Large-Type Edition

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

LIVING ENVIRONMENT

Tuesday, January 21, 2020 — 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 <u>all</u> questions in all parts of this examination. Record your answers for <u>all</u> multiple-choice questions, including those in Parts B–2 and D, on the separate answer sheet. Record your answers for <u>all</u> 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 <u>all</u> 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.

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 There are over 2000 kinds of edible insects in the world, and they are becoming an increasingly popular source of protein. One cup of cricket flour contains over 28 grams of protein. The building blocks of the protein in cricket flour are

(1) amino acids
(2) water
(3) simple sugars
(4) carbohydrates

2 Which list contains only abiotic conditions that might be found in a pond ecosystem?

(1) temperature of the water, green plant populations, dissolved minerals in the water
(2) temperature of the water, dissolved oxygen in the water, dissolved minerals in the water
(3) bacteria, dissolved minerals in the water, temperature of the water
(4) dissolved oxygen in the water, fish populations, insect populations

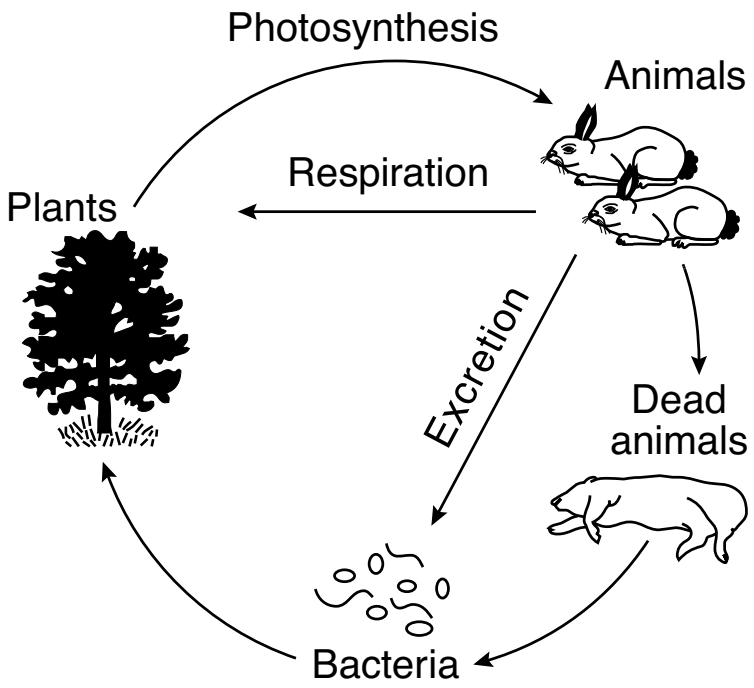
3 Protein synthesis is accomplished primarily by the interaction of which two cell structures?

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

4 Identical twins were separated at birth and raised by two different families. Years later, one twin was a physically fit member of the cross-country team, and the other twin was overweight with slightly higher-than-normal blood pressure. The differences in these twins could be explained by the fact that

(1) the genes in the two individuals are completely different
(2) in twins, each individual inherits genes from only one parent
(3) the DNA bases in twins combine differently
(4) the environment can influence the expression of genes

5 The diagram below represents various factors in an area.



The diagram best represents

(1) the recycling of energy in a forest community
(2) ecological succession after climatic changes
(3) competition for limited resources in a population
(4) the flow of materials in a forest community

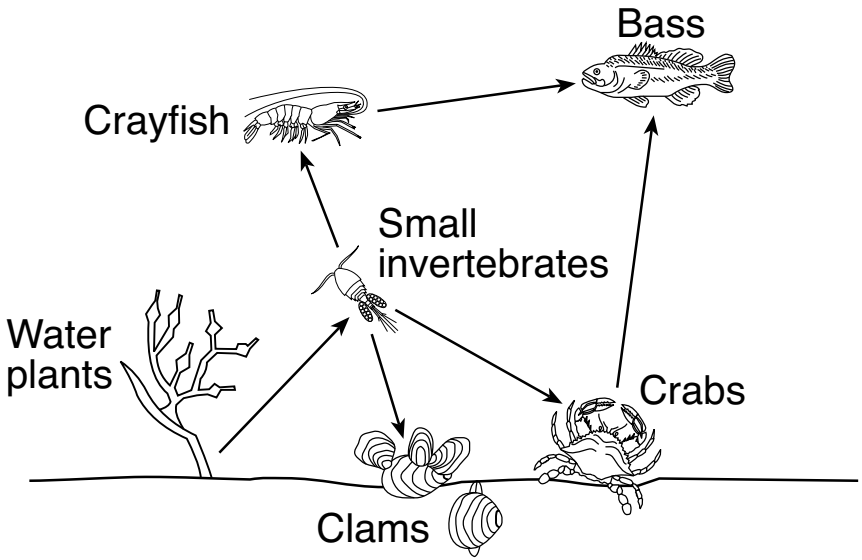
6 Traits are passed from parents to offspring. These traits are determined by

(1) chromosomes, located on genes, found in the nucleus
(2) genes, located on chromosomes, found in the nucleus
(3) chromosomes, located on genes, found in the ribosomes
(4) genes, located on chromosomes, found in the ribosomes

7 In which cell structure is energy extracted from nutrients?

(1) chloroplast
(2) ribosome
(3) mitochondrion
(4) vacuole

8 The diagram below represents a food web in a pond ecosystem.



Two carnivores in the food web are

(1) bass and small invertebrates
(2) small invertebrates and crabs
(3) water plants and clams
(4) crabs and crayfish

9 Dodder plants consist of tangled masses of yellow, leafless vines and contain few chloroplasts. The vines twist around and grow into the stems of other plants and absorb water and nutrients from them. Which statement best describes this relationship?

(1) Dodder plants are parasitic, relying on host organisms for resources.
(2) Dodder plants are decomposers, returning organic material back to the environment.
(3) Dodder plants are producers, while the other plants that they attach to are consumers.
(4) Dodder plants are consumers, transferring energy to other plants in the ecosystem.

10 Two kittens in a litter are genetically different from each other and from their parents. These genetic differences are most directly due to

(1) sexual reproduction
(2) asexual reproduction
(3) cloning
(4) evolution

11 A genetic change that occurs in a body cell of a mouse will *not* contribute to the evolution of the species because

(1) body cell mutations will cause the cell to die before it reproduces
(2) the evolution of a species can result from changes in reproductive cells, not body cells
(3) random changes are repaired by enzymes before they are passed on to offspring
(4) the evolution of a species is caused by natural selection, not genetic variation

12 Scientists who have examined the fossil record have noted that some species have changed very little over long periods of geologic time. The lack of change in such organisms is most likely because

(1) all members of their population were genetically identical, and they lived in a rapidly changing environment
(2) there was a large amount of variation in their population, and the environment changed frequently
(3) they could move between different environments when food supplies became scarce
(4) the environment that they lived in remained the same, and they were well-adapted to it

13 Doctors often use certain medications to treat infections. A few people have a reaction to some of these medications, such as itching, swelling, or trouble breathing. This is an example of

(1) using antibodies to cure a medical problem
(2) the body's immune system overreacting to a usually harmless substance
(3) the body creating a mutation to fight unknown pathogens
(4) a vaccine causing the body to produce antigens against the infection

14 Organisms that live on land rarely compete for

(1) food
(2) space
(3) water
(4) oxygen

15 Orcas are endangered whales. Only about 80 individuals remain off the coast of Washington State. Salmon are a source of food for orcas. Some individuals are proposing that four dams in Washington State be removed so that habitat areas for salmon will be increased. Those opposed to the dam removals say that the dams provide low-cost hydroelectric power and positively influence the local economy.

Source: The Times-Tribune 11/3/16

This situation is an example of

(1) direct harvesting of an endangered orca species by humans
(2) orcas overproducing in an ecosystem with no resources
(3) a community relying on nonrenewable energy sources
(4) a decision where benefits and risks have to be weighed

16 A small lizard spends the morning hours lying in the sunlight until its body temperature rises. Later on in the day, the lizard rests in a shady area until its body temperature cools. This type of behavior is important to

(1) maintain homeostasis
(2) detect variations
(3) attract mates
(4) obtain nutrients

17 Sexually reproducing organisms pass on genetic information as a

(1) long chain of amino acids
(2) complex series of inorganic proteins
(3) sequence of complex sugars
(4) sequence of the bases A, T, C, and G

18 Some viruses attack cells by attaching to their outer covering, entering, and taking over their genetic "machinery." Viruses are able to invade cells after first attaching to their

(1) nuclear membrane
(2) cell membrane
(3) genetic machinery
(4) viral proteins

19 Gene mutations can be caused by many things. These mutations are biologically important because they

(1) occur at a regular rate and therefore can be controlled
(2) can be passed to the offspring if they occur in any cell of the body
(3) are always harmful and therefore help to eliminate weak traits
(4) can result in a new variety of gene combinations in the species

20 Maintaining a rich variety of genetic material that may lead to discoveries useful to humans can be ensured by

(1) preserving biodiversity
(2) increasing cloning
(3) asexual reproduction
(4) selective breeding

21 Many bacteria and fungi are important in the environment because they

(1) return energy to the environment, making it available for plants
(2) recycle nutrients, making them available for other organisms
(3) produce glucose through the process of respiration
(4) reverse the flow of energy in the ecosystem

22 Which statement best describes a characteristic of the carrying capacity of an ecosystem?

(1) It can be illustrated with a food web.
(2) It allows organisms to produce populations of unlimited size.
(3) It is determined directly by an organism's reproductive success.
(4) It is limited by the habitat's available energy and nutrients.

23 The Venus flytrap is a plant that has a unique system by which it traps and breaks down its prey. Unsuspecting insects land on the leaf and touch tiny hairs located on the leaf, triggering the leaf to close around the prey.

