

LIVING ENVIRONMENT

Tuesday, January 24, 2023 — 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 The removal of mitochondria from a typical animal cell would have an immediate effect on the cell's production of

- (1) DNA
- (2) oxygen
- (3) ATP
- (4) glucose

2 Which factor would be an abiotic limiting factor for fish living in a lake in New York State?

- (1) amount of algae
- (2) number of humans fishing
- (3) number of fish predators
- (4) acidity of the water

3 A native species is competing for resources with a nonnative species that was accidentally introduced into the area. The nonnative species is more likely to survive than the native species when

- (1) both species eat the same food
- (2) predators prey on both species
- (3) the native species is immune to a particular pathogen present in the ecosystem
- (4) the nonnative species has no natural enemies present in the ecosystem

4 Evidence suggests that a large meteorite hit Earth 65 million years ago, causing a layer of dust to block the Sun, cooling the planet. It is estimated that 70% of all plant and animal species, including the dinosaurs, died off as a result. The best explanation for the deaths of these organisms is that

- (1) consumers require sunlight to make sugars in order to survive
- (2) the amount of energy available to the biosphere was decreased
- (3) energy is produced only by plants
- (4) all animals eat plants for energy

5 DNA is formed using four kinds of base subunits. In a double-stranded segment of DNA, the percentage of the base C is 18%. What is the approximate percentage of base T?

- (1) 18%
- (2) 32%
- (3) 36%
- (4) 64%

6 Students were studying the different species of organisms in two different pond ecosystems. Their findings are summarized in the chart below.

**Species Present in
Two Pond Ecosystems**

	Plant Species	Microorganism Species
Pond A	10	20
Pond B	11	5

Based on the information in the chart, how does the biodiversity present in pond A compare to the biodiversity present in pond B?

- (1) Pond A has greater biodiversity than pond B because there are more species present.
- (2) Pond B has more biodiversity than pond A because there are more plants present.
- (3) Both ponds have the same levels of biodiversity because there is a variety of species present.
- (4) The biodiversity cannot be determined without also identifying the abiotic factors present.

7 When a person receives a transplanted organ, many medications are necessary to keep the organ from being rejected. The process of organ rejection is similar to the one involved in

- (1) the growth of cancerous tissue
- (2) an allergic reaction
- (3) a genetic mutation
- (4) the production of an antigen

8 *Hydrilla*, a plant native to Central Africa, was widely used in home aquaria. *Hydrilla* was often dumped with aquarium water into drains, sewers, or ponds. It then thrived and has become an invasive species, disrupting aquatic ecosystems from Florida through the northeast United States. Removing *Hydrilla* from these ecosystems will most likely require either physically removing it or adding chemicals to the affected waters to kill it.



Source: South Carolina Department of Natural Resources

The result of the introduction of *Hydrilla* into native ecosystems in the United States has shown that

- (1) chemical controls will now be necessary to maintain every stable ecosystem
- (2) *Hydrilla* will not continue to expand beyond one year because it is not native to the United States
- (3) organisms in ecosystems of the United States can eventually build up an immunity to *Hydrilla*
- (4) when humans alter ecosystems by adding specific organisms, serious consequences can result

9 One result of the ability of organisms to detect and appropriately respond to stimuli is

- (1) an organ malfunction
- (2) an allergic reaction
- (3) dynamic equilibrium
- (4) gene manipulation

10 The tube-lipped nectar bat, found in Madidi National Park in Ecuador, has the longest tongue in relation to its size of any mammal. Its 8.5 cm tongue can reach into the deepest flowers.



Source: <http://www.wild-facts.com/>
2013

It is likely that the population of these bats with exceptionally long tongues will increase in the Madidi National Park ecosystem if

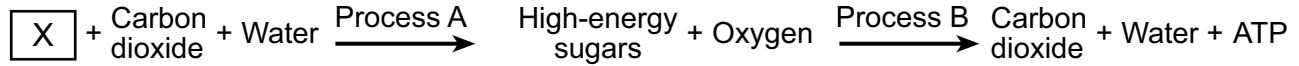
- (1) the population of plants with very deep flowers suffers a sharp decrease in number
- (2) the gene for the long tongue trait cannot get passed on to future generations of nectar bats
- (3) other mammal species with long tongues move into the area and increase competition
- (4) the tongue variation provides the species with an advantage in surviving and reproducing

11 Some organisms have variations. Two sources of these variations are

- (1) mitotic and meiotic cell division
- (2) mutations and recombination
- (3) cloning and sexual reproduction
- (4) natural selection and evolution

- 12 In order to prepare for a future outbreak of Ebola, a harmful virus, two vaccines were tested. In order for either of these vaccines to be effective, they must
- (1) cause the immune system to produce special proteins that will recognize and destroy the virus
 - (2) be able to destroy the DNA code that produces white blood cells that can carry the virus
 - (3) stimulate the human body to produce antigens that can attach to and destroy the Ebola virus
 - (4) produce bacterial cells that can attack the Ebola virus
- 13 The population of reindeer has been decreasing over the last 20 years in the Arctic because climate change has led to more rainfall there. The rain freezes on top of the snow, preventing the reindeer from getting through the snow to find food. Which action by humans has most likely contributed to climate change?
- (1) recycling materials
 - (2) protecting wildlife
 - (3) maintaining the ozone shield
 - (4) burning fossil fuels
- 14 Which statement about the functioning of the human reproductive system is correct?
- (1) The zygote helps the mother provide milk to the fetus before it is born.
 - (2) Testes produce unfertilized eggs and release them so that they can be fertilized by sperm.
 - (3) Ovaries are where male gametes undergo meiosis to reduce their chromosome number.
 - (4) The uterus is where the fetus develops internally until birth.
- 15 A Christmas tree farmer cuts down a native forest to plant Fraser fir trees. Compared to the original forest, the newly planted Christmas tree farm will most likely be
- (1) more stable and more diverse
 - (2) more stable and less diverse
 - (3) less stable and more diverse
 - (4) less stable and less diverse
- 16 A major environmental concern in urban areas is pollution produced by automobiles. Fluids, such as oil and gasoline, may leak out of vehicles and end up in lakes, streams, and rivers. One reason why scientists are concerned about this type of pollution is that
- (1) the presence of these fluids in waterways could make them uninhabitable for aquatic organisms and reduce water supplies for humans
 - (2) the addition of these fluids will cause an increase in the levels of lakes and rivers, possibly causing flooding in nearby areas
 - (3) these fluids increase the rate of photosynthesis in aquatic plants, reducing the amount of O₂ available for other life forms
 - (4) the addition of these chemicals to waterways reduces air quality, which would lead to increased respiratory diseases and global warming
- 17 When a plant is in a hot and dry environment, the guard cells may close the stomate openings in the leaves. This action will directly
- (1) maintain homeostasis by reducing the evaporation of water
 - (2) harm the plant by cutting off its oxygen supply
 - (3) maintain homeostasis by preventing carbon dioxide from entering
 - (4) harm the plant by cutting off its energy supply
- 18 Destruction of ocean habitats by pollution today means that the organisms living there may not survive in the future. By polluting the oceans, humans are
- (1) helping advance economic gains by using resources wisely
 - (2) altering the equilibrium of ocean ecosystems
 - (3) decreasing the rate of species extinction
 - (4) increasing the stability of the oceans
- 19 Each of the cells present in a woman contains a complete set of chromosomes. The only exceptions are her
- | | |
|----------------|-----------------|
| (1) skin cells | (3) nerve cells |
| (2) egg cells | (4) lung cells |

