

Biology

2 points

Part of the 3-point test

ביולוגיה

2 יחידות לימוד

חלק מבחינת 3 יחידות לימוד

Instructions for examinees

- א. Duration of the exam: Two and a half hours
- ב. Exam structure and breakdown of points:
This exam has four parts.
Part One — 37.5 points
Part Two — 22.5 points
Part Three — 15 points
Part Four — 25 points
Total — 100 points
- ג. Material that may be used during the exam:
A Hebrew-foreign language / foreign language-
Hebrew dictionary
- ד. Special instructions:
(1) For the questions in Part One, mark your
answers in the answer sheet found at the end of
the answer booklet (page 19).
For the questions for the other three parts of
the exam, write your answers in the answer
booklet.
(2) At the end of the exam, hand your answer
booklet to the proctor.

Write all of your rough work (calculations, notes,
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!

הוראות לנבחן

- א. משך הבחינה: שתיים וחצי.
- ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה ארבעה פרקים.
פרק ראשון — 37.5 נקודות
פרק שני — 22.5 נקודות
פרק שלישי — 15 נקודות
פרק רביעי — 25 נקודות
סה"כ — 100 נקודות
- ג. חומר עזר מותר בשימוש:
מילון עברי-לועזי / לועזי-עברי
- ד. הוראות מיוחדות:
(1) את תשובותיך לשאלות בפרק הראשון סמן
בתשובון שבסוף מחברת הבחינה (עמוד 19).
את תשובותיך לשאלות בשלושת הפרקים
האחרים כתוב במחברת הבחינה.
(2) בתום הבחינה מסור לבוחן את מחברת
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 (37.5 points)

Part One is made up of 15 questions, 1-15.

You must answer all of the questions. If you answer at least 13 of the questions correctly, you will receive all 37.5 points.

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

- * 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 (ד-א) 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 square 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 the answer booklet itself and only later enter them into the answer sheet.

Answer all of the questions 1-15.

1. A red blood cell exits a person's right hand and then returns to his right hand.
Through which body parts must the cell have passed?
 - א. the heart and the lungs
 - ב. the head and the lungs
 - ג. the heart and the left hand
 - ד. the intestine and the left leg
2. What characteristics would you expect to find among plants growing in a hot, dry greenhouse?
 - א. branched roots and large leaves
 - ב. unbranched roots and large leaves
 - ג. unbranched roots and small leaves
 - ד. branched roots and small leaves
3. Which of the substances listed below must be broken down as part of the digestive process before it can be absorbed in the intestine?
 - א. water
 - ב. glucose
 - ג. proteins
 - ד. minerals
4. Following meiosis [חלוקת הפחתה]:
 - א. the number of chromosomes in the cells of the body remains constant in every generation.
 - ב. each of the produced cells has the same DNA.
 - ג. the proteins in the cell are constructed according to the information in the DNA.
 - ד. there are no harmful mutations in the chromosomes.

5. Which of the activities listed below helps to intensify the greenhouse effect?
- א. planting plants
 - ב. cutting down forests
 - ג. growing plants in greenhouses
 - ד. lowering the concentration of oxygen in the air
6. Which two substances can serve as a source of energy for a cell?
- א. water and proteins
 - ב. CO₂ and fats
 - ג. water and carbohydrates
 - ד. carbohydrates and fats
7. What determines the order of the amino acids in proteins produced in the cells of the human body?
- א. the type of enzymes active in the digestive system
 - ב. the type of proteins that make up the food
 - ג. the amount of amino acids absorbed into the blood
 - ד. the information found in the DNA in the cells
8. The cell membrane is selectively permeable. This means that:
- א. substances can enter the cell only if energy is invested.
 - ב. any substance can enter the cell, but not every substance can exit the cell.
 - ג. the movement of substances in and out of the cell depends upon the properties of those substances.
 - ד. any substance can exit the cell, but not every substance can enter the cell.

