Print your name and the name of your school on the lines above. Then turn to the last page of this booklet, which is the answer sheet for Part A and Part B–1. Fold the last page along the perforations and, slowly and carefully, tear off the answer sheet. Then fill in the heading of your answer sheet.

You are to answer all questions in all parts of this examination. Write your answers to the Part A and Part B–1 multiple-choice questions on the separate answer sheet. Write your answers for the questions in Parts B–2, C, and D directly in this examination booklet. All answers 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 and in this examination booklet.

When you have completed the examination, you must sign the statement 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 made available for you to use while taking this examination.

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

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, write on your separate answer sheet the number of the word or expression that, of those given, best completes the statement or answers the question.

1. The greatest number of relationships between the organisms in an ecosystem is best shown in
   (1) a food chain
   (2) an energy pyramid
   (3) a food web
   (4) an ecological succession diagram

2. The diagram below shows stages of human reproduction.

   ![Diagram of human reproduction stages]

   The direct result of fertilization is represented at
   (1) A
   (2) B
   (3) C
   (4) D

3. Certain organisms are able to store energy from the Sun in energy-rich compounds. Which event best illustrates this activity?
   (1) A fox captures and eats a young rabbit.
   (2) A caterpillar is eaten by a blackbird.
   (3) Lettuce produces organic substances.
   (4) Bacteria change organic material into simple nutrients.

4. The diagram below shows how a chemical message produced by one cell is received by other cells.

   ![Diagram of chemical message reception]

   If these chemical messages are destroyed, the target cells will
   (1) produce their own chemical messages
   (2) not respond with appropriate actions
   (3) develop different receptors
   (4) no longer be produced in the organism

5. Coded instructions that are passed from one generation to the next can be most directly changed by the processes of
   (1) passive transport, natural selection, and synthesis
   (2) selective breeding, replication, and absorption
   (3) recombination, mutation, and genetic engineering
   (4) evolution, reproduction, and digestion
6 The diagram below represents a cross section of a leaf of a green plant, showing an opening (stomate) in the lower surface.

A stomate in the lower surface of the leaf has a function most similar to the function of which cell structure?

(1) cell membrane  (3) ribosome
(2) vacuole       (4) nucleus

7 When *S. marcescens*, a bacterium, is grown in a refrigerator, it produces red-colored colonies. However, if the bacterium is grown at room temperature, the colonies are white. The best explanation for this situation is that

(1) refrigeration changes the structure of genes
(2) room temperature stimulates the synthesis of a red pigment
(3) temperature has an effect on the expression of genes
(4) only temperature is responsible for the expression of a trait

8 In sexually reproducing organisms, mutations can be inherited if they occur in

(1) the egg, only
(2) the sperm, only
(3) any body cell of either the mother or the father
(4) either the egg or the sperm

9 The diagram below represents a structure found in most cells.

The section labeled A in the diagram is most likely a

(1) protein composed of folded chains of base subunits
(2) biological catalyst
(3) part of a gene for a particular trait
(4) chromosome undergoing a mutation

10 Researchers have reported that the number of different species of fish found in certain areas of the ocean has been greatly reduced over the past 50 years. This situation is an example of

(1) a loss of biodiversity
(2) an increase in ecological succession
(3) a lack of differentiation
(4) an increased carrying capacity

11 Large rebates and low-cost loans have been made available to homeowners to install solar panels to heat their homes. The use of these incentives benefits ecosystems because it

(1) encourages conservation of resources
(2) reduces the need for recycling
(3) promotes the use of nonrenewable resources
(4) discourages the use of alternative energy
12 Which sequence represents the correct order of events for the production of necessary complex molecules after food is taken in by a multicellular animal?

(1) diffusion → synthesis → absorption → digestion → circulation
(2) circulation → diffusion → synthesis → absorption → digestion
(3) digestion → absorption → circulation → diffusion → synthesis
(4) synthesis → digestion → absorption → diffusion → circulation

13 The number in each circle below represents the chromosome number of the cell. Which diagram represents the production of offspring by an asexually reproducing organism?

14 The arrows in the diagram below indicate the development of four different varieties of vegetable plants from wild mustard.

Each of these varieties was most likely produced as a result of

(1) asexual reproduction in the wild for many years  (3) competition between plants
(2) changes in light availability                 (4) selective breeding over many generations
15 The sorting and recombination of genes during reproduction is important to evolution because these processes
(1) decrease variation and help maintain a stable population
(2) increase variation that enables species to adapt to change
(3) decrease the chances of producing offspring that are adapted to the environment
(4) increase the ability of all the offspring to adapt to the environment

16 A diagram of evolutionary pathways of various animal species is shown below.

The pattern of these evolutionary pathways is most likely the result of alterations within which structure?
(1) vacuole (3) nucleus
(2) cell membrane (4) ribosome

17 Which situation is least likely to result in new inherited characteristics?
(1) altering genetic information
(2) changes in the structure of genes
(3) producing new individuals by means of cloning
(4) changes in the structure of individual chromosomes

18 In most mammals, the placenta is essential to the embryo for the processes of
(1) meiosis and excretion
(2) nutrition and excretion
(3) milk production and digestion
(4) blood exchange and digestion

19 Ancestors of the giant panda had rounded paws with five very short toes. Today, the giant panda has a sixth toe, often referred to as a thumb, even though it develops from a wrist bone. This unique thumb is an adaptation that allows the panda to easily hold and eat bamboo shoots. The presence of the giant panda’s thumb is most likely the result of
(1) natural selection
(2) selective breeding
(3) asexual reproduction
(4) ecological succession

