State of Israel
Ministry of Education
Exam Type: *Bagrut*
Exam date: Summer 2019
Exam number: 043381
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ט, 2019
מספר השאלון: 043381
תרגום לאנגלית (3)

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 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:
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 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. רשום "טיוטה" בראש כל עמוד טיוטה. כתיבת טיוטה בדפים שאינם בלמחברת 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. Which of the following factors is part of an insect's biotic environment?

א. the air it breathes

ב. the soil in which it lays its eggs

ג. the flowers it feeds on

ד. the water it consumes

2. When a person smokes a cigarette, the nicotine passes from the alveoli [נאדיות הריאה] to the blood. Which blood vessel does the nicotine reach sooner?

א. pulmonary (lung) vein

ב. coronary vein

ג. pulmonary artery

ד. the aorta

3. In the cells of the digestive tract there is an enzyme that breaks down milk sugar (lactose). The amino acid sequence of this enzyme is different in babies who are unable to digest lactose and babies who are able to digest lactose.

What might be the cause of this difference in enzyme composition?

א. shortage of nucleotides in the cells of the baby's digestive tract

ב. the enzyme's inability to pass through the cell membrane

ג. a difference in nucleotide sequence in the DNA that encodes the enzyme

ד. a difference in nucleotide sequence in the transfer RNA (tRNA)

4. In a certain unicellular organism that inhabits a puddle, the mechanism for removing water requires energy. This mechanism is an adaptation to:

א. an environment with a higher temperature than the temperature in the cell

ב. an environment with a lower temperature than the temperature in the cell

ג. an environment with a lower concentration of solutes than the concentration of solutes in the cell

ד. an environment with a higher concentration of solutes than the concentration of solutes in the cell

/continued on page 4/

5. What is the difference between an autotrophic unicellular organism and a heterotrophic unicellular organism?

א. The autotroph does not have mitochondria and ribosomes.

ב. The autotroph produces carbohydrates from inorganic materials.

ג. The autotroph does not breathe, because it utilizes the energy of the sun.

ד. The autotroph absorbs materials from the environment.

6. Which of the following changes will increase cardiac output [תפוקת הלב]?

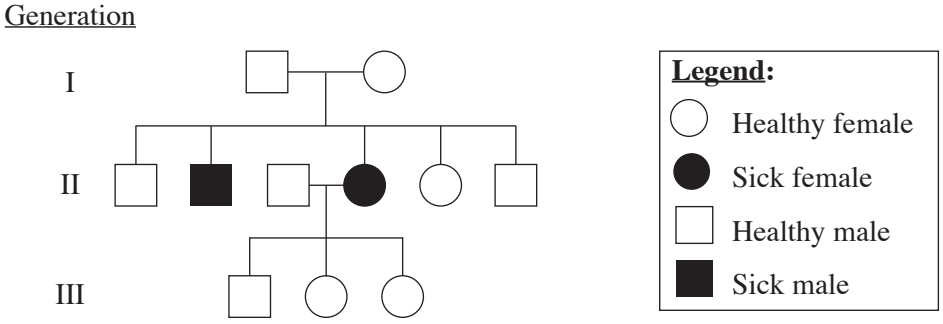
א. an increase in the rate of gas exchange in the alveoli [נאדיות]

ב. increased perspiration

ג. slowing down of the pulse

ד. an increase in stroke volume [נפח הפעימה]

7. The following figure describes a family tree. Some family members have a disease that is <u>not</u> sex linked.



Which item of information below allows us to determine that the allele for this disease is recessive and not dominant?

א. Two healthy parents have a sick offspring.

ב. Both men and women have the disease.

ג. There are no sick individuals in Generation **III**.

ד. Most individuals in this family tree are healthy.

/continued on page 5/

8. The hormone TSH, which is secreted by the hypophysis, stimulates the thyroid gland to secrete the hormone thyroxine. The level of thyroxine in the blood regulates TSH secretion into the blood in a negative feedback loop. Read the four statements below. Select the correct statement.

א. An increase in the level of thyroxine will increase TSH secretion.

ב. An increase in the level of thyroxine will inhibit TSH secretion.

ג. An increase in the level of TSH will inhibit thyroxine secretion.

ד. A decrease in the level of TSH will increase thyroxine secretion.

9. Which of the following statements is true for decomposers [מְפָרְקִים]?

א. They feed on organic material.

ב. They are parasites that live inside living organisms.

ג. They decompose minerals in the soil.

ד. They do not need energy.

10. The male of the fruit fly (Drosophila) has XY chromosomes and the female has XX. A rare mutation caused the appearance of a recessive allele on the X chromosome in a sperm cell of a male fruit-fly (Generation P). The offspring of this male were crossed among themselves. In the phenotype of which individual can we expect to see this mutation expressed?

