State of Israel
Ministry of Education
Exam Type: *Bagrut*
Exam date: Summer 2022
Exam number: 043381
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשפ"ב, 2022
מספר השאלון: 043381
תרגום לאנגלית (3)

Note: There are special instructions in this exam. Please answer the questions according to these instructions.

שימו לב: בבחינה זו יש הנחיות מיוחדות.
יש לענות על השאלות על פי הנחיות אלה.

Biology

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

ביולוגיה

שאלות וניתוח מחקר מדעי בנושאי הליבה
שאלות בנושאי ההעמקה

Instructions

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:
Mark your answers to Part One on the answer sheet provided 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 in the answer booklet only.
Write the word "טיוטה" at the top of each of draft page.
If you write any draft material on paper outside the answer booklet, your exam may be disqualified.

Good Luck!

הוראות

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 התשובות על השאלות בפרק הראשון יש לסמן בתשובון שבסוף מחברת הבחינה (עמוד 19).
את התשובות על השאלות בפרק השני, בפרק השלישי ובפרק הרביעי יש לכתוב במחברת הבחינה.

יש לכתוב במחברת הבחינה בלבד. יש לרשום "טיוטה" בראש כל עמוד המשמש טיוטה. כתיבת טיוטה בדפים שאינם במחברת הבחינה עלולה לגרום לפסילת הבחינה.

בהצלחה!

Questions

Part One (32 points)

Part One has 20 questions, 1-20.

You must answer all of the questions. If you answer at least 15 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. Which of following systems coordinates between different parts of the human body?

א. the respiratory system

ב. the defense system

ג. the endocrine system

ד. the urinary system

2. Photosynthesis affects global warming. How does it do so?

א. by reducing the concentration of CO_2 in the air

ב. by reducing the concentration of oxygen in the air

ג. by converting heat energy to light energy

ד. by reducing the biomass in nature

3. Which of the following substances can serve as a source of energy in cells?

א. oxygen

ב. protein

ג. water

ד. minerals

4. Read the four statements about capillaries below. Which statement is not correct?

א. Blood flow in the capillaries is faster than in the veins.

ב. The diameter of a capillary is similar to the diameter of a red blood cell.

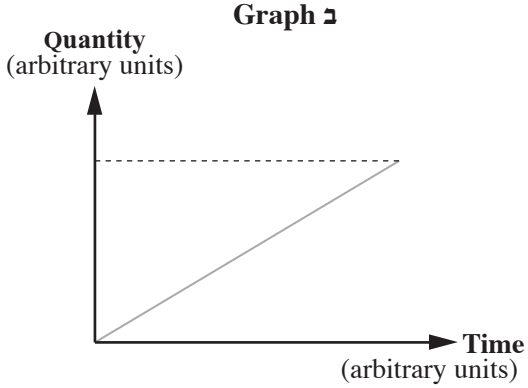
ג. The total surface area of the capillaries in the body is very large.

ד. Capillaries have a single-layer wall.

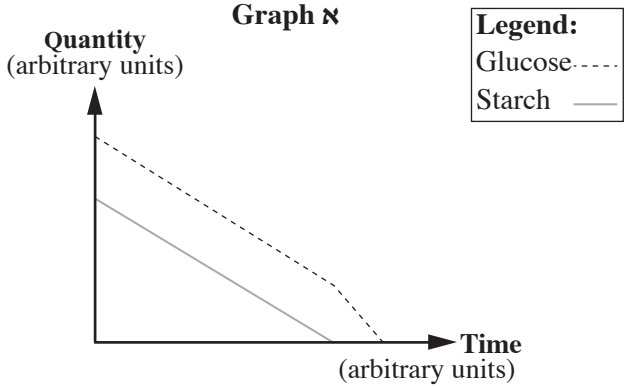
/continued on page 4/

5. Which of the following graphs correctly describes the changes in the quantity of starch and glucose in the enzymatic process of **synthesizing** starch under laboratory conditions?

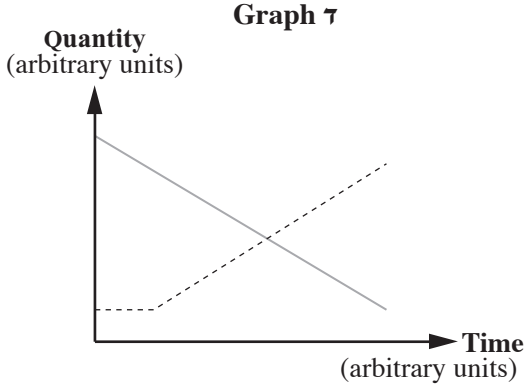
Graph ב



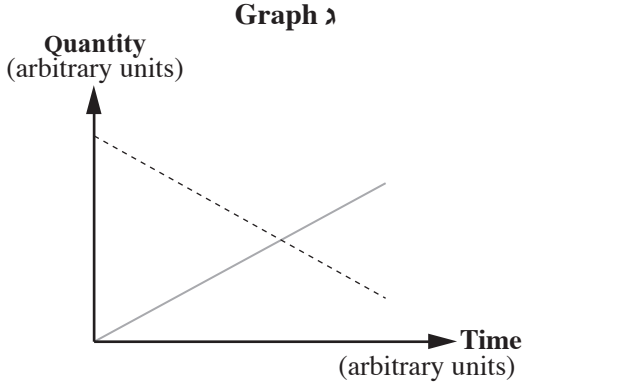
Graph א



Graph ד



Graph ג



א. Graph א

ב. Graph ב

ג. Graph ג

ד. Graph ד

6. Which of the following statements describes an adaptation to an **a**biotic factor?

א. Some butterflies have colors that scare off their predators.