Source: https://gardenofeaden.blogspot.co.uk/2010/ 02/ why-do-carnivorous-plants-eat-animals.html

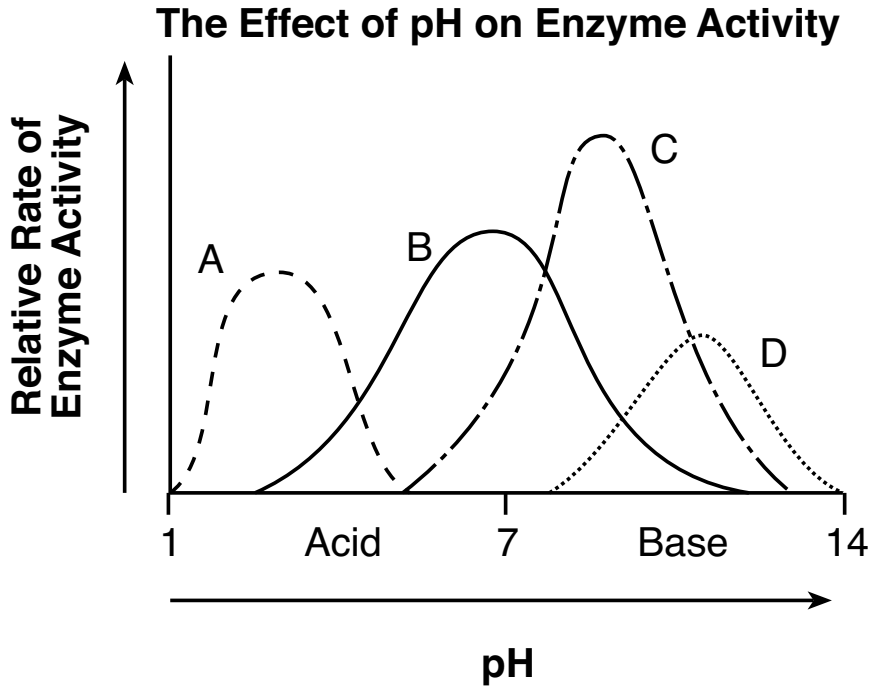
The substance responsible for breaking down the Venus flytrap's prey most likely contains

(1) chlorophyll molecules
(2) glucose molecules
(3) hormone molecules
(4) enzyme molecules

24 It may be harmful when people compete to see who can hold their breath the longest under water. Without oxygen, brain cells

(1) cannot make enough ATP
(2) have too few mitochondria
(3) make too many enzymes
(4) have too much water

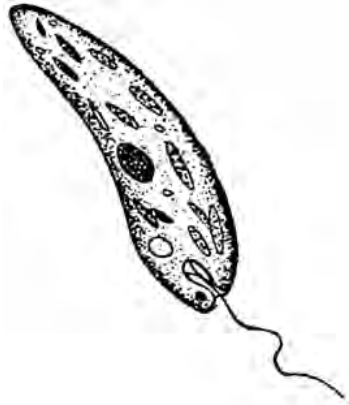
25 Students did an experiment comparing the activity of four different enzymes, *A*, *B*, *C*, and *D*. The results are represented in the graph below.



A valid conclusion based on the information in the graph is that

(1) the pH of some enzymes changes as the temperature changes
(2) enzymes change color in proportion to the rate of activity
(3) a difference in the pH of an environment changes enzyme activity
(4) enzyme activity causes acids to change into bases over time

26 *Euglena* are unique single-celled organisms. Depending on the physical conditions present in their aquatic environment, *Euglena* can act as either producers or consumers.

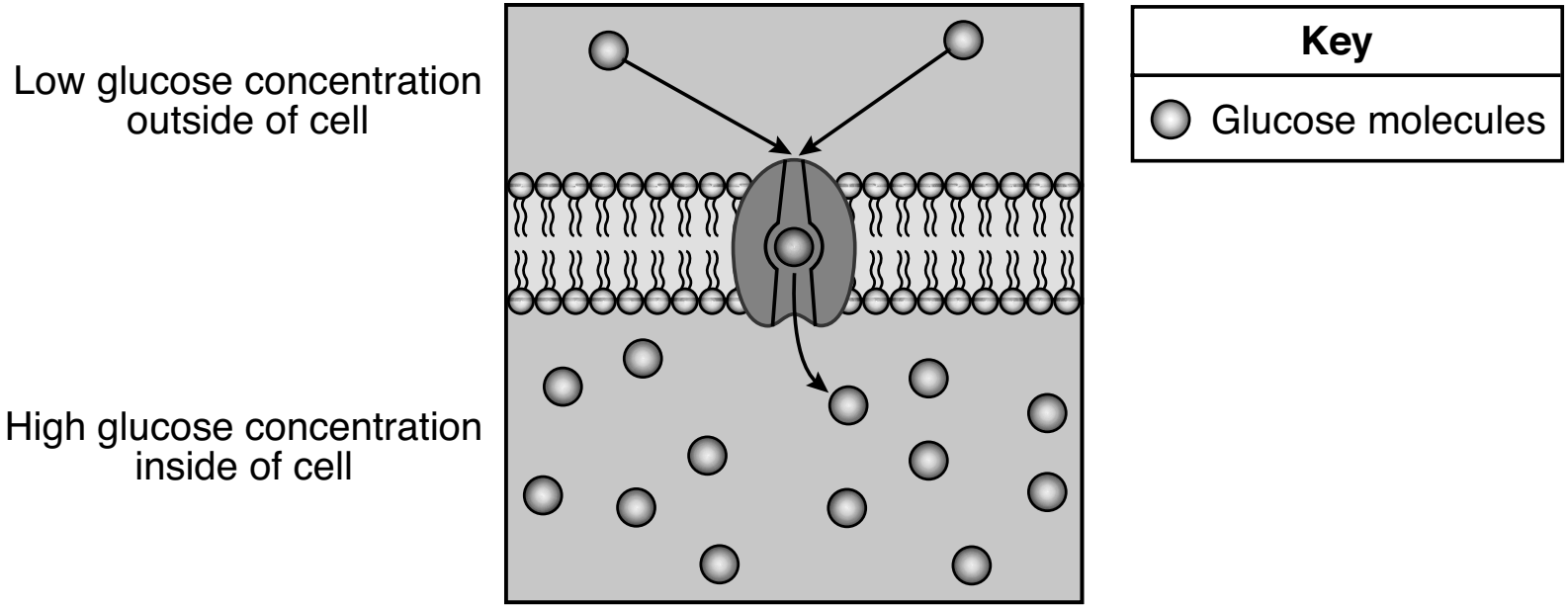


Source: Adapted from
http://www.microscope-microscope.org

Euglena will most likely act as consumers when placed in an environment that has

(1) an acidic pH
(2) a low oxygen level
(3) little or no light present
(4) many predators

27 The diagram below illustrates the movement of glucose across a cell membrane.

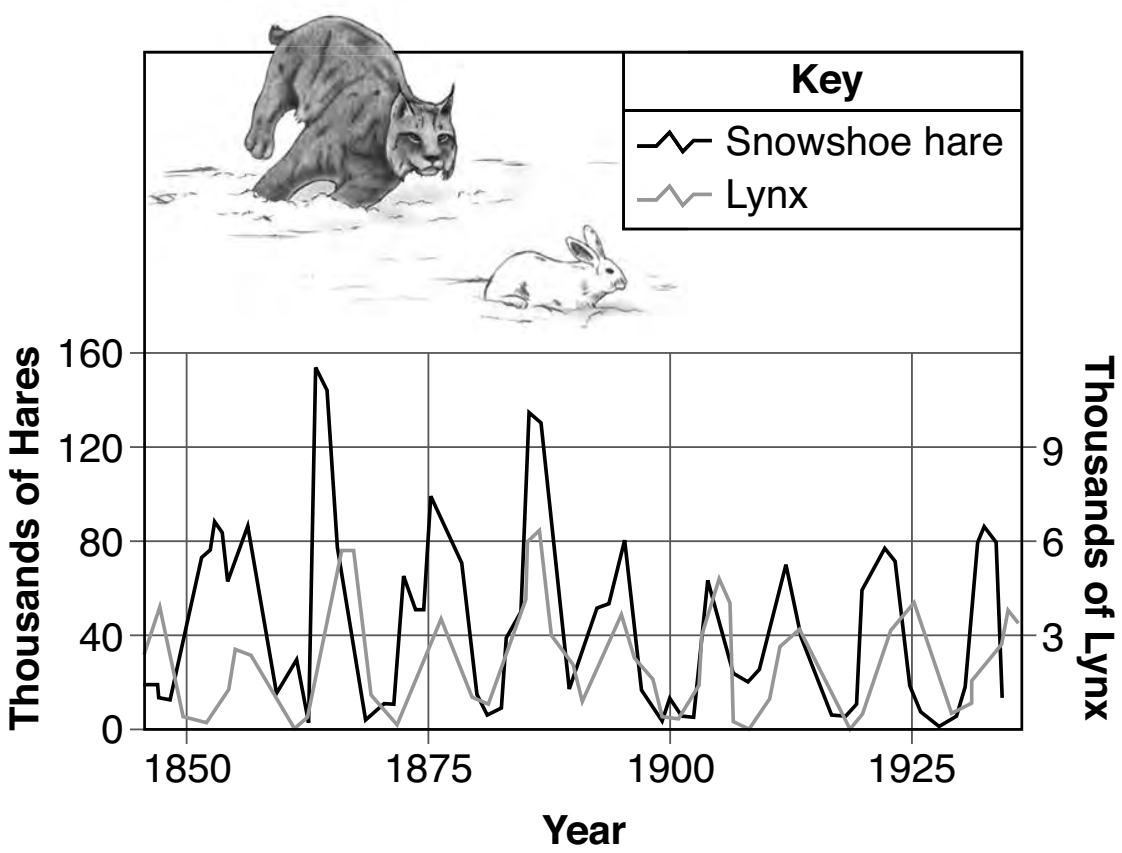


Source: Adapted from http://bodell.mtchs.org/

Which two processes are most directly represented in this diagram?