א. Generation F1 female

ב. Generation F1 male

ג. Generation F2 female

ד. Generation F2 male

11. A student examined four types of cells, A-D, under a microscope. He recorded his findings in a table.

Cell / Organelle	Cell A	Cell B	Cell C	Cell D
Mitochondria	many	many	none	few
Chloroplasts	present	none	none	present
Ribosomes	present	present	present	present

Which of the following statements is consistent with the findings in the table?

א. Cell A is a skin cell.

ב. Cell C is a cell from the leaf of a plant.

ג. Cell B is a muscle cell.

ד. Cell D is a cell of the underground root of a plant.

/continued on page 6/

12. How will a rise in ambient temperature and excessive sweating affect the volume and concentration of urine in a healthy human?

א. The volume will be reduced and the concentration will rise.

ב. The volume will increase and the concentration will rise.

ג. The volume will be reduced and the concentration will remain the same.

ד. Due to homeostasis there will be no change.

13. Many couples have twins - a boy and a girl. How are these twins formed?

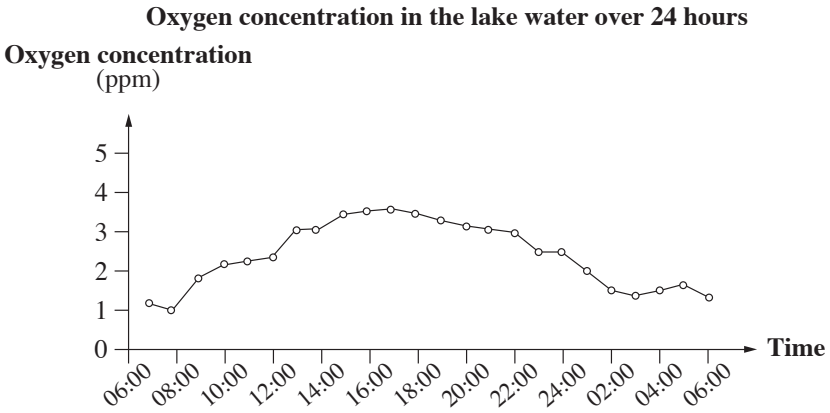
א. One ovum is fertilized by two sperm cells.

ב. One ovum is fertilized by one sperm cell, and the ovum develops into two embryos.

ג. Two ova are fertilized by one sperm cell.

ד. Two ova are each fertilized by a different sperm cell.

14. The following chart describes the concentration of oxygen in the water of a lake over 24 hours.



What is the explanation for the changes in oxygen concentration shown in the chart?

א. During the night, the water is colder so it contains more oxygen.

ב. During the night, the rate of cellular respiration is reduced in most of the organisms in the water.

ג. During the day, photosynthesis takes place in plants, not cellular respiration.

ד. During the day, the rate of photosynthesis is higher than the rate of cellular respiration.

/continued on page 7/

15. The concentration of sodium ions in most living cells is lower than the concentration of sodium ions outside the cells.

The concentration of sodium ions in dead cells is equal to their concentration outside the cells.

What can we conclude from these facts?

א. Sodium is essential to cells' existence.

ב. Sodium is removed from the cells in a process that requires energy.

ג. Sodium penetrates the cells via channels in the cell membrane.

ד. Sodium is removed from the cells by diffusion.

16. Determine in which of the options א-ד the components of the nervous system are arranged from the molecular level to organ level.

א. neuron, neurotransmitter, axon, brain

ב. brain, axon, neurotransmitter, neuron

ג. neurotransmitter, axon, neuron, brain

ד. neurotransmitter, neuron, brain, axon

17. Why does an ecological pyramid usually have no more than 4-5 trophic levels?

א. The last level must be a top predator level.

ב. A large amount of energy is not transferred from level to level.

ג. There are only four types of interactions between organisms in an ecosystem.

ד. The higher the trophic level, the smaller the organisms.

18. What might be the effect of using the same chemical pesticide repeatedly on a population of harmful insects?

א. The incidence of individuals that are resistant to this substance will rise.

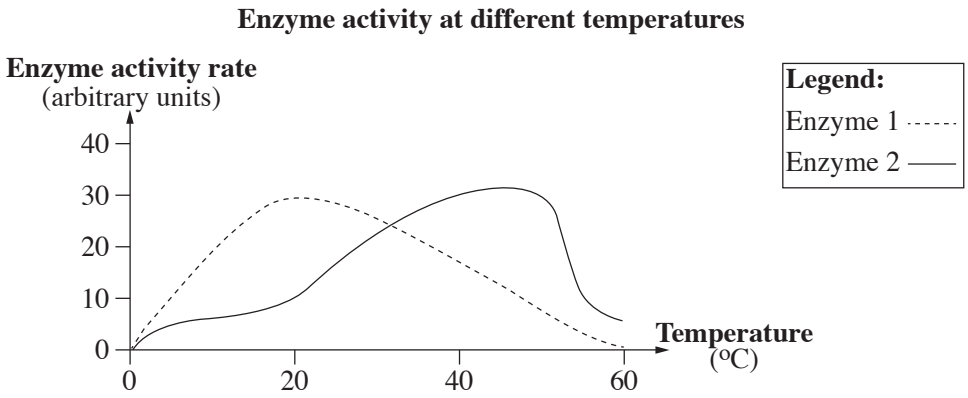
ב. Resistant individuals will be increasingly harmed by the substance.

