State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 10)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 10)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 1

בעיה 1

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

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

ג. Special instructions:
(1) Read the instructions carefully and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and the results that you obtained, even if they are not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
מחשבון
מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את ההנחיות ביסודיות ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 1

In this problem, you will examine the effect of solutions of different concentrations on various plant parts.

The questions in this exam are numbered **1-12**. The point value of each question appears on the left.

Answer all of the questions in your notebook.

Part א I— Immersing black-eyed pea radicles in sucrose solutions of various concentrations

On your table is a disposable plate with black-eyed pea seedlings and 4 test-tubes. Each test-tube contains a blue sucrose solution with a different initial concentration. A blue substance has been added to the sucrose solutions so that you can tell them apart from other sucrose solutions. In this experiment, the blue sucrose solutions in which you will immerse the radicles are called the '**immersion solutions**'.

Preparing radicles for the experiment

א. Detach the cotyledons (seed leaves) from all the seedlings (see Figure 1). Discard the cotyledons in the waste container. Place the remaining parts of the seedling on a paper towel. Note: In this experiment, the remaining parts of the seedlings (hypocotyl [תת-פסיג] and radicle) are referred to together as the '**radicle**'.

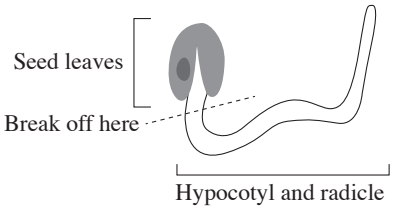


Figure 1: Black-eyed pea seedling

Preparing groups of seedlings

ב. Sort the radicles into 4 groups that are as similar as possible; put 10 radicles in each group. Work as follows:

— Lay out 4 paper towels on the table, side by side.

— Select 4 radicles of similar length. Place each radicle on a separate paper towel.

— Repeat this process 9 more times, each time selecting 4 radicles of similar length (but not necessarily similar in length to the previous set of radicles you placed on the paper towels).

/continued on page 3/

ג. Write 'השריה' on each of the four test-tubes containing blue sucrose solution.

The concentrations of sucrose solution in these test-tubes are: 0.8M, 0.3M, 0.2M, 0.05M.

— Gently place one group of radicles in each of the test-tubes that contain immersion solution. Make sure the radicles remain whole. Make sure the radicles in all the test-tubes are covered by the solution. Use the top of a pencil to push the radicles into the liquid.

— Write down the time: _____.

/continued on page 4/

Informative Note 1:

The blue substance does not pass through cell membranes and does not harm them.

You must wait at least half an hour before you continue the experiment according to the instructions in Item יד.

The results of this experiment will not be negatively affected if immersion continues for longer than half an hour.

While you are waiting, perform Items ד-יג and answer Questions 1 and 2.

Part א II — Method for finding the relative concentrations of solutions (without radicles)

You have been given two 10 ml pipettes, one 1 ml pipette, a container with distilled water, and a test-tube with a colorless 1M sucrose solution.

ד. Write on each of the three test-tubes you were given the concentration of the sucrose solution that you will prepare in it: 0.8M, 0.3M, 0.05M.

— Also write 'בדיקה' on each of the test-tubes.

— Label a 10 ml pipette and the 1 ml pipette 'סוכרוז'.

— Label a 10 ml pipette 'מים'.

ה. Prepare sucrose solutions of different concentrations according to the information in Columns a and b in Table 1.

Use the 1 ml pipette when you need to transfer 0.5 ml of sucrose solution.

These colorless sucrose solutions that you are preparing are the '**test solutions**'.

Table 1

a	b	c	d	e
Volume of sucrose solution (ml)	Volume of water (ml)	Sucrose concentration in the test solution (M)	Sucrose concentration in the blue solution received from the proctor (M)	Position of the blue solution in the test solution: (top/middle/bottom)
8	2	0.8	0.3	
3	7	0.3	0.3	
0.5	9.5	0.05	0.3	

ו. Cap the test solution test-tubes and shake them well.

— Remove the cap from all the test-tubes and wipe them thoroughly with a paper towel.

/continued on page 5/

ז. Ask the proctor for a test-tube containing blue sucrose solution in which the sucrose concentration is 0.3M.

ח. Use a Pasteur pipette to withdraw about 0.5 ml (no need to be exact) of the blue sucrose solution you received.

— Insert the end of the pipette down to the middle of the test solution in the 0.8M test-tube (see Figure 2), and slowly and gently empty all of the blue solution from the pipette into the test-tube. **Do not shake the test-tube!**

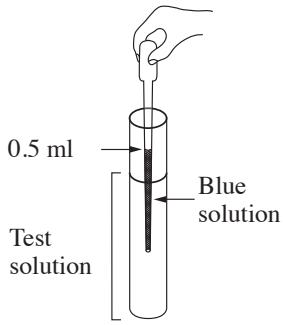


Figure 2: Adding blue solution to the test solution

ט. Take the pipette out and return the test-tube to the rack. If there is any liquid left in the pipette, empty it into the waste container.

— Wipe the pipette with a paper towel.

י. Repeat the procedure described in Items ח-ט with the 0.3M test solution and with the 0.05M test solution. **Do not shake the test-tubes.**

Answer Questions **1-2**.

(7 points) **1.** Copy Columns c, d, and e of Table 1 to your **notebook**.

— Consult Figure 3, and write in Column e of Table 1 **in your notebook** the position of the blue solution in each of the test solutions.

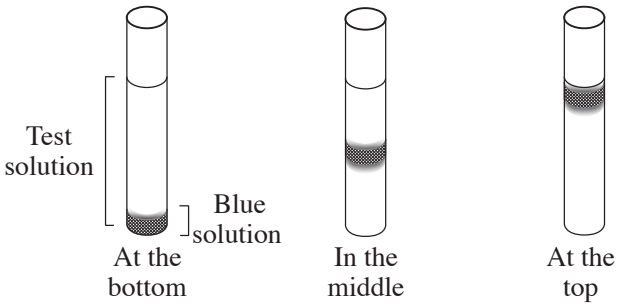


Figure 3: Position of the blue solution in the test solution

Note: If the position of the blue solution is the same in all three test-tubes, ask the proctor for help.

— Place the three test-tubes in the container on your table marked "חלק א II".

— Put the Pasteur pipette in the waste container.

/continued on page 6/

(5 points) **2.** Copy the three sentences א-ג, below, to **your notebook**.
Based on the results you recorded in Table 1, in each of these sentences in your notebook, circle the position of the blue color: at the top **or** middle **or** bottom of the solution.

א. In the test-tube in which the concentration of sucrose in the blue solution is **lower** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ב. In the test-tube in which the concentration of sucrose in the blue solution is **the same** as the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ג. In the test-tube in which the concentration of sucrose in the blue solution is **higher** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

— Continue to Part ב.

Part ב — The experiment: Examining the changes that occurred in the sucrose solutions in which black-eyed pea radicles were immersed

יא. Prepare four test-tubes of new test solutions. Work as follows:

— Write on four test-tubes: 0.8M ב', 0.3M ב', 0.2M ב', 0.05M ב' (the letter ב signifies בדיקה [test]).

— Use the pipettes you labeled in Part א II to prepare the sucrose solutions in the test solution test-tubes, according to Table 2.

Table 2

Sucrose concentration in the test solution (after dilution) (M)	Volume of 1M sucrose solution (ml)	Volume of water (ml)
0.8	8	2
0.3	3	7
0.2	2	8
0.05	0.5	9.5

יב. Cap the test-tubes, shake them well, and remove the caps.

/continued on page 7/

יג. Copy Table 3 to **your notebook**.

— Fill in Column **A** with the initial concentration of the immersion solutions (Item ג). Start with the **highest** concentration and end with the lowest.

— Fill in the missing information in Column **B** of Table 3 in your notebook.

— Fill in Column **D** with the concentrations of the test solutions. Start with the **highest** concentration and end with the lowest (based on Table 2).

Table 3

A	B	C	D	E	F	G
Initial concentration of sucrose in the blue immersion solution (M)	Number of radicles in the immersion solution	Immersion time (minutes)	Sucrose concentration in the test solution (M)	Results: **Position** of the blue immersion solution in the test solution (top/middle/bottom)	**Final** concentration of the blue immersion solution relative to the test solution (lower/similar/higher)	Change in concentration of the blue immersion solution (decreased/ unchanged/ increased)

When at least 30 minutes have passed from the time you recorded in Item ג, the immersion time has ended. Proceed to Item יד.

