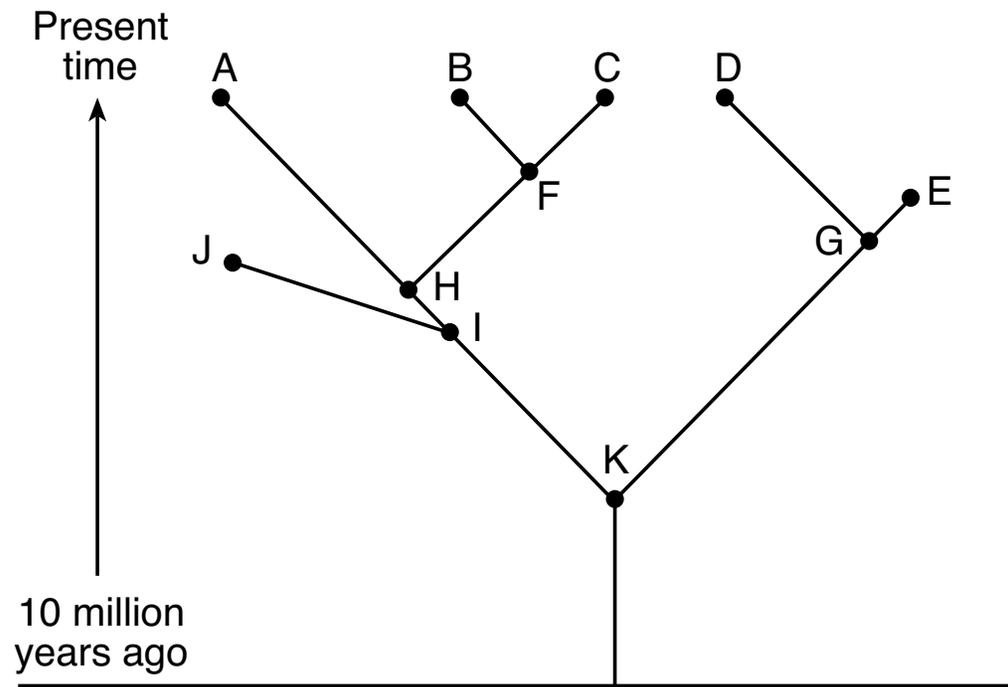
67 Explain why taking folic acid early in pregnancy is important to the prevention of neural tube defects. [1]

68 Describe how a fetus receives folic acid and other essential materials directly from its mother for its development. [1]

69 Identify *one* factor, other than a lack of folic acid, that may interfere with the proper development of essential organs during pregnancy. [1]

70 Many foods, such as breads, cereals, pastas, and rice, are fortified or enriched with folic acid. Explain why adding folic acid to foods is an advantage to people other than pregnant women. [1]

Base your answers to questions 71 and 72 on the diagram below and on your knowledge of biology. The diagram represents an evolutionary tree.



71 Are species *A* and *B* more closely related than *A* and *D*? Circle yes *or* no and support your answer with information from the diagram. [1]

Circle one: Yes *or* No

72 State *one* possible cause for the extinction of species *E*. [1]

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Part D

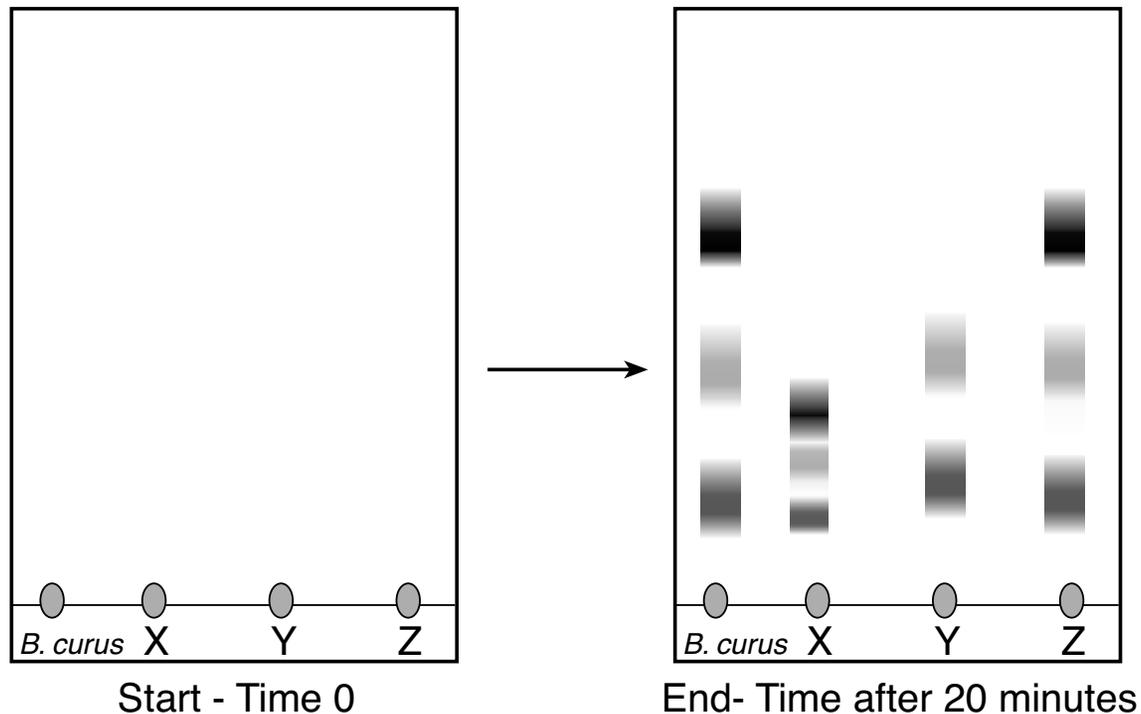
Answer all questions in this part. [13]