ב. Flowers that are pollinated by insects have a strong scent.

ג. Birds that feed on flower nectar have long, thin beaks.

ד. Fish have a body shape that is suited to rapid movement in water.

/continued on page 5/

7. What does the vaccine given to healthy dogs to **prevent** rabies contain?

א. antibodies to the rabies virus

ב. weakened rabies virus

ג. white blood cells that can attack the rabies virus

ד. plasma [נוזל דם] of a horse that has been vaccinated against rabies

8. A very large amount of messenger RNA (mRNA) was measured in a body cell.
This finding indicates that a certain process is taking place in the cell. What is this process?

א . increased DNA replication

ב. creation of mutations

ג. meiosis [חלוקת הפחתה]

ד. increased protein production

9. A person has a defect in the valve located between the right ventricle and the pulmonary artery.
This defect prevents the valve from closing properly. What can this defect cause?

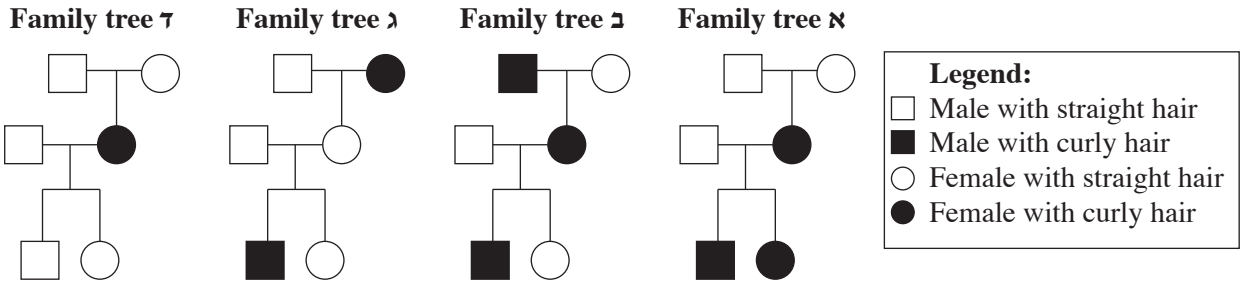
א. low-oxygen blood returning to the right ventricle

ב. high-oxygen blood mixing with low-oxygen blood

ג. blood flow from the right ventricle to the left ventricle

ד. blockage of the coronary arteries

10. Curly hair is a dominant hereditary trait that is passed in Norwegian families.
Of the four family trees א-ד below, which one describes the way this trait is passed in families?



א. Family tree א

ב. Family tree ב

ג. Family tree ג

ד. Family tree ד

/continued on page 6/

11. A population of reptiles lives in a certain habitat. A deep ditch was dug across this habitat, creating two sub-populations. Many generations later each sub-population was found to have acquired a different collection of genetic changes.

What could be the **result** of acquisition of these genetic changes by the two sub-populations?

א. The rate of mutations increases in both sub-populations.

ב. Both sub-populations develop the same adaptations.

ג. Natural selection processes stop in both sub-populations.

ד. A reproductive barrier develops between the sub-populations.

12. The concentration of oxygen in the kidney vein is lower than the concentration of oxygen in the kidney artery. What is the reason for this?

א. Excess oxygen from the plasma [נוזל הדם] is secreted in the urine.

ב. Oxygen is used to produce glucose in the kidney cells.

ג. Kidney cells consume oxygen during cellular respiration.

ד. The kidney is a homeostatic organ that regulates oxygen concentration.

13. The protein hemoglobin is composed of hundreds of amino acids. People who have the hereditary disease sickle cell anemia have a different amino acid in the sixth position in the hemoglobin protein than healthy people do.

What type of mutation can cause this difference?

א. a nucleotide is inserted

ב. a nucleotide is substituted

ג. a nucleotide is deleted

ד. a whole chromosome is deleted

14. Of the four diagrams א-ד, below, which one <u>correctly</u> describes the flow of carbon dioxide (CO_2) and oxygen (O_2) in nature?

Diagram ד

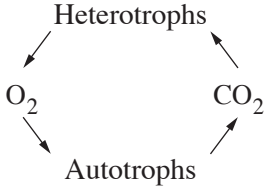


Diagram ג

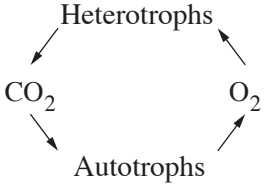


Diagram ב

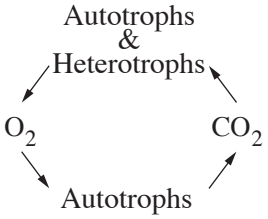
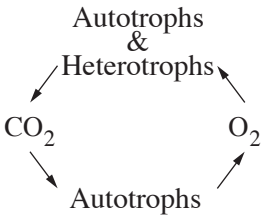


Diagram א



א. Diagram א

ב. Diagram ב

ג. Diagram ג

ד. Diagram ד

/continued on page 7/

15. Researchers tracked the enzymatic decomposition of hydrogen peroxide [מי חמצן] into water and oxygen in a closed container.

The concentration of oxygen stopped rising after 10 minutes. What could be the reason for this?

א. After 10 minutes all the available enzyme was used up.

ב. After 10 minutes all the available substrate was used up.

ג. The enzyme started breaking down the oxygen in the container.

ד. The enzyme molecules bound irreversibly to the substrate.

16. What is the correct sequence of processes involving CO_2 molecules in the human body?

א. cellular respiration ⟶ diffusion into the blood ⟶ diffusion into the alveolar cavity

ב. diffusion into the blood ⟶ diffusion into the alveolar cavity ⟶ cellular respiration

ג. diffusion into the blood ⟶ cellular respiration ⟶ diffusion into the alveolar cavity

ד. cellular respiration ⟶ diffusion into the alveolar cavity ⟶ diffusion into the blood

17. In what type of habitat would you expect to find plants that complete a life cycle—from germination to seed—in the shortest time?

