State of Israel
Ministry of Education
Exam Type: *Bagrut*
Exam date: Summer 2018
Exam number: 043381
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 043381
תרגום לאנגלית (3)

Biology

Questions and Analysis of Scientific Research in the Core Topic Areas Questions in Areas of In-Depth Study

ביולוגיה

שאלות וניתוח מחקר מדעי בנושאי הליבה שאלות בנושאי ההעמקה

Instructions for examinees

א. Duration of the exam: Three hours

ב. Exam structure and breakdown of points:
This exam has four parts.

Part One	—	32 points
Part Two	—	35 points
Part Three	—	18 points
Part Four	—	15 points
Total	—	100 points

ג. Material that may be used during the exam:
A Hebrew-foreign language/foreign language-Hebrew dictionary

ד. Special instructions:
For the questions in Part One, mark your answers on the answer sheet found at the end of the answer booklet (page 19).
Answer the questions in Part Two, Part Three and Part Four in the answer booklet.

Write all of your rough work (notes, calculations, etc.) on separate pages of the answer booklet only.
Write the word "טיוטה" on the top of each of these pages.
If you write any sort of work outside the answer booklet, your exam may be disqualified!

Good Luck!

הוראות לנבחן

א. משך הבחינה: שלוש שעות.

ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה ארבעה פרקים.

פרק ראשון	–	32 נקודות
פרק שני	–	35 נקודות
פרק שלישי	–	18 נקודות
פרק רביעי	–	15 נקודות
סה"כ	–	100 נקודות

ג. חומר עזר מותר בשימוש:
מילון עברי-לועזי / לועזי-עברי.

ד. הוראות מיוחדות:
את תשובותיך על השאלות בפרק הראשון סמן בתשובון שבסוף מחברת הבחינה (עמוד 19).
את תשובותיך על השאלות בפרק השני, בפרק השלישי ובפרק הרביעי כתוב במחברת הבחינה.

כתוב במחברת הבחינה בלבד, בעמודים נפרדים, כל מה שברצונך לכתוב כטיוטה (ראשי פרקים, חישובים וכדומה).
רשום "טיוטה" בראש כל עמוד טיוטה. רישום טיוטות כלשהן על דפים שמחוץ למחברת הבחינה עלול לגרום לפסילת הבחינה!

בהצלחה!

Questions

Part One (32 points)

There are 20 questions, 1-20, in this part.

You must answer all of the questions. If you answer at least 17 questions correctly, you will receive all 32 points.

Four possible answers are presented for each question. Choose the most appropriate answer.

* Mark the answer you have chosen on the answer sheet at the end of the answer booklet (page 19).
* For each question, draw an × in pen in the box under the letter (א-ד) that represents the answer you chose.

Example:

47. Which disease is carried by mosquitoes?

א. jaundice

ב. rubella

ג. malaria

ד. whooping cough

In this case, you would mark your answer on the answer sheet as follows:

	ד	ג	ב	א	.47
	☐	☒	☐	☐	

* Draw only one × for each question.
* To erase an answer, fill in the entire box like this: ■ .
* You **may not** use White-Out to erase answers.

/continued on page 3/

Note: In order to limit the need to erase answers on the answer sheet, we recommend that you first mark the correct answers inside this booklet and only later enter them into the answer sheet.

Answer all of the questions 1 to 20.

1. The following sentence has four possible endings (א-ד). Select the correct ending.
Taking a long time to chew food accelerates its digestion, because the smaller the bits of food

א. the easier it is for the bits of food to enter the bloodstream.

ב. the greater the surface area on the bits of food that comes into contact with the enzymes.

ג. the faster the proteins are broken down in the mouth.

ד. the more efficiently the body excretes the bits of food.

2. Which of the following characterizes viruses?

א. Some viruses are parasitic and some are not parasitic.

ב. They are sensitive to antibiotics.

ג. Their metabolic rate is very fast.

ד. They reproduce only in living cells.

3. A donkey, a mouse, and an elephant are at rest in an identical ambient temperature. In which of the options א-ד are the animals arranged in descending order of their oxygen consumption per unit of body weight (from the highest to the lowest)?

א. elephant, donkey, mouse

ב. mouse, donkey, elephant

ג. donkey, mouse, elephant

ד. elephant, mouse, donkey

4. Which of the following statements about a signal transmitted through sensory neurons is correct?

א. It is transmitted as an electrical signal along the cell.

ב. It is transmitted as a chemical signal along the cell.

ג. It is transmitted as a sound wave along sensory neurons in the ear.

ד. Different types of signals can be transmitted by the same sensory neuron.