20 The diagram below represents levels of organization within a cell of a multicellular organism.

Which statement is correct regarding the structure represented by X?
(1) Structure X is composed of many different amino acids that determine the type of cell it will become in the organism.
(2) Structure X has the same base sequence in all the body cells of the organism.
(3) Structure X is a folded chain arrangement of carbohydrate found in all the body cells of the organism.
(4) Structure X contains 20 different kinds of subunits that are present in all the cells of the organism.
21 A pathogen passing from a mother to her fetus could cause
(1) a decrease in the chromosome number of the fetus
(2) an increase in milk production in the mother
(3) gamete production to increase
(4) an infection in the fetus

22 The diagram below represents the human male reproductive system.

Which activity would be prevented by blockages at X and Y?
(1) transport of urine out of the body
(2) passage of testosterone to the female to stimulate egg production
(3) movement of sperm out of the body
(4) movement of testosterone to the testes to stimulate sperm production

23 One environmental problem caused by the use of nuclear power as an energy source is the
(1) destruction of the ozone shield
(2) disposal of wastes
(3) production of acid rain
(4) accumulation of CO₂ in the atmosphere

24 Which method of protecting members of an endangered species is most ecologically sound?
(1) protecting the habitats where these animals live from human development
(2) capturing these animals and putting them in wildlife parks
(3) feeding and constructing shelters for these organisms
(4) passing laws that encourage hunting of the predators of these species

25 The interaction of which two systems provides the molecules needed for the metabolic activity that takes place at ribosomes?
(1) digestive and circulatory
(2) reproductive and excretory
(3) immune and nervous
(4) respiratory and muscular

26 The swordfish contains a heat generating organ that warms its brain and eyes up to 14°C above the surrounding ocean water temperature. Which structures are most likely to be found at relatively high concentrations within the cells of this heat generating organ?
(1) nuclei (3) chromosomes
(2) chloroplasts (4) mitochondria

27 Two species of animals with a similar appearance live in the same habitat but do not compete for food. This is because they most likely
(1) reproduce at different times of the year
(2) are the same size
(3) occupy different ecological niches
(4) are active at night

28 During its annual migration, the red knot, a medium-size shorebird, flies the entire length of North and South America. During one critical stop to feed on the eggs of horseshoe crabs, the birds nearly double their body mass. The relationship between the red knot and the horseshoe crab is that of
(1) parasite–host
(2) consumer–producer
(3) scavenger–producer
(4) predator–prey

29 It is recommended that people at risk for serious flu complications be vaccinated so that their bodies will produce
(1) antigens to fight the flu virus
(2) antibodies against the flu virus
(3) toxins to fight the infection caused by the flu virus
(4) antibiotics to reduce symptoms caused by the flu virus
The diagram below represents a process that occurs during normal human development.

Which statement is correct regarding the cells and DNA?
(1) All the cells have identical DNA.
(2) The DNA of the fertilized egg differs from the DNA of all the other cells.
(3) The DNA of the fertilized egg differs from some, but not all, of the other cells.
(4) Only the fertilized egg contains DNA.
31 Activities in the human body are represented in the diagram below.

Which title would be appropriate for the diagram?

(1) Rate of Excretion Varies in Response to Amount of Water Taken In
(2) Feedback Mechanisms Help to Maintain Homeostasis
(3) Respiratory Rate Responds to an Increase in Muscle Activity
(4) The Nervous System Responds to Changes in Blood Sugar Levels
32 A company that manufactures a popular multivitamin wanted to determine whether their multivitamin had any side effects. For its initial study, the company chose 2000 individuals to take one of their multivitamin tablets per day for one year. Scientists from the company surveyed the participants to determine whether they had experienced any side effects. The greatest problem with this procedure is that
(1) only one brand of vitamin was tested
(2) the study lasted only one year
(3) the sample size was not large enough
(4) no control group was used

33 In a particular ecosystem, squirrels make up a large portion of the diet of coyotes. A fatal disease in the squirrel population begins to reduce their population over a period of months. Which graph best represents the expected changes in population size of the coyotes and the squirrels?

![Graphs showing population changes](image)

34 Which statement would most likely be used to describe the procedure represented in the diagram below?

![Diagram showing DNA interaction](image)

(1) Enzymes are used to assemble an insulin gene, which is then attached to bacterial DNA.
(2) Bacterial DNA is cut from a human DNA strand and inserted into a human cell to form an insulin gene.
(3) The insulin gene is cut out of a human DNA strand using an enzyme and inserted into bacterial DNA, resulting in a combination of different DNA segments.
(4) A gene is deleted from bacterial DNA to produce an insulin gene, which is then inserted into human DNA.
35 Part of a molecule found in cells is represented below.

Which process is most directly affected by the arrangement of components 1 through 4?
(1) diffusion through cell membranes
(2) fertilization of a sex cell
(3) sequencing of amino acids in cells
(4) increasing the number of cells in an organism

36 What is the volume of water represented in the graduated cylinder shown below?

(1) 10.3 mL  (3) 14.0 mL
(2) 13.0 mL  (4) 15.0 mL

37 A student prepared a test tube containing yeast, glucose, and water. After 24 hours, the test tube was analyzed for the presence of several substances.

What substance would the student expect to find if respiration occurred in the test tube?
(1) a hormone  (3) nitrogen
(2) starch     (4) carbon dioxide

38 A student used the low-power objective of a compound light microscope and observed a single-celled organism as shown in the diagram below.