(1) ATP synthesis and the diffusion of water
(2) molecule transport and energy use
(3) homeostasis and ATP synthesis
(4) homeostasis and the diffusion of water

28 The diagram below shows the relationship between the snowshoe hare and the lynx. The snowshoe hare is prey of the lynx.



Source: Adapted from http://gaiachange.blogspot.com/p/global-change-model.html

The populations of the two species increase and decrease based on the numbers of each species present. This relationship is an example of

(1) ecological succession
(2) an energy pyramid
(3) interdependency
(4) competition

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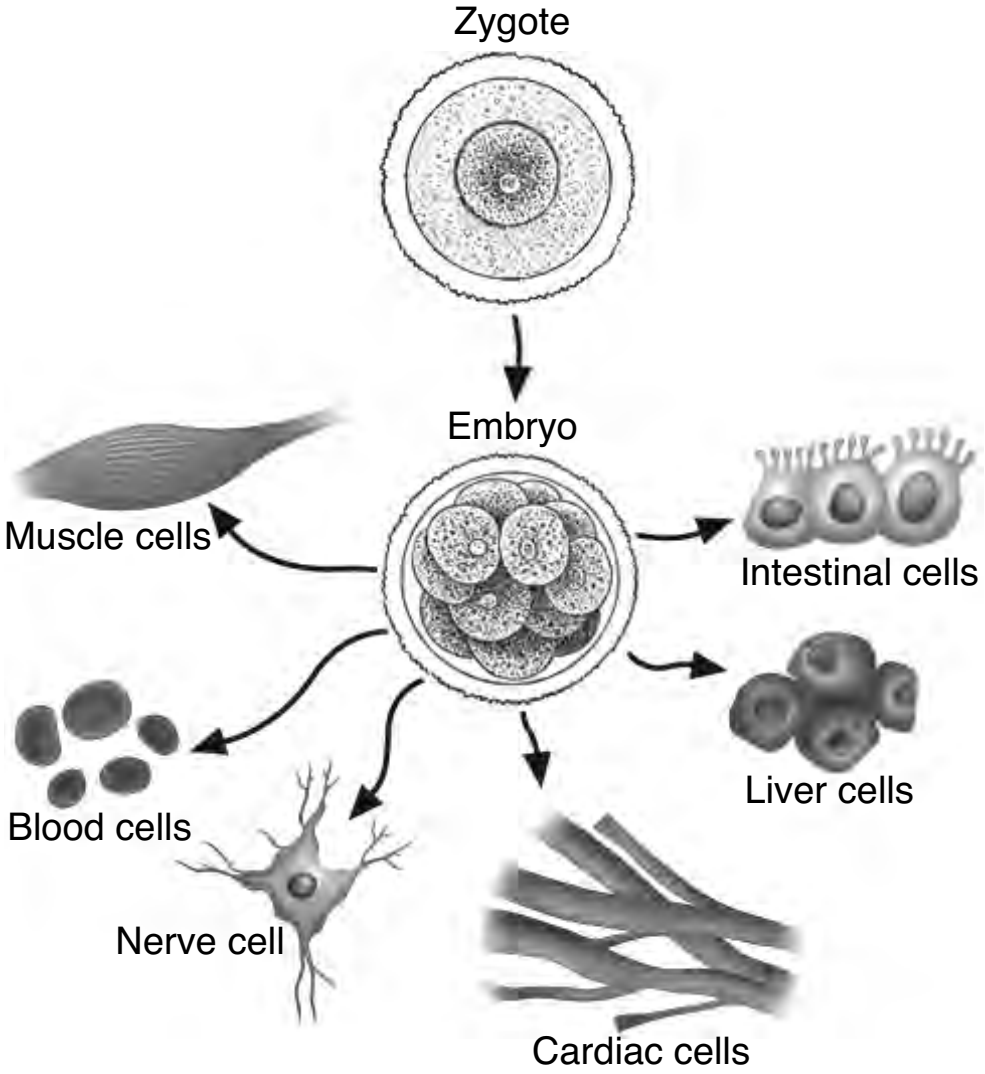
29 Following fertilization, a zygote divides and soon becomes a multicelled embryo with many different cell types, as represented below.



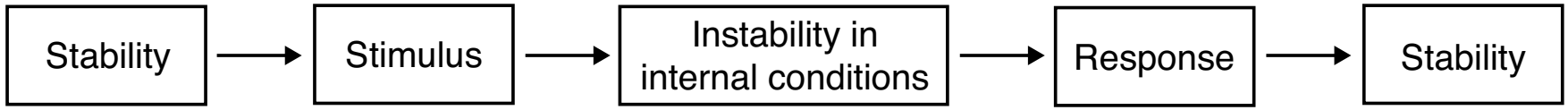
Source: Adapted from http://www.buzzle.com/articles/cell-differentiation.html and https://en.wikipedia.org/wiki/embryogenesis

Question 29 is continued on the next page.

Which statement best explains this development?

(1) Specialization occurs, resulting in the formation of a great variety of cell types.
(2) Genes are inserted into the zygote to allow for the formation of different cell types.
(3) The expression of genes responsible for the different cell types is controlled by the placenta.
(4) The genetic information in the zygote is divided to produce a complete set for each cell type.

30 The diagram below represents changes that take place within the human body.



The diagram represents

(1) cellular differentiation
(2) dynamic equilibrium
(3) gene interaction
(4) biological evolution

Part B–1

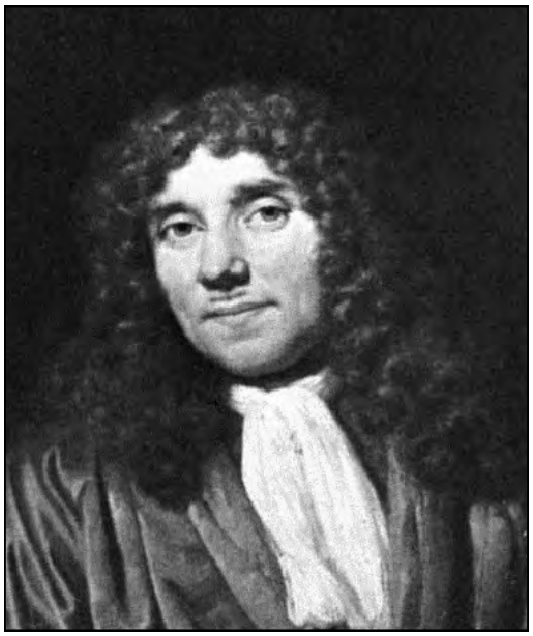
Answer all questions in this part. [13]

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

31 An experiment is carried out to determine how different pH values of soil will affect the growth of tomato plants. In this experiment, the dependent variable could be the

(1) height of the tomato plants
(2) pH of the soil
(3) specific variety of tomato plants used
(4) pH of enzymes in tomato leaf cells

32 Using microscopes he constructed in the 1600s, Antonie van Leeuwenhoek discovered a new microscopic world. His discoveries paved the way for the development of the microscopes used today and for many important biological breakthroughs.



Source: http://famousbiologists.org/antonie-van-leeuwenhoek/

Which statement best describes van Leeuwenhoek's work?

(1) His observations alone provided enough information to form modern biological theories.
(2) The microscopes he made were used by all scientists and have remained unchanged over the years.
(3) Knowledge gained by his work has led to the improvement and development of modern scientific concepts.
(4) Explanations of the microscopic world today are solely based on his observations and conclusions.

Base your answers to questions 33 and 34 on the information below and on your knowledge of biology.

Anabolic Steroids

Anabolic steroids are hormones that affect muscle growth. Many athletes take synthetic anabolic steroids, in hopes of developing larger muscles so they can perform better at their sport. These hormones can act like the hormone testosterone. When men take an excess of anabolic steroids, they can have an increase in feminine features. This is due to the fact that the excess of these chemicals signals the male body to stop producing testosterone.

33 This signal in the male body to stop producing testosterone is an example of

(1) an underproduction of estrogen
(2) a feedback mechanism
(3) an overproduction of testosterone
(4) a decrease in anabolic steroid use

34 One reason why anabolic steroids can imitate the hormone testosterone is because

(1) anabolic steroids and testosterone both interact with the same cell receptors
(2) testosterone acts only on muscle cells
(3) females produce small amounts of the hormone testosterone
(4) an increase in testosterone in males using anabolic steroids increases male features

Base your answers to questions 35 and 36 on the information in the chart below and on your knowledge of biology.

Leopard Frog Reproduction Facts

Where in New York State do leopard frogs live?	Marshes, ponds, swamps, and slow-moving water
How often do they breed?	Once each year
When is their breeding season?	March until June
How many eggs does one frog produce?	3000 to 6500
How long until the fertilized eggs hatch?	2 to 3 weeks
When do they reach sexual maturity?	Males: 365 days Females: 730 days

35 How does the ability to produce 3000 to 6500 eggs benefit the species?

(1) It decreases the opportunity for more frogs to compete for limited resources.
(2) More offspring are likely to survive and reproduce.
(3) The offspring will be more widely distributed by fast-moving water.
(4) The chances for asexual reproduction in the frogs will increase.

36 One explanation for the timing and length of the leopard frog breeding season is that it occurs

(1) when environmental conditions are most favorable
(2) 365 days after the eggs have hatched the year before
(3) 2 to 3 weeks after female frogs have reached sexual maturity
(4) when there is a greater chance of mutation producing favorable variations

37 Sailors in the past may have heard the greeting from a passing ship, "Avast ye scurvy dogs." This greeting would be a reference to a disease known as scurvy, which is due to inadequate intake of vitamin C. Which row in the chart below correctly identifies the cause of this disease and a possible treatment for it?