יד. Fill in the missing information in Column **C** of Table 3 in your notebook.

טו. Shake the test-tube with the blue **immersion** solution that is labeled 0.8M.

— Use a Pasteur pipette to withdraw about 0.5 ml of solution from this test-tube (no need to be exact).

— Insert the end of the pipette down to the middle of the **test** solution in the 0.8M 'ב test-tube, and slowly and gently empty all of the blue solution from the pipette into the test-tube (see Figure 2). **Do not shake the test-tube!**

— Put the Pasteur pipette in the waste container.

טז. Repeat the procedure described in Item טו, with clean Pasteur pipettes and the immersion solutions labeled 0.3M, 0.2M, 0.05M, and with the test solutions labeled 0.3M 'ב, 0.2M 'ב, 0.05M 'ב, respectively.

/continued on page 8/

Answer Questions **3-7**.

3. Fill in the missing data in Table 3 in **your notebook**:

(8 points) **א.** In Column **E**, write the position of the blue immersion solution in each of the test solutions (use Figure 3).

— If it is difficult to determine the position of the blue solution, ask the proctor for help.

(10 points) **ב.** Use your answer to Question 2 to complete Column **F**.

— Fill in the information in Column **G** (assume that the amount of solutes leaving the cells while the radicles were immersed is negligible).

(4 points) **ג.** Give Table 3 a title.

Informative Note 2:
* Sucrose does not pass through cell membranes.
* When water moves from the plant cells into the immersion solution, the concentration of the immersion solution decreases.
* When water from the immersion solution penetrates the plant cells, the concentration of the immersion solution increases.

4. Based on Informative Note 2:

(1 point) **א.** What is the process that causes the water to move between the cells and the solution in which the cells are immersed?

(7 points) **ב.** **(1)** In what case will there be **no** change in the concentration of the immersion solution?

(2) Explain why there will be no change in the case you described in Sub-Item ב(1).

(5 points) **5.** What is the **independent** variable in the experiment you conducted? Of the five answers I-V, below, copy the most suitable answer to your notebook.

I. initial concentration of sucrose in the test solutions
II. initial concentration of sucrose in the immersion solutions
III. concentration of the blue substance in the immersion solutions
IV. final concentration of sucrose in the test solutions
V. final concentration of sucrose in the immersion solutions

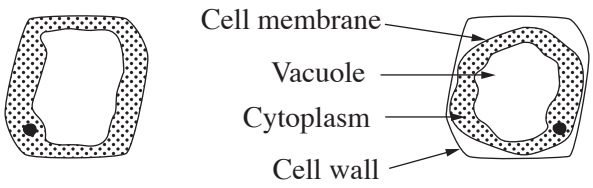
/continued on page 9/

(5 points) **6.** **א.** Explain the result in each of the experiment's test-tubes (Table 3).

(5 points) **ב.** Figure 4, below, describes cells from two black-eyed pea radicles. One radicle was immersed in water and the other in a 0.8M sucrose solution.

Determine which of the two cells, Cell A or Cell B, was taken from a radicle that had been immersed in the sucrose solution.

Explain your answer. Your answer must also refer to the results of the experiment you conducted.



Cell A **Cell B**

Figure 4: Black-eyed pea radicle cells that were immersed in water and in a sucrose solution (magnified)

(4 points) **7.** Explain why it was important to sort the radicles in the way you did in Item ב.

In your experiment you examined the effect of an external solution of a solute (sucrose) that does not penetrate the radicle cells.

In a natural setting, some solutes in the soil, such as chlorine ions ($C\ell^-$) and sodium ions (Na^+) from salt ($NaC\ell$), do penetrate plant root cells.

Part ג introduces a study of the effect of chlorine ions on barley.

/continued on page 10/

Part ג — Analysis of experimental results: Effect of chlorine ions in the culture solution on barley plants

In some regions of the world it is difficult to cultivate food crops because of a high concentration of salts in the soil, mainly chlorine ions and sodium ions. Researchers are investigating which plants can be cultivated in such soils.

Researchers conducted an experiment to test the effect of the concentration of chlorine ions ($C\ell^-$) in the culture solution on several varieties of barley. They germinated seeds of barley under optimal conditions. After the leaves had developed, the plants were transferred to culture solutions with various concentrations of chlorine ions.

Step 1 - Preparing solutions with various concentrations of chlorine ions

The researchers had a stock solution with a **1000mM** (millimolar) concentration of chlorine ions. The researchers diluted the stock solution and prepared chlorine ion solutions at five different concentrations.

The solutions were prepared as shown in Table 4.

Table 4

Solution	**Volume of stock solution** (ml)	**Volume of water** (ml)
א	2	98
ב	5	95
ג	10	90
ד	12	88
ה	15	85

Answer Questions **8-9**.

(6 points) **8.** Calculate the final concentration of chlorine ions in each of the solutions א-ה that the researchers prepared. Write the results of your calculation for each of the solutions א-ה in your **notebook.**

Step 2 — Preparing the culture solutions

To each of the chlorine solutions א-ה the researchers added a different amount of solutes (not chlorine) so that all the solutions had the same initial concentration of solutes (the same osmotic concentration).

The researchers placed the plants in these solutions and continued culturing them.

/continued on page 11/

(4 points) **9.** Use your answer to Question 4 to explain why it was important to maintain the same initial concentration of solutes in all the culture solutions.

50 days after the seedlings were transferred to the culture solutions, the researchers took some leaves from five plants of each of the two varieties of barley, Barque and Tadmor, and measured the relative quantity of chlorine ions in the leaves.
Table 5 shows the results of these measurements.

Table 5

Solution	**Concentration of chlorine ions in the culture solution** (millimolar)	**Average quantity of chlorine ions in barley leaves** (millimole/gram dry weight*)	
		Barque	Tadmor
א		100	200
ב		200	400
ג		350	650
ד		400	750
ה		500	850

*Dry weight is the plant's weight without the water it contains.

יז. In Question 8 you calculated the concentration of chlorine ions in each of the solutions and recorded the results in your notebook.
In order to make a chart, copy the results of your calculations to the correct places in Table 5 **in this exam booklet**.

Answer Questions **10-12**.

10. Present the data shown in Table 5 graphically.

(3 points) **א.** What type of graphical representation is best suited to describing the results, a line graph or a column diagram?
Explain your answer.

(7 points) **ב.** You have been given graph paper in the attachment. Use it to draw an appropriate graphical representation of the experimental results in Table 5.

(Note: Questions 11-12 are on the next page.)

/continued on page 12/

(6 points) **11.** **א.** Describe the experiment results according to the graphical representation.

(3 points) **ב.** Studies have found differences in DNA between the two varieties of barley, which are expressed as differences in cell properties. How can a difference in DNA between the two varieties cause a difference in the quantity of chlorine measured in the leaves of the two varieties? Suggest <u>one</u> explanation (no need to describe a mechanism).

Next, the researchers tested the effect of chlorine ion quantity in barley leaves of both varieties on the amount of chlorophyll in the leaves and on the dry weight of the barley plants.

12. They found that leaves with a chlorine content of more than 500 millimole/gram dry weight have <u>less</u> chlorophyll compared with leaves with chlorine content that is less than 500 millimole/gram dry weight.

(5 points) **א.** Based on the information in the introduction to this question and based on the results in Table 5, determine which variety of barley cultured in **Solution ד** has a lower chlorophyll content in its leaves. Explain your answer.

(5 points) **ב.** At the end of the experiment the researchers checked the dry weight of the plants cultured in **Solution ד**. They found that the dry weight of the Barque variety was greater than that of the Tadmor variety. Use your answer to Item א to explain the difference in dry weight between the two varieties.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return this exam booklet, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck!

בהצלחה!

State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 22)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 22)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 2

בעיה 2

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

ב. Material that may be used during the exam:
(1) Calculator
(2) Hebrew-foreign language / foreign language-Hebrew dictionary

ג. Special instructions:
(1) Read the instructions carefully and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and the results that you obtained, even if they are not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
(1) מחשבון
(2) מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את הנחיות ביסודיות, ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 2

In this problem, you will examine the effect of solutions of different concentrations on various plant parts.

The questions in this exam are numbered **13-24**. The point value of each question appears on the left.

Answer all of the questions in your notebook.