When he switched to high power, the organism was no longer visible. This most likely happened because switching to high power made the
(1) field too bright to see the organism
(2) image too small to be seen
(3) area of the slide being viewed smaller
(4) fine-adjustment knob no longer functional

39 The daphnia shown below has produced three egg cells, eats live single-celled organisms, lives in freshwater, and is caught and eaten by animals known as hydra.

Which terms would most likely be used in a description of this organism?
(1) asexual reproduction, herbivore, prey, aquatic, heterotrophic
(2) sexual reproduction, predator, aquatic, heterotrophic, prey
(3) asexual reproduction, autotrophic, predator, terrestrial, scavenger
(4) sexual reproduction, carnivore, aquatic, autotrophic, prey
40 Changes in a deer population are shown in the graph below.

![Changes in a Deer Population](image)

Which statement best explains section X?

(1) The population has reached the carrying capacity of its environment.
(2) Energy is used for interbreeding between members of different species.
(3) A predator recycles the remains of dead organisms.
(4) Competition does not occur between members of different species in the same habitat.

41 The diagram below shows various ecological communities that occupied an area over a period of 300 years.

![Diagram of ecological communities](image)

Which statement best describes the diagram?

(1) Community A is the most stable community.
(2) Community B replaced community C after a period of 100 years.
(3) Community C developed into community A after a period of 75 years.
(4) Community D modified the environment, making it more suitable for community E.
Base your answers to questions 42 and 43 on the food web below and on your knowledge of biology.

42 Which organisms are carnivores?
(1) grass and trees  (2) mouse, rabbit, and cricket  (3) deer and mountain lion  (4) frog, snake, and hawk

43 A decrease in the grass population will most immediately decrease the available energy for the
(1) mouse  (2) hawk  (3) snake  (4) frog

44 The diagram below shows two different kinds of substances, A and B, entering a cell.

ATP is most likely being used for
(1) substance A to enter the cell  (2) substance B to enter the cell  (3) both substances to enter the cell  (4) neither substance to enter the cell
A biological process that occurs in plants is represented below.

![Diagram of plant process]

Which row in the chart below identifies the lettered substances in this process?

<table>
<thead>
<tr>
<th>Row</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>enzymes</td>
<td>oxygen</td>
<td>carbon dioxide</td>
<td>glucose</td>
</tr>
<tr>
<td>(2)</td>
<td>carbon dioxide</td>
<td>glucose</td>
<td>oxygen</td>
<td>enzymes</td>
</tr>
<tr>
<td>(3)</td>
<td>glucose</td>
<td>enzymes</td>
<td>oxygen</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>(4)</td>
<td>oxygen</td>
<td>glucose</td>
<td>carbon dioxide</td>
<td>enzymes</td>
</tr>
</tbody>
</table>
Part B–2

Answer all questions in this part. [10]

Directions (46–55): For those questions that are followed by four choices, circle the number preceding the choice that, of those given, best completes the statement or answers the question. For all other questions in this part, follow the directions given in the question and record your answers in the spaces provided.

Base your answers to questions 46 through 50 on the data table below and on your knowledge of biology. The data table shows the concentrations of oxygen in parts per million (ppm) present in freshwater and seawater at various temperatures.

### Concentration of Oxygen in Water

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Oxygen Concentration in Freshwater (ppm)</th>
<th>Oxygen Concentration in Seawater (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14.0</td>
<td>11.0</td>
</tr>
<tr>
<td>10</td>
<td>11.5</td>
<td>9.0</td>
</tr>
<tr>
<td>15</td>
<td>10.0</td>
<td>8.0</td>
</tr>
<tr>
<td>20</td>
<td>9.0</td>
<td>7.5</td>
</tr>
<tr>
<td>25</td>
<td>8.0</td>
<td>7.0</td>
</tr>
<tr>
<td>30</td>
<td>7.5</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Directions (46–48): Using the information in the data table, construct a line graph on the grid on the next page, following the directions below.

46 Mark an appropriate scale on each labeled axis. [1]

47 Plot the data for freshwater oxygen concentration on the grid. Surround each point with a small circle and connect the points. [1]

Example:

![Circle Graph Example]

48 Plot the data for seawater oxygen concentration on the grid. Surround each point with a small triangle and connect the points. [1]

Example:

![Triangle Graph Example]
49 Predict the oxygen concentration in freshwater at 35°C. [1]

________ ppm

50 State one relationship between temperature and dissolved oxygen concentration in water. [1]

_______________________________________________________________________
_______________________________________________________________________

50
A New Theory on Malaria Transmission

*Plasmodium falciparum*, one parasite that causes malaria, spreads rapidly, infecting up to 500 million people every year. Malaria spreads when an infected mosquito bites an uninfected human, who then becomes infected. This infected human is bitten by an uninfected mosquito, which then becomes infected. This infected mosquito then bites and infects an uninfected human. Malaria transmission is illustrated below.

Scientists have a new idea about how this disease spreads. When the malaria parasite is passed to humans through the bite of an infected mosquito, there is a great possibility that this action alters the chemical scent of the human. The altered human body scent then attracts more uninfected mosquitoes, which bite the infected person, thus spreading the disease.

To test this hypothesis, an experiment was conducted on humans infected with malaria. The results indicate that malaria gametocytes (a stage of the parasite) may trigger the production of chemicals that change the scent of the human. The change in human scent makes humans more appealing to mosquitoes.