20 The diagram below represents two processes that occur in some living organisms.



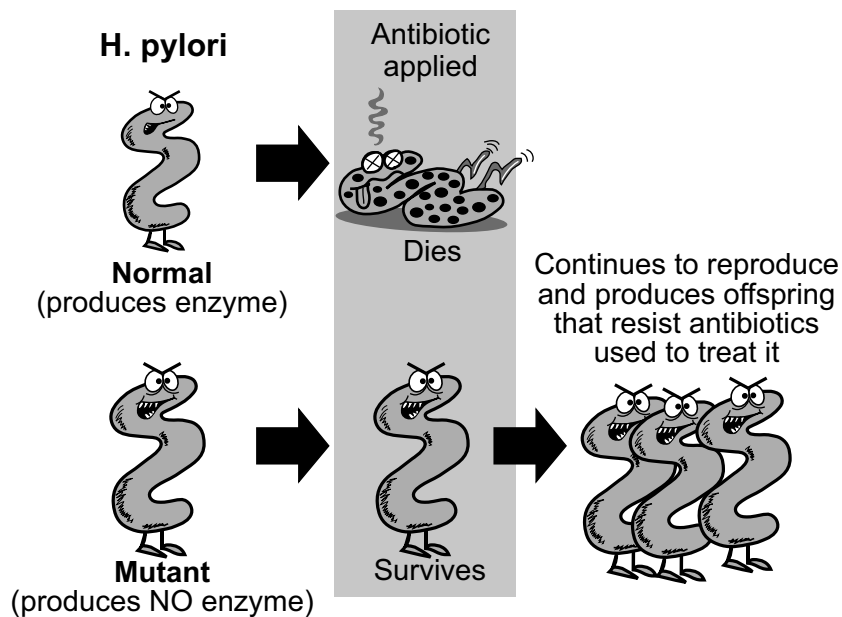
X most likely represents

- (1) the nucleus
- (2) the mitochondrion
- (3) sunlight
- (4) carbohydrates

21 Which row in the chart below contains the correct sequence of events involved in the formation of a human embryo?

Row	Sequence of Events
(1)	meiosis, differentiation, fertilization, mitosis
(2)	differentiation, meiosis, mitosis, fertilization
(3)	fertilization, mitosis, meiosis, differentiation
(4)	meiosis, fertilization, mitosis, differentiation

22 *Helicobacter pylori* (*H. pylori*) is the bacterium responsible for most ulcers and many cases of stomach inflammation. An antibiotic has been found to kill these bacteria. It works because *H. pylori* makes a particular enzyme that happens to react with the antibiotic and makes it poisonous to the bacterium. The sequences in the diagram below show the effects of antibiotic treatment on two strains of *H. pylori*, one of which does not produce the enzyme.



Source: Adapted from <https://econjsun.files.wordpress.com/2011/11/h-pylori.jpg>

The overall series of events best illustrates the process of

- (1) *H. pylori* control by the stomach
- (2) DNA replication in bacterial cells
- (3) mutation of the antibiotic used in the treatment
- (4) natural selection in *H. pylori* bacteria

23 The illustrations below are of an organism called *Archeopteryx*, which lived approximately 150 million years ago. *Archeopteryx* had teeth and claws like a dinosaur and wings with feathers like a bird.

Archeopteryx



Source: The Guardian (online)



Source: <http://www.dinosaurusi.com/en/post/252/flying-dinosaur-pictures---archopteryx/>

Such fossils allow scientists to conclude that

- (1) dinosaurs and birds all ate the same foods
- (2) sexual reproduction in birds resulted in dinosaurs
- (3) dinosaurs and birds share a common ancestor
- (4) dinosaurs and birds belong to the same species

24 Infestation with bedbugs is a serious health problem, and scientists seeking to control bedbug reproduction are constantly researching new options. It has now been shown that freezing any articles of clothing or bedding containing bedbugs at a temperature below -15°C for 3.5 days will kill all of the bedbugs and their eggs.



Source: Science Daily 12/8/13

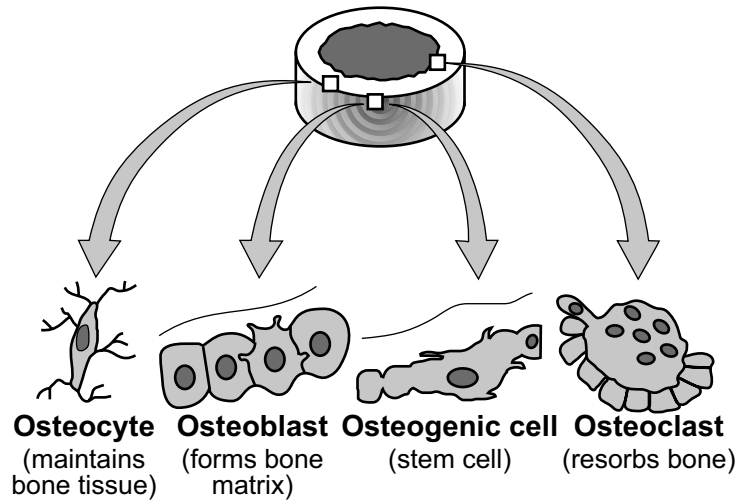
Using the technique of freezing is preferable to using chemical insecticides because a major *disadvantage* of using chemical pesticides is that they

- (1) are highly toxic to the bedbugs, but not toxic to other organisms
- (2) could remain in the clothing or bedding and harm humans later
- (3) are made of molecules so the bedbugs will not develop resistance to them
- (4) could be useful for medical research and should not be wasted on bedbugs

25 Human society has become increasingly dependent on industry and technology. While this has had many benefits, it also has had the *disadvantage* of

- (1) reducing the amount of food that can be produced by one acre of farmland
- (2) lowering the level of carbon dioxide available for plants to use for photosynthesis
- (3) raising the number of producers worldwide to dangerous levels
- (4) increasing our reliance on energy sources such as fossil fuels

26 Within a specific kind of tissue, there are different types of cells. In bone tissue, there are four different cell types, as shown below.



Source: <https://www.boundless.com/biology/textbooks/boundless-biology-textbook/the-musculoskeletal-system-38/bone-216/cell-types-in-bones-816-12058/>

Since the four types of cells contain the same genetic instructions, how is it possible for them to have different shapes and carry out different functions?

- (1) Each cell type has the ability to remove unnecessary DNA sequences.
- (2) Different parts of the genetic code may be used in each of the cell types.
- (3) Different gene mutations take place within each cell type.
- (4) Each cell type is the result of different methods of cell division.

27 The series of fossil snail shells below represents 10 samples that were collected from deposits laid down from 10 million years ago to 3 million years ago. The shells are arranged in order by age. The shells shown represent how they looked at various times over a 7-million-year period.



Source: Life, The Science of Biology, Second Ed., Purves and Orians, Sinauer Associates 1987

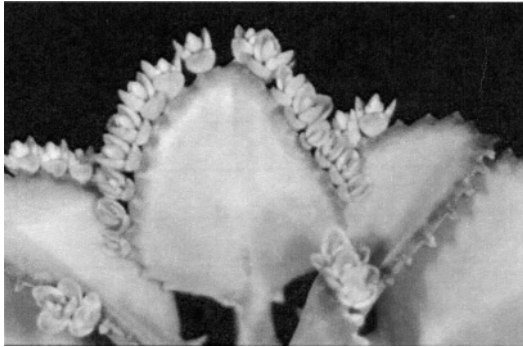
It would be most accurate to conclude that the snails of this species

- (1) changed in size due to environmental changes that affected the survival of different-sized snails
- (2) grew smaller, then larger over time as the environment changed from a wetter to a drier climate
- (3) changed in size at different times, because they needed better protection from predators
- (4) grew larger because, as organisms evolve, they always become larger and more complex

28 When a person is threatened, the pituitary gland releases a hormone that stimulates the adrenal glands to release stress hormones. These stress hormones can cause a temporary increase in heart rate. This is an example of

- (1) an enzyme interaction
- (2) a feedback mechanism
- (3) an immune-system response
- (4) an allergic reaction

29 A plant commonly referred to as “Mother of Thousands” has lost its ability to produce seeds. In order to reproduce, the edges of the plant’s leaves asexually develop miniature plants that drop off and grow into mature plants.