/continued on page 4/

5. Where is the factor that determines the gender of a human fetus located?

א. in the DNA in the sperm cell

ב. in the DNA in the ovum (egg cell)

ג. in the RNA of all body cells

ד. in the RNA in the ovum (egg cell) and in the sperm cell

6. Which one of the following is <u>not associated</u> with homeostasis?

א. removing undigested food from the body via the digestive system

ב. constriction of blood vessels that are just under the skin at low ambient temperatures

ג. increased secretion of the hormone ADH in reaction to a major loss of body water

ד. increased salt concentration in the urine after eating food with a high salt content

7. A mutation may occur in brown rabbits which causes the occurrence of white rabbits. Can we expect the incidence of this mutation to be the same in a population of brown rabbits inhabiting a snowy region as in such a population inhabiting a desert region?

א. No. The rate at which the mutation occurs will be higher in the snowy region, because white fur is an adaptation to snowy conditions.

ב. Yes, because both white rabbits and brown rabbits can survive in both regions.

ג. Yes. The occurrence of a mutation is a random event that is independent of the climate in the animal's habitat.

ד. No. Mutations will occur at a higher rate in the desert region, because white fur absorbs less heat.

8. A person became sick with a disease that damages the liver. What function might be impaired in this person as a result of the damage to the liver?

א . the ability to bind oxygen to hemoglobin

ב. the ability to produce urea from ammonia

ג. the ability to regulate blood flow to the tissues

ד. the ability to secrete insulin

9. From which of the following substances does the cell produce the most energy?

א. glucose

ב. lactic acid

ג. oxygen

ד. carbon dioxide

/continued on page 5/

10. Which one of the following sentences describes natural active immunity?

א. producing antibodies in reaction to the injection of dead pathogens

ב. producing antibodies in reaction to exposure to a sick person

ג. injecting antibodies to the pathogen

ד. passage of antibodies from a mother to her baby

11. Which one of the following sentences correctly describes energy transfer in an ecosystem?

א. All organisms receive energy from other organisms.

ב. All the energy that organisms emit is used by other organisms.

ג. Energy is passed between organisms by feeding.

ד. The amount of energy increases as it passes from producers to consumers.

12. What characterizes the blood that enters the heart atria?

א. Blood entering the right atrium is richer in oxygen than blood entering the left atrium.

ב. Blood entering the left atrium is richer in oxygen than blood entering the right atrium.

ג. Blood entering the right atrium is poorer in carbon dioxide than blood entering the left atrium.

ד. The blood entering both atria contains the same amount of carbon dioxide.

13. In the DNA of the cells of a certain organism the percentage of nucleotides that contain adenine (A) is 20% of all the nucleotides.

What can we infer about the composition of nucleotides in the DNA of these cells?

א. The percentage of uracil (U) is 20%.

ב. The percentage of thymine (T) is 30%.

ג. The percentage of cytosine (C) is 20%.

ד. The percentage of guanine (G) is 30%.

14. Of the following functions, which one is the cerebral cortex not responsible for?

א. thinking and memory

ב. walking

ג. regulating blood pressure

ד. learning language

/continued on page 6/

15. What do the processes of cellular respiration and photosynthesis have in common?

א. Enzymes participate in both processes.

ב. Both processes take place during the day and during the night.

ג. In both processes sugars are broken down.

ד. Both processes take place in the mitochondria.

16. What do the channels in the cell membrane allow?

א. passage of substances only into the cell

ב. passage of substances only out of the cell into its surroundings

ג. passage of substances against the concentration gradient

ד. passage of substances along the concentration gradient

17. Does the amount of blood flowing to the various organs change when shifting from rest to vigorous activity?

א. No. The amount of blood flowing to each organ remains constant at all times.

ב. No, because the total amount of blood in the body remains unchanged.

ג. Yes. The amount of blood flowing to muscles increases and the amount of blood flowing to the digestive system decreases.

ד. Yes. The amount of blood flowing to muscles increases and the amount of blood flowing to the digestive system also increases.

18. How are geophytes adapted to the Mediterranean climate?

א. They disperse seeds in all seasons.

ב. They reproduce only by asexual reproduction.

ג. During the summer, only an underground storage organ remains of the plant.

ד. Their leaves have no stomata.

19. Read the following groups of features. Which group contains features that are <u>all</u> common to <u>all</u> living organisms?

א. building proteins, metabolism, transport system

ב. autotrophic nutrition, homeostasis, having genetic material

ג. reproduction, structure is compatible with function, constant body temperature

ד. having genetic material, reproduction, metabolism

/continued on page 7/

20. The graphs below illustrate the results of an experiment in which two species of unicellular organisms, Species א and Species ב, were cultured using three treatments.

Treatment 1: Species א was cultured on its own.

Treatment 2: Species ב was cultured on its own.

Treatment 3: The two species were cultured together.

Initial density in all treatments was the same.