Row	Cause	Treatment
(1)	inherited trait	gene manipulation
(2)	organ malfunction	antibiotic injections
(3)	poor nutrition	fresh fruit
(4)	virus	vaccination

38 Male birds of two different species living on the same island have developed different mating behaviors, as shown in the table below.

Species	Mating Behavior of Male Birds
A	rapid chirps while spreading their tail feathers
B	movement in circles while spreading their tail feathers

Which statement is best supported by information in the table?

(1) It is likely that male birds in species *A* will mate with female birds in species *B*.
(2) It is likely that birds from species *A* will only mate with birds from species *A*.
(3) Male birds from one species will change their mating behavior if the only female birds available are from the other species.
(4) Mating behaviors are important only when these two species live together in the same area.

39 In a DNA molecule, if 38% of the molecular bases are C (cytosine), what percent of the bases are T (thymine)?

(1) 12
(2) 24
(3) 38
(4) 62

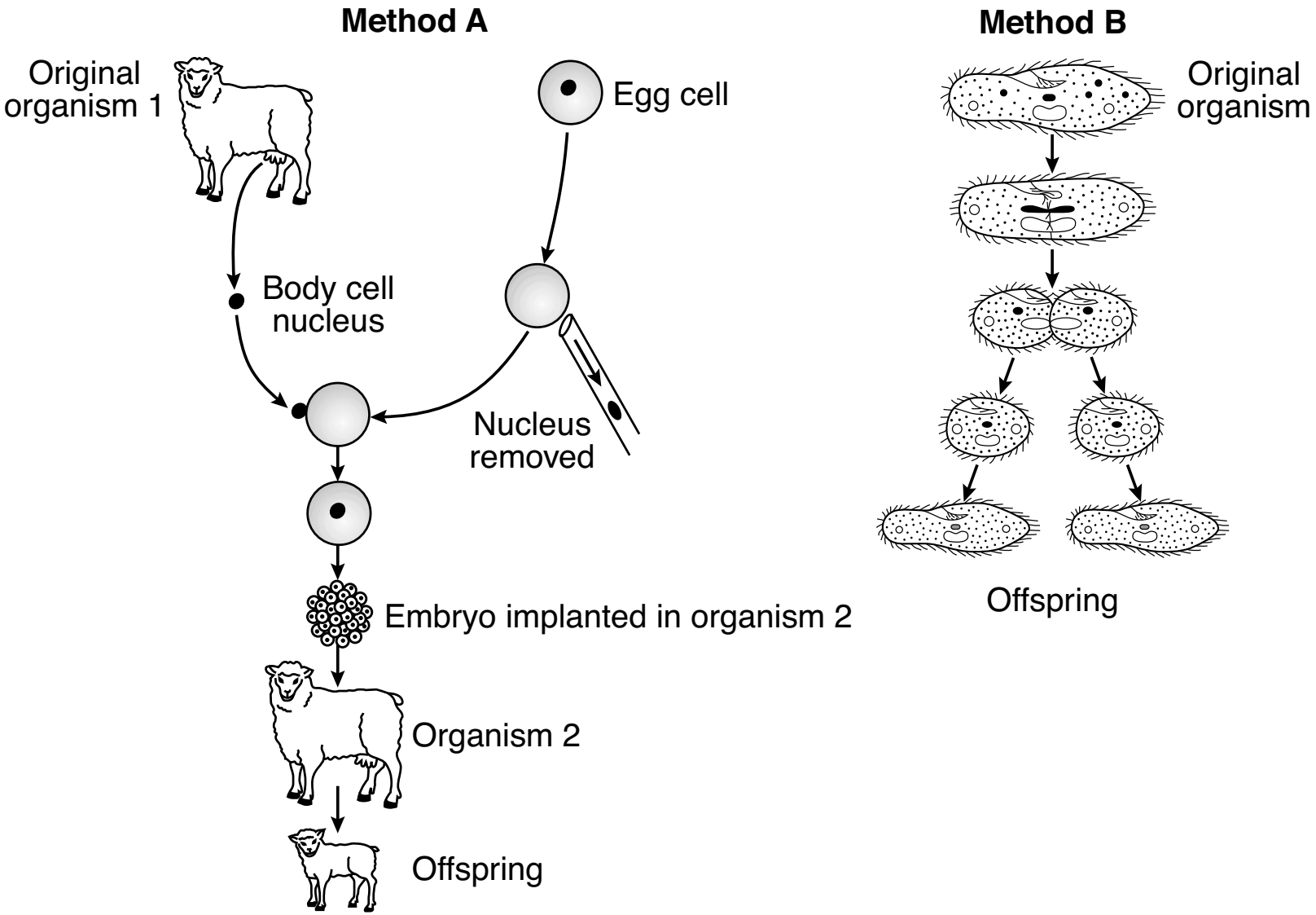
40 An increased demand for soybeans has led to an increase in converting native forests and grasslands to fields for growing soybeans. One *negative* consequence of this environmental change has been

(1) an increase in natural resources for the future
(2) an increase in the kinds of foods that can be produced
(3) a decrease in suitable habitats for wildlife
(4) a decrease in the need to set aside land for conservation

41 In the 1660s, Flemish physician Jan van Helmont grew a small willow tree in a pot of soil. He added only water to the pot. At the end of five years, he found that the tree had gained 75 kilograms, but there was very little change in the mass of the soil. Van Helmont concluded that the plant gained weight directly from the water. We now know that this conclusion is only partially correct because, in addition to water, photosynthesis also requires

(1) oxygen from the atmosphere
(2) carbon dioxide from the atmosphere
(3) proteins from animal prey
(4) carbohydrates from the soil

Base your answers to questions 42 and 43 on the illustration below and on your knowledge of biology. The illustration shows two methods of reproduction, method *A* and method *B*.



42 Which statement regarding these methods of reproduction is correct?

(1) They are both forms of asexual reproduction.
(2) They are both forms of sexual reproduction.
(3) Method *A* is a form of asexual reproduction and method *B* is a form of sexual reproduction.
(4) Method *A* is a form of sexual reproduction and method *B* is a form of asexual reproduction.

43 Which process takes place in both method *A* and method *B*?

(1) meiosis
(2) mitosis
(3) fertilization
(4) recombination

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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.

44 Corals are a group of organisms that live in shallow, warm areas of the world's oceans. Coral reefs are composed of a hard material that is produced by these small coral animals, and is then colonized by photosynthetic organisms called *Zooxanthellae*. These plant-like organisms generate sugars that are used by their animal partners for food and are needed for the survival of the coral.

State *one* possible reason that coral reefs exist only in shallow waters. [1]

Base your answers to questions 45 through 47 on the information and data table below and on your knowledge of biology.

Measles: Eliminated?

Measles is a highly contagious viral disease. Infected people first experience a fever, cold-like symptoms, and a rash. Several complications can develop, such as ear infections, diarrhea, pneumonia, encephalitis (swelling of the brain), and death. Prior to the widespread use of the measles vaccine in the 1960s, it is estimated that 3–4 million people were infected every year. The Centers for Disease Control and Prevention declared measles eliminated in the United States in 2000. This was accomplished, in part, due to a highly effective vaccination program. However, since 2016 the disease has made a comeback, and there has been an increase in measles cases in recent years.

Number of Measles Cases 2010-2016

Year	Number of Cases
2010	63
2011	220
2012	55
2013	187
2014	667
2015	188
2016	70

Source: www.cdc.gov/measles/cases-outbreaks.html

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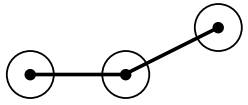
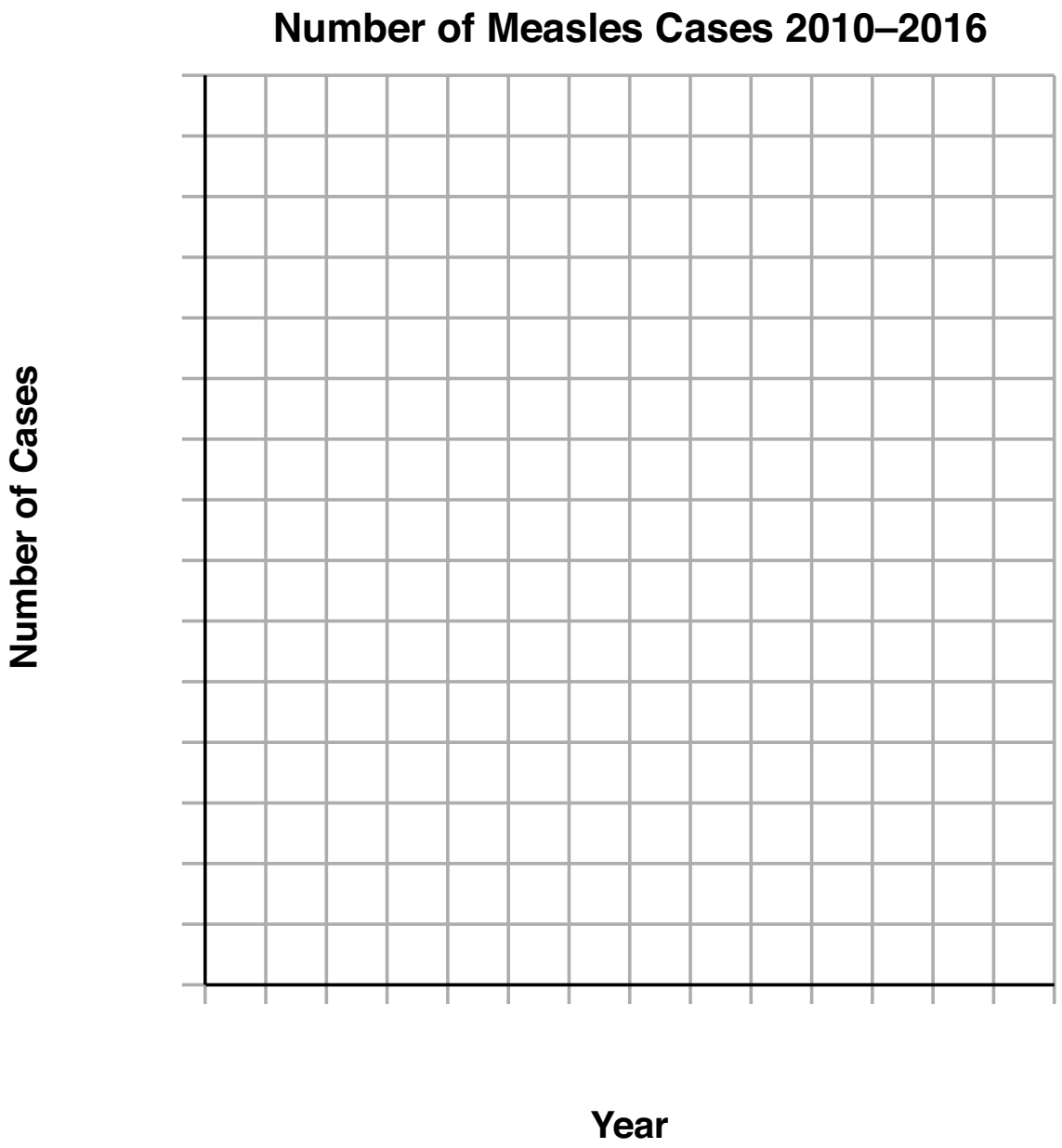
Directions (45–46): Using the information in the data table on page 27, construct a line graph on the grid on page 29, following the directions below.