9. The human body is made up of a number of systems. For the body to function efficiently, coordination is needed between all of the systems of the body. One of the systems responsible for this coordination is the:
- א. digestive system.
 - ב. nervous system.
 - ג. respiratory system.
 - ד. immune system.
10. When a person engages in intense physical activity, the skin of his face turns red. Why?
- א. The physical activity causes the capillaries close to the skin to burst.
 - ב. More blood flows to the capillaries in the skin to help cool the body.
 - ג. During periods of intense physical activity, the number of red blood cells in the body increases.
 - ד. The heat released into the environment causes the skin to become red.
11. What is the importance of green plants for an ecological system?
- א. the production of inorganic material and the absorption of oxygen
 - ב. the production of organic material and the absorption of oxygen
 - ג. the production of organic material and the emission of oxygen
 - ד. the production of inorganic material and the emission of oxygen
12. In order to prevent a person from contracting a contagious disease, should he be exposed to the pathogen, the person should be given:
- א. an active immunization
 - ב. a passive immunization
 - ג. medication that kills bacteria
 - ד. medication that kills viruses

- 13.** The pollution of the environment by humans:
- א. affects only biotic factors.
 - ב. affects only abiotic factors.
 - ג. does not affect biotic factors or abiotic factors.
 - ד. affects both biotic factors and abiotic factors.
- 14.** Which of the changes listed below might increase the rate of a reaction that is catalyzed by an enzyme?
- א. increasing the concentration of the product
 - ב. increasing the concentration of the substrate
 - ג. decreasing the concentration of the enzyme
 - ד. decreasing the concentration of the substrate
- 15.** Most of the organisms that "break things down" are:
- א. bacteria and fungi
 - ב. plants and fungi
 - ג. birds and insects
 - ד. insects and bacteria

Note: The test continues on the next page.

Part Two (22.5 points)

Part Two is made up of five questions, 16-20, on different core topics.

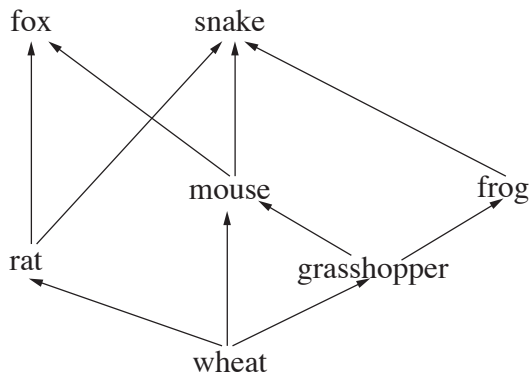
Choose three of these questions that you want to answer and write your answers in the **answer booklet** (each question is worth 7.5 points).

16. The table below shows the average heart rate and average stroke volume [נפח הפעימה] for three different levels of physical activity.

Average stroke volume (mL)	Average heart rate (beats per minute)	Level of physical activity
80	75	Rest
95	100	Light activity
100	180	Intense activity

- א. At which level of activity is the cardiac output [תפוקת הלב] highest? (You do not need to do any calculations.)
Explain your answer based on the information in the table. (3 points)
- ב. Explain the importance of a high cardiac output for the level of activity you noted for Item א. (4.5 points)
17. In an experiment, cubes of potato were put into two containers. Container א contained distilled water and Container ב contained a highly concentrated salt solution. After an hour, the cubes were weighed and it was noted that the weight of the cubes in one container had decreased, while the weight of the cubes in the other container had increased.
- א. In which container, א or ב, did the weight of the cubes decrease and in which container did it increase? (2.5 points)
- ב. Explain the reason for the change in the weight of the cubes in each container. (5 points)
18. Researchers introduced a substance that impairs the activity of mitochondria into cells. This had a negative effect on the movement of certain materials through the cell membrane. Explain what caused the damage to the functioning of the cell membrane.
19. A person ate a meal rich in carbohydrates. After the meal, the concentration of the hormone insulin in his blood increased.
- א. What caused the increase in the concentration of insulin in his blood after the meal? (3.5 points)
- ב. What is the effect of insulin on the concentration of sugar (glucose) in the blood? Explain. (4 points)

20. A food web is shown below.



- א. Which one of the organisms in the web is a primary consumer and a secondary consumer? Explain your answer. (3.5 points)
- ב. Based on the web shown above, what type of reciprocal relationship [יחסי גומלין] might exist between the snake and the fox? Explain. (4 points)

Part Three (15 points)

Part Three includes questions on three different topics.

Choose one topic and answer three questions according to the directions given for that topic.

Topic I — Animal Behavior

Answer three questions: Question 21 (required), one of the questions 22-23 and one of the questions 24-25.

Answer Question 21 (required).

21. Scientists wanted to study the development of the ability to sing among male swamp swallows [דרור ביצות]. To that end, they conducted an experiment using chicks of this species. They raised several male chicks, from the moment they hatched, in separate cages that were completely sound-proof. This meant that the chicks did not hear the songs of any other individuals.

When they matured, the songs that these males sang were undeveloped, but did include elements similar to those found in the songs of mature males raised under natural conditions.