Scientists are now studying ways to copy this chemical scent for use in traps that would attract mosquitoes.

51 Which statement best describes the role of gametocytes in the spread of malaria?

1. They give off a scent that attracts infected mosquitoes.
2. They absorb human body scents that attract mosquitoes.
3. They release a scent into the human body.
4. They cause a chemical reaction that alters human scent.
52 Malaria is easily spread because uninfected mosquitoes are attracted to

(1) humans without malaria
(2) humans infected with gametocytes
(3) gametocytes in other mosquitoes
(4) mosquitoes that are uninfected

53 State one reason why the use of synthetic scents in traps is a better way to lower mosquito populations than spraying with pesticides. [1]
Base your answers to questions 54 and 55 on the information below and on your knowledge of biology.

The graph below shows the effect of substrate concentration on the action of enzyme X. This enzyme is functioning at its optimal temperature, 36°C, and at its optimal pH, 5.5.

![Graph showing the effect of substrate concentration on the rate of enzyme action.](image)

54 When the substrate concentration increases from 0.4% to 0.5%, the rate of the reaction

(1) decreases

(2) increases

(3) remains the same

(4) increases, then decreases

55 State what would most likely happen to the rate of enzyme action if the temperature were reduced by 10 degrees. Support your answer. [1]

_______________________________________________________________________

_______________________________________________________________________
Part C

Answer all questions in this part. [17]

Directions (56–67): Record your answers in the spaces provided in this examination booklet.

Base your answers to questions 56 and 57 on the experimental setup shown below. The tubing connected to both flask setups used in the experiment provides oxygen to the solution.

56 State one possible hypothesis for the experiment. [1]

__________________________________________________________
__________________________________________________________

57 State what type of data would most likely be collected during the experiment to support or refute your hypothesis. [1]

__________________________________________________________
__________________________________________________________

Source: Campbell and Reece, *Biology*, 6th edition (adapted)
Base your answer to question 58 on the information below and on your knowledge of biology.

Stem cells present in an embryo are responsible for the formation of various tissues and organs. Recent research suggests that it may be possible to replicate stem cells from sections of skin taken from adult mice, rather than having to use stem cells from the embryos of mice. In the future, human stem cells may be used to replace human tissue damaged by diseases such as Parkinson’s disease and multiple sclerosis.

58 Discuss why the use of stem cells taken from a patient to replace damaged tissues and organs may decrease the potential risk to a patient. In your answer, be sure to:

• identify the major problem that may occur when tissues and organs donated by another individual are used [1]
• explain why this problem may occur [1]
• explain why this problem will not occur if tissues and organs produced by stem cells from the patient are used [1]
59 *Staphylococcus aureus* is a type of bacterium that lives on the skin and in the nostrils of most people. Generally, it is controlled by the immune system of the body. Occasionally, the antibiotic penicillin is needed to control the bacterium. However, some strains of *S. aureus* have a resistance to penicillin, which makes them hard to kill and infections difficult to cure.

Explain how the resistance to penicillin affects the *S. aureus* population. In your answer, be sure to include an explanation of:

- how the exposure to penicillin affects the survival of some bacteria in the population [1]
- why the frequency of penicillin-resistant bacteria can change over time within the population [1]
- how it is still possible to cure patients who are infected with penicillin-resistant bacteria [1]
Base your answers to questions 60 through 63 on the information below and on your knowledge of biology.

An ecology class is trying to help reduce the problem of global warming by asking their school district to change all of their old lightbulbs to compact fluorescent lightbulbs that use less electricity.

60 Identify one specific gas that contributes to the problem of global warming. [1]

___________________________________

61 State one activity of humans that increases the concentration of this gas. [1]

___________________________________

62 Describe one negative effect of global warming on humans or ecosystems. [1]

_______________________________________________________________________
_______________________________________________________________________

63 Explain why switching to more efficient lightbulbs will help reduce the school's contribution to global warming. [1]

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

There's No Place Like Home!

Some pets need expensive food, or grow to large sizes, or have nasty, dangerous behavior. Because of this, some people realize that they can no longer care for their pets. A pet twist-neck turtle in a state of near starvation was found by rescuers at the Brooklyn Botanic Garden. The food that this species eats is not commonly found in New York State. In Florida and other warm states, people have released pet snakes such as pythons and anacondas into local lakes and swamps, where they have become a threat to other animals and even to humans. Those released pets that survive in their new environment can eventually breed and multiply, causing even more problems!

64 Identify one abiotic factor that might affect the survival of a released pet and explain why that factor would affect survival. [1]

_______________________________________________________________________
_______________________________________________________________________

65 State one reason released pets that survive in a new environment may be able to form a large population. [1]

_______________________________________________________________________
_______________________________________________________________________
Base your answers to questions 66 and 67 on the information and diagrams below and on your knowledge of biology.

There are over 40 different species of butterfly fish found in tropical reefs throughout the world. Three different species of butterfly fish are shown below.

The fish fin diagram and dichotomous key shown below can be used to determine the species of each of these fish.

**Dichotomous Key to Butterfly Fish**

<table>
<thead>
<tr>
<th>1. a. Pelvic fin dark</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Pelvic fin light</td>
<td>4</td>
</tr>
</tbody>
</table>

| 2. a. Two large white spots below dorsal fin | C. quadrimacul |
| b. Lacks two large white spots below dorsal fin | 3  |

| 3. a. Caudal fin with two dark bars at tip | C. reticulatus |
| b. Caudal fin with one dark bar at tip | C. kleinii |

| 4. a. Dorsal fin has long filament extension | 5  |
| b. Filament extension lacking from dorsal fin | 6  |

| 5. a. Large dark spot on body near filament | C. ephippium |
| b. Small dark spot on body near filament | C. auriga |

6. a …
Directions (66–67): Using the information and dichotomous key, complete the table following the directions below.