ג. Individuals will be less resistant to this pesticide.

ד. Non-resistant individuals will develop a resistance to this pesticide.

/continued on page 8/

19. The curves in the following chart describe the activity of two enzymes at different temperatures.



Which of the two enzymes undergoes denaturation at a higher temperature?

א. Enzyme 1

ב. Enzyme 2

ג. Both enzymes undergo denaturation at the same temperature.

ד. It is not possible to determine the answer based on the data.

20. When caterpillars nibble the leaves of a certain plant they cause the plant to secrete substances from its leaves. These substances attract insects to the plant and the insects prey on the caterpillars.

Which type of biological interaction exists between the plant and the predator insects?

א. parasitism

ב. predation

ג. competition

ד. mutualism

/continued on page 9/

Part Two (35 points)

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

Choose five questions and write your answers in the **answer booklet** (each question — 7 points).

21. In a certain area of the body (Area A), oxygen (O_2) passes **out of** the capillaries, and in another area (Area B) oxygen passes **into** the capillaries.

א. **(1)** Determine which area, A or B, is a lung alveolus and which area is a muscle.

(2) The binding strength of oxygen to the hemoglobin in Area A is different from the binding strength of oxygen to hemoglobin in Area B.

How does this difference make it possible for the lungs to supply oxygen to muscle tissue?

(4 points)

ב. Blood transports carbon dioxide (CO_2) as well as oxygen. How is carbon dioxide transported in the blood? List two possibilities. (3 points)

22. **א.** **(1)** The food that a person ate contained various substances, as listed in the following table. Copy the table to your notebook, and for each of the substances specify whether it will be chemically metabolized [פירוק כימי] by digestive enzymes, and whether the substance or its metabolites are absorbed in the blood.

Substance	**Enzymatically metabolized** (yes/no)	**Substance or metabolites are absorbed** (yes/no)
Protein		
Water		
Starch		
Table salt ($NaC\ell$)		

Copy to notebook

(2) Some metabolites of the substances in the table can be used to build energy storage molecules in the body.

List the name of one **metabolite** and list the **energy storage molecule** it is used to build.

(4 points)

ב. In the debate for and against eating meat, provide one reason in **favor** of eating meat and one reason **against** eating meat. At least one of your two reasons must be biology-related (health or ecology). (3 points)

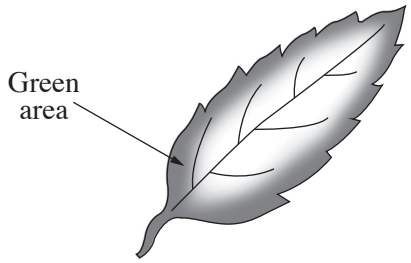
/continued on page 10/

23. Hepatitis B is a viral disease that affects the liver. It is possible to genetically engineer a vaccine for hepatitis B. To do this, a gene encoding an envelope protein of the hepatitis virus is inserted into yeast cells, causing the yeast to produce the envelope protein.

א. Genetic engineering is based on the principle that the genetic code is the same (universal) in all organisms. Explain this principle. (3.5 points)

ב. The hepatitis virus's envelope protein that is produced in the yeast cells is used to vaccinate against the virus. Is this vaccine an active immunization or a passive immunization? Explain your answer. (3.5 points)

24. When iodine solution (which is yellowish-brown) is added to starch (which is white) the reaction between the two produces a blue-black color.
In a certain species of plant, only part of the leaf is green (see figure). When an iodine solution is applied to the entire leaf, only the green areas turn blue-black.



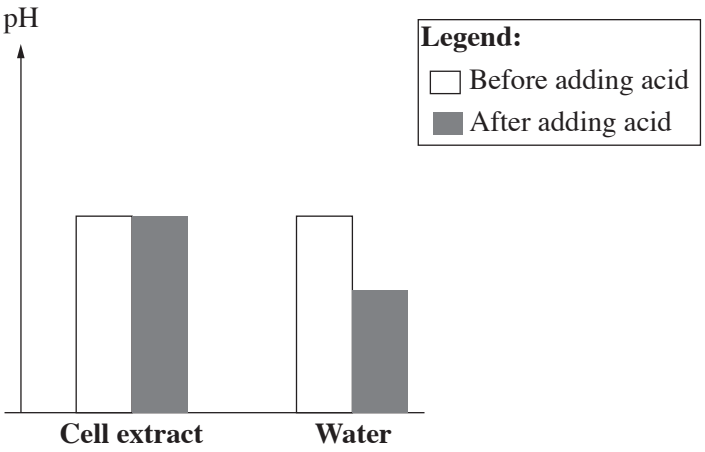
א. Explain how processes that take place in the leaf cells cause only the green areas of the leaf to be dyed blue-black when an iodine solution is applied to the leaf. (4 points)