- א. Based on the information in the passage, is the song of a mature male swamp swallow instinctive [מולדת] or learned or both instinctive and learned? Explain your answer. (3 points)
- ב. Name two different types of messages that are transmitted through bird song. (2 points)

Answer one of the questions 22-23.

- 22. א.** Bring two different examples of intrasexual [תוך-מינית] chemical communication among animals. For each example, state the name of the animal and the message that is transmitted. (3 points)
 - ב. Name one advantage and one disadvantage of **chemical** communication, as compared to other types of communication. (2 points)
- 23.** Bring three examples of intersexual [בין-מיני] communication among animals. For each example, state the name of the animal and the message that is transmitted. (5 points)

Answer one of the questions 24-25.

24. א. The males and females of a certain species of fish release large numbers of gametes into the water and do not take care of the offspring.

Explain one advantage and one disadvantage of this reproductive strategy. (3 points)

ב. Bring one example of an animal that invests a different amount of energy in its reproduction than that described in the example given in Item א. For your example, note how that energy is invested in reproduction. (2 points)

25. Female oystercatchers [שלצדף] (a type of bird) lay eggs in a hole in the ground and then sit on the eggs for 30 days.

The chicks hatch with their eyes open and are able to walk just a few hours after hatching.

The parents feed the chicks for about a month, until the offspring leave the nest.

א. There are those who claim that it is impossible to determine whether baby oystercatchers are גוזלים or אפרוחים. Explain this claim. (3 points)

ב. After the female oystercatcher lays the eggs, both parents sit on them. After the chicks hatch, both parents care for them. The male also drives strangers out of the territory and gets food for the female and the chicks.

What would we expect to find among oystercatchers –

sexual monomorphism [חד-פרצופיות מינית] or sexual dimorphism

[דו-פרצופיות מינית]? Explain your answer. (2 points)

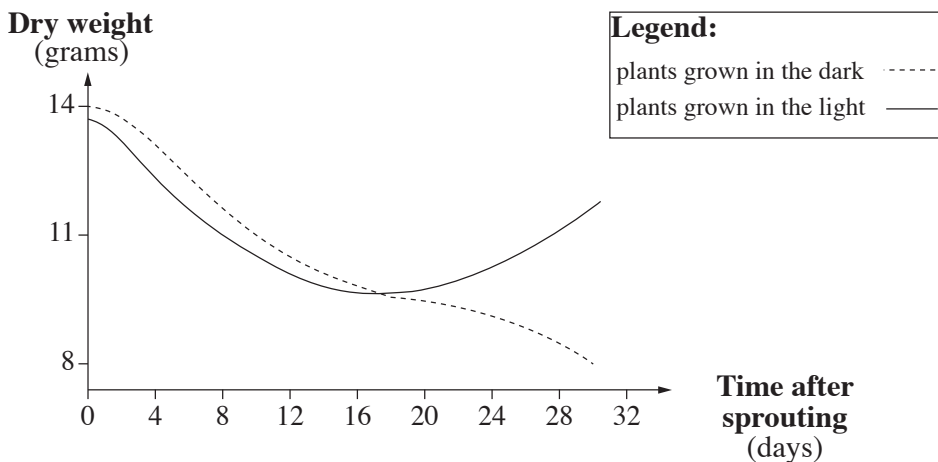
Topic II — From Seed to Seed

Answer three questions: Question 26 (required), one of the questions 27-28 and one of the questions 29-30.

Answer Question 26 (required).

26. In an experiment, two groups of seeds were sprouted and grown for 30 days under optimal conditions.

One group of seeds was sprouted and grown in the light and the other group of seeds was sprouted and grown in the dark. Every few days, the researchers measured the dry weight (weight excluding the water) of sprouts from each group. The results are shown in the graph below.



- a. Explain the changes in the dry weight of the sprouts from the two groups, from the time of sprouting through Day 12. (2.5 points)
- b. Explain the changes in the dry weight of the sprouts grown in the light, from Day 20 through the end of the experiment. (2.5 points)

Answer one of the questions 27-28.

27. What is one advantage of crop development based on genetic engineering and one advantage of crop development based on cross-breeding? (5 points)

28. Farmers are interested in crops that can be harvested at specific times. Give one example of an intervention in crop development designed to allow the farmer to harvest a crop at a specific time and explain how that intervention helps the farmer to achieve that goal. (5 points)

Answer one of the questions 29-30.

29. א. Pollination of plants occurs in two different ways: self-pollination and cross-pollination.

Explain the difference between self-pollination and cross-pollination.