א. in habitats on the banks of streams and rivers

ב. in warm, moist habitats

ג. in habitats with large amounts of precipitation

ד. in habitats with long dry spells

18. What is metabolism?

א. decomposition and synthesis of substances that are catalyzed by enzymes

ב. when CO_2 exits cells and oxygen enters them

ג. the passage of substances from the environment into cells or in the opposite direction, down (with) the concentration gradient [מפל הריכוזים]

ד. life processes that only take place in eukaryotic cells

19. What would be the result of removing all the decomposers from a habitat?

א. increased decomposition of inorganic substances

ב. reduced decomposition of organic substances into inorganic substances

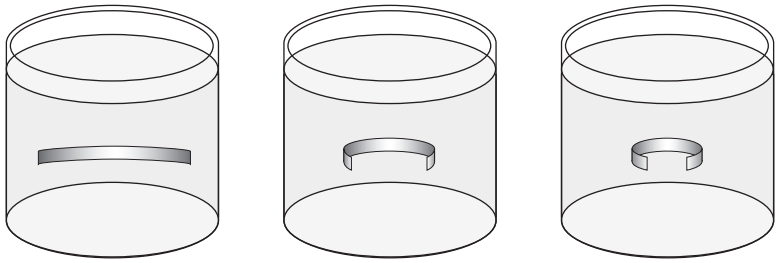
ג. reduced rate of osmosis of water into the roots of plants

ד. increased biomass of producers in the habitat

/continued on page 8/

20. In an experiment, straight strips of a spring onion (scallion) leaf were placed for 10 minutes in beakers that contained different concentrations of salt solution.

The results are shown in the the figure below.



2% salt 1% salt 0.5% salt

What caused the leaf strips to curl?

א. Salt entered the cells.

ב. Salt exited the cells.

ג. Water entered the cells.

ד. Water exited the cells.

Note: Mark your answers on the answer sheet on page 19 at the end of the answer booklet.

/continued on page 9/

Part Two (35 points)

Part Two has seven questions, 21-27.

Choose four questions and write your answers in the **answer booklet** (each question — 8.75 points).

21. א. Each item in the following list is a component of the mechanism for **inhalation**. Each item has two possible states, which are shown in parentheses.

Copy the components to your notebook in the correct order for inhalation, and **mark** next to each one its correct state.

– air (moves in/moves out)

– volume of chest cavity (thorax) (decreases/increases)

– intercostal (between the ribs) muscles and diaphragm (contract/relax)

– air pressure in the lungs (decreases/increases)

(5 points)

ב. Explain how impaired blood supply to the intercostal muscles and to the diaphragm can reduce the amount of air entering the lungs. (3.75 points)

22. The human body loses water in several different ways. A study tested how much water a person loses in two states, under identical ambient conditions: at rest and during vigorous physical activity. The results are shown in the table below.

	Water lost (mL per day)	
	At rest	**During vigorous activity**
From the lungs	350	650
In sweat	100	5000
In urine	1500	500

א. **(1)** Explain the advantage of increased sweating during vigorous physical activity.

(2) During vigorous physical activity the concentration of CO_2 in the blood increases. Explain the effect of this increase on the amount of water lost from the lungs.

(5.75 points)

ב. People with a certain disease have very low levels of the hormone ADH. People with this disease are advised to avoid vigorous physical activity.

Explain why they are advised to do so. Include data from the table in your explanation.

(3 points)

/continued on page 10/

23. Plastic is an artificial organic substance. In nature, it rarely breaks down into inorganic substances. In a landfill, researchers discovered bacteria that produce an enzyme that catalyzes the digestion of plastic and then feed on the digestion products.

א. **(1)** Explain why there is a greater chance of finding plastic-digesting bacteria in a plastic-rich environment than in a plastic-poor environment.

(2) Various efforts are underway to limit the use of plastic.

In view of this discovery of plastic-digesting bacteria, do you think trying to limit the use of plastic is still necessary?

Provide <u>one</u> reason to support your answer.

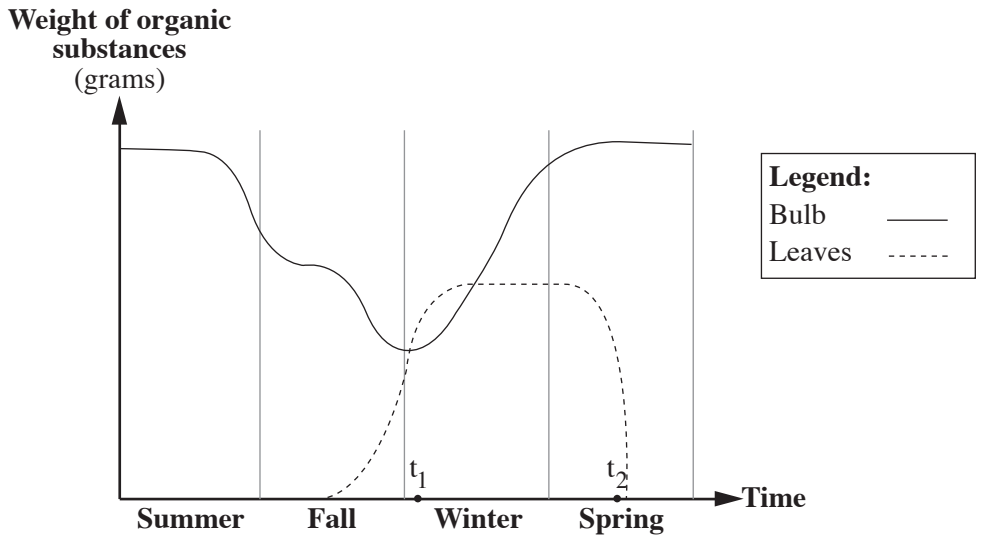
(5 points)

ב. The activity of decomposers in landfills raises the temperature in the landfills.