ב. Drimia [חצב] is a geophyte with a starch-rich storage organ. Based on this information, explain how it is that the Drimia flowers develop before the leaves appear.
(3 points)

/continued on page 11/

25. א. In a certain experiment scientists crushed cells from tissue taken from an animal and extracted the content of the cells. They added acid to the cell extract and to some water, and checked the effect of adding acid on the pH (acidity) of the cell extract and of the water. The results of this experiment are shown in the diagram below.

Effect of adding acid on the pH of cell extract and of water



The results shown in the diagram are also obtained when the experiment is conducted with whole cells.

Explain how the results of this experiment show that homeostasis takes place at cellular level. (3 points)

ב. During strenuous physical activity, the energy required for muscle cells to contract is produced in an aerobic [אוירנית] cellular-respiration process and in a lactic acid fermentation process.

(1) List a benefit of <u>each</u> of these processes to muscle function during exertion.

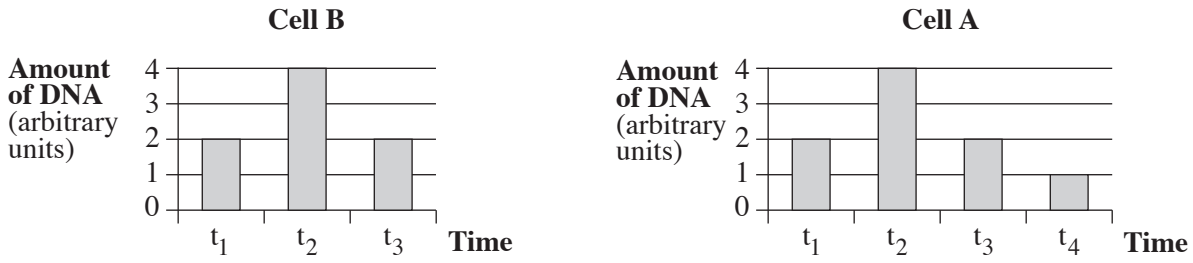
(2) List and explain a possible effect of lactic acid fermentation on cell pH (acidity) (4 points)

/continued on page 12/

26. Two cells, Cell A and Cell B, undergo cell division.

The diagrams below show the amount of DNA measured at various times, starting some time before division (t_1) and ending when division is complete. At each time point, the amount of DNA shown is for one cell.

Amount of DNA in a cell at different times



א. Determine which type of division Cell A underwent, and which type of division Cell B underwent. (2 points)

ב. Describe and explain each change in amount of DNA in **Cell A** that is shown in the diagram. (5 points)

27. Deep in the Cave of Perama in northern Greece live crickets (insects), spiders, and fruit-eating bats. The crickets feed on fruit found in the bat droppings, and the spiders feed on the crickets.

א. In your notebook, draw a chart of the food web [מארג המזון] described above. (3 points)

ב. The concentration of carbon dioxide (CO_2) outside the cave is lower than its concentration in the depths of the cave. Explain why. In your explanation, discuss a biotic factor that is present outside the cave. (2.5 points)

ג. One of the animals kept in zoos is bats. Are you **in favor** of or are you **opposed** to keeping animals in zoos? Provide one argument to support your position. (1.5 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 below, and answer all of the questions 28-30 (the point value of each item is given).

The blue mussel — a natural inspiration

Since the beginning of history, mankind has extracted useful substances from nature. Today, nature also inspires new technological developments. This area of study is known as biomimicry*. Its goal is to learn from nature how to solve problems encountered by humans.

The study of the blue mussel is an example of this: A protein that the mussel secretes inspired an artificial substance for medical use.

Blue mussels live on rocks on the sea shore. They remain attached to the rocks despite the water continuously washing over them and the impact of the waves.

Blue mussels adhere to rock using proteins secreted from glands on their body. These proteins form strong, flexible fibers that stick to the surface of the rocks. These protein fibers maintain their adhesive properties in a wet environment, unlike industrial adhesives that are usually ineffective in a wet environment.

(Based on a photo by Pallbo in Wikipedia)

* bio = life, mimicry = imitating

28. א. The ability to produce proteins for use as an adhesive is an adaptation of the blue mussel to its habitat. List one benefit that this ability confers on the blue mussel in its habitat. (2 points)

ב. Describe the stages of an evolutionary process in which this adaptation could have developed. (4 points)

In the first stage of this study, the scientists identified the sequence of amino acids of the adhesive protein that the mussel secretes. They were able to manufacture a substance with a structure that is similar to that of the mussel protein and can stick to various types of surfaces. This substance was named **P Glue**.