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.

Base your answer to question 73 on the information and diagram below and on your knowledge of biology.

During the *Relationships and Biodiversity* lab, simulated pigments from three plant species were compared to those in *Botana curus*. The results were similar to those represented below.



73 Based on the results of this comparison alone, is there enough information to conclude which of the other three species is most closely related to *Botana curus*?

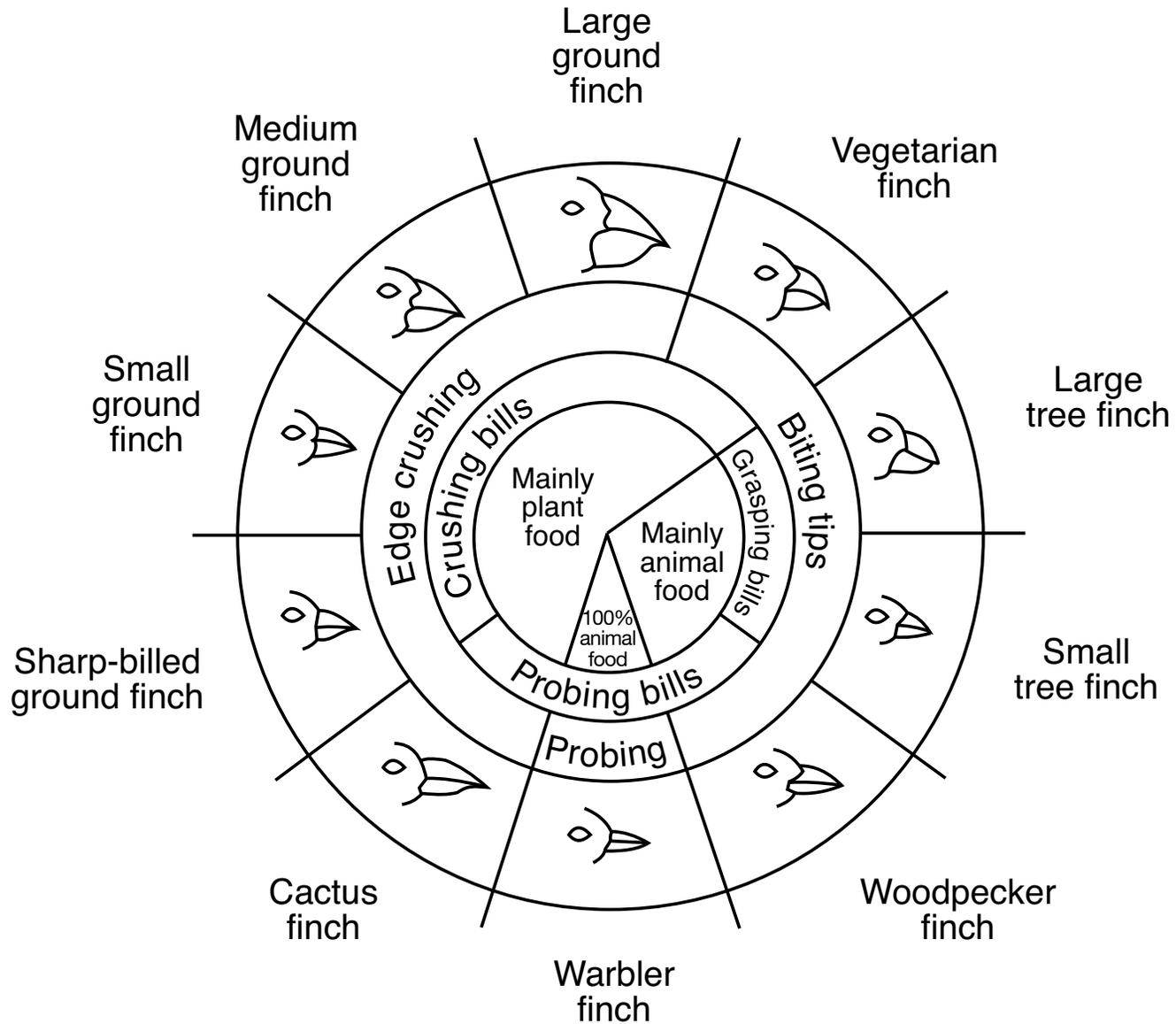
- (1) Yes. Only species X has the same bands as *Botana curus*.
 - (2) Yes. Species Z has only two of the bands that *Botana curus* has.
 - (3) No. Additional tests should be done to test for other chemical similarities.
 - (4) No. Other rainforest plant species should be tested.
-