Explain why a rise of temperature <u>within a certain range</u> can **increase** the rate of decomposition and why a rise of temperature <u>within a different range</u> can **reduce** the rate of decomposition. (3.75 points)

24. The sea squill [חצב] is a common geophyte in Israel. The graph below describes the weight of organic substances in the bulb and green leaves of sea squill over the course of the year.

Weight of organic substances in parts of the sea squill over the year



א. Explain the figures for weight of organic substances in the **bulb** at time t_1 and at time t_2 in the graph. Base your answer on the information from the graph and the processes taking place in the sea squill plant. (5.75 points)

ב. The sea squill's life-cycle is adapted to its habitat in several ways. Explain <u>one</u> adaptation of the sea squill (geophyte) to a Mediterranean environment in which it rains only part of the year. Use information from the graph in your explanation. (3 points)

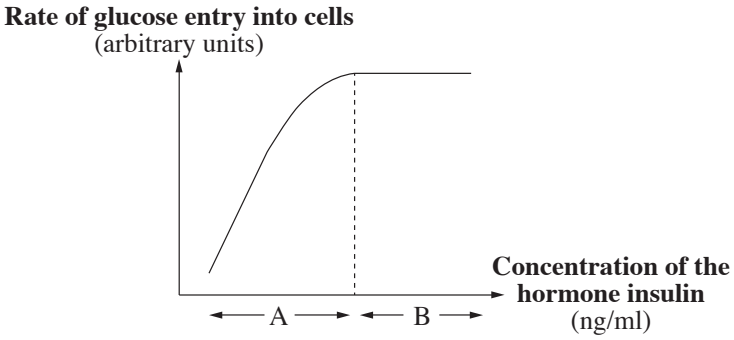
/continued on page 11/

25. א. The year 2021 marked 100 years since the discovery of insulin. Many studies of this hormone have been conducted over the years.

One study tested the rate at which glucose entered certain cells that had been placed in insulin solutions of different concentrations.

The results are shown in the graph below.

Effect of insulin concentration on rate of glucose entry into cells



(1) In what concentration range, A or B , is insulin concentration the factor limiting the rate of glucose entry into the cells? Explain your answer.

(2) What might be the factor limiting glucose entry in the other concentration range? Explain your answer.

(5.75 points)

ב. People with diabetes can have glucose in their urine, but healthy people do not have glucose in their urine.

Explain why there is no glucose in the urine of healthy people. (3 points)

26. Flower color in anemones [כלניות] is a hereditary trait.

א. (1) The following table shows data about breeding red anemones and white anemones. Assuming that two alleles determine flower color, either red or white, use these breeding results to determine which is the **recessive** allele. Explain your answer.

Parents	Offspring
white × white	17 white, 5 red
white × red	12 white, 14 red
red × red	0 white, 23 red

(2) One of the alleles encodes Protein A which causes the red pigment to decompose. **Name** the color of the heterozygote, and **explain** how this color is obtained, based on the information about Protein A .

(6.75 points)

ב. In the wild, there are anemones of other colors, not just red and white. The other colors emerge due to the effect of other genes. The range of anemone colors is an example of genetic variation [שונות תורשתית].

How does meiosis help to increase genetic variation in a population? Provide <u>one</u> explanation. (2 points)

/continued on page 12/

27. א. The indicator neutral red is red in an acidic solution and yellow in an alkaline (basic) solution.
In an experiment, a flask containing an alkaline solution was kept at a temperature of 40°C.
Yeast and the indicator neutral red were added to the flask. The yeast cells were red.
Next, a detergent was added to the flask, and the yeast cells turned yellow. Explain why the yeast cells changed color from red to yellow. (3.75 points)

ב. Yeast can perform both aerobic respiration and alcoholic fermentation.
Copy the table below to your **answer booklet**.

– For each of the substances in the table, select one possibility for each process: reactant or product or unrelated to the process, and write it in the correct place in the table in **your answer booklet**.

– For the amount of energy obtained, select one possibility for each process: a little or a lot, and write it in the correct place in the table in **your answer booklet**.

Process	**CO_2**	**Oxygen**	**Monosaccharide**	**Lactic acid**	**Energy obtained**
	(reactant / product / unrelated to the process)				(little / a lot)
Aerobic cellular respiration					
Alcoholic fermentation					

(5 points)

/continued on page 13/

Part Three (18 points)

Part Three has three questions, 28-30.
Read the description of a research study below, and answer all of the questions 28-30. The number of points is given at the end of each item.

Channel Blocker—Potential Disease Blocker

The study described in this passage proposes treating COVID infections with a substance that interferes with the functioning of a certain viral protein. Viruses are not active outside their host cells, so the possibilities for experimenting with viruses are limited. This is the reason that virus-related research often uses cells into which viral genes have been inserted. After the viral genes have been inserted, the cells can produce viral proteins. Cells like these, into which foreign genes have been inserted, are called **genetically-engineered cells**.
Professor Shai Arkin and his team at the Hebrew University in Jerusalem were trying to find substances that could damage the COVID virus. They hypothesized that damaging a viral protein would damage the virus's ability to reproduce. **Protein E** is one of the proteins in the COVID capsid [מעטפת].
The researchers created genetically-engineered cells that carried the viral gene for Protein E. The gene was expressed in these cells, and the cells produced Protein E. Protein E was found to function as a **channel** in the membranes of the genetically-engineered cells.