Part א I— Immersing sweet potato tissue in sucrose solutions of various concentrations

On your table is a disposable plate with half of a sweet potato tuberous root [שורש מעובה] and 4 test-tubes. Each test-tube contains a blue sucrose solution with a different initial concentration. A blue substance has been added to the sucrose solutions so that you can tell them apart from other sucrose solutions. In this experiment, the blue sucrose solutions in which you will immerse the sweet potato slices are called the '**immersion solutions**'.

Preparing sweet potato slices for the experiment

Prepare 40 slices of sweet potato, each about 0.5 cm thick, according to these instructions:

א. Place the sweet potato on a paper towel, cut side down.
Using a corer ["קודח פקקים"], prepare 10 cylinders of sweet potato. Take care to insert the corer perpendicularly to the work surface and not diagonally (see Figure 1).

— Use the top of a pencil to push the cylinders out of the corer onto the plate.

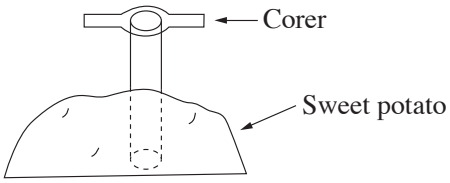
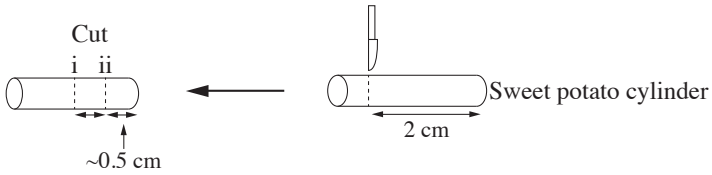


Figure 1: Preparing sweet potato cylinders with a corer

— Cut off the ends of the cylinders with a knife.
— Cut each cylinder into 2 cm segments using a ruler and a knife (Figure 2.א on page 3).
— Check the cylinder segments that you prepared: If a segment has air pockets or is not whole, throw it into the waste container, and prepare another in its place.
— Cut each segment into two halves (see Cut i in Figure 2.ב), and cut each half again into two (Cut ii). In this way, you will obtain 4 slices from each segment, each slice about 0.5 cm thick.

/continued on page 3/



2.ב: Cutting into slices **2.א: Cutting into segments**

Figure 2: Cutting the sweet potato cylinders into slices

— Count the number of slices you have prepared. If you have fewer than 40 whole slices, prepare additional slices, each about 0.5 cm thick.

ב. Put all the sweet potato slices in the container on your table labeled "לשטיפה". Add tap water up to the marked line. Stir the contents of the container with a teaspoon, and pour out the water and the slices into a strainer above the waste container.

— Repeat this rinsing process two more times, and place the sweet potato slices on a paper towel. Gently blot the excess water from the slices.

ג. Write 'השריה' on each of the four test-tubes containing blue sucrose solution.

The concentrations of sucrose solution in these test-tubes are: 0.8M, 0.3M, 0.2M, 0.05M.

— Place 10 sweet potato slices in each of the test-tubes that contain blue immersion solution. Make sure the slices in all the test-tubes are covered by the solution.

Use the top of a pencil to push the slices into the liquid.

— Write down the time: _____.

Informative Note 1:
The blue substance does not pass through the cell membranes and does not harm them.

You must wait <u>at least half an hour</u> before you continue the experiment according to the instructions in Item יד.

The results of this experiment will not be negatively affected if immersion continues for longer than half an hour.

While you are waiting, perform Items ד-יג and answer Questions 13 and 14.

/continued on page 4/

Part א II — Method for finding the relative concentrations of solutions (without sweet potato slices)

You have been given two 10 ml pipettes, one 1 ml pipette, a container with distilled water, and a test-tube with a colorless 1M sucrose solution.

ד. Write on each of the three test-tubes you were given the concentration of the sucrose solution that you will prepare in it: 0.8M, 0.3M, 0.05M.

— Also write 'בדיקה' on each of the test-tubes.

— Label a 10 ml pipette and the 1 ml pipette 'סוכרוז'.

— Label a 10 ml pipette 'מים'.

ה. Prepare sucrose solutions of different concentrations according to the information in Columns a and b in Table 1.

Use the 1 ml pipette when you need to transfer 0.5 ml of sucrose solution.

These colorless sucrose solutions that you are preparing are the '**test solutions**'.

Table 1

a	b	c	d	e
Volume of sucrose solution (ml)	Volume of water (ml)	Sucrose concentration in the test solution (M)	Sucrose concentration in the blue solution received from the proctor (M)	Position of the blue solution in the test solution: (top/middle/bottom)
8	2	0.8	0.3	
3	7	0.3	0.3	
0.5	9.5	0.05	0.3	

ו. Cap the test solution test-tubes and shake them well.

— Remove the cap from all the test-tubes and wipe them thoroughly with a paper towel.

ז. Ask the proctor for a test-tube containing blue sucrose solution in which the sucrose concentration is 0.3M.

ח. Use a Pasteur pipette to withdraw about 0.5 ml (no need to be exact) of the blue sucrose solution you received.

— Insert the end of the pipette down to the middle of the test solution in the 0.8M test-tube (see Figure 3 on the next page), and slowly and gently empty all of the blue solution from the pipette into the test-tube. **Do not shake the test-tube!**

/continued on page 5/

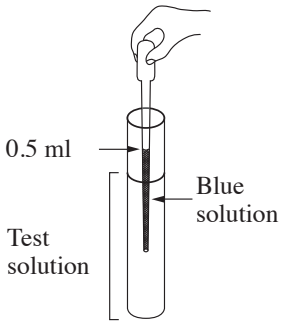


Figure 3: Adding blue solution to the test solution

ט. Take the pipette out and return the test-tube to the rack. If there is any liquid left in the pipette, empty it into the waste container.
— Wipe the pipette with a paper towel.

י. Repeat the procedure described in Items ח-ט with the 0.3M test solution and with the 0.05M test solution. **Do not shake the test-tubes.**

Answer Questions **13-14**.

(7 points) **13.** Copy Columns c, d, and e of Table 1 to your **notebook**.
— Consult Figure 4, and write in Column e of Table 1 **in your notebook** the position of the blue solution in <u>each</u> of the test solutions.

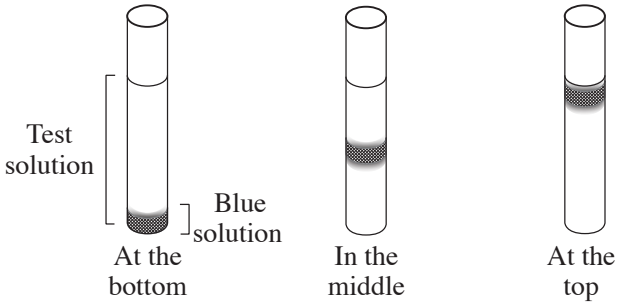


Figure 4: Position of the blue solution in the test solution

<u>Note</u>: If the position of the blue solution is the same in all three test-tubes, ask the proctor for help.

— Place the three test-tubes in the container on your table marked "חלק א II".

— Put the Pasteur pipette in the waste container.

/continued on page 6/

(5 points) **14.** Copy the three sentences א-ג, below, to **your notebook**.
Based on the results you recorded in Table 1, in each of these sentences in your notebook, circle the position of the blue color: at the top **or** middle **or** bottom of the solution.

א. In the test-tube in which the concentration of sucrose in the blue solution is **lower** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ב. In the test-tube in which the concentration of sucrose in the blue solution is **the same** as the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ג. In the test-tube in which the concentration of sucrose in the blue solution is **higher** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

— Continue to Part ב.

Part ב — The experiment: Examining the changes that occurred in sucrose solutions in which sweet potato slices were immersed

יא. Prepare four test-tubes of new test solutions. Work as follows:

— Write on four test-tubes: 0.8M 'ב, 0.3M 'ב, 0.2M 'ב, 0.05M 'ב (the letter 'ב signifies בדיקה [test]).

— Use the pipettes you labeled in Part א II to prepare the sucrose solutions in the test solution test-tubes, according to Table 2.

Table 2

Sucrose concentration in the test solution (after dilution) (M)	Volume of 1M sucrose solution (ml)	Volume of water (ml)
0.8	8	2
0.3	3	7
0.2	2	8
0.05	0.5	9.5

יב. Cap the test-tubes, shake them well, and remove the caps.