66 Use the dichotomous key and fish fin diagram to identify fish A, B, and C and write the name of each fish in the column labeled “Scientific Name” in the table below. [1]

67 Select two characteristics from the dichotomous key that are useful for determining the identity of fish A, B, and C. Using these characteristics, label the headings for the last two columns in the table and complete the last two columns in the table. [2]

<table>
<thead>
<tr>
<th>Fish</th>
<th>Scientific Name</th>
<th>Subgroup</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Rabdophorus</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Lepidochaetodon</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Rabdophorus</td>
<td></td>
</tr>
</tbody>
</table>
Part D

Answer all questions in this part. [13]

Directions (68–78): For those questions that are followed by four choices, circle the number of the choice that, of those given, best completes the statement or answers the question. For all other questions in this part, follow the directions given in the question and record your answers in the spaces provided.

Base your answer to question 68 on the chart below and on your knowledge of biology.

### Universal Genetic Code Chart

**Messenger RNA and the Amino Acids for Which They Code**

<table>
<thead>
<tr>
<th>U</th>
<th>C</th>
<th>A</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
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<td>GCG</td>
<td>GAA</td>
<td>GGC</td>
</tr>
</tbody>
</table>

68 Fill in the missing mRNA bases and the amino acid sequence that corresponds to the DNA base sequence below. [2]

**DNA**

CAC   GTG   GAC   TGA

**mRNA**

_______   _______   _______   _______

**Amino acids**

_______   _______   _______   _______
An investigation is carried out to determine the effect of exercise on the rate at which a person can squeeze a clothespin.

69 In this investigation, the independent variable is the

(1) control  
(2) exercise  
(3) rate of squeezing  
(4) number of participants

70 Muscle fatigue occurs during this activity when

(1) carbon dioxide is used up in the muscle cells  
(2) simple sugar is converted to starch in the muscle cells  
(3) proteins accumulate in mitochondria in the muscle cells  
(4) certain waste products collect in the muscle cells

71 Part of a laboratory procedure is shown in the diagram below.

This setup would most likely be involved in a procedure to

(1) stain specimens while making a wet mount  
(2) test for the presence of glucose using an indicator  
(3) separate pigments in a mixture  
(4) determine the pH of solutions
Base your answers to questions 72 and 73 on the information below and on your knowledge of biology.

A valuable medicine is obtained from a certain rare species of plant. Scientists are anxious to find another more abundant species of plant that is closely related to the rare one, and also produces the medicine.

Two newly discovered plant species, A and B, were studied and compared to the rare one. The results of the study are shown in the table below.

<table>
<thead>
<tr>
<th>Species of Plant</th>
<th>Characteristics of Flowers</th>
<th>Shape of Leaves</th>
<th>Species Number of Chromosomes</th>
<th>Enzyme A Present</th>
<th>Enzyme B Present</th>
<th>Enzyme C Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>rare species</td>
<td>pink 5 petals</td>
<td>round</td>
<td>36</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>species A</td>
<td>pink 5 petals</td>
<td>oval</td>
<td>34</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>species B</td>
<td>white 5 petals</td>
<td>round</td>
<td>36</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

72 Which newly discovered species is more closely related to the rare species? Support your answer.  [1]

Species: ______________

_______________________________________________________________________

_______________________________________________________________________

73 Which procedure could also be carried out to help determine which newly discovered species is most closely related to the rare species?

(1) measurement of respiration rate in the plants
(2) chromatography of pigment extracts from the plants
(3) determination of the type of gas released by photosynthesis in the plants
(4) analysis of chemical bonds present in glucose in the plants

_______________________________________________________________________
74 The characteristics of four finches that inhabit the same island are represented in the chart below.

Characteristics Chart

<table>
<thead>
<tr>
<th>Competes With the Large Tree Finch</th>
<th>Type of Finch</th>
<th>State one reason why it competes or does not compete with the large tree finch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>Large Ground Finch</td>
<td>Beak: crushing Food: mainly plant</td>
</tr>
<tr>
<td>yes</td>
<td>Warbler Finch</td>
<td>Beak: probing Food: 100% animal</td>
</tr>
<tr>
<td></td>
<td>Small Ground Finch</td>
<td>Beak: crushing Food: mainly plant</td>
</tr>
<tr>
<td></td>
<td>Large Tree Finch</td>
<td>Beak: grasping Food: mainly animal</td>
</tr>
</tbody>
</table>

Complete the table below using information in the characteristics chart and your knowledge of biology. [2]

75 Studies of the finches of the Galapagos Islands have shown that

(1) DNA will change to produce structures needed by birds to survive intense competition

(2) a bird’s beak changes annually in response to the type of food that is most abundant each year

(3) natural selection occurs when there are scarce resources and intense competition

(4) the beak of a finch will change if the environment of the bird remains stable
Base your answers to questions 76 through 78 on the information below and on your knowledge of biology.

A student prepared four different red blood cell suspensions, as shown in the chart below.