28. Channels and pumps operate in cell membranes. List one difference between a channel and a pump. (4 points)

In the experiments described below, the researchers used genetically-engineered cells that contained the viral gene for Protein E to test substances that affect the activity of Protein E.
Protein E produced in the engineered cells disrupts processes in cells and affects cell division: Cell division in cells engineered to contain the viral gene had a much lower division rate compared with cells that did not contain this gene.
The researchers tested the effects of many substances on Protein E in the engineered cells and decided to focus on **Substance Z**, which blocks membrane channels. They conducted two experiments to test how Substance Z affects the functioning of Protein E (Protein E disrupts cell division).

/continued on page 14/

Experiment 1

Cell division rate was tested under three treatments:

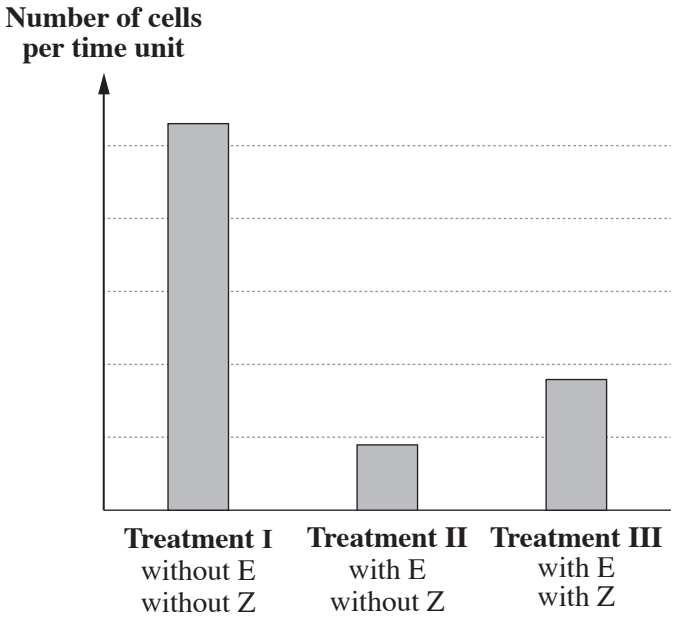
Treatment I: non-engineered cells with no Protein E gene and no added Substance Z ;

Treatment II: engineered cells with the Protein E gene and no added Substance Z ;

Treatment III: engineered cells with the Protein E gene and added Substance Z .

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

Graph 1: Effect of different treatments on the rate of cell division



29. א. **(1)** Explain the difference in results between Treatment II and Treatment I .

(2) Explain the difference in results between Treatment III and Treatment II .

(5 points)

Experiment 2

In this experiment the researchers used **mutant** cells. These were the same type of cells as used in Experiment 1, except that due to a mutation their membrane is less permeable to potassium. Cells require an optimal concentration of potassium for normal functioning and division. Potassium enters the cells through the channel that Protein E forms in the cells' membranes.

(Note: This question continues on the following page.)

/continued on page 15/

In Experiment 2 the rate of cell division in the **mutant** cells was tested under three treatments, as in Experiment 1.

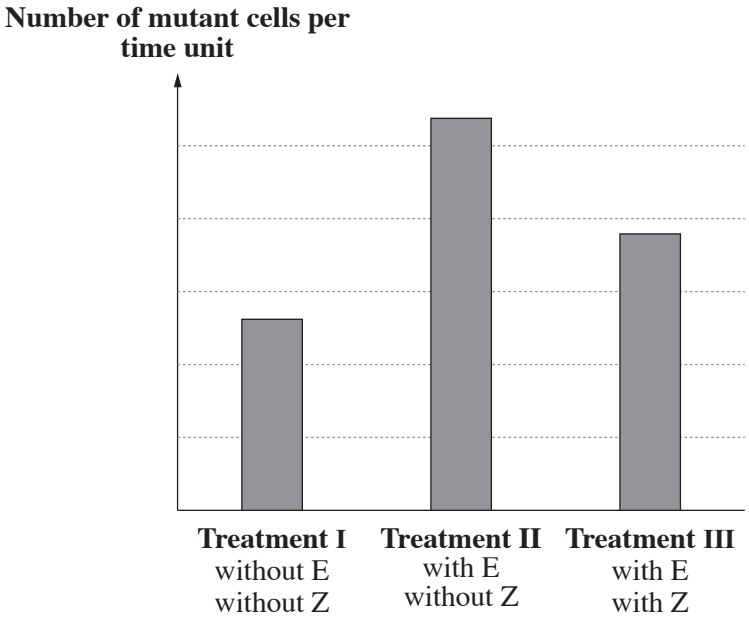
Treatment I: non-engineered mutant cells with no Protein E gene and no added Substance Z;

Treatment II: engineered mutant cells with the Protein E gene and no added Substance Z;

Treatment III: engineered mutant cells with the Protein E gene and added Substance Z.

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

Graph 2: Effect of treatments on cell division rate in mutant cells



ב. **(1)** Explain the difference in results between Treatment I in Experiment 2 and Treatment I in Experiment 1.

(2) Explain how the difference in results between Treatment II and Treatment III in Experiment 2 supports the hypothesis that Substance Z disrupts Protein E's ability to function as a channel.

(5 points)

Based on the results of these experiments in **cells**, the researchers hypothesized that Substance Z can disrupt Protein E function in **viruses**. As noted above, Protein E is a viral protein that is essential to COVID reproduction.

30. Based on the information and experimental results in the passage, do you think Substance Z can be recommended as a treatment for COVID infection?
Provide one biological reason to support your answer. (4 points)

/continued on page 16/

Note: The exam continues on Page 17.

