

Biology

Questions and Analysis of Scientific Research in the Following Areas: Introduction to the Human Body, Cell Structure and Function, and Ecology

Part of the 5-point test

Instructions for examinees

- א. Duration of the exam: Two hours and fifteen minutes
- ב. Exam structure and breakdown of points:
This exam has three parts.
Part One — 45 points
Part Two — 35 points
Part Three — 20 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 items in Part One, mark your answers in the answer sheet found at the end of the answer booklet (page 19).
For the questions in Part Two and Part Three, write your answers in the answer booklet.

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

Good Luck!

ביולוגיה

שאלות וניתוח מחקר מדעי
בנושאי הליבה:
מבוא לגוף האדם, התא –
מבנה ופעילות, אקולוגיה

חלק מבחינת 5 יחידות לימוד

הוראות לנבחן

- א. משך הבחינה: שתיים ורבע.
- ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה שלושה פרקים.
פרק ראשון – 45 נקודות
פרק שני – 35 נקודות
פרק שלישי – 20 נקודות
סה"כ – 100 נקודות
- ג. חומר עזר מותר בשימוש:
מילון עברי-לועזי / לועזי-עברי.

ד. הוראות מיוחדות:

את תשובותיך לסעיפים בפרק הראשון סמן
בתשובון שבסוף מחברת הבחינה (עמוד 19).
את תשובותיך לשאלות בפרק השני והשלישי
כתוב במחברת הבחינה.

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

בהצלחה!

Questions

Part One (45 points)

Part One is consists of one question, which is made up of the items א to ט.

You must answer all of the items. If you answer at least 17 of the items correctly, you will receive all 45 points.

Question 1 (45 points)

Four possible answers are presented for each item. 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 item, draw an ✕ in pen in the box under the number (1-4) that represents the answer you chose.

Example:

נט. Which disease is carried by mosquitoes?

1. jaundice
2. rubella
3. malaria
4. whooping cough

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

4	3	2	1	נט.
☐	☒	☐	☐	

- * 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.

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 items, א to כ.

א. Oxygen-rich blood flows through:

1. the arteries of the lungs
2. the veins of the lungs
3. the coronary arteries [וורידים הכליליים]
4. the veins of the legs

ב. A reflex:

1. is a fixed reaction to a certain stimulus
2. is caused by hormonal activity
3. is something that is found among humans, but not among animals
4. is learned only through training

ג. In a potato plant (a geophyte), the starch in the tuber [פקעת] is made up of molecules of glucose that:

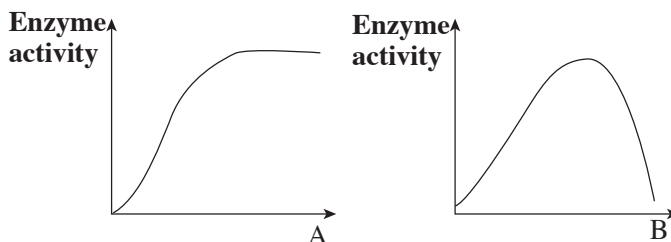
1. were absorbed through the roots and then transported to the tubers
2. were produced in the leaves and then transported to the tubers
3. were produced in the tubers from CO_2 that came from the leaves and water that came from the roots
4. were produced in the roots by bacteria that bind CO_2 and then transported to the tubers

ד. Which of the following adaptations is an adaptation to biotic conditions?

1. Desert plants have branched root systems.
2. Deer have long, thin legs that allow them to run quickly.
3. Camels have red blood cells that can tolerate a wide range of salt concentrations.
4. Water plants whose leaves float on the surface of the water have large, wide leaves.

- ה. In contrast to mitosis, in meiosis:
1. DNA is replicated before the process begins
 2. DNA is replicated at the end of the process
 3. DNA is divided twice
 4. DNA is replicated twice
- ו. Which of the following sentences best explains why many leaf aphids are green?
1. Green substances from the leaves seep into the aphids' bodies, turning them green.
 2. In previous generations, more non-green aphids were hunted by natural enemies.
 3. Green aphids live only on green leaves.
 4. Close contact between the aphids and leaves over generations has led these aphids to be able to synthesize chlorophyll.
- ז. Stem cells can be used to treat certain diseases, mainly because:
1. stem cells have more genes than other cells of the body
 2. there are more types of tRNA in stem cells than in other cells of the body
 3. stem cells can differentiate into different types of cells
 4. stem cells multiply quickly
- ח. In the past, it was customary to inject a weakened virus into a horse, in order to use the antibodies produced in the horse's blood and inject them into a human.
- What type of immunization did the horse get and what type of immunization did the human get?
1. The horse got active immunization and the person got passive immunization.
 2. The horse got passive immunization and the person got active immunization.
 3. They both got active immunization.
 4. They both got passive immunization.
- ט. A decrease in the amount of blood platelets will immediately
1. cause an increase in blood pressure
 2. impair the production of antibodies
 3. slow clotting
 4. impair the transport of oxygen