<table>
<thead>
<tr>
<th>Suspension</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>red blood cells in normal blood serum (0.7% salt solution)</td>
</tr>
<tr>
<td>B</td>
<td>red blood cells in 10% salt solution</td>
</tr>
<tr>
<td>C</td>
<td>red blood cells in distilled water</td>
</tr>
<tr>
<td>D</td>
<td>red blood cells in tap water</td>
</tr>
</tbody>
</table>

76 Which suspension would contain red blood cells that would appear wrinkled and reduced in volume?

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

77 The change in red blood cell volume is principally due to the movement of

(1) serum  
(2) oxygen  
(3) water  
(4) salt

78 Which process is most likely involved in the change in red blood cell volume?

(1) active transport  
(2) evaporation  
(3) replication  
(4) diffusion
The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

LIVING ENVIRONMENT

Tuesday, January 25, 2011 — 9:15 a.m. to 12:15 p.m., only

ANSWER SHEET

Student ........................................ Sex: ☐ Male ☐ Female
Teacher ........................................
School ........................................ Grade ...........

Record your answers to Part A and Part B–1 on this answer sheet.

Part A

1 .......... 11 .......... 21 ..........
2 .......... 12 .......... 22 ..........
3 .......... 13 .......... 23 ..........
4 .......... 14 .......... 24 ..........
5 .......... 15 .......... 25 ..........
6 .......... 16 .......... 26 ..........
7 .......... 17 .......... 27 ..........
8 .......... 18 .......... 28 ..........
9 .......... 19 .......... 29 ..........
10 .......... 20 .......... 30 ..........

Part A Score

Part B–1

31 .......... 39 ..........
32 .......... 40 ..........
33 .......... 41 ..........
34 .......... 42 ..........
35 .......... 43 ..........
36 .......... 44 ..........
37 .......... 45 ..........
38 .........

Part B–1 Score

The declaration below must be signed when you have completed the examination.

I do hereby affirm, at the close of this examination, that I had no unlawful knowledge of the questions or answers prior to the examination and that I have neither given nor received assistance in answering any of the questions during the examination.

Signature
# SCORING KEY AND RATING GUIDE

**Directions to the Teacher:**

Refer to the directions on page 2 before rating student papers.

Updated information regarding the rating of this examination may be posted on the New York State Education Department’s web site during the rating period. Check this web site [http://www.p12.nysed.gov/osa/](http://www.p12.nysed.gov/osa/) and select the link “Examination Scoring Information” for any recently posted information regarding this examination. This site should be checked before the rating process for this examination begins and several times throughout the Regents examination period.

## Part A and Part B–1

Allow 1 credit for each correct response.

<table>
<thead>
<tr>
<th>Part A</th>
<th>Part B–1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 . . . 3 . . .</td>
<td>31 . . . 2 . . .</td>
</tr>
<tr>
<td>2 . . . 3 . . .</td>
<td>32 . . . 4 . . .</td>
</tr>
<tr>
<td>3 . . . 3 . . .</td>
<td>33 . . . 2 . . .</td>
</tr>
<tr>
<td>4 . . . 2 . . .</td>
<td>34 . . . 3 . . .</td>
</tr>
<tr>
<td>5 . . . 3 . . .</td>
<td>35 . . . 3 . . .</td>
</tr>
<tr>
<td>6 . . . 1 . . .</td>
<td>36 . . . 2 . . .</td>
</tr>
<tr>
<td>7 . . . 3 . . .</td>
<td>37 . . . 4 . . .</td>
</tr>
<tr>
<td>8 . . . 4 . . .</td>
<td>38 . . . 3 . . .</td>
</tr>
<tr>
<td>9 . . . 3 . . .</td>
<td>39 . . . 2 . . .</td>
</tr>
<tr>
<td>10 . . . 1 . . .</td>
<td>40 . . . 1 . . .</td>
</tr>
<tr>
<td></td>
<td>41 . . . 4 . . .</td>
</tr>
<tr>
<td></td>
<td>42 . . . 4 . . .</td>
</tr>
<tr>
<td></td>
<td>43 . . . 1 . . .</td>
</tr>
<tr>
<td></td>
<td>44 . . . 1 . . .</td>
</tr>
<tr>
<td></td>
<td>45 . . . 2 . . .</td>
</tr>
</tbody>
</table>
Follow the procedures below for scoring student answer papers for the Regents Examination in Living Environment. Additional information about scoring is provided in the publication Information Booklet for Scoring Regents Examinations in the Sciences.

Use only red ink or red pencil in rating Regents papers. Do not attempt to correct the student’s work by making insertions or changes of any kind.

Allow 1 credit for each correct response for multiple-choice questions.

On the detachable answer sheet for Part A and Part B–1, indicate by means of a check mark each incorrect or omitted answer to multiple-choice questions. In the box provided in the upper right corner of the answer sheet, record the number of questions the student answered correctly for each of these parts.

At least two science teachers must participate in the scoring of the Part B–2, Part C, and Part D open-ended questions on a student’s paper. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score all the open-ended questions on a student’s answer paper.

Students’ responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. In the student’s examination booklet, record the number of credits earned for each answer in the box printed to the right of the answer lines or spaces for that question.

Fractional credit is not allowed. Only whole-number credit may be given for a response. If the student gives more than one answer to a question, only the first answer should be rated. Units need not be given when the wording of the questions allows such omissions.