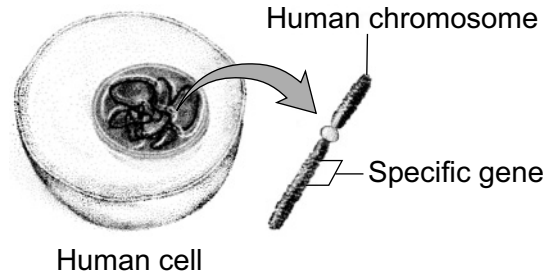


Source: <http://www.guide-to-houseplants.com/mother-of-thousands.html>

The cells of the offspring would have

- (1) half the genetic information, when compared to cells of the parent plant’s leaves
- (2) the same genetic information, when compared to cells of the parent plant
- (3) twice as much genetic information as is present in the cells of the parent plant
- (4) incomplete genetic information, because the parent plant does not produce seeds

30 The diagram below represents part of a biological process that begins with a chromosome containing a specific human gene being removed from a human cell.



Human cell
Source: Adapted from *Biology, Ninth Ed.* Sylvia Mader. McGraw-Hill, Higher Education, Boston, 2007, p.268

The overall process is important because it

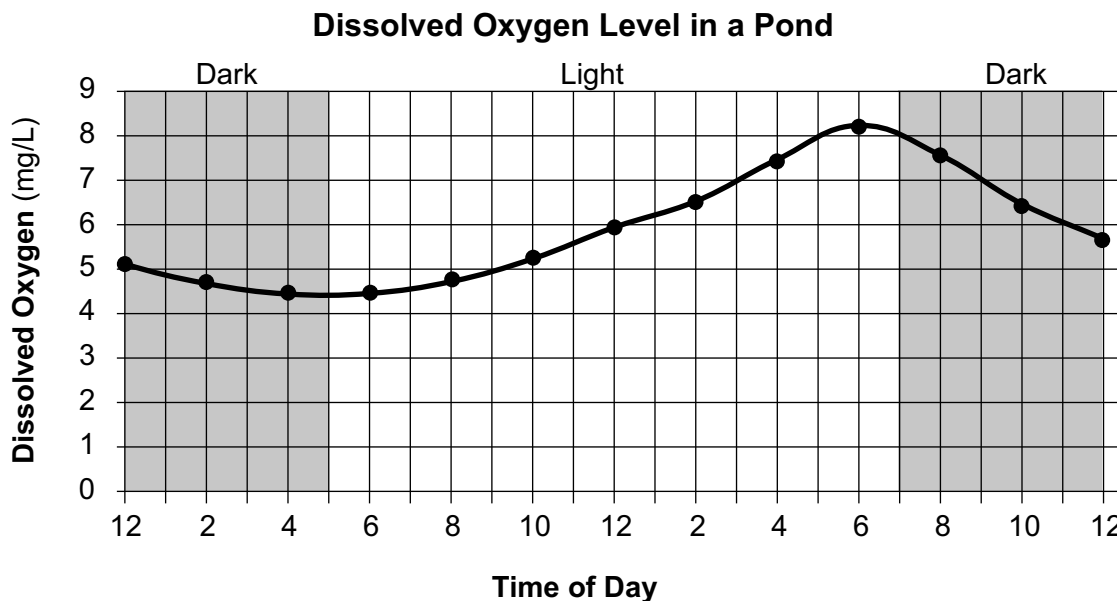
- (1) may be used to make human DNA identical to that of other organisms
- (2) helps scientists understand how amino acids are grouped together to form a genetic code
- (3) results in the production of carbohydrates that cannot mutate and cause disease
- (4) may be used to produce chemicals that can be used to treat certain human disorders

Part B-1

Answer all questions in this part. [13]

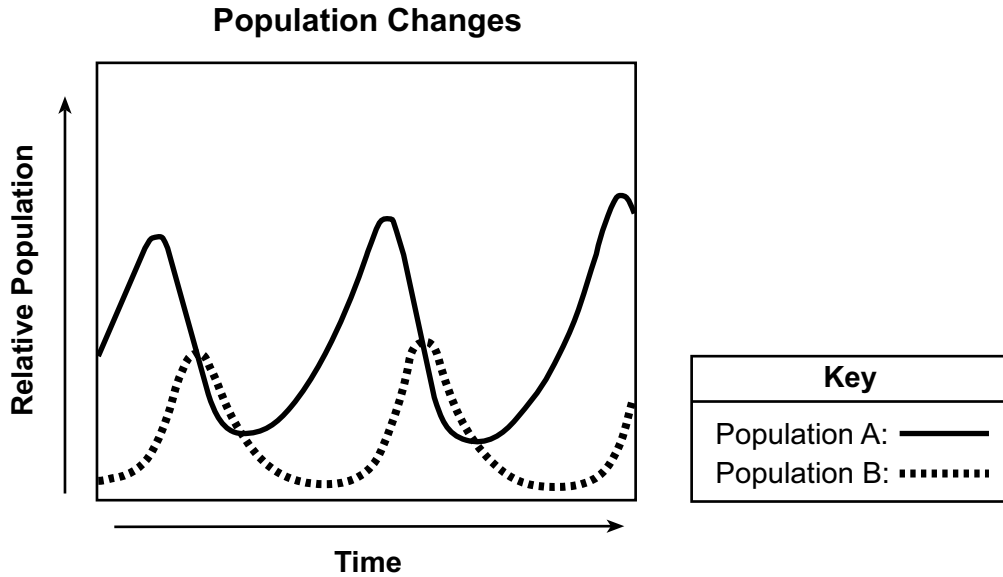
Directions (31–43): For *each* statement or question, record on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question.

Base your answers to questions 31 and 32 on the information and graph below and on your knowledge of biology. The graph below shows changes in dissolved oxygen in a pond in the summertime over a 24-hour period.



- 31 What is the most likely reason for the variation in the dissolved oxygen levels in the pond over the 24-hour period?
- (1) The increased light during the day decreases the oxygen produced by photosynthesis.
 - (2) Photosynthesis produces more oxygen during the day than is used by respiration.
 - (3) Respiration is reduced at night, so the oxygen produced by photosynthesis increases.
 - (4) More producers are active at night, so the dissolved oxygen increases.
- 32 A large population of fish was introduced into the pond. During which part of the day would these fish affect the dissolved oxygen level in the pond?
- (1) both day and night, because respiration is occurring all the time in plants and animals
 - (2) nighttime, because no respiration is occurring
 - (3) daytime, because that is when plants are most active
 - (4) neither day nor night, because only plants produce oxygen
-
- 33 An enzyme that rapidly breaks down a protein molecule in the stomach may break down that same protein much more slowly in the small intestine or mouth because
- (1) the enzyme is digested in those locations
 - (2) no protein molecules are located in the small intestine or the mouth
 - (3) the enzyme changes to fit different molecules in different locations
 - (4) the stomach may have a more suitable environment for the enzyme to work

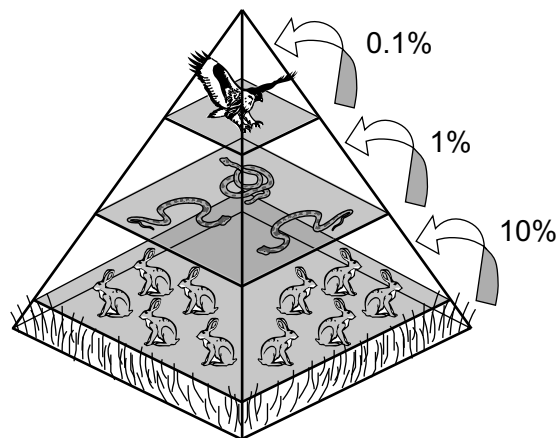
34 A graph of population changes of two animal species over time is shown below.



Using the information on the graph, what is the most likely relationship between these two populations?

- (1) predator/prey
- (2) parasite/host
- (3) consumer/decomposer
- (4) pathogen/host

Base your answer to question 35 on the information and diagram below and on your knowledge of biology. The diagram represents the energy relationships in a forest ecosystem.