- י. During an enzymatic reaction:
1. the concentration of substrate increases
 2. the concentration of enzyme remains constant
 3. the concentration of substrate remains constant
 4. the concentration of product remains constant
- יא. A human liver cell and a plant cell were transferred from their natural environments to distilled water.
What happened to the cells?
1. The liver cell was not damaged, but the plant cell burst.
 2. The plant cell was not damaged, but the liver cell burst.
 3. The liver cell was not damaged, but the plant cell contracted.
 4. The plant cell was not damaged, but the liver cell contracted.
- יב. Which materials can serve as a source of energy for a cell?
1. carbohydrates, minerals, proteins
 2. vitamins, proteins, carbohydrates
 3. fats, carbohydrates, proteins
 4. ATP, carbohydrates, minerals
- יג. The two graphs below describe the activity of an enzyme as a function of two different factors, A and B.
What might A and B be?
1. A – temperature; B – pH
 2. A – pH; B – substrate concentration
 3. A – substrate concentration; B – enzyme concentration
 4. A – substrate concentration; B – temperature



- ד. What is the order of the phases that starch that is consumed undergoes until its components are used to produce energy in a muscle cell?
1. Absorption, digestion, entry into a muscle cell
 2. Absorption, entry into a muscle cell, digestion
 3. Digestion, entry into a muscle cell, absorption
 4. Digestion, absorption, entry into a muscle cell
- ה. What can we correctly say about the respiration of plants and the respiration of animals?
1. The processes differ in terms of the organelles in which they are carried out.
 2. The processes differ in terms of the time of day at which they are carried out.
 3. The processes differ in terms of the gases that they emit.
 4. There is no fundamental difference between these processes.
- ו. Sickle-cell anemia is a hereditary disease in which the hemoglobin of an individual differs from that of a healthy individual at one amino acid. The difference between a healthy person and a person with sickle-cell anemia is found:
1. in DNA and messenger RNA (mRNA)
 2. in messenger RNA (mRNA) and ribosomes
 3. in the way that transfer RNA (tRNA) binds messenger RNA (mRNA)
 4. in the activity of the ribosomes and DNA activity
- ז. A person is in a room in which the temperature is 25°C. What will happen to the level of ADH hormone in his blood if he drinks nothing for 24 hours?
1. It will increase.
 2. It will decrease.
 3. It will not change.
 4. It will alternately increase and decrease.

- יח. A red blood cell travels from a person's right hand to his right leg. Along the way, the cell must pass through:
1. the head
 2. the lungs
 3. the small intestine
 4. the liver
- יט. Which one of the processes listed below requires energy?
1. the passage of CO_2 from the blood into the alveoli [נאדיות] of the lung
 2. re-absorption of glucose in the kidney
 3. the passage of oxygen from capillaries into cells
 4. re-absorption of water in the kidney
- כ. A small mammal will have trouble surviving a low environmental temperature because:
1. the rate of its cellular respiration will decrease
 2. its body will lose heat to the environment
 3. its peripheral blood vessels [כלי דם היקפיים] will contract
 4. its consumption of food will decrease

Part Two (35 points)

Part Two is made up of eight questions, 2-9.

Choose five of these questions that you want to answer, and write your answers in the **answer booklet** (each question — 7 points).

2. Two one-celled organisms are fed only on a sugar solution. One of these organisms is aerobic and the other is anaerobic. The two organisms produce the same amount of ATP within a given period of time.

Which organism uses a greater quantity of glucose? Explain.

3. Farmers have asked to import a species of insect-eating bird into Israel, in order to control insects that are agricultural pests.