Raters should enter the scores earned for Part A, Part B–1, Part B–2, Part C, and Part D on the appropriate lines in the box printed on the answer sheet and should add these five scores and enter the total in the box labeled “Total Raw Score.” Then the student’s raw score should be converted to a scaled score by using the conversion chart that will be posted on the Department’s web site http://www.p12.nysed.gov/osa/ on Tuesday, January 25, 2011. The student’s scaled score should be entered in the box labeled “Final Score” on the student’s answer sheet. The scaled score is the student’s final examination score.

All student answer papers that receive a scaled score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student’s paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student’s final examination score is based on a fair, accurate, and reliable scoring of the student’s answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided for that administration be used to determine the student’s final score.
Part B–2

46 [1] Allow 1 credit for marking an appropriate scale on each axis.

47 [1] Allow 1 credit for correctly plotting freshwater data, surrounding each point with a small circle, and connecting the points.

48 [1] Allow 1 credit for correctly plotting seawater data, surrounding each point with a small triangle, and connecting the points.

Example of a 3-credit response to questions 46–48:

![Graph of Concentration of Oxygen in Water vs. Temperature](image)

**Key**

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Oxygen in freshwater</td>
<td></td>
</tr>
<tr>
<td>▲ Oxygen in seawater</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Allow credit only if circles and triangles are used. Make no assumptions about the origin unless it is labeled. Do not allow credit for plotting points that are not in the data table, e.g., (0, 0), or for extending lines beyond the data points. Do not deduct more than 1 credit for plotting points that are not in the data table or for extending lines beyond the data points.

49 [1] Allow 1 credit for response between 6 ppm and 7.5 ppm.

50 [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— As temperature increases, oxygen concentration decreases.
— As temperature decreases, oxygen concentration increases.
Allow 1 credit. Acceptable responses include, but are not limited to:

— The scents are very specific for the insect they attract.
— Pesticides disrupt food webs.
— Pesticides affect organisms other than mosquitoes.
— Over time, more insects that are resistant to the pesticide would appear in the population.

Allow 1 credit. Acceptable responses include, but are not limited to:

— The reaction will slow down because it is below the optimal temperature.
Part C

56  [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— Potassium helps plants grow.
— Potassium is not needed by plants for proper growth.
— Plants missing potassium will not grow tall.
— Plants lacking potassium will not be green.

Note: Do not allow credit for a hypothesis written in the form of a question.

57  [1] Allow 1 credit. Acceptable responses include, but are not limited to:

— plant height
— number/size of leaves/roots
— amount/percent of leaf discoloration
— daily growth

Note: The type of data must be measurable. Allow credit for an answer consistent with the student’s hypothesis.

58  [3] Allow a maximum of 3 credits, allocated as follows:

• Allow 1 credit for identifying the major problem that may occur when tissues and organs donated by another individual are used. Acceptable responses include, but are not limited to:

  — rejection of tissues or organs

• Allow 1 credit for explaining why this problem may occur. Acceptable responses include, but are not limited to:

  — foreign proteins from donated/tissues/organs trigger immune response
  — immune system attacks foreign tissues/organs

• Allow 1 credit for explaining why this problem will not occur if tissues and organs produced by stem cells from the patient are used. Acceptable responses include, but are not limited to:

  — Proteins in tissues/organs will be the same as those of the patient, so the immune system will not attack.
Allow a maximum of 3 credits, allocated as follows:

- Allow 1 credit for explaining how the exposure to penicillin affects the survival of some bacteria in the population. Acceptable responses include, but are not limited to:
  
  — Bacteria may vary in their susceptibility to penicillin, and resistant ones survive.
  — In the bacteria that survive, there are naturally occurring variations that provide resistance to penicillin.
  — When exposed to penicillin, more of the resistant ones survive.
  — Nonresistant bacteria die off.

- Allow 1 credit for explaining why the frequency of penicillin-resistant bacteria can change over time within the population. Acceptable responses include, but are not limited to:
  
  — When exposed to penicillin, the frequency of resistant bacteria will increase as those that are resistant survive and reproduce.
  — The resistant bacteria will survive and they will produce offspring that are resistant.

- Allow 1 credit for explaining how it is still possible to cure patients who are infected with penicillin-resistant bacteria. Acceptable responses include, but are not limited to:
  
  — Patients can be treated with antibiotics other than penicillin.

Allow 1 credit. Acceptable responses include, but are not limited to:

- carbon dioxide (CO₂)
- methane
- nitrous oxide
- CFCs
Allow 1 credit. Acceptable responses include, but are not limited to:

Carbon dioxide:
- burning fossil fuels
- deforestation
- driving cars

Methane:
- establishing landfills
- raising cattle

Nitrous oxide:
- treating raw sewage
- producing synthetic fertilizers

CFCs:
- air conditioner leaks
- use of certain aerosols

Allow 1 credit. Acceptable responses include, but are not limited to:

- higher sea levels
- habitat loss
- climate change

Allow 1 credit. Acceptable responses include, but are not limited to:

- They would use less electricity, resulting in less fossil fuels being burned.
- Reduced energy use would decrease the amount of fossil fuels burned.

Allow 1 credit. Acceptable responses include, but are not limited to:

- Lack of water could result in dehydration, which interferes with cell functions.
- Temperature, because different species are adapted to live in different climates

Allow 1 credit. Acceptable responses include, but are not limited to:

- lack of natural predators
- Food/prey may be extremely abundant in the new environment.
- breed and multiply in the new environment
66 [1] Allow 1 credit for identifying fish A, B, and C and writing the name of each fish in the column labeled “Scientific Name” in the table.

Note: Allow this credit even if the genus (C.) is not included.