Source: Adapted from <http://www.sky-hunters.org/Presentations.html>

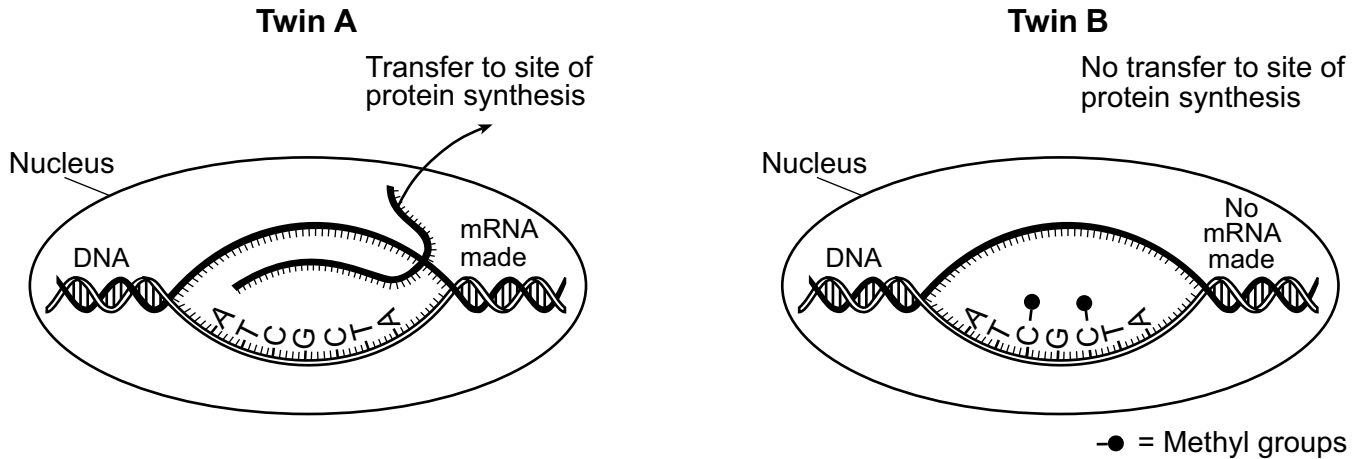
35 The best explanation for the *decrease* in the amount of energy available as one moves up the pyramid is that

- (1) producers require more energy than consumers to survive
- (2) decomposers recycle nutrients at each level
- (3) much of the energy at each level is lost as heat
- (4) animals use less energy than plants

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

Epigenetics

The field of epigenetics is the study of changes in gene expression due to factors other than a change in the DNA sequence. One factor that can change gene expression is the attachment of a chemical, called a methyl group, to the DNA molecule. This attachment prevents that gene from being expressed, thereby altering that trait. Due to epigenetic effects, even identical twins may not be as identical as was once thought. The diagram below shows the DNA sequence of a gene present in a pair of identical twins. Twin B's gene shows an epigenetic effect.



- 36 Researchers have shown that environmental factors, such as exposure to toxins, can bring about epigenetic effects. This research suggests that an organism's traits
- (1) are always determined by its DNA sequences
 - (2) are only determined by environmental effects
 - (3) can be influenced by environmental factors
 - (4) alter half of the DNA they inherited from their parents
- 37 Based on the diagram, an explanation for why these identical twins are *not* identical in all traits is that
- (1) twin A can synthesize a protein resulting in a particular trait and twin B cannot
 - (2) twin B can express a gene that twin A cannot
 - (3) they have different DNA sequences for this particular gene
 - (4) they were formed from the fertilization of two different eggs by two different sperm

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

Copy Cat

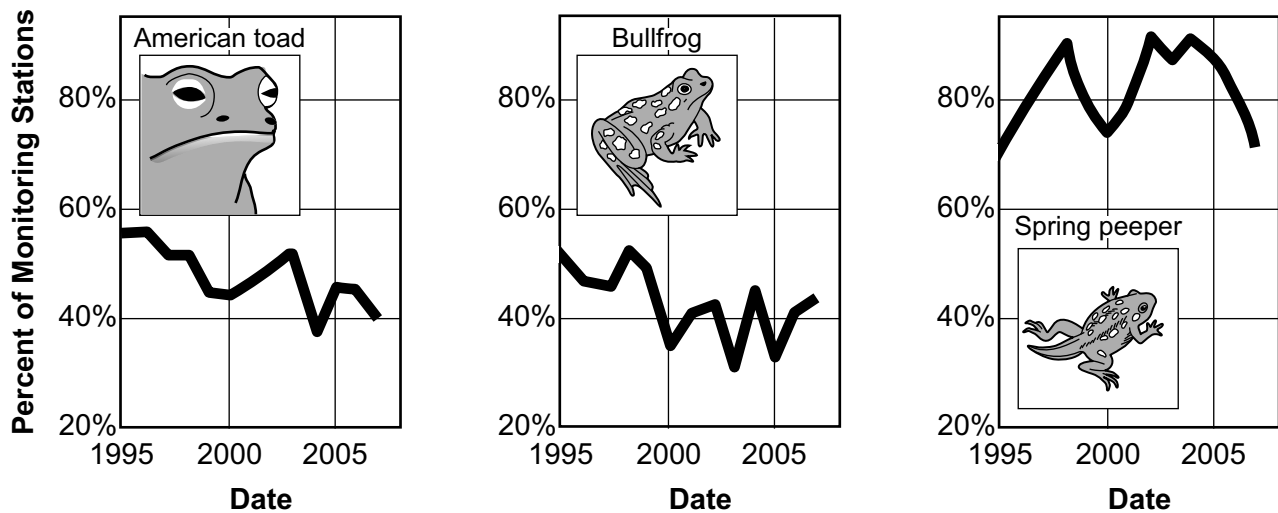
In February 2002, Cc — the first-ever cloned cat — was introduced to the public by researchers at Texas A&M University. The kitten had been born December 22, 2001, but announcement of the successful cloning was delayed until the animal had completed its shot series and its immune system was fully developed. In the cloning process, DNA [the nucleus] was transplanted from the 2-year-old donor mother cat into an egg cell whose nucleus had been removed. This embryo then was implanted into the surrogate mother cat. ...

Source: *Discover Science Almanac*. 2003:452-453. Editors of *Discover Science Magazine*. Stonesong Press: New York, NY.

- 38 Which statement represents an explanation for why it is necessary to remove the nucleus from the egg cell used during the cloning process?
- (1) If the egg cell nucleus remains in the cell, then there will be three copies of all cat chromosomes in the cloned cat.
 - (2) If the egg cell nucleus is not removed, it will be impossible to predict the color of the cloned cat.
 - (3) Removing the egg cell nucleus from the egg cell will cause the cell to become a body cell.
 - (4) If the egg cell nucleus is not removed, then the cloned cat will always develop into a male.
- 39 If a donor cat was black and the surrogate mother was white, then the cloned cat would likely be
- (1) white, due to the color of the surrogate mother cat
 - (2) white, due to mutations of the cloned cat
 - (3) black, due to having the same DNA as the donor cat
 - (4) black and white, due to mixing of the genes of the two cats during the cloning process
-
- 40 Bacteria reproduce asexually by a process known as binary fission. In binary fission, the bacterium's single chromosome is copied and the cell splits in half, with each new cell receiving a copy of the chromosome. The biggest advantage that binary fission often has over sexual reproduction is that
- (1) there is more genetic variety in the resulting cells
 - (2) the genetic material comes from two parents
 - (3) the offspring inherit only favorable genes
 - (4) a large number of identical offspring are produced
- 41 For years, scientists believed that flight evolved when ancestral birds climbed trees and then glided back to the ground. Recent fossil evidence suggests that flight may have evolved from the ground up, as early birds used to jump off the ground as a way to avoid predators. These discoveries suggest that
- (1) scientists use only fossil evidence to study flight
 - (2) scientific understandings can change as new information becomes available
 - (3) most birds avoid predators by jumping off the ground into the air
 - (4) ancestral birds always climbed trees

- 42 Colombia is a country in South America that grows and exports a large portion of the coffee that is used by Americans. A group of scientists in Colombia conducted an experiment on the effects of coffee on the development of Alzheimer's disease in elderly people. Their conclusion was that drinking coffee every day will decrease the occurrence of Alzheimer's disease, and they recommended that Americans drink coffee several times a day. In order to evaluate this conclusion and before they encourage Americans to drink more coffee, scientists in the United States should
- (1) conduct their own experiments to see if they arrive at the same conclusion
 - (2) go to Colombia and see how the coffee is grown
 - (3) provide coffee to people with Alzheimer's and see if it cures their disease
 - (4) construct a data table to test the hypothesis
- 43 The graphs below display the percent of monitoring stations where three different amphibian species were seen. The data were collected between 1995 to 2007 in the wetlands surrounding the Great Lakes.