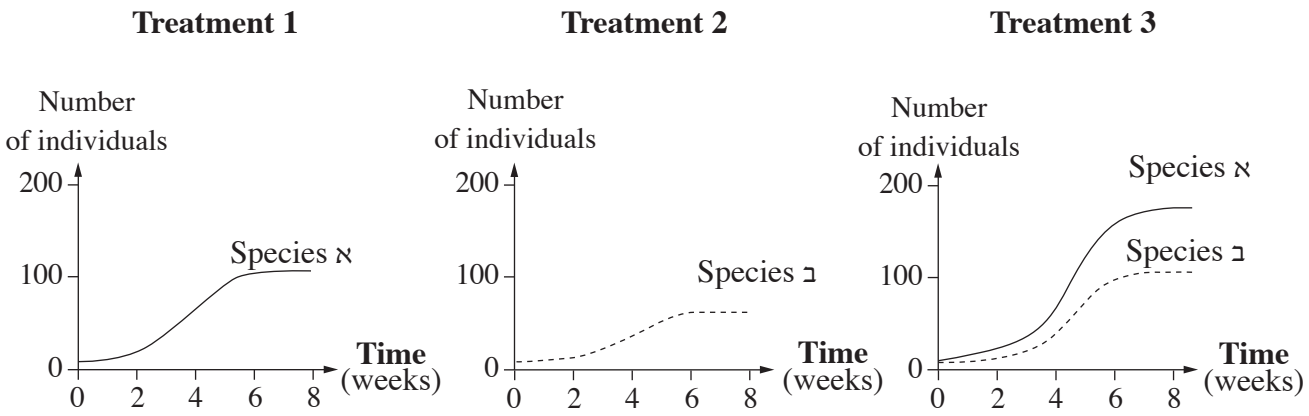
Which type of biological interaction is possible between the two species?

א. competition

ב. commensalism

ג. predation

ד. mutualism



/continued on page 8/

Part Two (35 points)

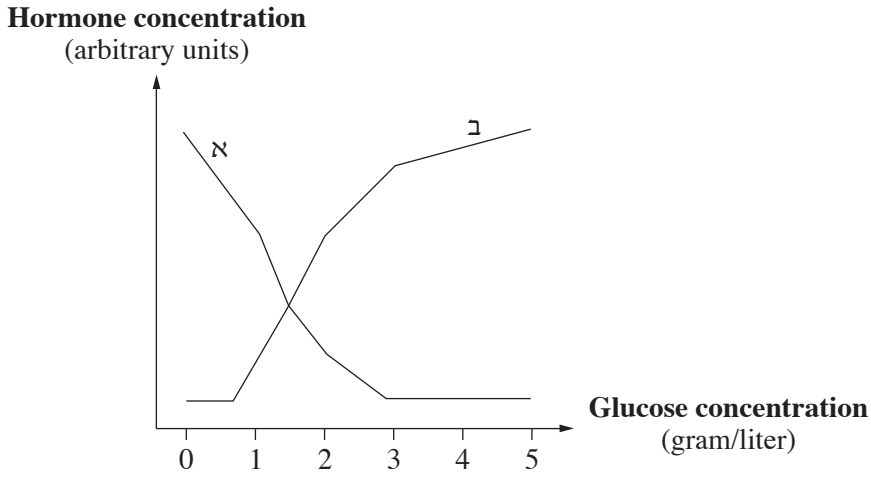
There are seven questions, 21-27, in this part.

Choose <u>five</u> of these questions and write your answers in the **answer booklet** (each question — 7 points).

21. Researchers conducted an experiment: They placed an identical quantity of pancreas cells in a number of test-tubes. They added a different concentration of glucose solution to each of the test-tubes. All the other conditions in this experiment were identical. After 20 minutes the researchers measured the concentration of the hormone insulin and the concentration of the hormone glucagon secreted by the pancreas cells in the test-tubes.

The results of this experiment are shown in the following graph.

Effect of glucose concentration on hormone secretion by pancreas cells



א. **(1)** Determine which curve, א or ב, represents insulin concentration, and which curve represents glucagon concentration. Explain your answer regarding <u>one</u> of the hormones.

(2) Choose <u>one</u> of the two hormones and explain <u>one</u> way in which it causes an increase or a decrease in the concentration of glucose in the blood.

(3.5 points)

ב. The pancreas contains cells that produce insulin and other cells that produce glucagon. The table on the following page shows components present in cells that produce insulin, or in cells that produce glucagon, or in both types of cells.

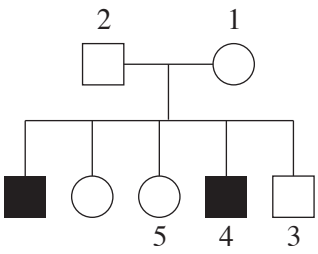
(**This question continues on the following page.**) /continued on page 9/

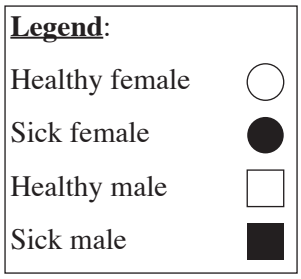
Copy the table below to your answer booklet and fill in the missing information ('present' or 'absent'). (3.5 points)

Components in an insulin-producing cell and in a glucagon-producing cell

Component in the cell	Insulin-producing cell	Glucagon-producing cell
Gene that codes for insulin (present/absent)		
Gene that codes for glucagon (present/absent)		
Messenger RNA (mRNA) that is translated into insulin (present/absent)		
Messenger RNA (mRNA) that is translated into glucagon (present/absent)		

22. The following figure describes a family tree. In the figure, the black shapes represent individuals who have a genetic disease in which the enamel coating of the teeth does not develop properly (amelogenesis imperfecta).