67 [2] Allow a maximum of 2 credits, allocated as follows:

- Allow 1 credit for selecting two characteristics from the dichotomous key that are useful for determining the identity of fish A, B, and C and labeling the headings for the last two columns in the table.

- Allow 1 credit for correctly completing the last two columns in the table.

Example of a 3-credit response for questions 66 and 67:

<table>
<thead>
<tr>
<th>Fish</th>
<th>Scientific Name</th>
<th>Subgroup</th>
<th>Pelvic Fin Color</th>
<th>Spot Near Dorsal Fin Filament</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><em>C. ephippium</em></td>
<td>Rabdophorus</td>
<td>light</td>
<td>large</td>
</tr>
<tr>
<td>B</td>
<td><em>C. kleinii</em></td>
<td>Lepidochaetodon</td>
<td>dark</td>
<td>none</td>
</tr>
<tr>
<td>C</td>
<td><em>C. auriga</em></td>
<td>Rabdophorus</td>
<td>light</td>
<td>small</td>
</tr>
</tbody>
</table>
Part D

68  [2] Allow a maximum of 2 credits, 1 credit for correctly filling in the missing mRNA bases and 1 credit for correctly filling in the amino acid sequence that corresponds to the DNA base sequence.

**Example of a 2-credit response:**

<table>
<thead>
<tr>
<th>DNA</th>
<th>CAC</th>
<th>GTG</th>
<th>GAC</th>
<th>TGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td>GUG</td>
<td>CAC</td>
<td>CUG</td>
<td>ACU</td>
</tr>
<tr>
<td>Amino acids</td>
<td>VAL</td>
<td>HIS</td>
<td>LEU</td>
<td>THR</td>
</tr>
</tbody>
</table>

**Note:** Allow credit for an amino acid sequence that is consistent with the student’s response for the mRNA sequence.

69  2

70  4

71  2

72  [1] Allow 1 credit for species B and supporting the answer. Acceptable responses include, but are not limited to:

— because it has more characteristics in common with the rare species

73  2
Allow a maximum of 2 credits, 1 credit for completing both columns for each of the finches.

Example of a 2-credit response:

<table>
<thead>
<tr>
<th>Competes With the Large Tree Finch</th>
<th>Type of Finch</th>
<th>State one reason why it competes or does not compete with the large tree finch.</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>large/small ground finch or warbler finch</td>
<td>The large tree finch eats mainly animal food, while the large/small ground finch eats mainly plant food. or The warbler finch may eat different animals.</td>
</tr>
<tr>
<td>yes</td>
<td>warbler finch</td>
<td>They both eat animal food.</td>
</tr>
</tbody>
</table>

| 75 | 3 |
| 76 | 2 |
| 77 | 3 |
| 78 | 4 |
Online Submission of Teacher Evaluations of the Test to the Department

Suggestions and feedback from teachers provide an important contribution to the test development process. The Department provides an online evaluation form for State assessments. It contains spaces for teachers to respond to several specific questions and to make suggestions. Instructions for completing the evaluation form are as follows:


2. Select the test title.

3. Complete the required demographic fields.

4. Complete each evaluation question and provide comments in the space provided.

5. Click the SUBMIT button at the bottom of the page to submit the completed form.
## Map to Core Curriculum

### January 2011 Living Environment

<table>
<thead>
<tr>
<th>Standards</th>
<th>Question Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1 — Analysis, Inquiry and Design</td>
<td></td>
</tr>
<tr>
<td>Key Idea 1</td>
<td></td>
</tr>
<tr>
<td>Key Idea 2</td>
<td></td>
</tr>
<tr>
<td>Key Idea 3</td>
<td></td>
</tr>
<tr>
<td><strong>Appendix A (Laboratory Checklist)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Standard 4</strong></td>
<td></td>
</tr>
<tr>
<td>Key Idea 1</td>
<td>1, 4, 6, 12, 20, 25, 26</td>
</tr>
<tr>
<td>Key Idea 2</td>
<td>5, 7, 9, 13, 14, 30</td>
</tr>
<tr>
<td>Key Idea 3</td>
<td>8, 15, 16, 19</td>
</tr>
<tr>
<td>Key Idea 4</td>
<td>2, 17, 18, 21, 22</td>
</tr>
<tr>
<td>Key Idea 5</td>
<td>3, 29</td>
</tr>
<tr>
<td>Key Idea 6</td>
<td>10, 27, 28</td>
</tr>
<tr>
<td>Key Idea 7</td>
<td>11, 23, 24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Part D</strong> 68–78</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab 1</td>
</tr>
<tr>
<td>Lab 2</td>
</tr>
<tr>
<td>Lab 3</td>
</tr>
<tr>
<td>Lab 5</td>
</tr>
</tbody>
</table>
To determine the student's final examination score, find the student's total test raw score in the column labeled “Raw Score” and then locate the scale score that corresponds to that raw score. The scale score is the student's final examination score. Enter this score in the space labeled “Final Score” on the student's answer sheet.

All student answer papers that receive a scale score of 60 through 64 must be scored a second time to ensure the accuracy of the score. For the second scoring, a different committee of teachers may score the student's paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student's final examination score is based on a fair, accurate and reliable scoring of the student's answer paper.

Because scale scores corresponding to raw scores in the conversion chart change from one examination to another, it is crucial that for each administration, the conversion chart provided for that administration be used to determine the student's final score. The chart above is usable only for this administration of the Regents Examination in Living Environment.