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

46 Plot the data on the grid. Connect the points and surround each point with a small circle. [1]

Example: 

Questions 45-47 are continued on the next two pages.


Number of Measles Cases 2010–2016
Number of Cases
Year

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

47 The reason for the dramatic decline in the number of measles cases from the 1960s to 2010 in the United States was because the vaccine

(1) contained pathogens to fight against this highly contagious virus
(2) prevented the development of serious complications after infection
(3) exposed many people to a weakened form of the measles virus, making them immune
(4) contained an antibiotic that killed the measles virus, preventing its spread

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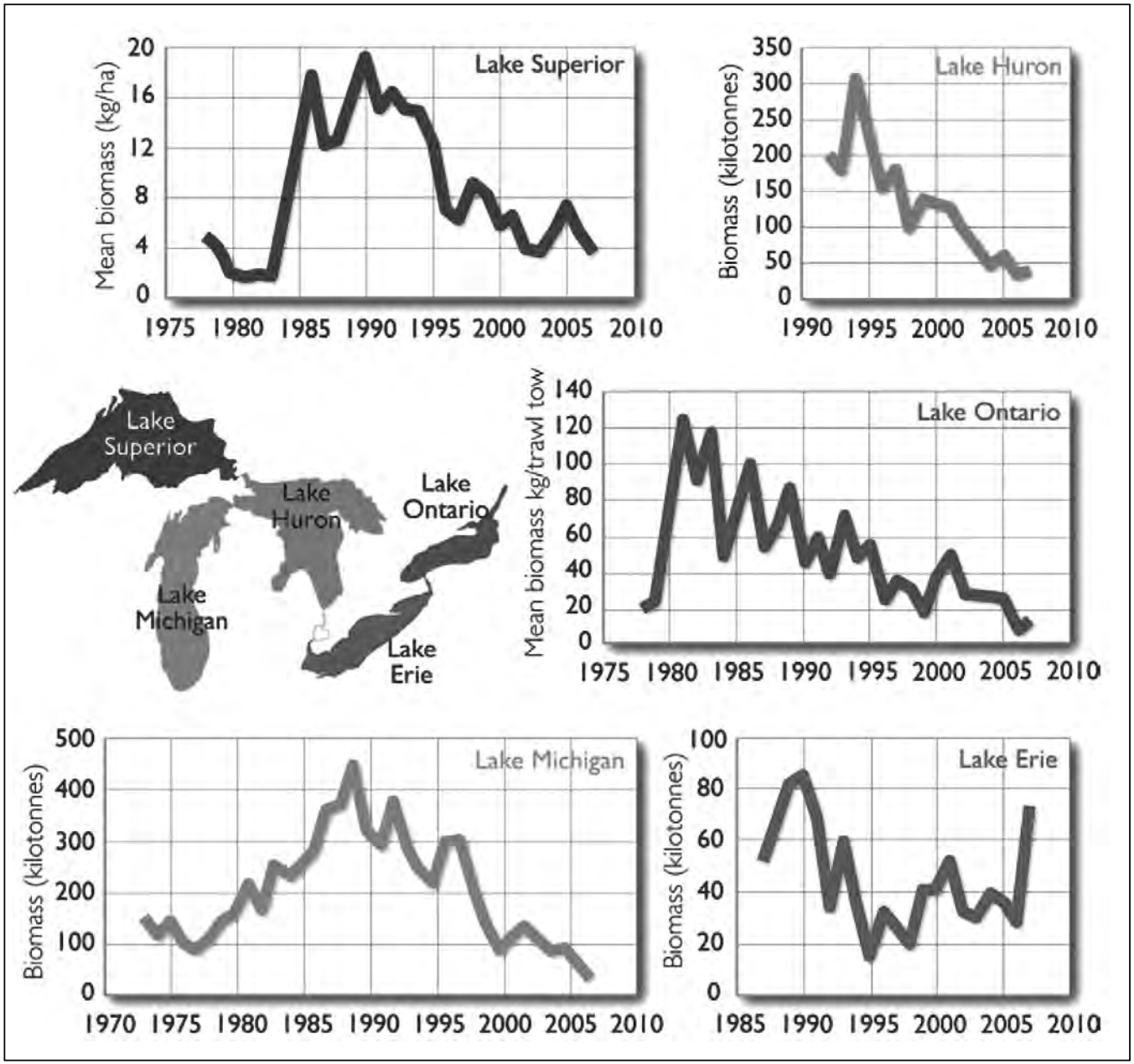
Base your answers to questions 48 and 49 on the information below and on your knowledge of biology.

The line graphs represent trends in prey fish populations for each of the five Great Lakes.

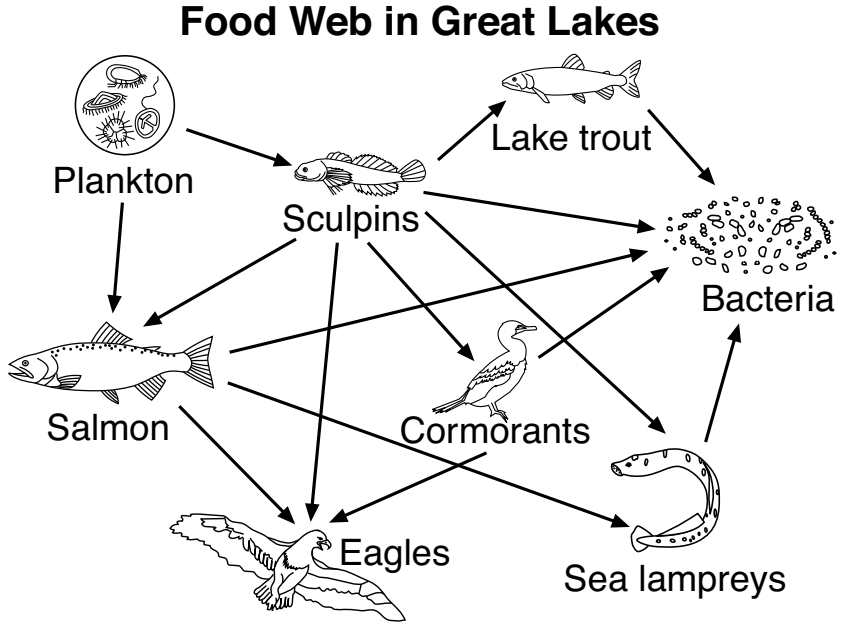
Biomass of Prey Fishes in the Great Lakes



Source: http://biodivcanada.ca (adapted)

48 Identify in which of the Great Lakes you would expect to see the greatest increase in the number of predatory fish in 2008 and 2009. Support your answer. [1]

Examine the Great Lakes food web represented below.



(Not drawn to scale)

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

49 Which statement is correct, based on the information in the diagram?

(1) Salmon are predators of sea lampreys.
(2) Plankton decompose salmon and sculpins.
(3) Cormorants and sea lampreys compete for bacteria.
(4) Lake trout and salmon compete for sculpins.