In the next step of the study, the scientists tested how P Glue can be used to bond human cells. In medicine, glue that bonds human cells can be used, for example, to bond cuts or repair birth defects in fetuses (before birth).

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Developing surgical glues is a great challenge because the glue must be effective in a wet environment, non-toxic, and highly specific (it will only bond a specific type of cell).

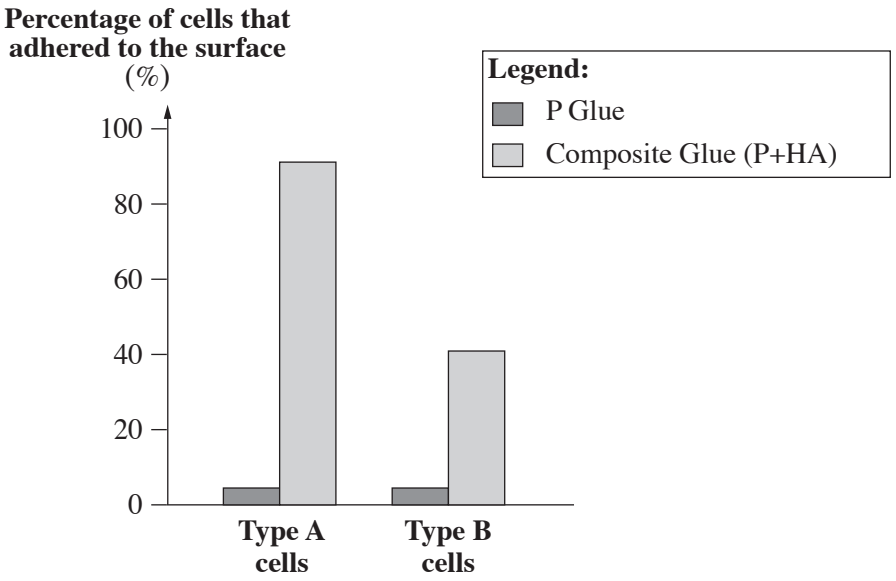
To make a cell-specific glue the scientists developed a **composite glue** [דבק משולב] made of two substances: P Glue and **HA**.

Certain types of body cells have HA receptors on their cell membrane.

In Experiment 1, the scientists tested the adhesion of two types of cells (Type A and Type B) to a surface coated with P Glue and a surface coated with the composite glue (P+HA).

The results of Experiment 1 are shown in Diagram 1.

Diagram 1: Adhesion of two types of cells to surfaces coated with P Glue or composite glue



In Experiment 2, the scientists tested the effect of the concentration of HA in the composite glue on adhesion of Type A cells. They coated a number of surfaces with the composite glue. The composite glue on each surface contained a different concentration of HA.

The results of this experiment are shown in Diagram 2 on the following page.

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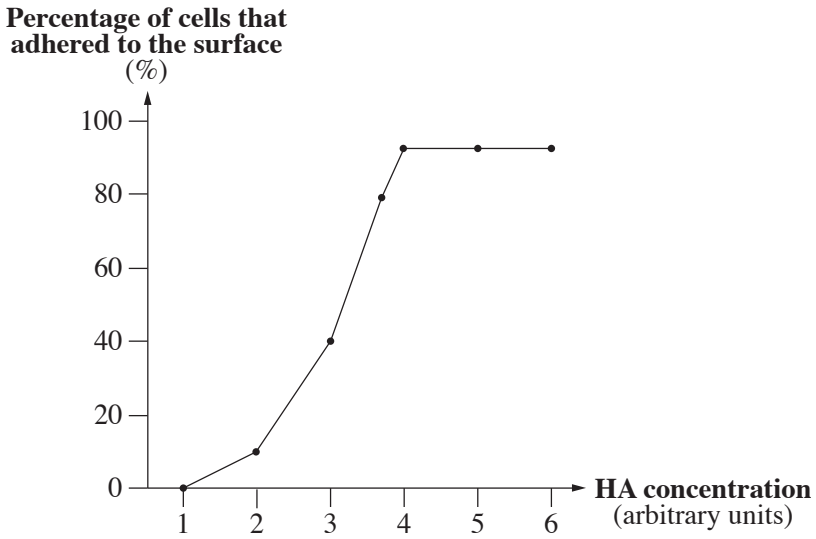
Diagram 2: Effect of HA concentration on percentage of Type A cells that adhered to a surface coated with composite glue



29. א. List one conclusion that can be drawn from both experiments about the contribution of HA to the composite glue's ability to bond cells. Use the data shown in Diagrams 1 and 2 to explain your conclusion. (3 points)

ב. Based on the information shown in Diagram 1 and the information preceding it, propose an explanation for the difference between Type A cells and Type B cells in the percentage of cells that adhered to the composite-glue coated surface. (2.5 points)

ג. At which concentrations is HA a limiting factor in the rate of cell bonding? Explain your answer using the data shown in Diagram 2. (2.5 points)

30. Of the actions listed below, determine which action humankind must take today so that in the future it will be possible to develop solutions inspired by nature. Explain.