(2.5 points)

ב. What is one advantage of sexual reproduction over asexual (vegetative) reproduction? (2.5 points)

30. Plants may have an annual life-cycle or a perennial life-cycle.

א. Explain what is meant by the terms "annual [חד-שנתי] plant life-cycle" and "perennial [רב-שנתי] plant life-cycle". (2 points)

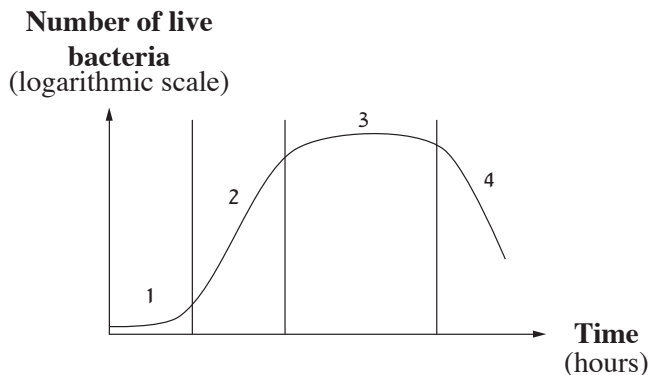
ב. What is the advantage of an annual life-cycle, as compared to a perennial life-cycle? (3 points)

Topic III — Microorganisms

Answer three questions: Question 31 (required), one of the questions 32-33 and one of the questions 34-35.

Answer Question 31 (required).

31. The graph below shows the growth curve of bacteria grown under aerobic conditions. Four stages of growth, 1-4, are labeled.



- א. During Stages 1 and 3, the number of bacteria remained steady. Explain why the number of bacteria did not change during Stage 1 and explain why it did not change during Stage 3. (2.5 points)
- ב. The bacteria whose growth curve is shown in the figure above are also capable of growing under anaerobic conditions. Under anaerobic conditions, they multiply more slowly. Explain why. (2.5 points)

Answer one of the questions 32-33.

- 32.**
 - א. Can antibiotic drugs be used to treat diseases caused by viruses? Explain. (2.5 points)
 - ב. Explain why penicillin is a suitable choice for the treatment of a disease caused by bacteria, whereas substances that damage the cell membrane are not. (2.5 points)
- 33.** The roots of pea plants (pea is a type of legume) have nodules [פקעיות] that contain a certain type of bacteria.
 - א. What type of reciprocal relationship [יחסי גומלין] exists between the bacteria in the nodules and the pea plant? (2.5 points)
 - ב. Explain why there is no need to apply nitrogen fertilizer to soil in which pea plants are being grown. (2.5 points)

Answer one of the questions 34-35.

34. If strawberries are not kept in the refrigerator, they will spoil very quickly.

In contrast, strawberry jam can be kept outside of the refrigerator for a long time without spoiling.

- א. Explain why strawberries need to be kept in the refrigerator.
(2.5 points)
- ב. Explain why strawberry jam does not spoil even after a long period of time outside the refrigerator. (2.5 points)

35. Sterilization and freezing are two methods of preserving food. Explain how each of these methods helps to preserve food. (5 points)

Part Four (25 points)

In Part Four, there are two passages, I-II.

Choose one of the passages and answer all of the questions for the passage that you chose (each question — 5 points). Write your answers in the **answer booklet**.

Passage I — Malaria: An Ancient Disease and an Ancient-New Treatment

Malaria is one of the most ancient and most devastating diseases known to humankind. More than 200 million people are infected with malaria each year and hundreds of thousands of people die from this disease each year.

Today, we know that malaria is caused by a one-celled parasite — a plasmodium. The life-cycle of a plasmodium includes one phase that occurs in the human body and another phase that occurs in female *Anopheles* mosquitoes.

When a female mosquito carrying the plasmodium bites a person and sucks his blood, saliva containing the plasmodium gets into his blood. Plasmodium cells penetrate the person's red blood cells and multiply inside them. At a certain point, the red blood cells burst, releasing plasmodium cells into the bloodstream, where they penetrate additional red blood cells. At this stage, the body temperature of the sick person rises and may even reach 42°C.

When a female mosquito bites an infected human and sucks his blood, plasmodium cells enter her digestive system and from there move into her salivary glands. When this infected female bites a healthy person, she infects him, beginning a new round of the plasmodium life-cycle. The disease continues to spread in this manner.