/continued on page 17/

Part Four (15 points)

Part four includes three topics:

Choose one topic and answer **two** questions on that topic, according to the directions given for the topic you chose.

(Note: The exam continues on the next page.)

/continued on page 18/

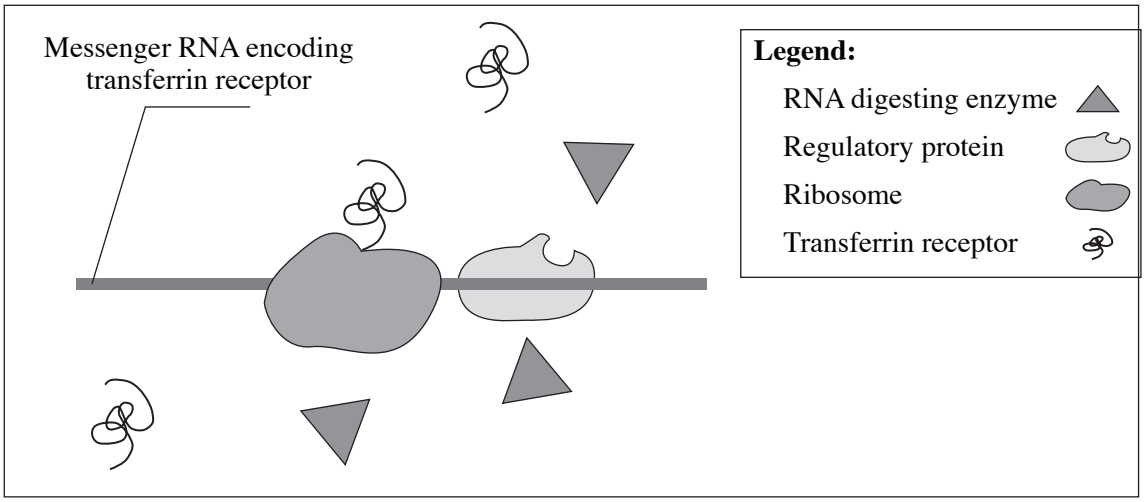
Topic I — Regulation of Gene Expression and Genetic Engineering

Answer two questions: Question 31 (required) and one of the questions 32-33. The number of points is given at the end of each item.

Answer Question 31 **(required)**.

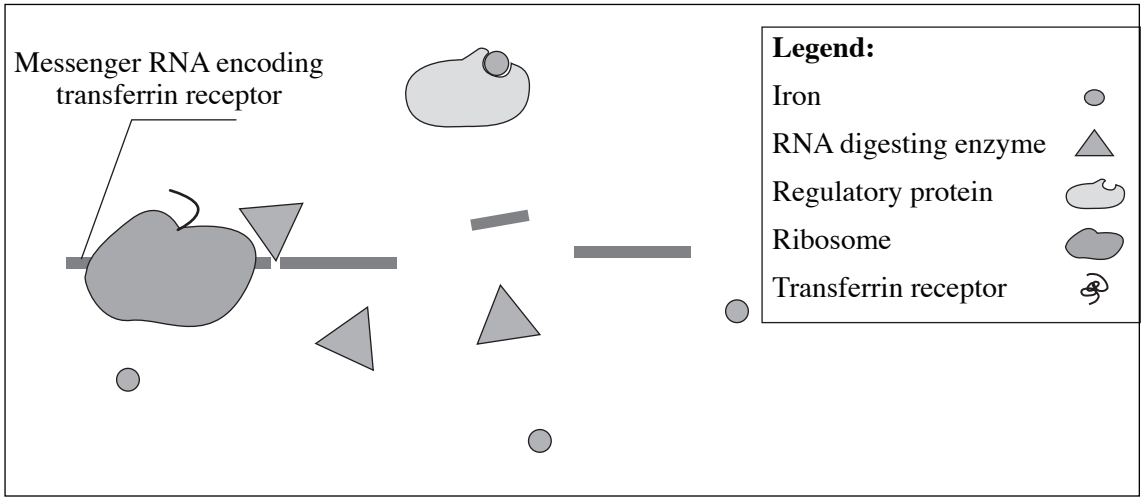
31. Iron is essential to the normal function of cells. Too much or too little iron can disrupt processes in cells. Iron is transported in the blood bound to a protein called transferrin. A transferrin **receptor** on the cell membrane mediates the entry of iron bound to transferrin into the cells. The concentration of iron inside the cell affects the number of transferrin receptors. This effect is mediated by a regulatory protein: When iron in a cell gets too low, the regulatory protein binds to the messenger RNA (mRNA) and protects it from digestion. This allows production of the transferrin receptor to proceed (see Figure 1).

Figure 1: Production of transferrin receptor is active



When there is excess iron in a cell, iron binds to the regulatory protein and this prevents the regulatory protein from binding to messenger RNA. This messenger RNA is rapidly digested by an enzyme. In this state production of the transferrin receptor stops (see Figure 2).

Figure 2: Production of transferrin receptor is inactive



(Note: The questions are on the next page.)

/continued on page 19/

א. Explain how the regulatory protein affects production of the transferrin receptor when there is too little iron in the cell. (2 points)

ב. Explain how the processes described on the previous page help maintain homeostasis of the cell's **iron concentration**. (2.5 points)

ג. Consider the following three mutations I-III :

I a mutation in the gene encoding the regulatory protein which prevents the regulatory protein from binding to the messenger RNA (mRNA)

II a mutation in the gene encoding the enzyme that digests messenger RNA which damages the enzyme's active site

III a mutation in the gene encoding the regulatory protein which damages the regulatory protein's ability to bind iron

Choose two mutations of the mutations I-III and **determine** for each one whether it will cause an increase or a decrease in iron concentration in the cell. **Explain** your answer in each case. (4.5 points)

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Answer one of the questions 32-33.