/continued on page 7/

יג. Copy Table 3 to **your notebook**.

— Fill in Column **A** with the initial concentration of the immersion solutions (Item ג). Start with the **highest** concentration and end with the lowest.

— Fill in the missing information in Column **B** of Table 3 in your notebook.

— Fill in Column **D** with the concentrations of the test solutions. Start with the **highest** concentration and end with the lowest (based on Table 2).

Table 3

A	B	C	D	E	F	G
Initial concentration of sucrose in the blue immersion solution (M)	Number of sweet potato slices in the immersion solution	Immersion time (minutes)	Sucrose concentration in the test solution (M)	Results: **Position** of the blue immersion solution in the test solution (top/middle/bottom)	**Final** concentration of the blue immersion solution relative to the test solution (lower/similar/higher)	Change in concentration of the blue immersion solution following immersion of the sweet potato slices (decreased/unchanged/ increased)

When at least 30 minutes have passed from the time you recorded in Item ג, the immersion time has ended. Proceed to Item יד.

יד. Fill in the missing information in Column **C** of Table 3 in your notebook.

טו. Shake the test-tube with the blue **immersion** solution that is labeled 0.8M.

— Use a Pasteur pipette to withdraw about 0.5 ml of solution from this test-tube (no need to be exact).

— Insert the end of the pipette down to the middle of the **test** solution in the 0.8M ב' test-tube, and slowly and gently empty all of the blue solution from the pipette into the test-tube (see Figure 2). **Do not shake the test-tube!**

— Put the Pasteur pipette in the waste container.

טז. Repeat the procedure described in Item טו, with clean Pasteur pipettes and the immersion solutions labeled 0.3M, 0.2M, 0.05M, and with the test solutions labeled 0.3M ב', 0.2M ב', 0.05M ב', respectively.

/continued on page 8/

Answer Questions **15-19**.

15. Fill in the missing data in Table 3 in **your notebook**:

(8 points) **א.** In Column **E**, write the position of the blue immersion solution in each of the test solutions (use Figure 4).

— If it is difficult to determine the position of the blue solution, ask the proctor for help.

(10 points) **ב.** Use your answer to Question 14 to complete the information in Column **F**.

— Fill in the information in Column **G** (assume that the amount of solutes leaving the cells while the sweet potato slices were immersed is negligible).

(4 points) **ג.** Give Table 3 a title.

Informative Note 2:
* Sucrose does not pass through cell membranes.
* When water moves from the plant cells into the immersion solution, the concentration of the immersion solution decreases.
* When water from the immersion solution penetrates the plant cells, the concentration of the immersion solution increases.

16. Based on Informative Note 2:

(1 point) **א.** What is the process that causes water to move between the cells and the solution in which the cells are immersed?

(7 points) **ב.** **(1)** In what case will there be **no** change in the concentration of the immersion solution?

(2) Explain why there will be no change in the case you described in Sub-Item ב(1).

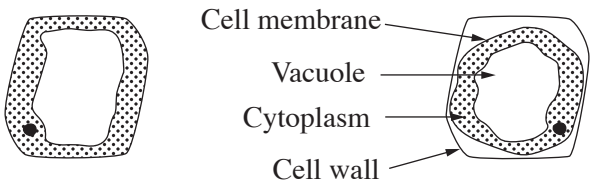
(5 points) **17.** What is the **independent** variable in the experiment you conducted? Of the five answers I-V, below, copy the most suitable answer to your notebook.

I. final concentration of sucrose in the test solutions
II. final concentration of sucrose in the immersion solutions
III. concentration of the blue substance in the immersion solutions
IV. initial concentration of sucrose in the test solutions
V. initial concentration of sucrose in the immersion solutions

/continued on page 9/

(5 points) **18.** **א.** Explain the result in each of the experiment's test-tubes (Table 3).

(5 points) **ב.** Figure 5, below, depicts cells from two sweet potato slices.
One slice was immersed in water and the other in a 0.8M sucrose solution.
Determine which of the two cells, Cell A or Cell B, was taken from a slice that had been immersed in the sucrose solution.
Explain your answer. Your answer must also refer to the results of the experiment you conducted.



Cell A **Cell B**

Figure 5: Sweet potato cells that were immersed in water and in a sucrose solution (magnified)

(4 points) **19.** Explain the importance of rinsing the sweet potato slices as you did in Item ב.

In your experiment you examined the effect of an external solution of a solute (sucrose) that does not penetrate sweet potato cells.
In a natural setting, some solutes in the soil, such as chlorine ions ($C\ell^-$) and sodium ions (Na^+) from salt ($NaC\ell$), do penetrate plant root cells.
Part ג introduces a study of the effect of chlorine ions on barley.

/continued on page 10/

Part ג — Analysis of experimental results: Effect of chlorine ions in the culture solution on barley plants

In some regions of the world it is difficult to cultivate food crops because of a high concentration of salts in the soil, mainly chlorine ions and sodium ions. Researchers are investigating which plants can be cultivated in such soils.

Researchers conducted an experiment to test the effect of the concentration of chlorine ions ($C\ell^-$) in the culture solution on several varieties of barley. They germinated seeds of barley under optimal conditions. After the leaves had developed, the plants were transferred to culture solutions with various concentrations of chlorine ions.

Step 1 - Preparing solutions with various concentrations of chlorine ions

The researchers had a stock solution with a **1000mM** (millimolar) concentration of chlorine ions. The researchers diluted the stock solution and prepared chlorine ion solutions at five different concentrations.

The solutions were prepared as shown in Table 4.

Table 4

Solution	**Volume of stock solution** (ml)	**Volume of water** (ml)
א	2	98
ב	5	95
ג	10	90
ד	12	88
ה	15	85

Answer Questions **20-21**.

(6 points) **20.** Calculate the final concentration of chlorine ions in each of the solutions א-ה that the researchers prepared. Write the results of your calculation for each of the solutions א-ה in your **notebook.**

Step 2 — Preparing the culture solutions

To each of the chlorine solutions א-ה the researchers added a different amount of solutes (not chlorine) so that all the solutions had the same initial concentration of solutes (the same osmotic concentration).

/continued on page 11/

The researchers placed the plants in these solutions and continued culturing them.

(4 points) **21.** Use your answer to Question 16 to explain why it was important to maintain the same initial concentration of solutes in all the culture solutions.

50 days after the seedlings were transferred to the culture solutions, the researchers took some leaves from five plants of each of the two varieties of barley, Barque and Tadmor, and measured the relative quantity of chlorine ions in the leaves.
Table 5 shows the results of these measurements.

Table 5

Solution	**Concentration of chlorine ions in the culture solution** (millimolar)	**Average quantity of chlorine ions in barley leaves** (millimole/gram dry weight*)	
		Barque	Tadmor
א		100	200
ב		200	400
ג		350	650
ד		400	750
ה		500	850

*Dry weight is the plant's weight without the water it contains.

יז. In Question 20 you calculated the concentration of chlorine ions in each of the solutions and recorded the results in your notebook.
In order to make a chart, copy the results of your calculations to the correct places in Table 5 **in this exam booklet**.

Answer Questions **22-24**.

22. Present the data shown in Table 5 graphically.

(3 points) **א.** What type of graphical representation is best suited to describing the results, a line graph or a column diagram?
Explain your answer.

(7 points) **ב.** You have been given graph paper in the attachment. Use it to draw an appropriate graphical representation of the experimental results in Table 5.

/continued on page 12/

(6 points) **23.** **א.** Describe the experiment results according to the graphical representation.

(3 points) **ב.** Studies have found differences in DNA between the two varieties of barley, which are expressed as differences in cell properties. How can a difference in DNA between the two varieties cause a difference in the quantity of chlorine measured in the leaves of the two varieties? Suggest <u>one</u> explanation (no need to describe a mechanism).

Next, the researchers tested the effect of chlorine ion quantity in barley leaves of both varieties on the amount of chlorophyll in the leaves and on the dry weight of the barley plants.

24. They found that leaves with a chlorine content of more than 500 millimole/gram dry weight have <u>less</u> chlorophyll compared with leaves with chlorine content of less than 500 millimole/gram dry weight.

(5 points) **א.** Based on the information in the introduction to this question and based on the results in Table 5, determine which variety of barley cultured in **Solution ד** has less chlorophyll content in its leaves. Explain your answer.