Percent of Monitoring Stations Reporting Amphibians in the Great Lakes Basin



Source: Adapted from <http://www.biodivcanada.ca/default.asp?lang=En&n=3AF43Cbb-1>

Which claim is best supported by the data represented in the graphs?

- (1) The American toad population increased by approximately 57% in 1995 and 40% more in 2007.
- (2) The bullfrog population decreased every year between 1995 and 2005.
- (3) The spring peeper population is at about the same level in 2007 as it was in 1995.
- (4) All three amphibian populations were infected by a parasite in 2003.

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 and data table below and on your knowledge of biology.

Protecting Nesting Habitats

Sea turtles repeatedly return to the same beach to nest and there is no parental care once the eggs have been deposited in the nest. Therefore, the characteristics of the nest determine whether the eggs will survive or not. The mother turtle must choose her nest site carefully. Nests farther inland are more likely to dry out, and due to the distance that the hatchlings have to travel to reach the sea, there is a greater chance that they will be preyed upon. Nests too close to the sea are more likely to be damaged by erosion or flooding.

Two endangered turtle species are regularly found around Akumal, a popular tourist destination in the Caribbean. The local beaches are an important nesting ground for the loggerhead turtle and green turtle. The beaches are managed by a local organization that makes daily patrols to locate turtle nests and place protective barriers around them. Night patrols ensure that turtle nests are not disturbed by tourists. Local residents have agreed to minimize light pollution by closing all shops, bars, and restaurants before 11 p.m., and local fishermen and tour boats avoid areas of sea grasses that are roped off, so that feeding turtles will not be disturbed.

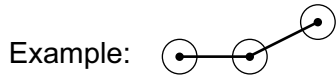
The data table below shows the results of efforts to increase the numbers of loggerhead and green turtles.

Turtle Hatching Success

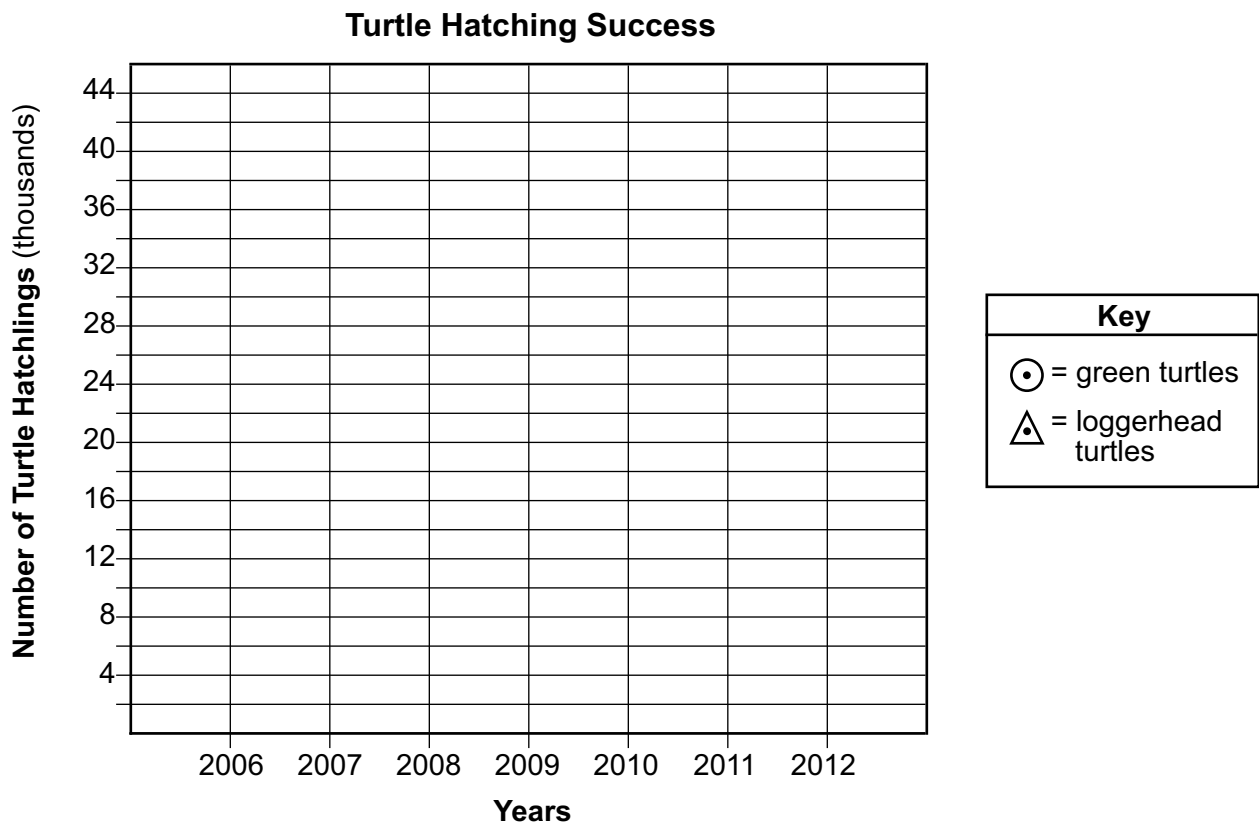
Year	Number of Turtle Hatchlings (in thousands)	
	Green Turtles	Loggerhead Turtles
2006	8	4.5
2007	6	8
2008	18	10
2009	11	9
2010	29	8
2011	23	10
2012	43	14

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

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



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

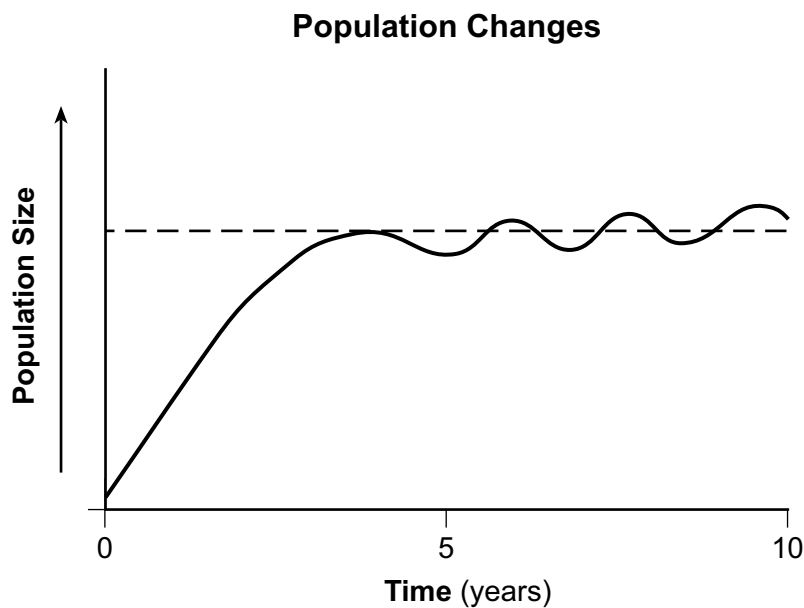


46 Based on the information and data provided, identify which turtle population is having the most success in rebuilding their numbers. Support your answer. [1]

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

- 47 A trade-off was made by the local population that has increased the number of turtles in the area. Which statement best describes the trade-off?
- (1) Placing barriers around the turtle nests made it easier for tourists to find and photograph them.
 - (2) The night patrols kept tourists from raiding the turtle nests and selling the eggs.
 - (3) The shops, bars, and restaurants agreed to close early, even though they could lose customers, so that the turtles could have a better chance to nest successfully.
 - (4) Local fishermen agreed to stay away from certain fishing areas and catch fewer fish so that the tour boats could bring tourists into the sea-grass areas.
-

Base your answers to questions 48 and 49 on the graph below and on your knowledge of biology. The graph shows the changes in a population over a period of 10 years.