The Chinese researcher Youyou Tu was awarded the Nobel Prize in Medicine in 2015 for her development of a drug that is effective against malaria. In Chinese literature from 2200 years ago, she found that the plant *Artemisia annua* was mentioned as a cure for malaria. The researcher produced the substance **artemisinin** from this plant and discovered that, in the presence of iron, artemisinin harms the plasmodium.

When the plasmodium penetrates human red blood cells, it breaks down the hemoglobin in those cells, releasing iron. In the presence of iron, artemisinin becomes poisonous to the plasmodium and the plasmodium cells are destroyed. Thanks to the use of artemisinin in the treatment of malaria patients, the rate of mortality from malaria has decreased considerably in recent years.

/continued on page 17/

If you chose Passage I, answer the five questions 36-40
(each question — 5 points).

- 36.** What type of reciprocal relationship [יחסי גומלין] exists between the human and the plasmodium? Explain.
- 37.** Explain how the plasmodium cells move from a person who is sick with malaria to a healthy person.
- 38.** What are two changes that occur in the body of a person who is sick with malaria? Explain the harm caused by each of these changes.
- 39.** One way to prevent the spread of malaria is to act against the Anopheles mosquitoes. This may involve chemical control or biological control [הדברה ביולוגית]. Explain one advantage and one disadvantage of biological control.
- 40.** If plasmodium cells multiplied in white blood cells, could artemisinin be used to treat malaria? Explain your answer.

Passage II — Substitutes for Red Blood Cells

There are situations in which the body can lose a lot of blood, such as those involving a deep wound, complex surgery, etc. A person who has lost a large quantity of blood needs to receive a **blood donation** — a unit of blood donated by somebody else. The body of a healthy blood donor is not harmed: A considerable portion of the volume of the plasma [נוזל הדם] removed from his body is restored by drinking fluids and the quantity of blood cells returns to the normal level following an increase in the rate at which they are produced in his body.

Donated blood is stored in a blood bank, which is responsible for checking the donations and storing them under appropriate conditions. Each blood donation is checked to make sure that it does not contain any pathogens, such as viruses, that could be transferred to the recipient of the donated blood.

Each blood donation is also checked to determine what type of blood it is, since the blood type of the donated blood must match the blood type of the recipient. If a person receives an inappropriate type of blood, he may die.

The blood bank supplies blood as needed and, therefore, it is important that it maintain a large inventory of all types of blood.

Since blood donations can be used for only one month from the day of donation, there is always a need for blood donations. Sometimes rare types of blood are in short supply.

In order to meet the regular demand for blood, scientists around the world are trying to find substitutes for natural blood and red blood cells, in particular.

Scientists are focusing on two different approaches: the development of an artificial substitute for red blood cells and the production of red blood cells in the laboratory.

1. Development of an artificial substitute for red blood cells: the production of tiny, artificial corpuscles [גופיפים] that can transport oxygen just like natural red blood cells.

The scientists hope that these corpuscles will be able to be introduced into the blood of recipients regardless of their blood type. They are trying to produce corpuscles that can be preserved for several years in a dry, inactive state without any impairment of their ability to act, so that once they enter the blood, they will be activated and able to transport oxygen. However, the scientists estimate that the corpuscles will be able to survive in the blood for only a short amount of time.

The artificial substitute is produced under sterile conditions, to avoid contamination.

(Note: This passage continues on the next page, followed by questions.)

2. Production of red blood cells in the laboratory: production of red blood cells from special committed stem cells found in the body that can divide and form several different types of blood cells.

The researchers cause the committed stem cells to multiply outside the body and produce red blood cells.

This research has reached an advanced phase and, in the near future, researchers will be able to conduct a preliminary experiment to determine what will happen when blood cells produced in the laboratory are introduced into the bodies of healthy volunteers. A very small number of cells will be put into the blood of each participant, in order to avoid any undesirable reactions by the body. The researchers will then check whether these cells can survive in the body and whether they transport oxygen like the red blood cells produced in the body.

If you chose Passage II, answer the five questions 41-45
(each question — 5 points).

41. A person who has lost a lot of blood feels weak. Explain the connection between the loss of blood and weakness.
42. Based on the information in the passage, explain why donating blood does not harm the donor.
43. What is one advantage and one disadvantage of using an artificial substitute for red blood cells (Approach 1) rather than donated natural blood?
44. Red blood cells produced in a laboratory (Approach 2) lack nuclei, just like the red blood cells produced in the body. Explain how the lack of a nucleus improves the functioning of a red blood cell.
45. Based on the information given in the passage (Approach 2), name two goals of the preliminary human experiment.

Good Luck!

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בהצלחה!

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