(5 points) **ב.** At the end of the experiment the researchers checked the dry weight of the plants cultured in **Solution ד**. They found that the dry weight of the Barque variety was greater than that of the Tadmor variety. Use your answer to Item א to explain the difference in dry weight between the two varieties.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return this exam booklet, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck!

בהצלחה!

State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 34)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 34)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 3

בעיה 3

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

ב. Material that may be used during the exam:
(1) Calculator
(2) Hebrew-foreign language / foreign language-Hebrew dictionary

ג. Special instructions:
(1) Read the instructions carefully and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and the results that you obtained, even if they are not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
(1) מחשבון
(2) מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את הנחיות ביסודיות, ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 3

In this problem, you will examine the effect of solutions of different concentrations on various plant parts.

The questions in this exam are numbered **25-36**. The point value of each question appears on the left.

Answer all of the questions in your notebook.

Part א I— Immersing red onion tissue in sucrose solutions of various concentrations

On your table is a disposable plate with a quarter of a red onion and two test-tubes.

Each test-tube contains a blue sucrose solution with a different initial concentration.

A blue substance has been added to the sucrose solutions so that you can tell them apart from other sucrose solutions. In this experiment, the blue sucrose solutions in which you will immerse the onion disks are called the '**immersion solutions**'.

Preparing red onion disks for the experiment

א. Remove the outer scale leaf from the quarter-onion, and put it in the waste container.

— Remove the next three scale leaves together, and place them on the plate without separating them from each other. Be sure that the innermost scale leaf faces upward (see Figure 1).

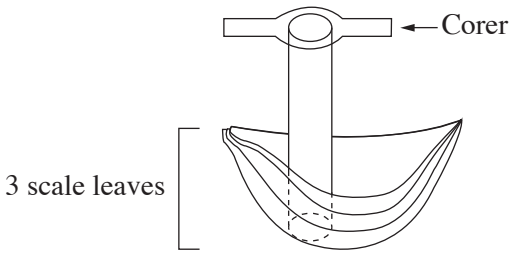


Figure 1: Preparing disks from three onion scale leaves with a corer ["קודח פקקים"]

ב. Place the corer you have been given on the upper scale leaf, far from the edges (see Figure 1). Press down on the corer so that it reaches the bottom of the scale leaves, and will have three disks of onion inside it. Use the top of a pencil to push the disks onto the plate.

— Repeat this procedure three more times, in other areas of the three scale leaves.

/continued on page 3/

Preparing groups of onion disks

ג. Sort the onion disks into two groups that are as similar as possible; put 5 disks in each group. Work as follows:
   — Lay out two paper towels on the table, side by side.
   — Select two disks of similar thickness. Place each disk on a separate paper towel.
   — Repeat this process 4 more times, each time selecting two disks of similar thickness (but not necessarily similar in thickness to the previous set of disks you placed on the paper towels).

ד. Write 'השריה' on each of the test-tubes containing blue sucrose solution.

The concentrations of sucrose solution in these test-tubes are: 0.8M, 0.05M.

   — Gently place one group of 5 disks in each of the test-tubes that contain immersion solution. Make sure the disks remain whole. Make sure the disks in all the test-tubes are covered by the solution. Use the top of a pencil to push the disks into the liquid.
   — Write down the time: _____.

Informative Note 1:
The blue substance does not pass through the cell membranes and does not harm them.

You must wait at least half an hour before you continue the experiment according to the instructions in Item טו.

The results of this experiment will not be negatively affected if immersion continues for longer than half an hour.

While you are waiting, perform Items ה-יד and answer Questions 25 and 26.

Part א II — Method for finding the relative concentrations of solutions (without onion disks)

You have been given two 10 ml pipettes, one 1 ml pipette, a container with distilled water, and a test-tube with a colorless 1M sucrose solution.

ה. Write on each of the three test-tubes you were given the concentration of the sucrose solution that you will prepare in it: 0.8M, 0.3M, 0.05M.
   — Also write 'בדיקה' on each of the test-tubes.
   — Label a 10 ml pipette and the 1 ml pipette 'סוכרוז'.
   — Label a 10 ml pipette 'מים'.

/continued on page 4/

ו. Prepare sucrose solutions of different concentrations according to the information in Columns a and b in Table 1.

Use the 1 ml pipette when you need to transfer 0.5 ml of sucrose solution.

These colorless sucrose solutions that you are preparing are the '**test solutions**'.

Table 1

a	b	c	d	e
Volume of sucrose solution (ml)	Volume of water (ml)	Sucrose concentration in the test solution (M)	Sucrose concentration in the blue solution received from the proctor (M)	Position of the blue solution in the test solution: (top/middle/bottom)
8	2	0.8	0.3	
3	7	0.3	0.3	
0.5	9.5	0.05	0.3	

ז. Cap the test solution test-tubes and shake them well.

— Remove the cap from all the test-tubes and wipe them thoroughly with a paper towel.

ח. Ask the proctor for a test-tube containing blue sucrose solution in which the sucrose concentration is 0.3M.

ט. Use a Pasteur pipette to withdraw about 0.5 ml (no need to be exact) of the blue sucrose solution you received.

— Insert the end of the pipette down to the middle of the test solution in the 0.8M test-tube (see Figure 2), and slowly and gently empty all of the blue solution from the pipette into the test-tube. **Do not shake the test-tube!**

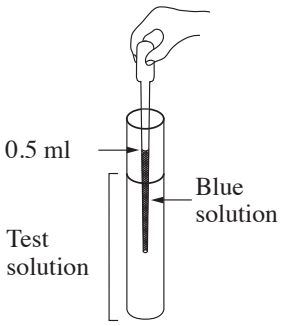


Figure 2: Adding blue solution to the test solution

י. Take the pipette out and return the test-tube to the rack. If there is any liquid left in the pipette, empty it into the waste container.

— Wipe the pipette with a paper towel.

יא. Repeat the procedure described in Items ט-י with the 0.3M test solution and with the 0.05M test solution. **Do not shake the test-tubes.**

/continued on page 5/

Answer Questions **25-26**.

(7 points) **25.** Copy Columns c, d, and e of Table 1 to your **notebook**.

— Consult Figure 3, and write in Column e of Table 1 **in your notebook** the position of the blue solution in <u>each</u> of the test solutions.

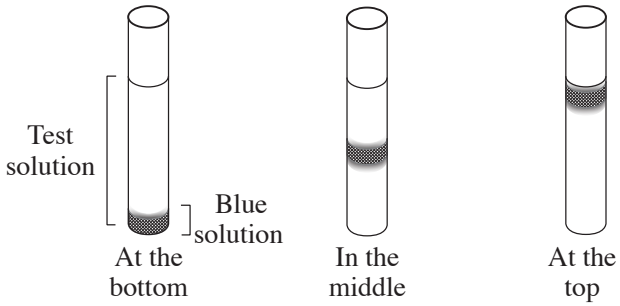


Figure 3: Position of the blue solution in the test solution

<u>Note</u>: If the position of the blue solution is the same in all three test-tubes, ask the proctor for help.

— Place the three test-tubes in the container on your table marked "חלק א II".

— Put the Pasteur pipette in the waste container.

(5 points) **26.** Copy the three sentences א-ג, below, to **your notebook**.
Based on the results you recorded in Table 1, in <u>each</u> of these sentences in your notebook, circle the position of the blue color: at the top **or** middle **or** bottom of the solution.

א. In the test-tube in which the concentration of sucrose in the blue solution is **lower** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ב. In the test-tube in which the concentration of sucrose in the blue solution is **the same** as the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

ג. In the test-tube in which the concentration of sucrose in the blue solution is **higher** than the concentration of sucrose in the (colorless) test solution, the blue color is at the top / middle / bottom of the solution.

— Continue to Part ב.

/continued on page 6/

Part ב — The experiment: Examining the changes that occurred in sucrose solutions in which onion disks were immersed

יב. Prepare two test-tubes of new test solutions. Work as follows:

— Write on one test-tube: 0.8M 'ב, and on the other: 0.05M 'ב (the letter 'ב signifies בדיקה [test]).

— Use the pipettes you labeled in Part א II to prepare the sucrose solutions in the test solution test-tubes, according to Table 2.

Table 2

Sucrose concentration in the test solution (M)	Volume of 1M sucrose solution (ml)	Volume of water (ml)
0.8	8	2
0.05	0.5	9.5

יג. Cap the test-tubes, shake them well, and remove the caps.