א. What danger is there in importing a new species of bird into Israel?
(3 points)

ב. Name two things about the bird that need to be clarified before a decision can be made to import it, in order to avoid the danger you mentioned for Item א. (4 points)

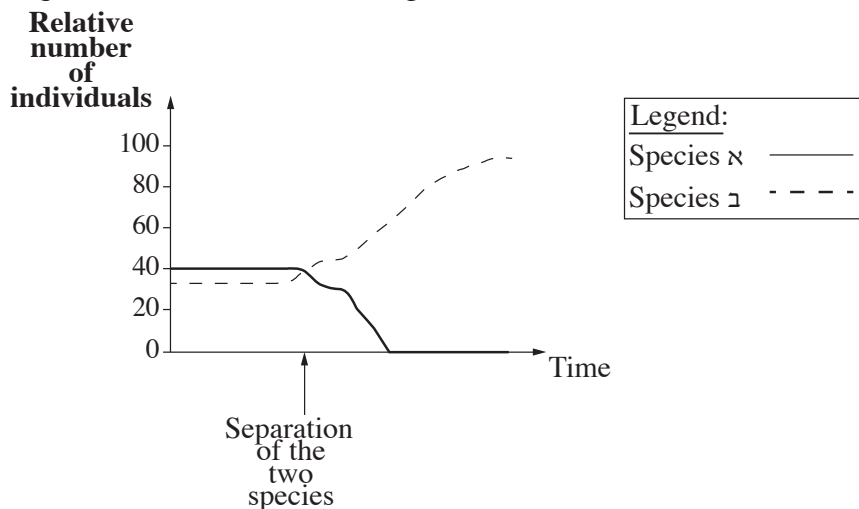
4. One-celled organisms of a certain species are in an oxygen-rich solution that contains potassium ions. The cells absorb potassium ions until the concentration of potassium ions inside the cells is 50 times higher than the concentration of those ions in the solution. When the cells are in a solution with very little oxygen that contains the same concentration of potassium ions as the first solution, the concentration of potassium ions inside the cells does not increase.

Explain why the concentration of potassium ions does not increase in the cells in the solution that contains only a small amount of oxygen.

5. Diphtheria [קרמת] is among the diseases known as "childhood diseases" (for example, chicken pox [אבעבועות רוח], whooping cough [שעלת], rubella [אדמת] and measles [חצבת]).

Explain why someone who had one of these diseases as a child will not get it again.

6. Professor Ada Yonat of the Weizmann Institute of Science won the Nobel Prize in Chemistry for 2009 for deciphering the structure of the ribosome.
- א. At which step in the pathway from DNA to protein does the ribosome act? (2 points)
- ב. Name two types of RNA molecules that are involved in the step you mentioned for Item א and explain the role that they each play in the production of protein. (5 points)
7. As part of a study of the function of the pancreas that was carried out in the 19th century, pancreases were removed from dogs. To the surprise of the researchers, flies were particularly attracted to the urine of those dogs. Based on what we know today about the functioning of the pancreas, explain why the flies were attracted to that urine.
8. When a person runs, his body heats up and his peripheral blood vessels expand. This change in the blood vessels helps maintain a stable body temperature. Explain.
9. Researchers raised two species together in a container and, at a certain point, the two species reached a state of equilibrium. At some later point, the researchers separated the two species and raised them in separate containers. They then measured the size of each population. The graph below describes the collected data, from the point in time at which equilibrium between the two species was reached.



- א. What type of reciprocal relationship [יחסי גומלין] is there between the two species? (2 points)
- ב. Based on the graph, explain the change in the size of each of two populations after they were separated. (5 points) /continued on page 10/

Part Three (20 points)

Part Three is made up of three questions, 10-12.

Read the description of research presented below and answer all of the questions 10-12. (The point value of each question is given.)

Parental behavior

(Based on: Scott, N. et al [2015]. *A sexually dimorphic hypothalamic circuit controls maternal care and oxytocin secretion*. **Nature**, 525. 519-522)

Just like many other mammals, female mice exhibit maternal behavior even before their pups are delivered, but mostly afterwards. Before delivery, their maternal behavior is largely centered around selecting a suitable place for delivery and building a nest. After delivery, maternal behavior is expressed, among other ways, by caring for the pups and protecting them. Maternal behavior is affected by activity in certain areas of the brain. This activity is expressed in the transmission of nerve impulses.