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

Base your answer to question 74 on the diagram below and on your knowledge of biology.

Variations in Beaks of Galapagos Islands Finches



74 Insects can get diseases just like other organisms. A deadly bacteria infected the insects on one Galapagos Island. Among the birds living there, the finches most likely to experience a drastic *decrease* in population size would be the

(1) warbler finches

(3) large ground finches

(2) cactus finches

(4) medium ground finches

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

75 A variety of species of Galapagos finches evolved from one original species long ago through the process of

(1) asexual reproduction

(3) natural selection

(2) ecological succession

(4) selective breeding

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

76 If scientists want to determine the similarities in the DNA fragments in several plant species, they should

(1) add salt water to cells from each plant

(3) compare seed structures of the plants

(2) analyze electrophoresis results

(4) examine their chromosomes with a microscope

77 One coach of an Olympic rowing team makes his athletes warm up by doing 30 minutes of stretching and jogging in place before practicing each day. Another coach suggests that resting before practicing will result in better performance by her team. They decide to conduct an experiment to see which practice is correct. One team rests before practice, the other team warms up for thirty minutes, and they then record the time that it takes each team to row a specific distance. Identify the dependent variable in this experiment. [1]

78 A student squeezes a clothespin 82 times in a minute. Then, using the same hand and the same clothespin, he squeezes the clothespin 68 times in a minute. State *one* biological reason for the decrease in the number of squeezes during the second trial. [1]

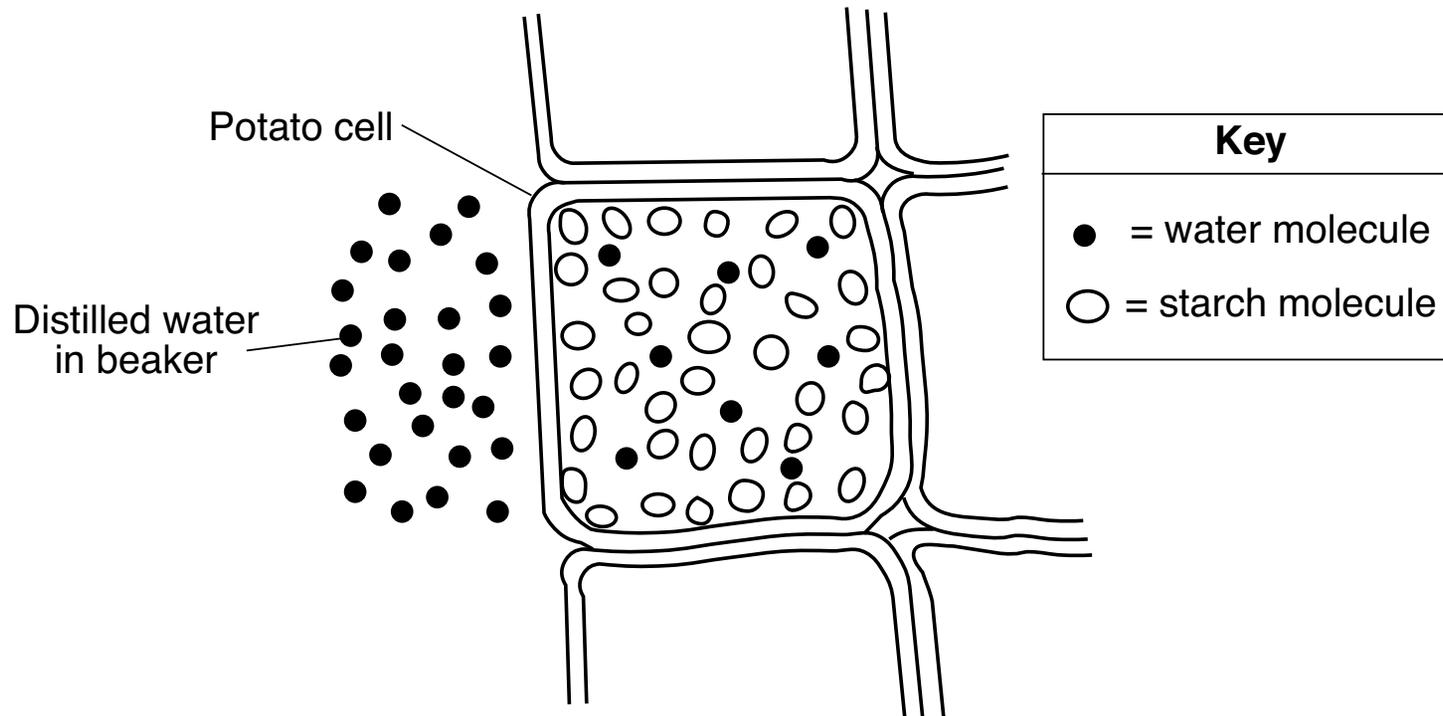
79 During rest, an adult's heart rate averages 60-100 beats per minute. When exercising, an adult's heart rate may increase to 100-170 beats per minute. State *one* reason why the heart rate increased during exercise. [1]