יד. Copy Table 3 to **your notebook**.

— Fill in Column **A** with the initial concentration of the immersion solutions (Item ד). Start with the **highest** concentration and end with the lowest.

— Fill in the missing information in Column **B** of Table 3 in your notebook.

— Fill in Column **D** with the concentrations of the test solutions. Start with the **highest** concentration and end with the lowest (based on Table 2).

Table 3

A	B	C	D	E	F	G
Initial concentration of sucrose in the blue immersion solution (M)	Number of onion disks in the immersion solution	Immersion time (minutes)	Sucrose concentration in the test solution (M)	Results: **Position** of the blue immersion solution in the test solution: (top/middle/bottom)	**Final** concentration of the blue immersion solution relative to the test solution (lower/similar/higher)	Change in concentration of the blue solution after immersion of onion disks (decrease/no change/ increase)

When at least 30 minutes have passed from the time you recorded in Item ד, the immersion time has ended. Proceed to Item טו.

טו. Fill in the missing information in Column **C** of Table 3 in your notebook.

/continued on page 7/

טז. Shake the test-tube with blue **immersion** solution that is labeled 0.8M.

— Use a Pasteur pipette to withdraw about 0.5 ml of solution from this test-tube (no need to be exact).

— Insert the end of the pipette down to the middle of the **test** solution in the 0.8M 'ב test-tube, and slowly and gently empty all of the blue solution from the pipette into the test-tube (see Figure 2). **Do not shake the test-tube!**

— Put the Pasteur pipette in the waste container.

יז. Repeat the procedure described in Item טז with a clean Pasteur pipette, the immersion solution labeled 0.05M, and the test solution labeled 0.05M 'ב.

Answer Questions **27-29**.

27. Fill in the missing data in Table 3 in **your notebook**:

(4 points) **א.** In Column **E**, write the position of the blue immersion solution in each of the test solutions (use Figure 3).

— If it is difficult to determine the position of the blue solution, ask the proctor for help.

(10 points) **ב.** Use your answer to Question 26 to complete the information in Column **F**.

— Fill in the information in Column **G** (assume that the amount of solutes leaving the cells while the onion disks were immersed is negligible).

(4 points) **ג.** Give Table 3 a title.

Informative Note 2:
* Sucrose does not pass through cell membranes.
* When water moves from the plant cells into the immersion solution, the concentration of the immersion solution decreases.
* When water from the immersion solution penetrates the plant cells, the concentration of the immersion solution increases.

28. Based on Informative Note 2:

(1 point) **א.** What is the process that causes water to move between the cells and the solution in which the cells are immersed?

(7 points) **ב.** **(1)** In what case will there be **no** change in the concentration of the immersion solution?

(2) Explain why there will be no change in the case you described in Sub-Item ב(1).

/continued on page 8/

(5 points) **29. א.** What is the **independent** variable in the experiment you conducted? Of the five answers I-V, below, copy the most suitable answer to your notebook.

I. initial concentration of sucrose in the test solutions
II. final concentration of sucrose in the test solutions
III. concentration of the blue substance in the immersion solutions
IV. initial concentration of sucrose in the immersion solutions
V. final concentration of sucrose in the immersion solutions

(3 points) **ב.** Explain the result in each of the experiment's test-tubes.

Examining preparations made from the epidermis of a red onion under a microscope

You have been given two microscope slides and equipment for making preparations for examination under a microscope.

יח. Write "סוכרוז" on one slide and "מים" on the other slide, using a pen that writes on glass.

יט. Using the dropper, put one drop of distilled water on the slide labeled "מים".

— Use a Pasteur pipette to put one drop of 1M sucrose solution (that is on your table) on the slide labeled "סוכרוז".

כ. Using tweezers, remove a small piece of the (purple) outer epidermis of the onion, and place it on the drop of water. Cover with a cover glass. Blot the excess liquid with blotting paper.

— Remove an additional piece of the external epidermis, and place it on the drop of sucrose solution. Cover with a cover glass. Blot the excess liquid with blotting paper.

כא. Examine the preparation with the epidermis in a drop of water at the microscope's lowest magnification. Locate one layer of red-purple cells in the preparation.
Bring these cells to the center of the field of view.

— If you do not find a layer of red-purple cells in the preparation you made, make a new preparation.

— Change to intermediate or high magnification.

/continued on page 9/

Answer Questions **30-31**.

(8 points) **30. א.** Draw in your notebook two or three cells from the "מים" preparation.
- Mark the parts of the cell (at least two parts), and write their names.
- Record the magnification you used.
- Give an appropriate title to the drawing.

(2 points) **ב.** Is the purple pigment in the onion's epidermal cells dissolved in the vacuole or is it organized in plastids?

כב. Examine the preparation with the epidermis in a drop of sucrose under the microscope.

(6 points) **31. א.** **(1)** Describe the difference between the two preparations, which appeared following immersion of the cells in different liquids.

(2) Explain how the type of liquid caused the difference you described in Sub-item א(1).

(4 points) **ב.** Explain how the change that occurred in the "סוכרוז" solution helps explain the result you obtained in the 0.8M ב' test-tube (in Table 3).

In your experiment you examined the effect of an external solution of a solute (sucrose) that does not penetrate onion cells.

In a natural setting, some solutes in the soil, such as chlorine ions ($C\ell^-$) and sodium ions (Na^+) from salt ($NaC\ell$), do penetrate plant root cells.

Part ג introduces a study of the effect of chlorine ions on barley.

/continued on page 10/

Part ג — Analysis of experimental results: Effect of chlorine ions in the culture solution on barley plants

In some regions of the world it is difficult to cultivate food crops because of a high concentration of salts in the soil, mainly chlorine ions and sodium ions. Researchers are investigating which plants can be cultivated in such soils.

Researchers conducted an experiment to test the effect of the concentration of chlorine ions ($C\ell^-$) in the culture solution on several varieties of barley. They germinated seeds of barley under optimal conditions. After the leaves had developed, the plants were transferred to culture solutions with various concentrations of chlorine ions.

Step 1 - Preparing solutions with various concentrations of chlorine ions

The researchers had a stock solution with a **1000mM** (millimolar) concentration of chlorine ions. The researchers diluted the stock solution and prepared chlorine ion solutions at five different concentrations.

The solutions were prepared as shown in Table 4.

Table 4

Solution	**Volume of stock solution** (ml)	**Volume of water** (ml)
א	2	98
ב	5	95
ג	10	90
ד	12	88
ה	15	85

Answer Questions **32-33**.

(6 points) **32.** Calculate the final concentration of chlorine ions in each of the solutions א-ה that the researchers prepared. Write the results of your calculation for each of the solutions in your **notebook.**

Step 2 — Preparing the culture solutions

To each of the chlorine solutions א-ה the researchers added a different amount of solutes (not chlorine) so that all the solutions had the same initial concentration of solutes (the same osmotic concentration).

/continued on page 11/

The researchers placed the plants in these solutions and continued culturing them.

(4 points) **33.** Use your answer to Question 28 to explain why it was important to maintain the same initial concentration of solutes in all the culture solutions.

50 days after the seedlings were transferred to the culture solutions, the researchers took some leaves from five plants of each of the two varieties of barley, Barque and Tadmor, and measured the relative quantity of chlorine ions in the leaves.
Table 5 shows the results of these measurements.

Table 5

Solution	**Concentration of chlorine ions in the culture solution** (millimolar)	**Average quantity of chlorine ions in barley leaves** (millimole/gram dry weight*)	
		Barque	Tadmor
א		100	200
ב		200	400
ג		350	650
ד		400	750
ה		500	850

*Dry weight is the plant's weight without the water it contains.

כג. In Question 32 you calculated the concentration of chlorine ions in each of the solutions and recorded the results in your notebook.
In order to make a chart, copy the results of your calculations to the correct places in Table 5 **in this exam booklet**.

Answer Questions **34-36**.

34. Present the data shown in Table 5 graphically.

(3 points) **א.** What type of graphical representation is best suited to describing the results, a line graph or a column diagram?
Explain your answer.

(7 points) **ב.** You have been given graph paper in the attachment. Use it to draw an appropriate graphical representation of the experimental results in Table 5.

/continued on page 12/

(6 points) **35.** **א.** Describe the experiment results according to the graphical representation.