10. א. There are several stages in the transmission of a nerve impulse from one neuron to another. List three of these stages. (3.5 points)
- ב. List one difference between transmission of a nerve impulse along a nerve cell (neuron) and transmission of an impulse across a synapse. (2.5 points)

Among mice, like many other mammals, the females care for the pups most of the time and the males rarely take care of them. Researchers found a difference in parental behavior between individuals who are parents and individuals who are not parents.

Researchers at the Weizmann Institute of Science decided to investigate whether the differences in parental behavior in mice are related to the differences that exist between males and females in the structure of the brain and in brain function.

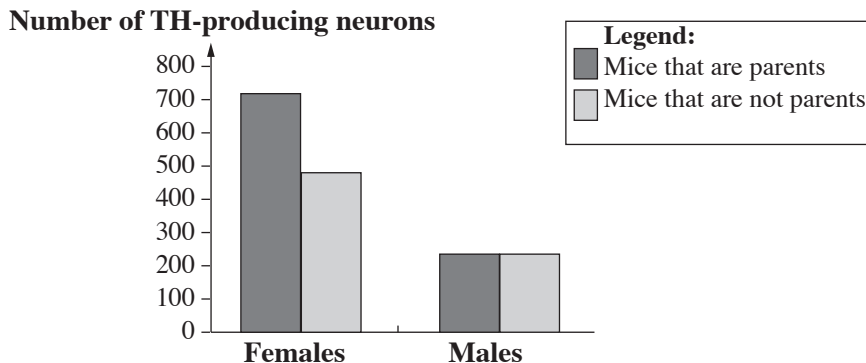
Researchers focused on a small area in the brain called the AVPV, because this area of the brain is different in females than in males. Brain activity in this area involves secreting the neurotransmitter **dopamine** into the synapses. Dopamine is produced in a process that involves the enzyme TH (tyrosine hydroxylase). Researchers chose to determine dopamine levels by checking levels of TH and in this way determine the level of brain activity.

(The text continues on the next page.)

In the first stage of this study, researchers investigated how many neurons produce the enzyme TH in the AVPV area in the brain of four groups of mice: females who were mothers, females who were not mothers, males who were fathers, and males who were not fathers. All the mice were the same age and were raised in the same cages and under identical conditions.

Results of the first stage are shown in Graph 1, below.

Graph 1: Number of TH-producing neurons in the AVPV area of the brain



11. א. Determine if there is a relation between the number of neurons that produce TH and mouse gender. Use the graph to explain your decision. (3 points)
- ב. Determine if there is a relation between the number of neurons that produce TH and the fact that the individual is a parent. Your answer should relate to both females and males. Use the graph to explain your decision. (3 points)

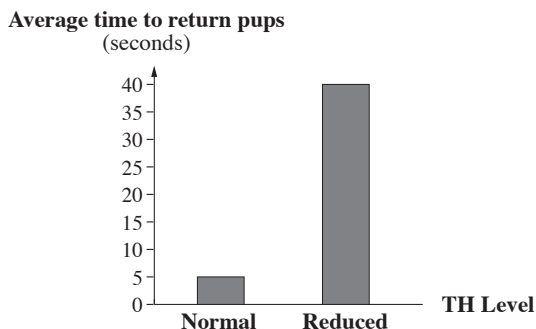
In the second stage of the study, researchers investigated the effect of levels of the enzyme TH on parental behavior of females living in cages. Parental behavior was measured by the amount of time it took a mother to return a pup placed in the corner of the cage to the breeding nest, which is a protected space in the cage.

The researchers took mother females and divided them into two groups: The females in one group received treatment to reduce production of TH in AVPV neurons, and the females in the other group were not treated. The researchers measured the amount of time it took the females to return pups placed in the corner of the cage to the breeding nest.

Results of this experiment are shown in Graph 2, on the following page.

/continued on page 12/

Graph 2: Time taken by mothers with normal or reduced TH levels in the brain to return pups to nest



12. א. What can you conclude from the results of this experiment about the relation between TH level and parental behavior? Base your answer on the data shown in Graph 2. (3 points)
- ב. Read the following statement: "The level of dopamine secreted in the brain of a female mouse is related to the mouse being a mother and affects its parental behavior."
Explain how the information brought in the first page of the study description (page 10) and the results shown in Graphs 1 and 2 support this statement. (5 points)

Good Luck!

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בהצלחה!

זכות היוצרים שמורה למדינת ישראל
אין להעתיק או לפרסם אלא ברשות משרד החינוך