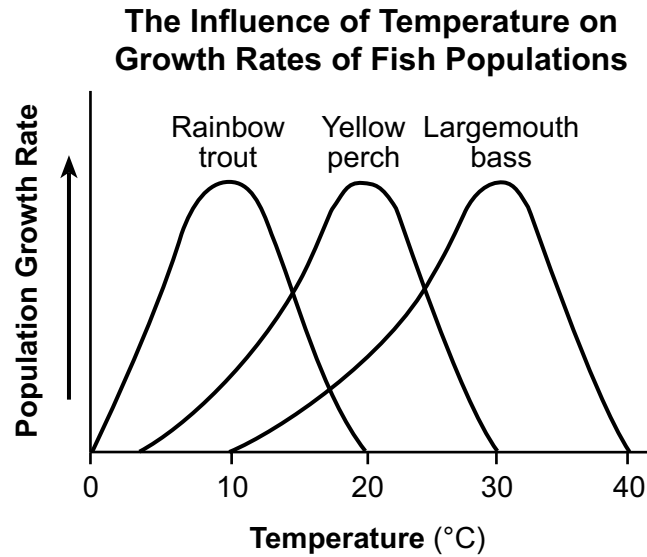


- 48 Explain *one* likely reason for the population-size changes, as indicated by the graph, between years 5 and 10. [1]

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

- 49 One factor that could result in an increase in the population size after year 10 would be
- (1) increased competition within the species
 - (2) additional food became available
 - (3) predators of the species became more numerous
 - (4) a new parasite negatively affected reproduction in the species
-

Base your answers to questions 50 and 51 on the graph below and on your knowledge of biology. The graph shows how the population growth rate of several species of fish is affected by temperature.



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

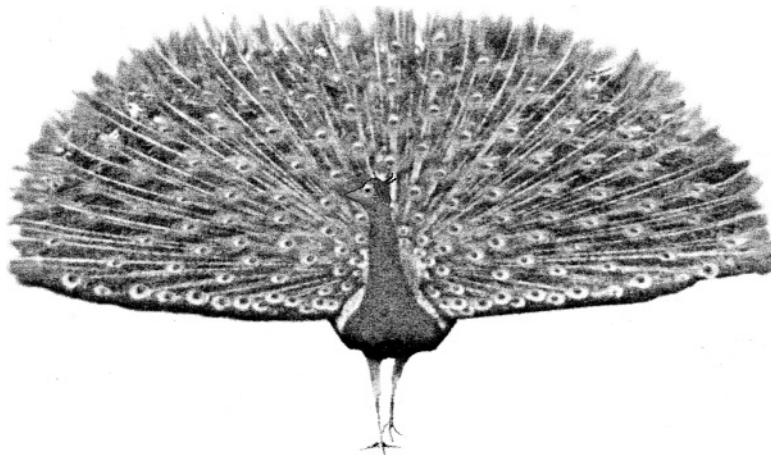
50 What is the most favorable temperature for the growth of the yellow perch population?

- (1) 10°C
- (2) 15°C
- (3) 20°C
- (4) 30°C

51 Several industries use water from a lake to cool their machinery. When this water is returned to the lake, it has been warmed by several degrees. Select *one* of the fish species and describe *one* way that a temperature increase from 20°C to 25°C could affect the growth rate of that species. [1]

Fish species: _____

52 The male peacock, illustrated below, attracts females (peahens) by fanning out his very long tail feathers in an elaborate display. However, the large fan of colorful feathers makes the males more noticeable to predators and makes it difficult for them to escape.



Source: <http://www.pngall.com/peacock-png>

Explain why male peacocks continue to have large tail feathers, even though having the feathers may make them more likely to be killed by predators. [1]

Base your answers to questions 53 through 55 on the information below and on your knowledge of biology.

Proteins are an important part of any diet. Many kinds of food can provide the proteins that we need.

53 State what must happen to protein molecules in food before cells can use them. [1]

54 Identify the structure in a cell where proteins are synthesized. [1]

55 Identify which characteristic of a protein molecule allows it to perform a specific function. [1]

Part C

Answer all questions in this part. [17]

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

Base your answer to question 56–58 on the information below and on your knowledge of biology.

Ecological succession and evolution are both processes that involve changes over time. However, these two processes are very different.

56–58 Explain how ecological succession differs from evolution. In your answer, be sure to:

- describe the specific kinds of changes that occur when ecological succession takes place [1]
- describe *one* way that a population of red foxes could be affected as a result of ecological succession in its habitat [1]
- describe *one* way that a population of red foxes could be changed as a result of evolution [1]

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

Nose Antibiotics

Scientists have found what they think could be an important weapon in the fight against superbugs, and it lives in your nose. A new antibiotic made by nose-dwelling bacteria, *Staphylococcus lugdunensis* (*S. lugdunensis*) has been found to kill drug-resistant MRSA, *Staphylococcus aureus* (*S. aureus*), which kills up to 10,000 people a year in the United States.

As a result of swabbing noses, scientists discovered that MRSA and *S. lugdunensis* are rarely found together. This discovery supports the idea that *S. lugdunensis* helps in fighting off MRSA. This bacterium produces an antibiotic, called lugdunin, which prevents MRSA from growing in Petri dishes. When applied to the skin of mice infected with MRSA, it reduced or eliminated the infection. MRSA shows no sign of antibiotic resistance to lugdunin. Although *S. lugdunensis* is effective in treating MRSA infections, it carries its own risk of causing infections in the heart, joints, skin, and eyes.

Normally, antibiotics are formed by soil bacteria and fungi. The idea that human bacteria may be a source of antimicrobial agents is a new discovery. A new class of antibiotics like this has not been found since the 1980s.

59 State *one* concern that doctors might have about using *S. lugdunensis* to treat MRSA. [1]

60 State *one* way that the antibiotic formed by *S. lugdunensis* is different from most other antibiotics. [1]

61 Describe *one* observation made by scientists that led them to think that lugdunin would be effective against MRSA. [1]

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

Lysosomes–Not Just Garbage Disposals

Lysosomes are cellular organelles that have the ability to break down large organic compounds or old, worn-out cell organelles. Some of the products that are produced as a result of this breakdown process can be reused as building blocks, while other products are released as wastes from the cell.

Recently, studies have shown that lysosomes are more than just garbage disposals. New research has shown that lysosomes have the ability to sense how well-nourished a cell is. If lysosomes detect that there is a lack of nutrients for energy, the organelle prompts the cell to produce more enzymes. These enzymes can break down fat reserves and other cellular materials that could be used as a source of energy. On the other hand, if the cell has an abundance of nutrients, signals are sent from the lysosome that prompt the cell to grow or divide, making more cells.

- 62 Identify *one* life function that lysosomes help the cell carry out, and describe how they help the cell perform this function. [1]

Life function: _____

- 63 Identify *one* additional cell structure and describe how the structure that you have selected interacts with the lysosome to carry out a specific cell function. [1]

Cell structure: _____

Base your answers to questions 64 and 65 on the information below and on your knowledge of biology.

HVTN 702 – A New Vaccine

In November 2016, a new vaccine against HIV was tested in South Africa in a study identified as HVTN 702.

The vaccine has been developed to protect against the HVTN 702 strain that is most common in southern Africa. It is hoped that the new vaccine will provide greater and more long-lasting protection.

64 Explain why most people who are infected with HIV generally do not die from the virus itself, but instead from infections caused by other viruses or bacteria. [1]

65 Describe what a vaccine, such as the one used in the HVTN 702 trial, might contain that would help to prevent an HIV infection in an individual. [1]

Base your answers to questions 66 through 68 on the passage below and on your knowledge of biology.

Frostbite

Frostbite occurs when tissues freeze. This condition happens when you are exposed to temperatures below the freezing point of skin.

...In conditions of prolonged cold exposure, your body sends signals to the blood vessels in your arms and legs telling them to constrict (narrow). By slowing blood flow to the skin, your body is able to send more blood to the vital organs, supplying them with critical nutrients, while also preventing a further decrease in internal body temperature by exposing less blood to the outside cold.