— Expand the area of farmed land
— Maintain species diversity
— Reduce the greenhouse effect

(4 points)

/continued on page 16/

Part Four (15 points)

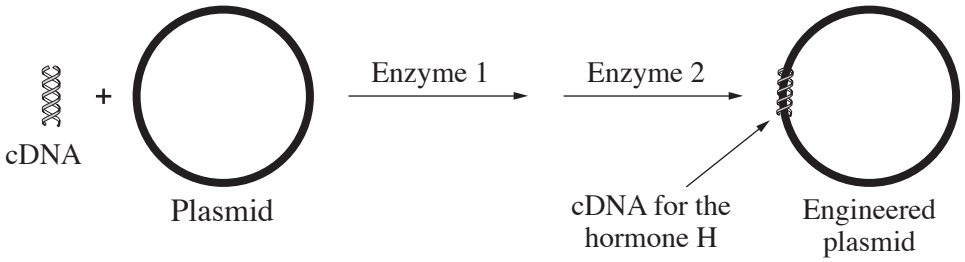
There are three topics in this part:

Choose <u>one</u> 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 <u>two</u> questions: Question 31 (required) and <u>one</u> of the questions 32-33.
Answer Question 31 (**required**).

31. The hormone H is secreted by certain cells in the human body. To produce this hormone in bacteria, scientists obtained messenger RNA (mRNA) from human cells that encodes the hormone H, and used the mRNA to produce complementary DNA (cDNA). The cDNA was inserted into plasmids, creating in this way genetically engineered plasmids that contain the DNA segment that encodes the hormone H (see figure). The genetically engineered plasmids were inserted into bacteria. The bacteria were cultured on a suitable medium and the hormone H was harvested from them.



א. List <u>one</u> structural difference between the gene encoding the hormone H in human cells and the complementary DNA (cDNA) that was manufactured in the lab. (2 points)

ב. **(1)** Two enzymes, 1 and 2, were used in the process of manufacturing the genetically engineered plasmids described in the figure. Explain the role of <u>each</u> of these two enzymes.

(2) Another gene was inserted into the engineered plasmids: a gene that codes for an enzyme that catalyzes [מזרז] breakdown of the antibiotic substance A.
Explain why this gene was inserted into the engineered plasmids.
(5 points)

ג. Cells have two types of nucleic acids: DNA and RNA. List <u>one</u> difference between the structure of DNA and the structure of RNA. (2 points)

/continued on page 17/

Answer one of the questions 32-33.

32. To determine whether a DNA specimen from a crime scene belongs to a certain suspect, the amount of DNA in the specimen is first amplified, and then compared to the DNA of the suspect.

א. In the first step the amount of DNA is amplified using PCR, which is a method that was developed based on the DNA replication mechanism in cells. Copy the following table to your **notebook** and fill in either Yes or No in each of the empty spaces. (4 points)

Comparing DNA replication in human cells and DNA replication by PCR

	Replication in human cells	Replication by PCR
Uses DNA nucleotides (yes / no)		
Separation of DNA strands (yes / no)		
Catalyzed by enzymes that are resistant to high temperatures (yes / no)		
Uses RNA nucelotides (yes / no)		

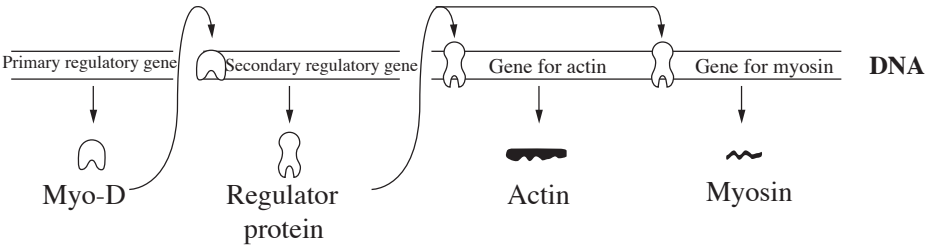
ב. In the second step the nucleotide sequence in certain areas of DNA from the sample is compared with the nucleotide sequence in the suspect's DNA.
For genetic identification purposes, is it necessary to compare areas that encode proteins or areas that do not encode proteins? Explain your answer. (2 points)

/continued on page 18/

33. A mature muscle cell has a primary regulatory gene that encodes the primary regulatory protein Myo-D. The protein Myo-D activates secondary regulatory genes - genes that encode regulator proteins (transcription factors). One of these regulator proteins activates genes that encode muscle proteins such as actin and myosin.

The following figure shows (from left to right) the activation mechanism of genes in a mature muscle cell.