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

Barley Gene Lowers Emissions From Rice

Over half the people on the planet eat rice as a staple food. Growing rice emits methane, a potent greenhouse gas—to the tune of 25 million to 100 million tons of methane every year, a notable contribution to human-caused greenhouse gas emissions…

…When rice paddies are flooded, methane-producing bacteria thrive on the carbohydrates secreted by rice roots in the oxygen-free soils. The rice plant itself acts as a conduit [pathway], transmitting methane from the soil into the atmosphere…

Source: Times Tribune 7/23/15

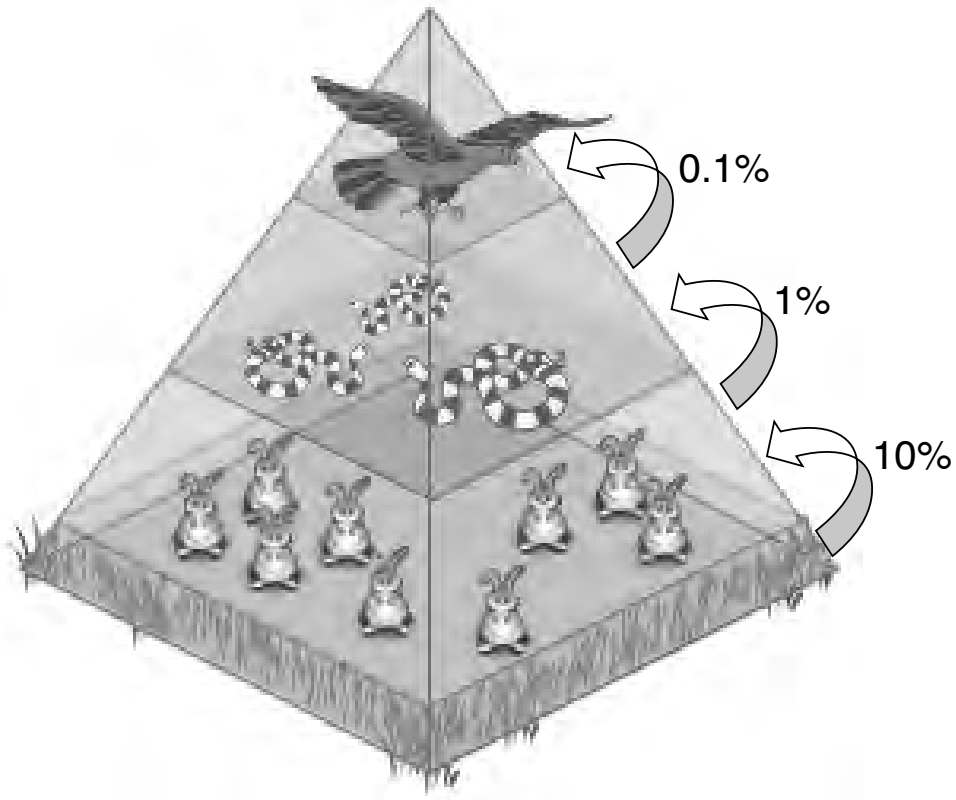
Note: The answer to question 50 should be recorded on your separate answer sheet.

50 Scientists have incorporated a barley gene into a type of rice and produced rice plants that have much lower methane emissions. It is most likely that the scientists incorporated the barley gene into the rice, producing a new variety, using the process of

(1) selective breeding
(2) meiosis, followed by recombination
(3) genetic engineering
(4) sexual reproduction, followed by mitosis

51 Now that the scientists have developed this new variety of rice plant, identify *one* method that could be used to produce large quantities of only these beneficial plants. [1]

Base your answer to question 52 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

52 Based on the information in the diagram, only some of the available energy is transferred from one energy level to the next. State what happens to the rest of the energy. [1]

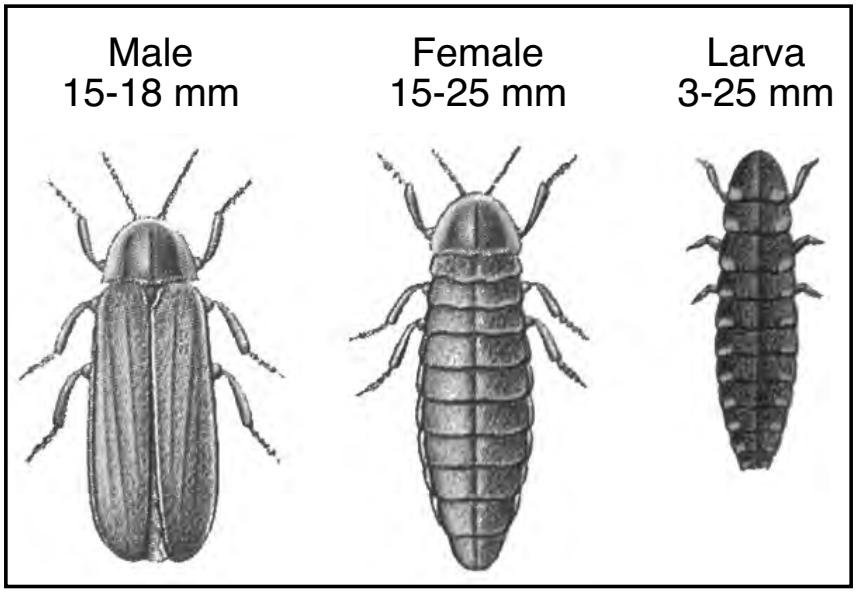
Base your answers to questions 53 through 55 on the information below and on your knowledge of biology.

Glow-Worms

The European glow-worm (*Lampyris noctiluca*) is an insect and a member of the firefly family. Males are ordinary-looking beetles with brown wings. Females are much larger, don't have wings, glow, and look like a large larva. Adult glow-worms usually live for less than two weeks. They don't eat, focusing all their energy on finding a mate. The glow-worm has few enemies. Its body contains a poison that protects it from predators and its light warns would-be attackers that it is not safe to eat.

Greenish light glows from the end of a female's abdomen, an organ called the lantern, for up to several hours each night. There are great differences in the size of the female lanterns. In an experiment, scientists found that females with larger lanterns glowed brighter, and the brightest females laid the most eggs. The diagram below shows three different glow-worms.

Lampyris noctiluca



Source: http://www.nynehead.org/index.php/environment/glow-worm-survey

53 Describe *one* way that a glowing abdomen helps the glow-worm increase its reproductive success. [1]

54 Explain why increased light pollution in areas where glow-worms are found could affect glow-worm populations. [1]

55 Although the females glow at night and are easily seen by predators, they have few enemies. State *one* characteristic that protects them from predators. [1]

Part C

Answer all questions in this part. [17]

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

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

Global Warming

Throughout its long history, Earth has warmed and cooled time and again. Climate has changed when the planet received more or less sunlight due to subtle shifts in its orbit, as the atmosphere or surface changed, or when the Sun's energy varied. But in the past century, another force has started to influence Earth's climate: humanity. …

…What has scientists concerned now is that over the past 250 years, humans have been artificially raising the concentration of greenhouse gases in the atmosphere at an ever-increasing rate, mostly by burning fossil fuels, but also from cutting down carbon-absorbing forests. Since the Industrial Revolution began in about 1750, carbon dioxide levels have increased nearly 38 percent as of 2009 and methane levels have increased 148 percent. …

Source: http://earthobservatory.nasa.gov

56 Other than the issues mentioned in the passage, state *one* action that humans could take to slow down the rate of global warming. [1]

57 Other than global warming, state *one* specific effect on the environment if the human activities mentioned in the passage continue. [1]

58 On November 4, 2016, the Paris Agreement brought many nations into a common cause to combat climate change and adapt to its effects on a global level. State *one* reason why climate change needs to be addressed globally as well as locally. [1]

Base your answers to questions 59 through 61 on the information and photograph below and on your knowledge of biology. The photograph shows a handful of croton nuts.

The Power of the Croton Nut

The croton nut tree grows in East Africa. It produces a nut that is inedible [to humans], and the tree itself was considered of little use except for firewood. The trees grow over vast areas, and many of these areas have been deforested to get rid of the trees and to make more land available for agriculture.

Recently, scientists and engineers in Kenya have been able to crush the nuts and obtain oil, which can be used as a less expensive substitute for diesel fuel, a nonrenewable fossil fuel. The leftover nut pulp can be processed and sold for fertilizer, compressed into biofuel briquettes for use in cooking stoves, or converted into feed for chickens, making the commercial use of the croton nut a zero-waste process.

Source: http://www.ozy.com/fast-forward/please-dont-eat-the-diesel-substitute/60533

59 Explain why the use of croton nut oil represents an advantage over the use of conventional diesel fuel. [1]

60 Describe *one* environmental benefit of maintaining croton forests rather than cutting them down to use the land for farming. [1]

61 Explain why the commercial use of the croton nut is considered a zero-waste process. [1]

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

DDT: A "Miracle Pesticide"

DDT is a pesticide developed during World War II that successfully killed insects, such as mosquitoes, that were a large problem for our soldiers in the Pacific. DDT was also very effective for preventing insect damage to crops, so it was considered, at the time, to be a "miracle pesticide."

Soon, however, scientists noticed that DDT was negatively affecting other animals and being passed along food chains. For example, some birds accumulated large amounts of DDT in their tissues, which caused them to lay eggs with weakened shells that broke before hatching.

Rachel Carson, a marine biologist and author, became concerned about the use of pesticides and their negative effects on the environment. Carson began to write books and speak about the dangers of pesticides. Her actions eventually led to many changes in our use of pesticides and proved valuable to protecting our environment and people from the negative effects that were being discovered about pesticides.

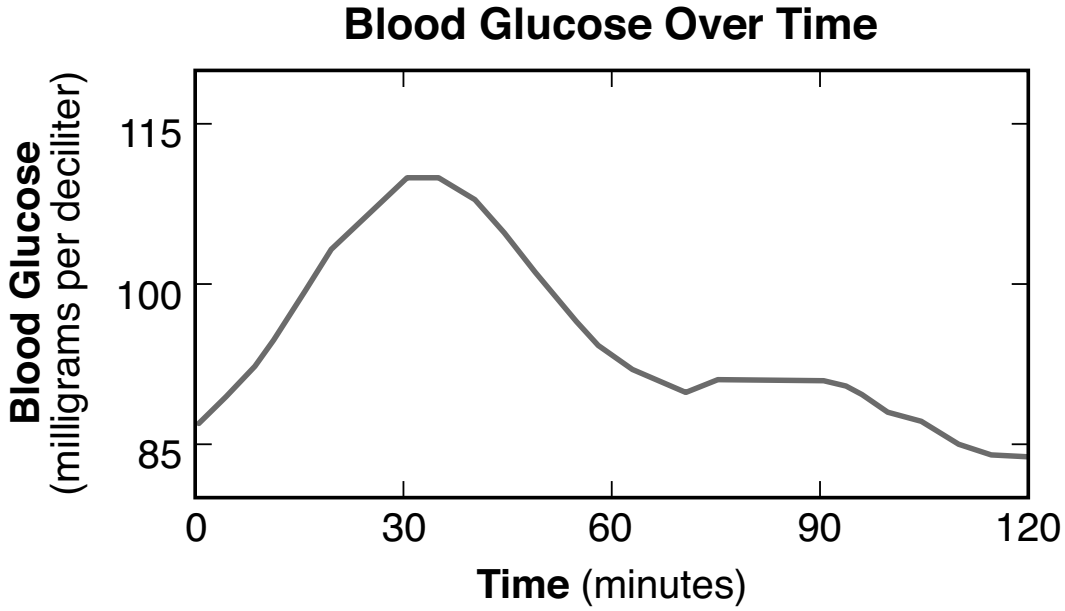
Rachel Carson

Source: http://www.signature-reads.com/2015/04/headstrong-52-female-scientists-and-their-earth-shaking-discoveries/

62 Some scientists began to suspect that DDT was not the "miracle pesticide" that it was originally thought to be. State *one* possible hypothesis that these scientists may have proposed to begin their research to find out more about DDT. [1]

63 All scientific explanations are tentative and subject to change or improvement. Explain how this statement relates to the scientific thinking about DDT. [1]

Base your answers to questions 64 through 67 on the information and graph below and on your knowledge of biology. The graph shows the change in the blood glucose level of one person after eating a cookie.