As this process continues and your extremities (the parts farthest from your heart) become colder and colder, a condition called the hunting response is initiated. Your blood vessels are dilated (widened) for a period of time and then constricted again. Periods of dilation are cycled with times of constriction in order to preserve as much function in your extremities as possible. However, when your brain senses that you are in danger of hypothermia (when your body temperature drops significantly below 98.6°F), it permanently constricts these blood vessels in order to prevent them from returning cold blood to the internal organs. When this happens, frostbite has begun. ...

Source: <http://webmd.com/a-to-z-guides/frostbite#1>

66 Identify *one* substance that the blood transports to organs and tissues of the body and explain why this substance is necessary for organs and tissues to continue to function. [1]

Substance: _____

Why necessary: _____

67 Describe how the hunting response helps to preserve functioning of the muscle tissue in your extremities, such as your fingers. [1]

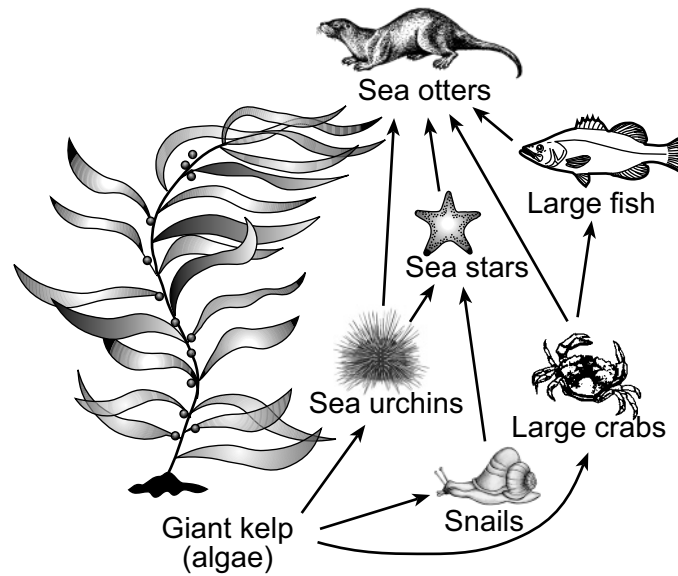
68 Describe *one* possible long-term result of frostbite and explain why this can happen. [1]

Base your answers to questions 69 through 72 on the information below and on your knowledge of biology.

Kelp Forest Food Web

Kelp forest ecosystems are primarily located in the Pacific Ocean off the coasts of California and Alaska. The increased demand for sea urchins, whose roe (a mass of eggs) is a Japanese sushi ingredient, is causing them to be overharvested. A team of students is concerned that this decrease might affect the number of other organisms inhabiting a kelp forest ecosystem.

The students studied the feeding relationships in the ecosystem and constructed the food web shown below.



69 Describe *one* role of the sea urchin population in the kelp forest ecosystem. Support your answer with information from the food web. [1]

70 Describe *one* way a *decrease* in the number of sea urchins would affect the population of large fish. Support your answer with information from the food web. [1]

71 Another team of students predicted that, if they removed all of the sea stars, the ecosystem might remain stable. Explain why removing sea stars might seem like a good way to make up for the overharvesting of the sea urchins. [1]

72 Explain why removing the sea stars could result in the loss of the entire kelp ecosystem. [1]

Part D

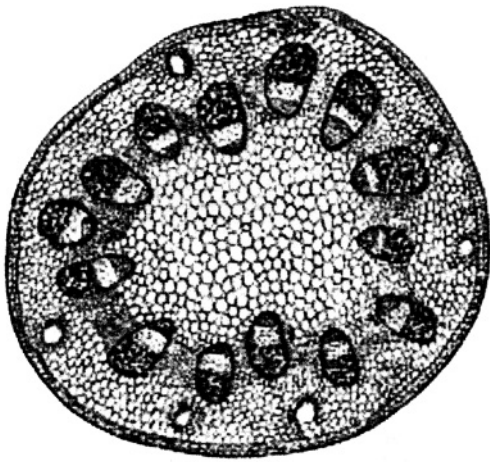
Answer all questions in this part. [13]

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.

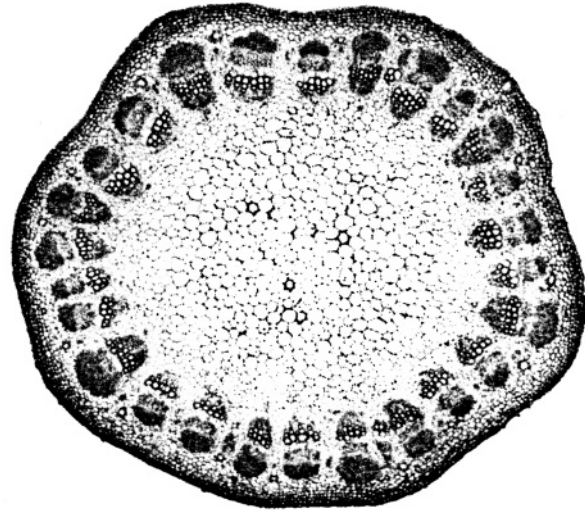
Base your answer to question 73 on the information and illustrations below and on your knowledge of biology. The illustrations represent cross sections of two different plant stems.

A student compared two stem cross sections. Stem cross section *A* is from a plant that can be used to produce products with valuable medicinal properties. Stem cross section *B* is from a plant growing in the same area of the forest and its usefulness for producing medicines is unknown. The student concluded that the stem cross sections had many structural similarities and that the plant that produced cross section *B* would produce the same valuable medicinal products.



A

Source: <http://www.proprofs.com/quiz-school/story.php?title=monocot-dicot-quiz>



B

Source: http://www.bio.miami.edu/dana/pix/dicot_stem.jpg

73 Is the student's conclusion valid?

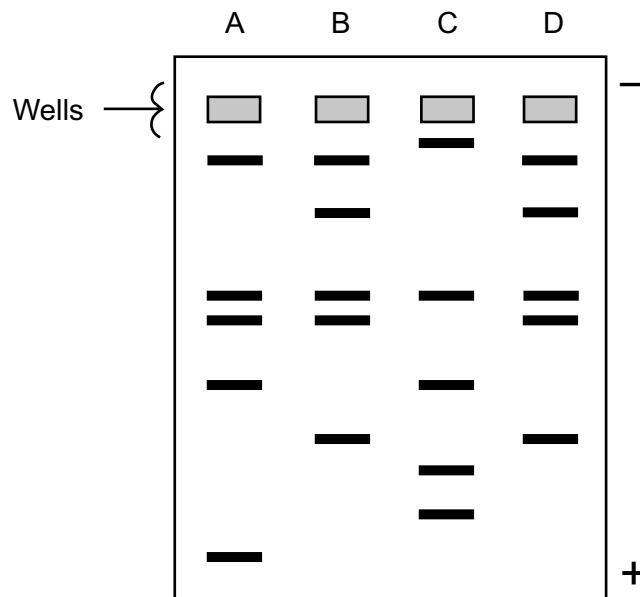
- (1) Yes, because the structural similarities indicate a close relationship between the organisms.
 - (2) Yes, because these plants grow in the same regions of the forest ecosystem and look similar.
 - (3) No, because he did not evaluate soil conditions, such as pH, with chemical indicators.
 - (4) No, because this structural evidence alone is insufficient and molecular evidence should be obtained.
-

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

- 74 A student was jumping rope and noticed that her heart was beating faster. The student's heart rate probably increased as a result of
- (1) a decrease in the need to provide waste materials to muscle cells
 - (2) an increase in the number of red blood cells circulating through her leg muscles
 - (3) an increase in carbon dioxide in her blood
 - (4) a decrease in respiration in her blood cells

Base your answers to questions 75 through 77 on the information and diagram below and on your knowledge of biology.

DNA samples were taken from four different species of animals labeled A, B, C, and D. The diagram below represents the results of a procedure that separated the DNA fragments from each species.



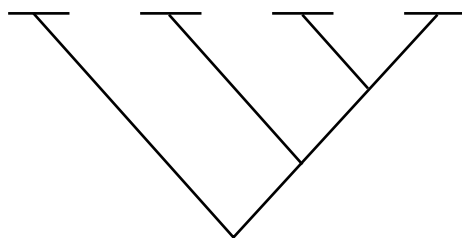
Note: The answer to question 75 should be recorded on your separate answer sheet.