The researchers hypothesized that the allele for the disease is located on the X chromosome.

א. **(1)** Based on this hypothesis, give the genotypes of the individuals 1, 2, 3, and 4.

(2) Based on this hypothesis, is it possible to determine the genotype of individual 5? Explain.

(4 points)

ב. Suggest one explanation for the fact that, based on this family-tree alone, it is impossible to prove the hypothesis that the allele for this disease is located on the X chromosome.

(3 points)

/continued on page 10/

23. א. Enzyme A catalyzes the synthesis of disaccharides from monosaccharides. In an experiment, identical quantities of Enzyme A and identical quantities of monosaccharides were added to three test-tubes. Each of the test-tubes was placed in a water bath with a different temperature, as shown in the table. After a few minutes the processes in the test-tubes were stopped and the amount of monosaccharides remaining in each test-tube was measured.

Test-tube	**Temperature** (°C)	**Amount of monosaccharides in the test-tube at the end of the experiment**
1	20	medium
2	35	none
3	60	largest

Explain the results obtained in this experiment at <u>each</u> of the three temperatures. (3.5 points)

ב. When flies (insects) are transported from an environment in which the temperature is 35°C to an environment in which the temperature is 10°C, the rate at which they move changes.

Explain the connection between the following changes: the change in ambient temperature, the change in the flies' body temperature, the change in the flies' movement rate. Also discuss the concept of enzymes in your answer. (3.5 points)

24. A certain species produces many offspring in every generation. If all the offspring also produce many offspring, the species' population will grow uncontrollably. However, in the wild, populations do not grow uncontrollably.

א. List <u>two</u> factors that limit population growth in the wild. (2 points)

ב. The population of the State of Israel in 2018 numbers over 8.7 million residents, compared with 0.8 million residents when the state was established.

(1) As a result of this population growth, more land has been allocated for intensive crop farming. Provide one argument <u>for</u> the expansion of intensive farming and one argument <u>against</u> it.

(2) What is your position regarding the expansion of intensive farming? Provide <u>one</u> argument in support of your position in addition to the argument you provided in Sub-item (1).

(5 points)

/continued on page 11/

25. א. The kidney is a homeostatic organ. List one homeostatic function of the kidney. (1 point)

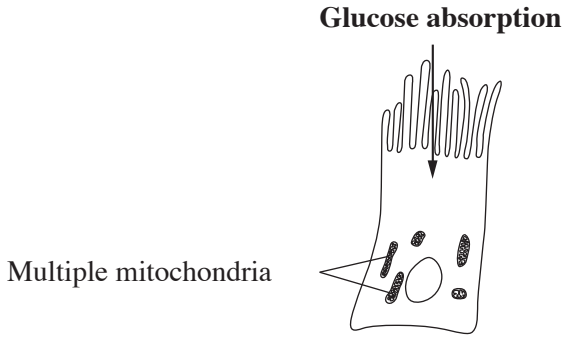
ב. The blood flowing through the kidney artery of a certain healthy person was tested and its glucose concentration was found to be 90 mg in 100 ml of blood.

— Determine the concentration of glucose in the filtrate of a nephron in this person. Is it **90** mg in 100 ml of liquid, or **0** mg in 100 ml of liquid?

— Determine the concentration of glucose in the urine of this person. Is it **90** mg in 100 ml of liquid, or **0** mg in 100 ml of liquid?

Explain your answer. (3 points)

ג. The figure below is an illustration of a certain kidney cell that absorbs glucose efficiently.



Based on the illustration, list two adaptations of the cell structure and of its organelles which make efficient glucose absorption possible. Explain how each adaptation contributes to efficient glucose absorption. (3 points)

26. Carnivorous plants are green plants that trap insects and small animals and feed on them. These plants usually grow in soils that are poor in nitrogen compounds.

א. To which trophic levels in the ecological pyramid do carnivorous plants belong? Explain your answer. (2.5 points)

ב. Name one substance that the plant produces that contains nitrogen. (1 point)

ג. **(1)** What is the carnivorous plant's source of nitrogen?

(2) Plants that are not carnivorous depend on soil bacteria for their nitrogen. Explain how these bacteria contribute to a plant's supply of nitrogen.

(3.5 points)

/continued on page 12/

27. In an experiment researchers tested the effect of various compositions of gases on respiration rate. Each time, a subject inhaled a different gas composition for 3 minutes and then the researchers tested his or her respiration rate.