Source: Adapted from https://www.sciencenews.org/article/good-diet-you-may-be-bad-me

64 Explain why most human cells require a supply of glucose. [1]

65 State *one* specific response of the body to the increase in blood glucose level that would account for the changes that begin about 30 minutes after eating the cookie. [1]

66 Describe how the line representing blood glucose would change if the body could *not* take corrective actions to return this system to normal levels after eating a cookie. [1]

67 Based on the data and information provided, state whether or not it would be valid to conclude that bananas supply more glucose than cookies. Support your answer. [1]

Base your answer to question 68–71 on the information below and on your knowledge of biology.

Artificial Placenta

It is estimated that every year more than 15 million babies are born too early. The lungs of these premature infants are often immature and easily damaged. Premature births happen for a variety of reasons—some known and some unknown. Those that are known include infections and conditions such as diabetes and high blood pressure. Scientists are researching what causes premature births, in an attempt to develop solutions to prevent them.

Scientists are also working on the development of an artificial placenta. At the University of Michigan, five premature lambs were placed in artificial placentas and kept alive for weeks. During this time, each lamb's blood was circulated through its artificial placenta.

68–71 Discuss how the development of an artificial placenta is an important step in the study of premature births. In your answer, be sure to:

- explain why it would be harmful for a human mother's blood to pass across the placenta and into the fetus [1]
- state how an artificial placenta would be of benefit to the lungs of premature infants [1]
- explain why the lambs' blood must be filtered as it circulates through the artificial placenta [1]
- state *one* reason why premature lambs were likely used as model organisms in this study rather than mice [1]

72 As the rate of environmental change has increased over the last 50-100 years, there has been an increase in extinction rates. Lower reproductive rates seem to have also contributed to this increase in extinctions.

Describe *one* possible reason for an increased extinction rate in populations of species with a lower rate of reproduction. [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.

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Base your answers to questions 73 and 74 on the information and Universal Genetic Code Chart below and on your knowledge of biology.

Universal Genetic Code Chart

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

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

73 The messenger RNA sequence that codes for the amino acid chain TYR–ARG–GLY–VAL–ALA–LEU is

(1) UAU–CGA–GUU–UUU–UUA–CUC
(2) UAU–CGA–GGA–GUU–GCG–CUC
(3) CUC–GCG–GUU–GGA–CGA–UAU
(4) CUC–UUA–UUU–GUU–CGA–UAU

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

74 The messenger RNA sequence that is most likely to produce a functional protein is

(1) UGA–UAU–CGA–GGA–GUU–GCG–CUC–UAG
(2) UAG–UAU–CGA–GGA–GUU–GCG–CUC–AUG
(3) AUG–UAU–CGA–GGA–GUU–GCG–CUC–UGA
(4) UAA–CUC–UUA–UUU–GUU–CGA–UAU–UAA

GO RIGHT ON TO THE NEXT PAGE ⇨

Base your answers to questions 75 and 76 on the information below and on your knowledge of biology.

A forensic scientist is trying to determine if the plant pieces found on a burglary suspect match the plants found outside a home that was robbed. The suspect had plant pieces in the hood of his jacket as well as green stains on the knees of his jeans.

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

75 In order to compare the composition of the pigments on the suspect's jeans to the pigments of the plants at the home, the forensic scientist should use

(1) restriction enzymes
(2) genetic engineering
(3) paper chromatography
(4) receptor molecules

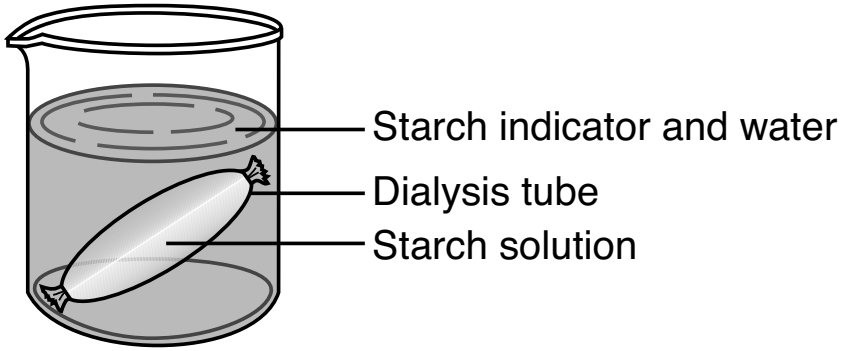
Note: The answer to question 76 should be recorded on your separate answer sheet.

76 The evidence that would be most convincing in determining that the plant pieces found in the suspect's hood matched the plants outside the home that was robbed would be if they both had the same

(1) color flower petal
(2) gene sequence
(3) kind of pollen grains
(4) type of leaf structure

Base your answers to questions 77 and 78 on the information below and on your knowledge of biology.

The diagram below represents a lab setup. The artificial cell (dialysis tube) contains a starch solution and the beaker contains a solution of starch indicator and water. The setup is left undisturbed for twenty minutes.



77 Identify *one* molecule, present in this setup, that will be able to pass through the dialysis tubing. [1]

_____

78 Describe *one* observation that could be made that would confirm that the molecule you identified in question 77 had passed through the membrane. [1]

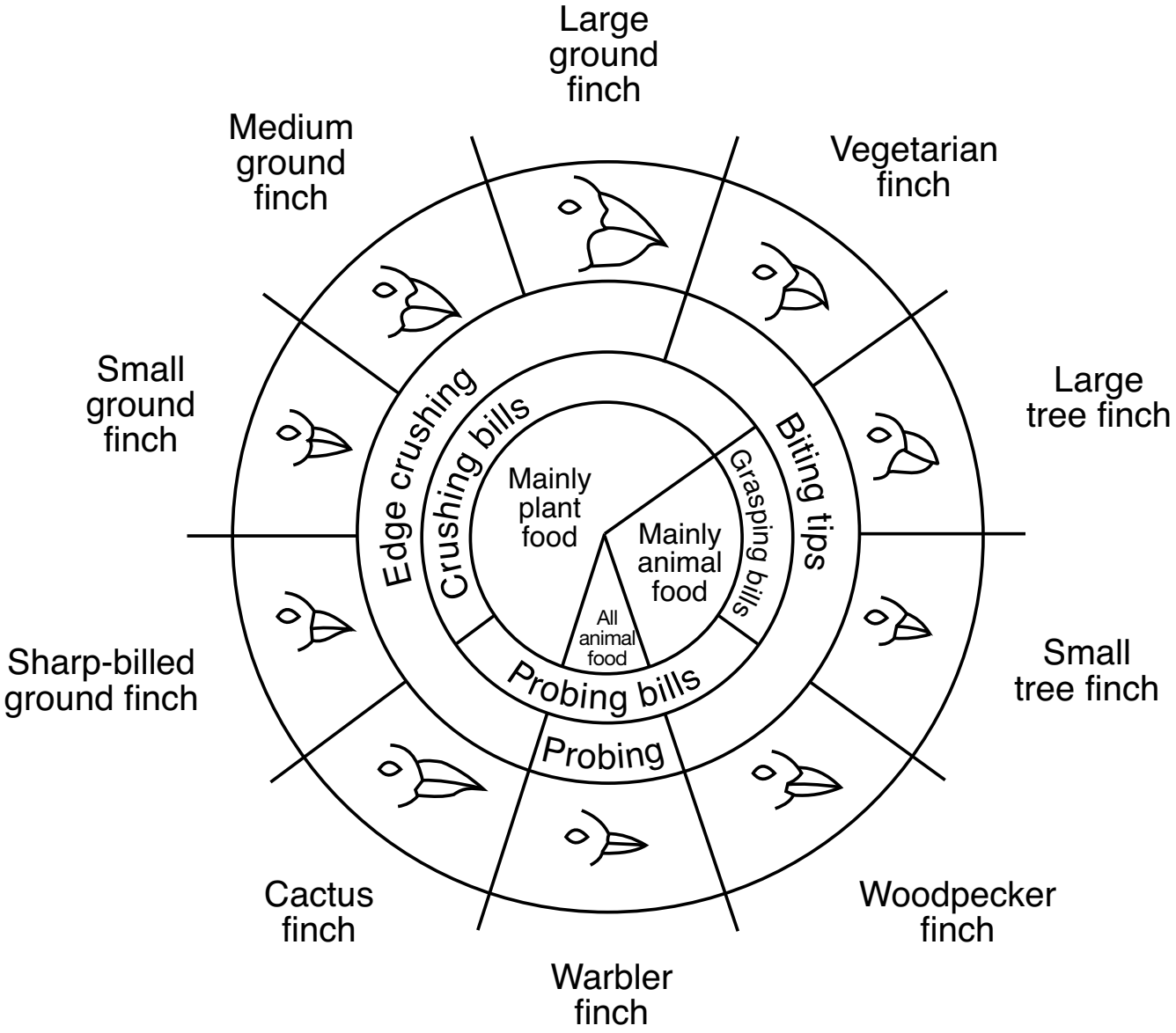
_____

_____

_____

Base your answer to question 79 on the diagram below and on your knowledge of biology.