Gene activation in a mature muscle cell



א. Is the regulation of muscle protein production positive or negative? Explain your answer. (2 points)

ב. **(1)** Two mice, each with a different mutation, were tested: Mouse A produces myosin but no actin in its muscle cells, and Mouse B does not produce myosin or actin in its muscle cells. For each mouse, determine which of the genes shown in the figure above could have had the mutation that resulted in that mouse's phenotype.

(2) A third mouse developed a mutation during its lifetime which resulted in production of flawed myosin in its muscle cells. Will the offspring of this mouse also produce flawed myosin? Explain your answer.

(4 points)

/continued on page 19/

Topic II — Developmental Comparative Physiology

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

Answer Question 34 (**required**).

34. א. **(1)** A fish in water opens and closes its mouth regularly. Explain how opening its mouth creates a concentration gradient that makes the gas exchange in the fish's respiratory system possible.

(2) When a person inhales air, their ribs rise and the diaphragm descends. Explain how these movements create a concentration gradient that makes the gas exchange in the respiratory system possible.

(4 points)

ב. In both fish and humans, oxygen-rich blood flows through the circulatory system from the respiratory system to the cells in the body. How do fish and humans differ in the pathway that blood travels from the respiratory system to the body cells?

(2.5 points)

ג. Dolphins (marine mammals) are able to stay under water longer than humans. The respiratory center in dolphins has been found to be **less** sensitive to blood CO_2 levels than the respiratory center in humans.

Explain how this property allows dolphins to stay underwater longer than humans.

(2.5 points)

Answer one of the questions 35-36.

35. א. Bird and fish embryos develop inside an egg. The table below contains a list of properties associated with reproduction and eggs. Copy the table to **your notebook** and fill in each blank space with one of the options in parentheses. (4 points)

Properties associated with reproduction and eggs in fish and birds

	Fish	Birds
Type of fertilization (internal/external)		
Number of eggs in a single clutch [הטלה] (large / small)		
Egg has calcareous [סידנית] shell (yes / no)		
Embryonic urinary reservoir (allantois) present in the egg (yes / no)		
Amniotic fluid in the egg (yes / no)		
Gases pass through the egg envelope (yes / no)		

ב. Bird embryos utilize the materials in the egg yolk as they grow. The weight of a fledgling when it hatches has been found to be lower than the initial weight of the yolk. Suggest an explanation for this finding. (2 points)

/continued on page 20/

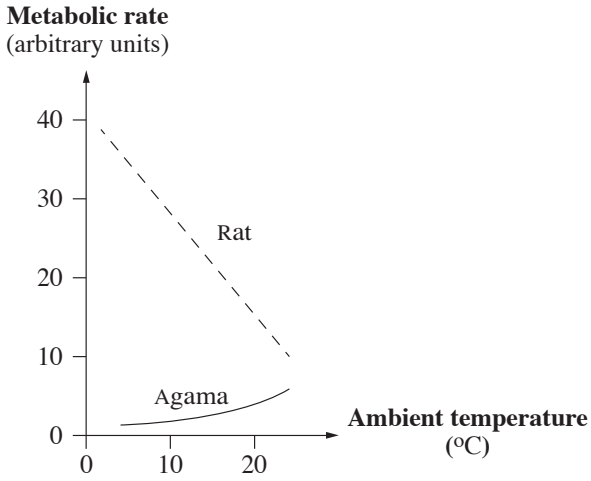
36. א. Scientists compared the metabolic rate in rats (mammals) to the metabolic rate in the lizard agama (a reptile) of similar size. They found that at a temperature of 20°C, a rat's metabolic rate is higher.

Explain the relationship between heart structure and metabolic rate in <u>each</u> of these animals. (3 points)

ב. The following graph shows the metabolic rate of a rat and the metabolic rate of an agama at various ambient temperatures.

Explain the relationship between ambient temperature and metabolic rate in <u>each</u> of the two animals. (3 points)

Metabolic rate in a rat and in an agama at different temperatures



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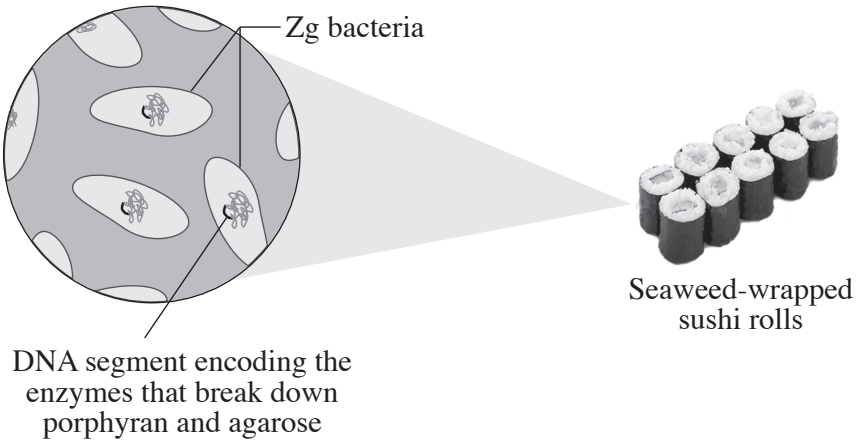
Topic III— Bacteria and viruses in the human body

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

Answer Question 37 (**required**).