The table below presents the results of this experiment.

Effect of gas composition on respiration rate after 3 minutes

Composition	**Gas composition** (%)		**Respiration rate** (number of breaths per minute)
	Oxygen (O_2)	**Carbon Dioxide** (CO_2)	
א	96	4	30
ב*	21	0.03	15
ג	100	0	8

*This composition of gases is identical to the composition of oxygen and CO_2 in the air around us.

א. Based on the table, determine which gas, oxygen or CO_2, caused an increase in respiration rate. Explain your answer. Base your explanation on the respiration rate in each of the three compositions א-ג. (3.5 points)

ב. In the experiment described above, researchers caused changes in respiration rate in humans. What is your opinion of conducting experiments on humans?
Provide one argument in support of your opinion. (1 point)

ג. When shifting from being at rest to vigorous physical activity, blood gas composition changes, and as a result, respiration rate rises. Below are stages in this process — starting with the change in gas composition in the blood and ending with increased respiration rate in the lungs.

Copy the stages to your answer booklet in their order of occurrence.

— Information is processed in the respiratory center in the brain.
— A signal is transmitted in a motor neuron.
— A signal is transmitted in a sensory neuron.
— The diaphragm and intercostal [between the ribs] muscles are activated.
— A stimulus is received in the sensory cells.

(2.5 points)

/continued on page 13/

Part Three (18 points)

There are three questions, 28-30, in this part.

Read the description of a research study presented below, and answer all of the questions 28-30 (the point value of each item is given).

Plant Communication

(Based on: O. Falik et al. Rumor Has It...: Relay Communication of Stress Cues in Plants **PLoS ONE**. November, 2011. Taken from: www.plosone.org)

Plants and animals have a natural way to communicate with each other. For example, a flower with a striking color or unusual shape attracts insects that mediate its pollination, or a colorful fruit attracts animals who will eat it and by excreting the seeds assist in their dispersal.

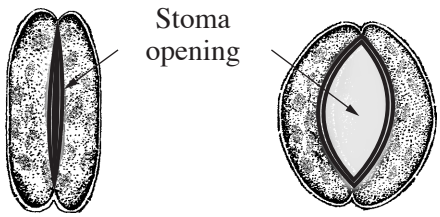
In recent years scientists have also investigated communication between plants, and have found that occasionally information related to environmental conditions passes from one plant to another.

Like all living creatures, plants are usually adapted to their environment, but sometimes plants are exposed to conditions that cause them stress [עֶקֶה].

Stress means that an organism is in a state of distress following exposure to extreme environmental conditions, such as high temperature, water deprivation, or high salinity, that can negatively affect a plant's functioning and ability to survive.

Lack of water in the soil is one of the causes of drought stress. Plants react to this stress by adjusting the openings of their stomata.

Information: When a plant that grows in the light has enough water the stomata in its leaves open up, and when a plant is in drought stress its stoma openings narrow.



28. **א.** Explain how a plant benefits by narrowing its stomata in drought conditions. (2 points).

ב. Plants absorb CO_2 through their stomata. Explain why keeping the stomata closed for most of the daytime hours can impair plant growth. (4 points)

/continued on page 14/

Researchers at Ben-Gurion University of the Negev conducted an experiment in which they investigated whether cues pass from plants exposed to drought conditions to neighboring plants **not exposed** to the same conditions.

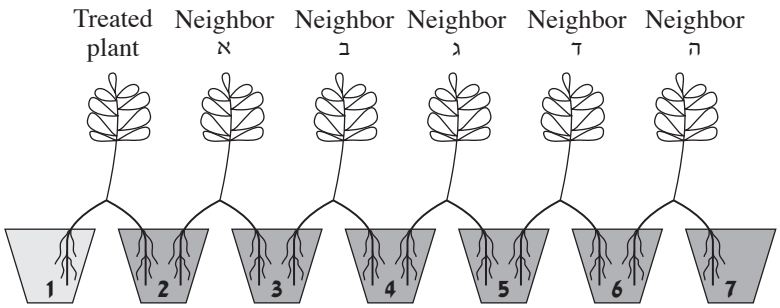
Experimental setup:

Step 1

The researchers took several pea plants, each with two roots of equal size. They planted the pea plants in a row of adjacent planters in such a way that each of the planters 2-6 contained two roots from two different plants. All plants were grown under identical conditions.

Next, the researchers created drought conditions in the first plant in Planter 1 (**treated plant**): Only one of this plant's roots was exposed to drought conditions. The treated plant's second root, and all the roots of its five neighbors were not exposed to these same drought conditions (see Figure 1).