32. Researchers wanted to create purple tomatoes. To do so, they inserted a beetroot gene that is essential to the production of a purple substance into tomato plants.

א. Three of the steps in the process are listed below:

I cutting the plasmid

II attaching the beetroot gene to the plasmid

III introducing the engineered plasmid into tomato plants

Consider these four enzymes: ligase, DNA transcription enzyme, restriction enzyme, DNA replication enzyme.

Determine which of these enzymes the researchers used. For each enzyme you list, **specify** the step in which it is active. (4 points)

ב. Explain why the researchers used genetic engineering rather than breeding to transfer the trait for purple pigment from beetroot to tomatoes. (2 points)

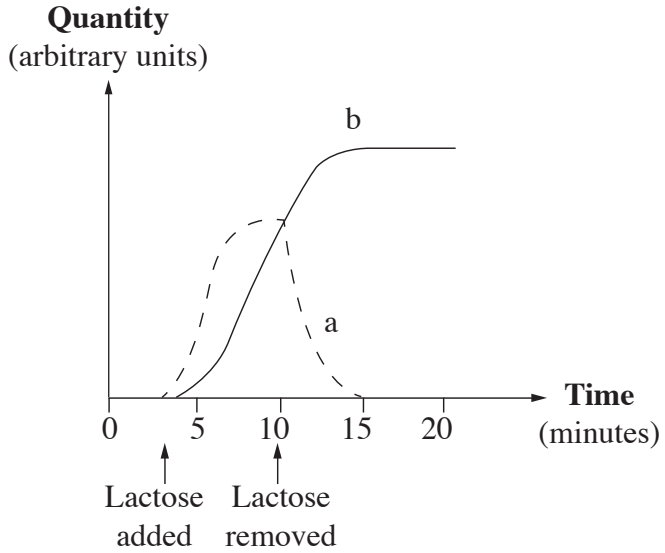
33. The lactose operon is active in many species of bacteria.

א. In bacteria that inhabit an environment with no lactose, the structural genes of the lactose operon are not transcribed.

Explain how this benefits these bacteria. (2.5 points)

ב. Researchers grew bacteria on a culture medium [מצע מזון] that did not contain lactose. Next, they first added lactose to the medium and then removed the lactose from the medium.

Graphs a and b below describe the amount of lactose-decomposing enzyme and the amount of messenger RNA (mRNA) encoding this enzyme, after lactose was added to the culture medium and after it was removed.



Determine which curve, a or b , describes the amount of enzyme, and which curve describes the amount of messenger RNA in the bacterial cells.

Explain each of your answers using data from the graph. (3.5 points)

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Topic II — Developmental Comparative Physiology

Answer two questions: Question 34 (required) and one of the questions 35-36. The point value is given at the end of each item.

Answer Question 34 **(required)**.

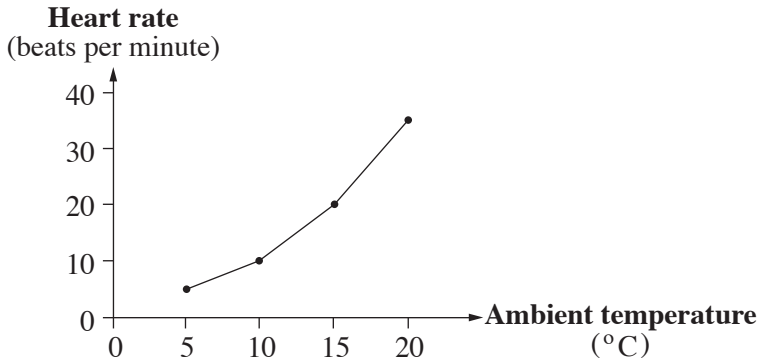
34. Multi-cellular organisms have transport systems.

א. Explain why multi-cellular organisms must have a transport system in order to exist. (2 points)

ב. Researchers studied the heart rate of frogs (frogs are members of the amphibian class) at different ambient temperatures.

The results are shown in Graph 1, below.

Graph 1



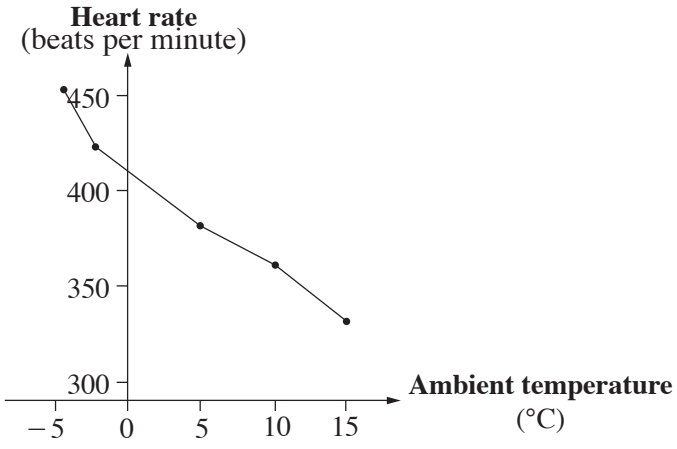
Amphibians are more active when the temperature in their environment rises within the temperature range shown in the graph.

Explain how the change in heart rate makes this possible. In your answer, also discuss processes that take place in the cells. (3.5 points)

ג. Researchers tested the effect of a drop in ambient temperature on the heart rate of blackbirds [שַׁחרוּרים] (blackbirds are members of the class of birds).

The results are shown in Graph 2, below.

Graph 2



Explain how the change in heart rate as the ambient temperature goes down helps birds maintain a constant body temperature. In your answer, also discuss processes that take place in the cells. (3.5 points)

/continued on page 22/

Answer one of the questions 35-36.