37. In Japan people eat sushi. One of the ingredients of sushi is seaweed (algae, a marine plant). This seaweed contains the substances porphyran and agarose. Some types of seaweed carry Zg bacteria. Zg bacteria have genes that encode enzymes that catalyze the breakdown of porphyran and agarose (see figure). When a person eats such seaweed both the algae and Zg bacteria are metabolized in the gut.

Zg bacteria on edible seaweed



One of the organisms in the microbiome in the human gut is Bp bacteria. Bp bacteria present in the gut of people who eat seaweed regularly have genes that encode enzymes that metabolize porphyran and agarose. There are **no** such genes in the Bp bacteria found in the gut of people who do **not** eat seaweed.

א. Explain the reason for the presence of genes that encode metabolizing enzymes for porphyran and agarose in Bp bacteria from the gut of people who eat seaweed.

(3 points)

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

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ב. Scientists tested the effect of boiling the bacteria on porphyran metabolism under laboratory conditions. The scientists cultured Zg bacteria taken from seaweed in one container, and in another container they cultured Bp bacteria taken from a person who **does not eat** seaweed.

In the next step, the scientists boiled some bacteria of each kind. They then placed bacteria of **both kinds** in test tubes 1-4, according to the combinations shown in the table below. A few hours later they added porphyran to the test tubes and checked whether it had been metabolized.

Copy the following table to your notebook and fill in the missing information in each of the blank spaces.

Effect of boiling bacteria on porphyran metabolism

Test tube	Bacteria combination		Porphyran metabolized (yes / no)	Explanation
	Zg	Bp		
1	boiled	boiled		
2	boiled	not boiled		
3	not boiled	boiled		
4	not boiled	not boiled		

(4 points)

ג. In addition to the digestive tract, the human body has other areas that are exposed to bacteria from the outside environment.

List one such area and one protective measure that prevents bacteria from entering this area . (2 points)

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Answer one of the questions 38-39.

38. א. A medical student received two test tubes. One contained **bacteria** that cause pneumonia and the other contained DNA **viruses** that cause pneumonia. The student did not know what was in each test tube.

Suggest two tests that the student can conduct to discover which test tube contains bacteria and which one contains viruses.

For each of the tests, specify the result that will allow the student to determine whether there are bacteria or viruses in the test tube. Note: You do not need to specify the steps in the tests. (3 points)

ב. A sample of white blood cells was taken from a healthy person. The blood cells were cultured in two separate cultures, under the same optimal conditions that are necessary for cell proliferation. White blood cells from a **patient sick with** AIDS were added to one culture, and white blood cells from a person who is an AIDS **carrier** were added to the second culture.

The scientists tested the quantity of AIDS virus envelope protein and the number of white blood cells in each culture twice: the first time, immediately after adding the blood cells and the second time after a certain interval. The following table shows the changes in each culture during the interval between the two tests.

Effect of the source of the white blood cells added to the culture on the amount of viral protein and number of white blood cells in the culture

Treatment / Tested factor	**White blood cells from patient sick with AIDS**	**White blood cells from AIDS carrier**
Amount of viral envelope protein	increased	unchanged
Number of white blood cells	decreased	increased

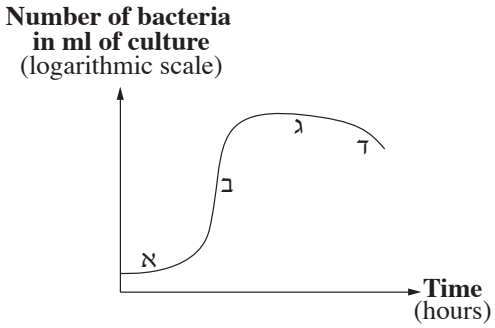
Explain the changes that occurred in each of the cultures following the addition of white blood cells from a patient who is sick with AIDS and from an AIDS carrier.

(3 points)

/continued on page 24/

39. It is customary to describe the growth of a bacterial population using a curve called a **growth curve** [עקום גידול].

Bacterial growth curve



א. Explain why in Stage א on the growth curve the number of bacteria remains constant. In your answer, refer to <u>one</u> process that takes place **inside** the bacteria cells. (2 points)

ב. In industry today, bacteria are utilized to produce various materials. Bacteria are cultured in large tanks. The amount of substance obtained from the bacteria is largest at the end of Stage ב on the growth curve.

List <u>two</u> environmental conditions that must be kept constant in the culturing tanks to extend Stage ב as long as possible. Explain the significance to bacteria of <u>one</u> of the environmental conditions you listed. (4 points)

Good Luck!