Figure 1: Step 1 Experimental Setup



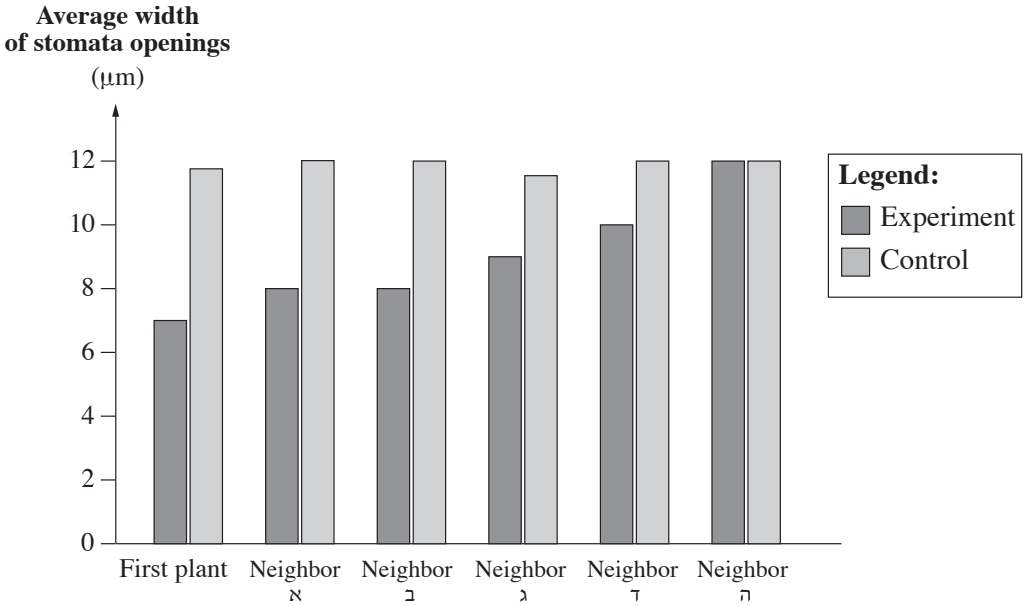
The control was an identical set of pea plants in planters, except that all the roots (of the first plant as well as its five neighbors) were not exposed to drought conditions.

The researchers monitored the response of the first plant and the responses of the five neighbors in the test and in the control setups. They measured plant response twice: the width of the stomata was measured at the beginning of the experiment, and then once again 15 minutes after the experiment started.

/continued on page 15/

The first measurement showed that the stomata were open in all the plants when the experiment began. The results of the second measurement are shown in the diagram below.

Stomata opening in the first plant and in its neighboring plants



29. א. We can conclude from the experiment's results that the plant that was exposed to drought conditions in the soil communicates a cue to its neighbor (Plant א) which was not exposed to the same conditions.

Provide grounds for this conclusion from the results obtained in the experimental setup and in the control. (3 points)

ב. Determine what conclusion can be drawn from the results in the experimental setup (Figure 1) about communicating cues between all the plants not exposed to drought conditions (neighbors א-ה). Explain your answer. (3 points)

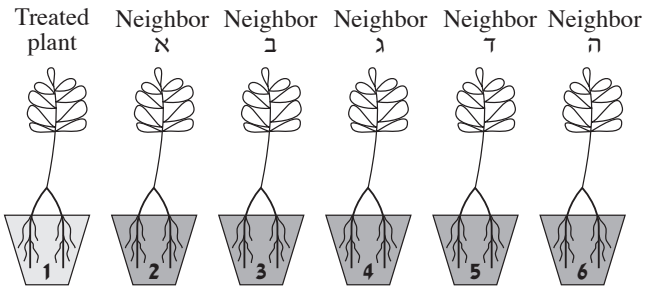
/continued on page 16/

Step 2

After Step 1, the researchers arranged another set of pea plants in a row of adjacent planters. As in Step 1, only the first plant was exposed to drought conditions (the treated plant) and all the neighbors were not exposed to these conditions.

Unlike Step 1, both roots of each plant were planted in a single planter, so that the roots of neighboring plants were not in the same planter (see Figure 2).

Figure 2: Step 2 Experimental Setup



30. א. Communication of cues between plants can occur in a number of ways. Two ways are presented below:

Route 1 — Cues pass through the soil from the roots of one plant to the roots of a neighboring plant.

Route 2 — Cues pass through the air from the leaves of one plant to the leaves of a neighboring plant.

The researchers measured the width of stomata opening in all the plants in Step 2.

(1) Which results in Step 2 could lead the researchers to conclude that the cue is communicated via Route 1? Explain your answer.

(2) Which results in Step 2 could lead the researchers to conclude that the cue is communicated via Route 2? Explain your answer.

(4 points)

ב. To create drought stress in the plants (in both steps of the experiment) under lab conditions, researchers added to the soil in Planter 1 a sugar solution that was hypertonic to the root cells. Explain why this treatment creates conditions that cause drought stress. (2 points)

After completing their study, the researchers concluded that the drought-stress cue was passed between the roots.