- 75 The species that has the band containing the *smallest* DNA fragment for the sample that was sequenced is
- (1) A
 - (2) B
 - (3) C
 - (4) D

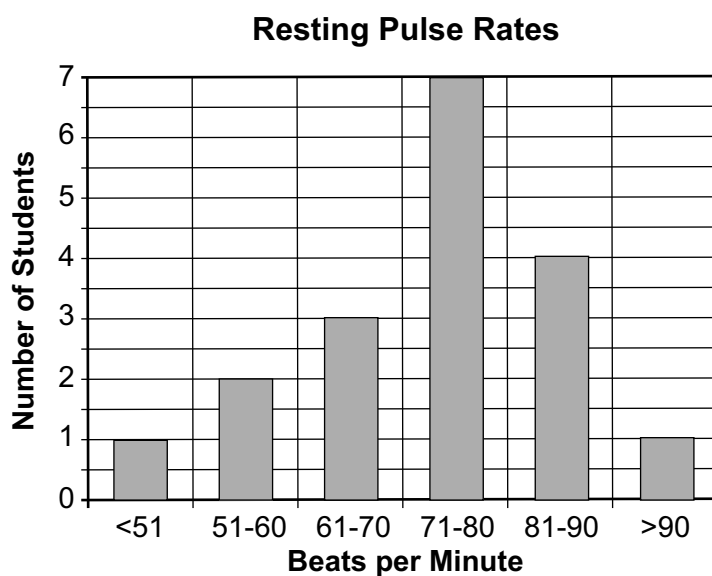
Note: The answer to question 76 should be recorded on your separate answer sheet.

- 76 The fragments of DNA separated into these bands because of their
- (1) pH and color
 - (2) charge and radioactivity
 - (3) electrical charge and size
 - (4) color and size

77 Based on these banding patterns, label the branching tree diagram below using the letters *A*, *B*, *C*, and *D* to represent their possible evolutionary relationships. [1]



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

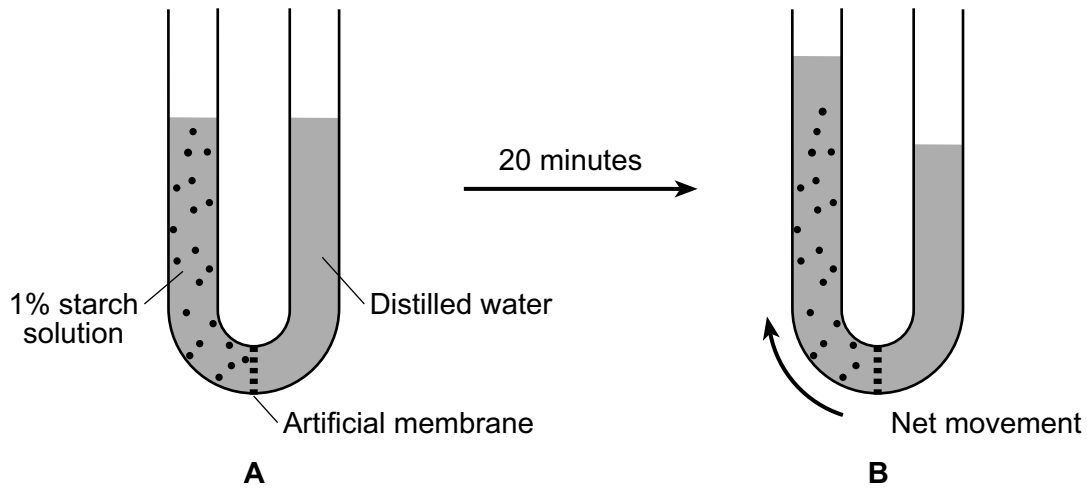


78 What is the total number of students who participated in this data collection? [1]

79 State *one* conclusion that can be drawn about heart rates from the data. [1]

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

The diagram illustrates the movement of molecules across an artificial membrane in a U-shaped glass tube. A 1% starch solution was poured into the left side of the tube, and distilled water was placed in the right side of the tube.



Source: Adapted from *Biology*, Barret, et al., 1986. p.147

80 Explain why the liquid level on the left side changed over the 20-minute period. [1]

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

- 81 If a 1% salt solution were substituted for the starch solution in this setup, the results would be
- (1) different, because all of the molecules would move to the right side of the tube
 - (2) similar, because the salt would block the movement of molecules across the membrane
 - (3) the same, because the movement of molecules in a tube always goes from right to left
 - (4) similar, because water molecules will still move across the membrane in a similar manner

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

- 82 During the *Making Connections* lab, several pulse readings are taken and averaged in order to
- (1) get the heart pumping faster
 - (2) increase muscle fatigue
 - (3) increase reliability
 - (4) increase lung size

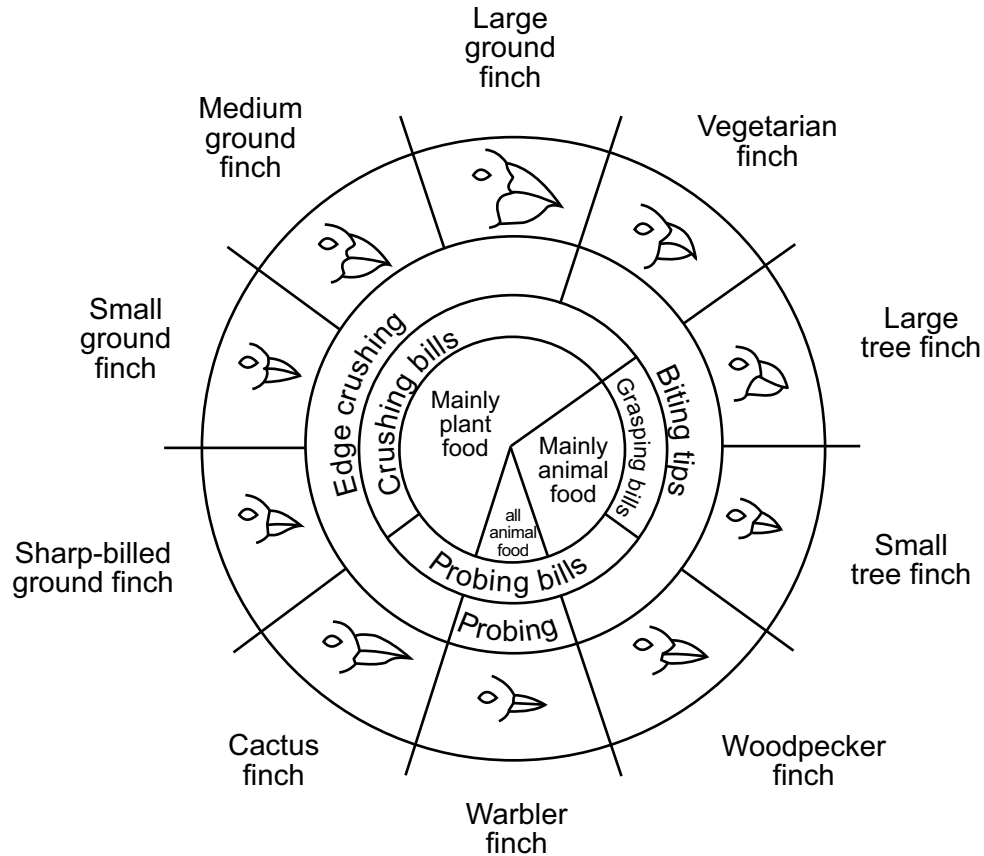
83 A student using a clothespin “beak” during the *Beaks of Finches* lab obtained the results shown below.

Trial	Number of Seeds Collected
1	12
2	15
3	10
4	11
Average	

Over the course of the four trials, an average of at least 13 seeds must be “eaten” in order to go to the next round. Will the student go on? Support your answer. [1]

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 The cactus finch and the sharp-billed ground finch both eat plants. Explain why these two finches may *not* be in competition for the same food. [1]

85 The small tree finch and the small ground finch occupy different niches. State *one* reason, other than food, why these finches might have different niches. [1]

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