(3 points) **ב.** Studies have found differences in DNA between the two varieties of barley, which are expressed as differences in cell properties. How can a difference in DNA between the two varieties cause a difference in the quantity of chlorine measured in the leaves of the two varieties? Suggest <u>one</u> explanation (no need to describe a mechanism).

Next, the researchers tested the effect of chlorine ion quantity in barley leaves of both varieties on the amount of chlorophyll in the leaves and on the dry weight of the barley plants.

36. They found that leaves with a chlorine content of more than 500 millimole/gram dry weight have <u>less</u> chlorophyll compared with leaves with chlorine content of less than 500 millimole/gram dry weight.

(5 points) **א.** Based on the information in the introduction to this question and based on the results in Table 5, determine which variety of barley cultured in **Solution ד** has less chlorophyll content in its leaves. Explain your answer.

(5 points) **ב.** At the end of the experiment the researchers checked the dry weight of the plants cultured in **Solution ד**. They found that the dry weight of the Barque variety was greater than that of the Tadmor variety. Use your answer to Item א to explain the difference in dry weight between the two varieties.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return this exam booklet, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck!

בהצלחה!

State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 45)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 45)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 4

בעיה 4

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

ב. Material that may be used during the exam:
(1) Calculator
(2) Hebrew-foreign language / foreign language-Hebrew dictionary

ג. Special instructions:
(1) Read the instructions carefully, and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and on the results that you obtained, even if they were not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
(1) מחשבון
(2) מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את הנחיות ביסודיות, ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 4

In this problem, you will examine the activity of enzymes that digest proteins.

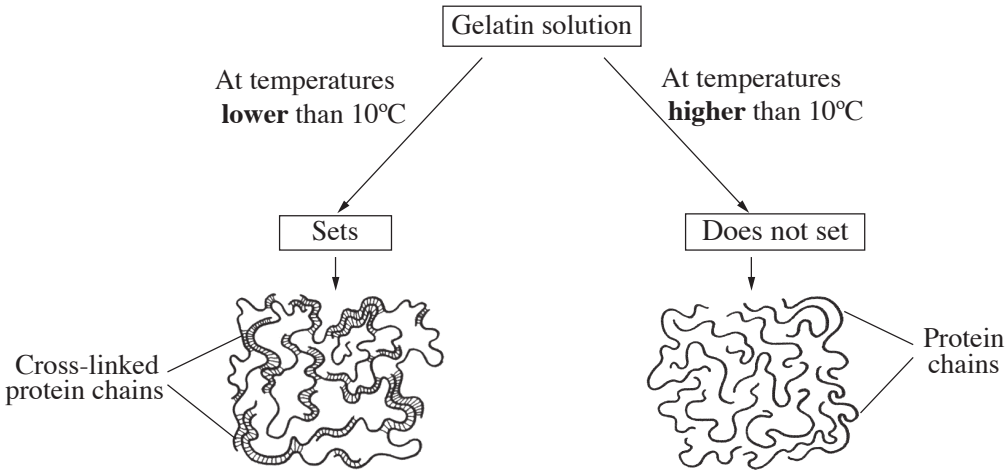
The questions in this exam are numbered **37-48**. The point value of each question appears on the left.

Answer all of the questions inside your notebook.

Part א — Effect of pineapple extract on the protein gelatin

The protein gelatin is used in the food industry in desserts, because at temperatures lower than 10°C gelatin sets to a jellylike texture. At low temperatures, the protein chains cross-link to form a lattice, as shown in Figure 1, and the protein sets to a gel.

Figure 1: Effect of temperature on gelation [קרישה] of a gelatin solution



Preparing pineapple extract

א. Use a pen for marking glass to write 'מיצוי אננס' (pineapple extract) on a test-tube.

ב. On your table you have a mortar and pestle, a knife, a spoon, and a disposable plate with a piece of pineapple on it.
Chop the pineapple into small pieces, and use the spoon to transfer the pineapple pieces and liquid from the plate to the mortar.

ג. You have been given a container with distilled water.
Write 'מים' on a 5 ml pipette. Use the pipette to transfer 5 ml of water to the mortar.
— Crush the pineapple pieces with the pestle.
— Transfer another 5 ml of water, and continue crushing until you have a pulp.

ד. On your table you have a funnel and a piece of gauze. Place the funnel over the מיצוי אננס test-tube, and line the funnel with the gauze.

/continued on page 3/

ה. Use a spoon to transfer the pineapple pulp and liquid into the funnel that is resting on top of the test-tube.
- Add 5 ml of water to the mortar. Use the pestle to mix the remaining pulp with the water, and transfer everything to the funnel.
- Gather up the gauze edges, and squeeze gently to filter out the remaining liquid into the test-tube.
- Throw the gauze into the waste container.

Testing gelatin gelation

ו. You have been given two disposable cups, one inside the other.
Write on the outer cup: 'אמבט ו'.
- Ask the proctor for some hot water, and prepare in the inside cup a water bath with a temperature in the range of 37°C-40°C.
Make sure the water level is at the marked line.

ז. Mark three test-tubes with the letters A, B, C.

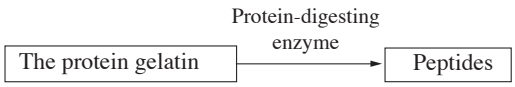
ח. You have been given a container with gelatin solution and a 10 ml pipette. Write 'ג'לטין' on the pipette.

ט. Use the ג'לטין pipette to transfer 2 ml of the gelatin solution to each of the three test-tubes, A-C.
Note: Withdraw the gelatin solution slowly so that you do not create air bubbles.
Note: If the gelatin solution in the container has set, tell the proctor.

י. You have been given three 1 ml pipettes. Write 'טריפסין' on one pipette, 'מיצוי אננס' on the second, and 'מים' on the third.

Informational note: Trypsin is an enzyme that catalyzes the digestion of various proteins, including the protein gelatin, into short chains called peptides. Peptides do not set at temperatures lower than 10°C.

Figure 2: Enzyme digestion of gelatin into peptides



יא. You have been given a test-tube with the enzyme trypsin. Use the pipette labeled טריפסין to transfer 1 ml of the trypsin solution to Test-Tube A.
- Use the מיצוי אננס pipette to transfer 1 ml of the pineapple extract you prepared to Test-Tube B.
- Use the מים pipette to transfer 1 ml of water to Test-Tube C.
- Mix the contents of each test-tube by shaking it gently.

/continued on page 4/

יב. Make sure that the temperature in the bath labeled אמבט 1 which you prepared in Item ו is in the range of 37°C-40°C, and adjust if necessary.
— Place the three test-tubes A-C in the bath labeled אמבט 1.
— Record the time _____, and wait 5 minutes.
— While you are waiting follow the instructions in Item יג.

יג. On your table you have a container with cold water labeled אמבט 2. Ask the proctor for 5 ice cubes, and put them in this bath.
Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some water from the bath into the waste container until the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.

יד. When 5 minutes have passed since the time you recorded in Item יב, transfer all three test-tubes A-C into the bath אמבט 2.
— Record the time _____, and wait 8 minutes.
While you are waiting answer Question **37.א.**

(5 points) **37. א.** **In your notebook,** draw a Table 1 for the experiment you performed. Start with Item ט. Include in the table a column for recording results.

טו. 8 minutes from the time you wrote down in Item יד, take Test-Tube C out of אמבט 2, and tilt it carefully to see whether the solution has set.
(i) If the solution in Test-Tube C has not set, return the test-tube to אמבט 2 and wait a further 5 minutes.
After waiting, check whether the solution in Test-Tube C has set, and follow the instructions in Sub-Item (ii).
— If the solution has not set, ask the proctor for help.
(ii) If the solution in Test-Tube C has set, put Test-Tube C in the rack, and take Test-Tubes A and B out of אמבט 2 and place them in the rack.

Answer Questions **37.ב - 38**.

(4 points) **37. ב.** In the results column of Table 1 in **your notebook**, record whether the solution in the test-tubes "set" or "did not set".
— Give the results column a title.

(3 points) **38. א.** Explain why it was important to keep Test-Tubes A-C in אמבט 1.

(6 points) **ב.** Explain the results you obtained in the three test-tubes A-C. In your explanation, use the Informational Note on page 3, Figures 1 and 2.

טז. Transfer <u>only</u> the three test-tubes A-C to the waste container.

/continued on page 5/

Part ב — The experiment: Activity of a pineapple-extract enzyme

Preparing several concentrations of pineapple extract

יז. Mark 4 test-tubes with the numbers 1-4.