/continued on page 17/

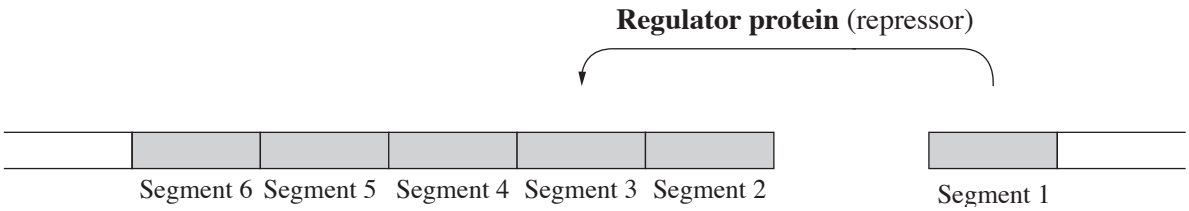
Part Four (15 points)

This part presents questions on three topics: Regulation of Gene Expression and Genetic Engineering; Developmental Comparative Physiology; and Bacteria and Viruses in the Human Body. Choose one topic and answer **two** questions on that topic, according to the directions given for the topic you chose.

Topic I — Regulation of Gene Expression and Genetic Engineering

Answer two questions: Question 31 (required) and one of the questions 32-33.
Answer Question 31 (**required**).

31. The figure below illustrates lactose operon regulation in bacteria.



א. Determine which of the six segments, 1-6, in the figure code for protein production. (2 points)

ב. A mutant strain of the bacteria *E. coli* constantly produces enzymes for digesting lactose, even in the absence of lactose. In which of the segments shown in the figure could the mutation in this strain be present? Explain. (4 points)

ג. Another strain of the bacteria *E. coli* with a normally-functioning lactose operon was cultured on a medium that contained lactose and glucose. Gradually, the glucose concentration in the medium declined.
How will the reduced concentration of glucose affect the production level of the enzymes that these bacteria use to utilize lactose? Explain.
In your answer, discuss how glucose affects the lactose operon. (3 points)

/continued on page 18/

Answer one of the questions 32-33.

32. Recently, genetically engineered white blood cells have been approved to treat cancer patients with certain types of cancer (immunotherapy).

White blood cells are taken from a patient, and are engineered and then returned to the patient's body. These cells are engineered to produce protein receptors that bind specifically to the cancer cells. The cancer cells are destroyed through binding to these receptors.

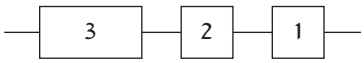
א. Researchers used viruses whose genetic material is RNA to create the engineered white blood cells. These viruses carry a reverse-transcription enzyme. Explain why this enzyme is crucial to the process of engineering white blood cells. (4 points)

ב. In the treatment described above, the patient's own immune cells are engineered. Explain why it is preferable to use cells from the patient's own body. (2 points)

33. *Bacillus* bacteria (Bt) produce a toxin that is harmful to certain insects that infest plants. Scientists created plants that are resistant to these insects by using genetic engineering to construct a plasmid with the genes that code for this toxin, and then inserting the plasmid into the plant.

Below is a diagram of part of the plasmid.

Legend:
Segment 1 — Control region for transcription start
Segment 2 — Selectable marker
Segment 3 — Genes that code for production of the Bt toxin



א. For each of the three segments 1-3, determine whether it is essential for producing the toxin in the plant. Explain your reasoning in each case. (3 points)

ב. Genes that code for producing the toxin were inserted into the chloroplasts of the plant's cells, and therefore were expressed only in the green cells of the plant.

Green plant-cells also carry the plant's own genes, some of which are expressed only in these cells.

(1) Provide one example of a plant's own gene that is expressed only in the green cells of the plant.

(2) Provide one example of a plant's own gene that is expressed in all the plant's cells.

(3 points)

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Topic II — Developmental Comparative Physiology

Answer two questions: Question 34 (required) and one of the questions 35-36.

Answer Question 34 (**required**).

Physiology

34. א. The figures below show a freshwater fish and a salt-water fish. The arrows represent substances entering or exiting the fish.

Figure 2: Salt-water fish

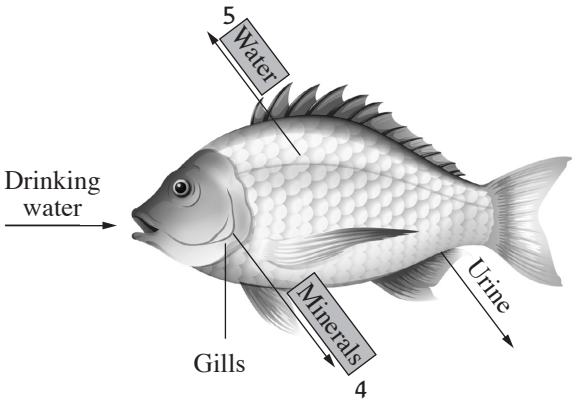
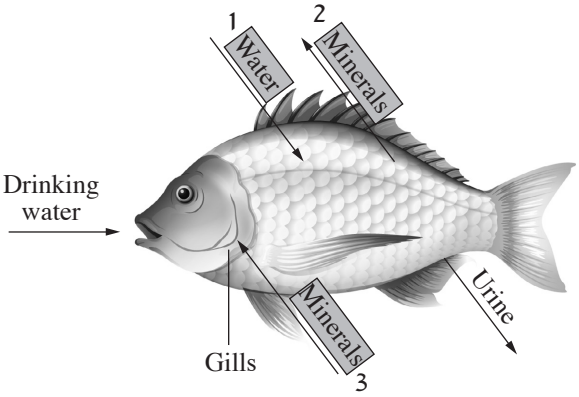