35. א. Name an essential function that is performed by the kidneys in mammals and is not performed by the kidneys in fish.

Name the organ in which this function is performed in fish. (2 points)

ב. **(1)** Animals who inhabit freshwater environments have difficulty in maintaining a normal water balance. Explain this difficulty.

(2) Organisms that inhabit freshwater have various mechanisms for maintaining a normal water balance.

List one mechanism that unicellular organisms use to maintain a normal water balance and two mechanisms that fish use to do so.

(4 points)

36. א. **(1)** Explain how oxygen from the air reaches the cells in the bodies of insects.

(2) Muscle activity in insects is **affected** by the amount of oxygen absorbed by the respiratory system.

Muscle activity (in some insects) also **affects** the amount of oxygen absorbed by the respiratory system.

Explain these two statements.

(4 points)

ב. In certain insects, airflow in the respiratory system is **bi**directional—air goes in and out through the same opening.

In other insects, airflow in the respiratory system is **uni**directional—air goes in through one opening and out through another opening.

Which of these two respiratory systems supplies cells with oxygen more efficiently? Explain.

(2 points)

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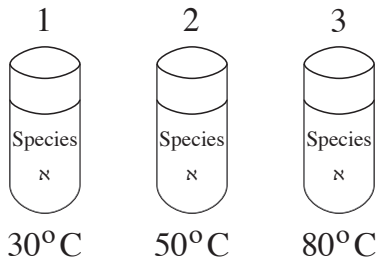
Topic III: Bacteria and Viruses in the Human Body

Answer two questions: Question 37 (required) and one of the questions 38-39. The point value is given at the end of each item.

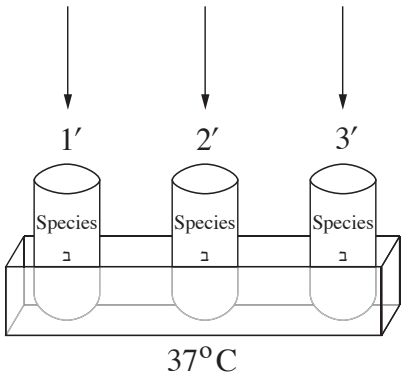
Answer Question 37 **(required)**.

37. Researchers isolated two species of bacteria from the body of a human. Both species require the amino acid X to live. Species א bacteria can produce the amino acid X and Species ב bacteria are unable to produce it. The researchers conducted an experiment with both species of bacteria.
The experimental setup is described in the following passage and in Figure 1, below.

Figure 1: Experimental setup



Step 1:
The researchers placed **Species א** bacteria in three test tubes, 1-3 , that contained liquid medium at three different temperatures.
After some time, the researchers separated the medium from the bacteria in each of the test tubes 1-3 .

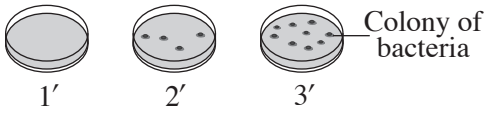


Step 2:
The researchers placed **Species ב** bacteria in three other test tubes, 1'-3' , at a temperature of 37°C .
Next, they transferred one drop of liquid from each of the test tubes 1-3 into each of the test tubes 1'-3' , respectively. The drops of liquid they transferred did not contain bacteria and did not contain the amino acid X .
Species ב bacteria were grown in drops of the liquid that was separated from Species א bacteria.

After two days at 37°C the researchers collected a sample of bacteria from each of the test tubes 1'-3' and plated each sample on dishes 1'-3' that contained a solid culture medium with no amino acid X .

Figure 2 describes the results obtained in the dishes after 24 hours.

Figure 2: Experiment results



(Note: The items of this question are on the next page.)

/continued on page 24/

א. Explain how exposing Species א bacteria to different temperatures in Step 1 of the experiment caused the different results in each of the dishes 1'-3' . (4 points)

ב. In Step 2 of the experiment the researchers maintained a temperature of 37°C in each of the test tubes 1'-3' .

Explain why it was important to keep the temperature the same in all three test tubes 1'-3' , and why the researchers chose a temperature of 37°C . (2.5 points)

ג. In the experiment described above, bacteria were grown in a liquid culture medium and also in a solid culture medium.

List one advantage of growing bacteria in a liquid medium compared with a solid medium, and one advantage of growing bacteria in a solid medium compared with a liquid medium. (2.5 points)

Answer one of the questions 38-39.

38. The FIV virus causes immune deficiency syndrome in cats. The effect this virus has on cats' immune cells is similar to the effect of the AIDS virus (HIV-1) on humans.

א. **(1)** The FIV virus is able to enter cat immune cells and is not able to enter human immune cells.

What difference between the cat cells and human cells could explain this?

(2) FIV is a retrovirus.

What would be the effect of a medicine that blocks the activity of the enzyme reverse transcriptase (RT) on the production of FIV viruses in a cat. Discuss the steps of viral reproduction in your answer.

(4 points)

ב. People who get AIDS are treated with a medicine that affects the reverse transcriptase enzyme (RT).

Would this medicine also negatively affect the reproduction of the **herpes** virus in a human body? Explain. (2 points)

39. Acne (pimples) is an infectious disease caused by bacteria. People with acne have inflamed sores on their face.

א. Is inflammation a specific immune defense [תגובה חיסונית ייחודית]? Explain. (2 points)

ב. Severe acne is sometimes treated with antibiotics.

(1) Excessive use of one antibiotic against acne has made bacteria that are resistant to that antibiotic more common. Explain.

(2) Explain why antibiotics attack bacteria but do not attack viruses.

(4 points)

Good Luck!

בהצלחה!