80 In some single-celled protozoans living in fresh water, such as the paramecium, contractile vacuoles are organelles used to pump excess water out of the cell. Explain why a paramecium would require contractile vacuoles while a similar protozoan living in salt water would *not*. [1]

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Base your answers to questions 81 through 83 on the information and diagram below and on your knowledge of biology.

A cube cut from a potato is placed in a beaker of distilled water. The potato cells have a relatively high concentration of starch and a relatively low concentration of water. The diagram represents the water and starch molecules in and around one of the potato cells in contact with the water in the beaker.



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

81 Which row in the chart correctly describes what would be expected to occur in the potato cells, with regard to both the starch and water molecules?

Row	Water	Starch
(1)	More water will move into the cell than will leave the cell.	Starch will remain inside the potato cell.
(2)	More water will leave the cell than will enter.	Starch will move out of the cell.
(3)	Water content of the cell will not change.	Starch will move out of the cell.
(4)	More water will leave the cell than will enter.	Starch will remain inside the potato cell.

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

82 Which statement correctly describes a possible result if starch indicator is added to the water in the beaker one hour after the potato cube was added?

- (1) The indicator solution would turn to an amber color in the water if starch molecules were present in the water in the beaker.
- (2) The indicator would remain amber in color if starch molecules were not present in the water in the beaker.
- (3) The indicator would change to a black color if starch molecules were not present in the water in the beaker.
- (4) The indicator solution would remain black in color if starch molecules were present in the water in the beaker.

83 Before placing the potato in the beaker, the student used an electronic balance to determine the mass of the potato cube. The mass of the cube was determined again after it was in the beaker for an hour. Describe how this information could specifically be used to determine if water moved during the investigation. [1]

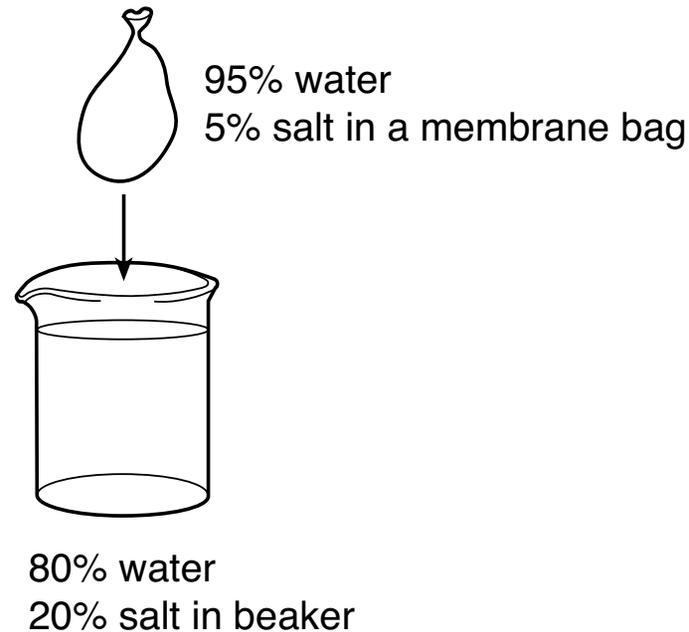
84 Select *one* row in the chart below and explain how the systems in that row work together during exercise. [1]

	System	System	System
Row 1	Respiratory	Circulatory	Muscular
Row 2	Muscular	Circulatory	Excretory
Row 3	Digestive	Circulatory	Muscular

Row: _____

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

In an experiment, a membrane bag containing 95% water and 5% salt was placed in a beaker containing 80% water and 20% salt, as shown below. The setup was put aside until the next day.



85 Based on the information given, state *one* way the bag or its contents will have changed by the next day. Support your answer with an explanation. [1]