Figure 1: Freshwater fish



(1) For each of the five arrows, 1-5, in the figures, write whether it describes active transport or diffusion.

(2) Which numbered arrow in **Figure 1** describes a process that contributes to homeostasis in a fish that inhabits freshwater? Explain.

(4 points)

ב. What is the difference in urine volume and in urine concentration between freshwater fish and salt-water fish? Explain. Base your explanation on the amount of filtrate or on re-absorption. (2 points)

ג. Different species of turtles excrete different types of nitrogen waste: ammonia, urea, or uric acid.

Turtles that live in water excrete mainly ammonia, but turtles that live on land excrete mainly uric acid.

Explain the compatibility between the type of nitrogen waste that the turtle excretes and the turtle's habitat (water or land). (3 points)

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Answer one of the questions 35-36.

35. א. The development of sexual reproduction systems in animals is related to the shift from life in the water to life on land.

Explain the connection between the habitat and the number — large or small — of egg cells (ova) in a single reproductive cycle in egg-laying fish and in humans.

(3.5 points)

ב. In humans fetal development ends at birth, and in some fish embryonic development ends at spawning [השרצה].

Copy the following table to your answer booklet and fill in the missing information (yes or no). (2.5 points)

Embryo development in humans and in fish

	Human	Spawning fish	Non-spawning fish
Embryo develops in the mother's body (yes/no)			
Embryo develops in an egg (yes/no)			

36. א. Multicellular organisms evolved from unicellular organisms. One of the systems that evolved in large multicellular organisms is the transport system. Explain why a transport system is essential for the normal functioning of large multicellular organisms.

(3 points)

ב. List two differences between the transport system in insects and the transport system in reptiles: one structural difference, and one difference in the functioning of the blood.

(3 points)

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Topic III — Bacteria and Viruses in the Human Body

Answer two questions: Question 37 (required) and one of the questions 38-39.

Answer Question 37 (**required**).

37. The bacteria that cause cholera secrete a toxin that is composed of two subunits: A and B. Subunit B binds to the membranes of cells in the intestine, and makes it possible for Subunit A to penetrate the cells. When Subunit A is inside an intestine cell it causes the cell to secrete minerals into the intestinal lumen (inside space), and its effect on intestine cells is long-lasting.

א. One of the symptoms of cholera is diarrhea, which causes the body to lose large amounts of water (up to 20 liters in 24 hours). Explain how the cholera toxin causes water loss.

(2.5 points)

ב. Use the information in the introduction to answer Sub-items (1) and (2).

(1) Antibiotic treatment that targets the cholera bacteria does not have an immediate effect on the disease's symptoms. Explain why damaging the cholera bacteria does not have an immediate effect on the cholera symptoms.

(2) Scientists have tried to develop a cholera vaccine that only targets the B subunit of the toxin and not the A subunit. Explain how this type of vaccine can be effective against the disease, even though the A subunit is not affected.

(3 points)

ג. List two ways in which bacteria in the intestine benefit humans. (2.5 points)

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Answer one of the questions 38-39.

38. א. **(1)** List four steps in reproduction that are common to **all** viruses that attack human cells.

(2) Finding medicines to treat virus infections is difficult. Suggest one reason for this difficulty.

(4 points)

ב. The HIV virus causes AIDS in humans.

(1) In which cells in the human body does the HIV virus reproduce?

(2) What makes it possible for the HIV virus to attack these cells and not others?

(3 points)

39. A peptic ulcer is a wound in the stomach wall. In the past, people believed that high acidity in the stomach is the cause of peptic ulcers.

The researchers Warren and Marshall tried to prove that peptic ulcers are caused by bacteria. The researchers identified the bacteria *Helicobacter pylori* in samples taken from peptic ulcer patients, and cultured the bacteria in a growth medium. As no suitable animal could be found for this experiment, one of the researchers decided to drink a solution containing the isolated bacteria himself. He drank the solution and developed a peptic ulcer.

א. The stages in the researchers' work match the first three of Koch's postulates.

(1) List the first three of Koch's postulates.

(2) Explain what action is required according to Koch's fourth postulate.

(4 points)

ב. Bacteria can be cultured in a solid or liquid growth medium. List one advantage of using each of these media.

(3 points)

Good Luck!