Variations in Beaks of Galapagos Islands Finches



Source: *Galapagos: A Natural History Guide*

79 A new finch is found to have a diet of worms and caterpillars. Identify *one* finch from the diagram that would have a beak most similar to the new finch. Support your answer. [1]

Finch: _____

_____

_____

_____

80 A student was given forceps (tweezers) as his tool in the *Beaks of Finches* lab. Circle which type of food he would likely pick up most easily – small seeds or large seeds. Support your answer. [1]

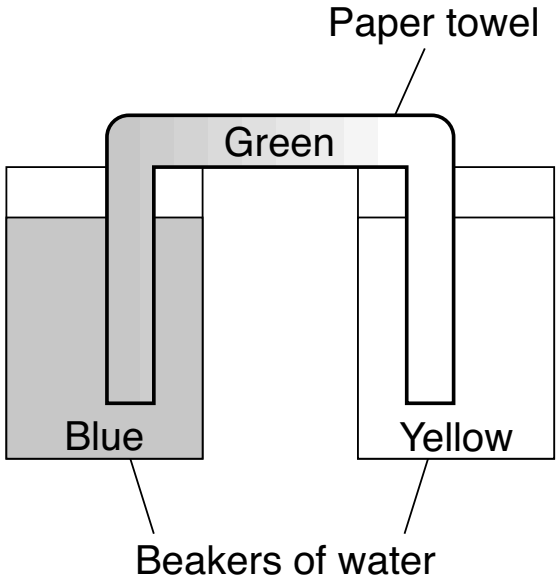
Small seeds Large seeds

Support: _____

_____

Base your answer to question 81 on the information and diagram below and on your knowledge of biology.

A student added equal volumes of water to two different beakers. He then added blue food dye to one and yellow to the other. Next, he placed a white paper towel across the two beakers so that it went down into the liquid and connected the two beakers.



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

81 After 20 minutes, the section of paper towel connecting the two beakers had turned color. The towel most likely turned green as a result of the

(1) separation of the dye molecules through the process of chromatography
(2) dyes moving across the towel due to the process of electrophoresis
(3) diffusion of the blue- and yellow-dyed water across the towel
(4) active transport of the blue and yellow food dyes

Base your answers to questions 82 and 83 on the information and photograph below and on your knowledge of biology.

A Close Relative of the Elephant

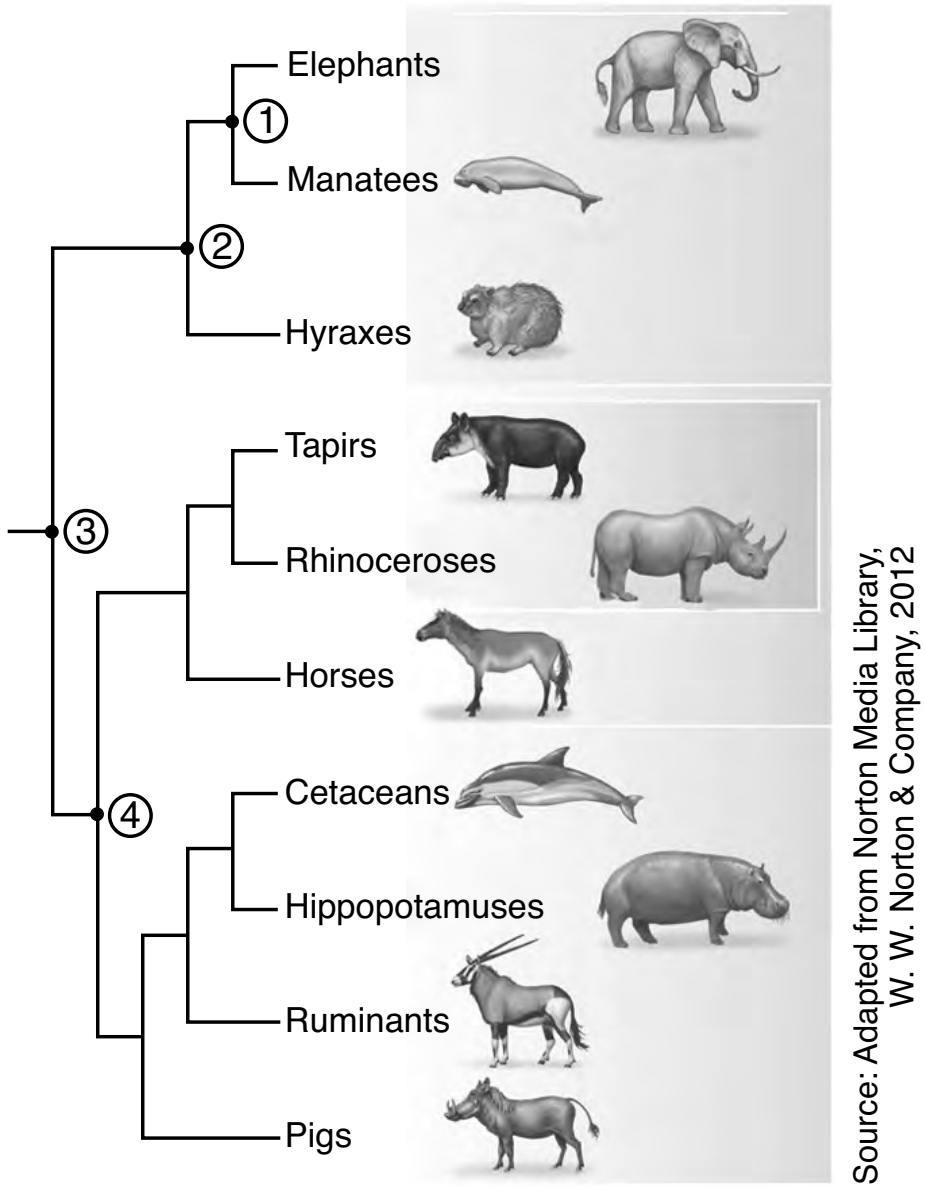
A hyrax is an animal that has been called a rock rabbit and looks like a guinea pig. Fossil records show that hyraxes first appeared on Earth approximately 37 million years ago. As they evolved, some became mouse-sized, while some were the size of a horse. Some eventually adapted to marine life and are related to manatees, and some became grazers and are related to elephants.

Hyrax and Elephant

Source: https://www.mnn.com/earth-matters/animals/photos/12-facts-change-way-see-elephants/elephants-closest-relative-rock-hyrax

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

82 A section of the mammalian evolutionary tree is shown below.



Source: Adapted from Norton Media Library, W. W. Norton & Company, 2012

Question 82 is continued on the next page.

Question 82 continued

Which number would indicate the most recent common ancestor of the hyrax, elephant, and manatee on the section of this mammalian evolutionary tree?

(1) 1
(2) 2
(3) 3
(4) 4

83 Identify *one* type of molecular evidence that could have been used to develop this mammalian evolutionary tree, and describe one specific way that the evidence could have been used to construct the tree. [1]

Evidence: _____

_____

_____

_____

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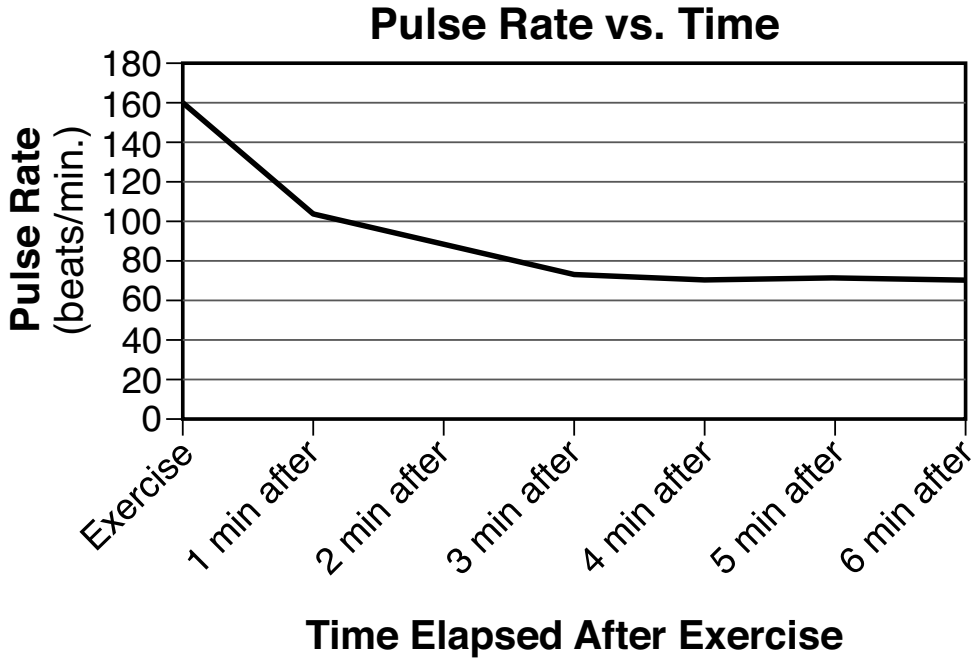
Base your answers to questions 84 and 85 on the information and graph below and on your knowledge of biology.

During a lab experiment a student took his resting pulse rate, counting 23 beats in 20 seconds. The student then exercised for several minutes. The student's pulse was taken immediately after the exercise, and then every minute for 6 minutes. The graph below shows changes in the pulse rate after the exercise was completed.



84 What was the student's resting pulse rate in beats per minute? [1]

_____ **beats/min.**

85 State *one* biological explanation for how the pulse rate increase benefited the student as he exercised. [1]