— Use the מיצוי אננס pipette and the 5 ml מים pipette to transfer pineapple extract and water, respectively, to each of the test-tubes 1-4, according to the information in Table 2.

Table 2

	א	ב	ג
Test-tube	Volume of pineapple extract (ml)	Volume of water (ml)	Concentration of pineapple extract (%)
1	0	4	
2	0.2	3.8	
3	0.4	3.6	
4	2	2	

— Gently shake each test-tube to mix its contents.

Answer Question **39**.

(6 points) **39.** Calculate the concentration of pineapple extract in each of the test-tubes 1-4. Write the concentrations you calculated in the correct places in Table 2 in the **exam booklet**.

Note: The concentration of pineapple extract that you prepared in Item ה will count as 100%.

יח. Use the 5 ml pipette labeled מים to transfer 3 ml of the solution in Test-Tube **1** to the waste container. This will leave a volume of 1 ml of liquid in the test-tube.

— Repeat this operation with Test-Tube **2**, using the same pipette, and again with Test-Tubes **3** and **4**.

יט. Use the pipette labeled ג'לטין to transfer 2 ml of gelatin solution to each of the four test-tubes 1-4.

— Gently shake each test-tube to mix its contents.

כ. Make sure that the temperature in the bath אמבט ו is in the range of 37°C-40°C.

כא. Place the test-tubes 1-4 in the bath labeled אמבט ו.

— Record the time _____, and wait 5 minutes.

— While you are waiting follow the instructions in Item כב.

/continued on page 6/

כב. Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some of the water in the bath into the waste container so that the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.

— 5 minutes after the time you recorded in Item כא, transfer the test-tubes 1-4 to the bath אמבט 2.

— Record the time _____, and wait 8 minutes.
While you are waiting, answer Question **40.א.**

(10 points) **40. א.** Copy Table 3 to **your notebook**.

(1) Copy the concentrations you calculated in Question **39** (Table 2 in the exam booklet) to Column א in Table 3 in **your notebook**.

(2) Fill in the missing information in Column ב.

Table 3

Test-tube	א	ב	ג	ד
	Pineapple extract concentration (%)	Volume of gelatin solution (ml)	Results: Degree of gelation at temperature lower than 10°C (set/partly set/not set)	Results: Volume of peptide solution (product of gelatin digestion) (ml)
1				
2				
3				
4				

כג. 8 minutes after the time you recorded in Item כב, take Test-Tube 1 out of the bath אמבט 2 and tilt it carefully so that you can see whether the solution has set.

(i) If the solution in Test-Tube 1 has not set, return the test-tube to אמבט 2 and wait a further 5 minutes.
After waiting, check whether the solution in Test-Tube 1 has set, and follow the instructions in Sub-Item (ii).

(ii) If the solution in Test-Tube 1 has set, record the degree of gelation in Table 3 Column ג in **your notebook**, and return the test-tube to the bath אמבט 2.

— Repeat this procedure with the three test-tubes 2-4, and return them to the bath אמבט 2.

/continued on page 7/

Checking the degree of gelatin digestion into peptides

Read Items כד-כו carefully before you follow the instructions.

In each of the test-tubes 1-4 you will measure the amount of liquid that did not set.

Note: This liquid is the product of digesting gelatin into peptides.

כד. Use the pipette labeled מים to fill your graduated cylinder up to the marked line (see Figure 3).

— Place a funnel on the graduated cylinder.

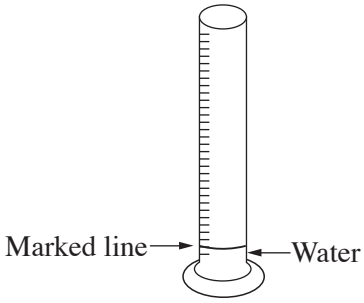


Figure 3: Graduated cylinder with marking

כה. Take Test-Tube 1 out of the bath labeled אמבט 2, and wipe the outside of the test-tube.

— Invert Test-Tube 1 over the funnel and shake it to pour the liquid that did not set (the peptide solution) into the graduated cylinder.

— Check the volume (in ml) of the liquid that was **added** to the graduated cylinder above the marked line.

— Record the result in the correct place in Table 3 in **your notebook**. If all the gelatin has set and no liquid was added to the graduated cylinder, record the result as 0.

— Empty the liquid in the graduated cylinder into the waste container.

כו. Repeat the procedure in Items כד and כה with the three remaining test-tubes 2-4, and record the result in Table 3 in **your notebook**. Note: The differences between the volumes of liquid that were added to the graduated cylinder may be small.

Answer Questions **40.ב-44**.

(4 points) **40 ב.** Give a title to Table 3 in your notebook.

(5 points) **41.** What is the independent variable in the experiment you conducted?

/continued on page 8/

(5 points) **42.** **א.** What is the dependent variable in the experiment you conducted? Of the four answers, I-IV, shown below, copy the correct one to your notebook.

I. degree of gelation of the gelatin solution

II. activity level of the protein-digesting enzyme

III. concentration of pineapple extract

IV. volume of gelatin solution

(6 points) **ב.** How was the dependent variable measured?

— Explain how this measuring method is suited to measuring the dependent variable.

(5 points) **43.** **א.** In the experiment you conducted the concentration of the gelatin solution in Test-Tubes 1-4 is constant. Explain why it was important to keep this specific factor constant in this experiment.

(3 points) **ב.** List one other factor that was kept constant in this experiment.

(6 points) **44.** What conclusion can you draw from the results of this experiment?

/continued on page 9/

Part ג — Analysis of experimental results: Pest-control in crops using the fungus Beauveria bassiana

Certain insects can damage crops. Increasing awareness of the need to protect the environment and human health has led scientists to search for environmentally-friendly ways to control pests. One such method uses the fungus B. bassiana.

This fungus produces protein-digesting enzymes that break down the insects' hard shell, which is composed of polysaccharides [רב־סוכר] and protein.

By enzymatically breaking down insects' shells, the fungus is able to penetrate their body and then secrete toxins that kill the insects.

Experiment 1

Researchers exposed two groups of insects to a liquid that contained cells of one of two strains of fungus. Each group of insects was exposed to a different strain of fungus. The researchers checked insect mortality rate in both groups for 18 days.

The results of this experiment are shown in Table 4, below.

Table 4

Time from exposure (days)	Insect mortality rate (%)	
	Fungus Strain א	Fungus Strain ב
4	15	30
8	35	60
12	45	90
16	60	97
18	62	97

Answer Questions **45-46**.

(3 points) **45. א.** Present in graphical form the experimental results shown in Table 4. What type of graphical representation is best suited to describing the results, a continuous graph or a column diagram? Explain your answer.

(7 points) **ב.** You have been given graph paper in the enclosed attachment. Use it to draw a suitable graphical representation of the results shown in Table 4.

(Note: Questions 46-48 are on the next page.)

/continued on page 10/

(6 points) **46.** **א.** Describe the results represented in the graph.

(5 points) **ב.** In a control group (not shown in Table 4), the researchers checked the mortality rate of insects that were maintained under the same conditions but were not exposed to Strain א or Strain ב fungi. Explain the importance of this control group.

The researchers wanted to discover the reason for the differences in insect mortality rate in Experiment 1 (Table 4). To do so, they conducted Experiment 2.

Experiment 2

Researchers cultured each of the two fungus strains, separately, on culture mediums that contained gelatin. They measured the level of gelatin digestion in the presence of each of the fungus strains.

In Experiment 2, they found that gelatin digestion in the presence of Strain ב was greater than the degree of digestion in the presence of Strain א.

Answer Questions **47-48.**

(6 points) **47.** Based on the introduction to Part ג and the findings of Experiment 2, explain the results of Experiment 1.

(5 points) **48.** The pineapple enzymes that digest protein are enclosed in organelles, and are not loose in the cytoplasm.
Based on the experiment you conducted in Part א and the results of the study you read about in Part ג, explain how keeping these enzymes inside organelles benefits the pineapple cells.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return this exam paper, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck!

בהצלחה!

State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 57)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 57)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 5

בעיה 5

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

ב. Material that may be used during the exam:
(1) Calculator
(2) Hebrew-foreign language / foreign language-Hebrew dictionary

ג. Special instructions:
(1) Read the instructions carefully, and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and on the results that you obtained, even if they were not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
(1) מחשבון
(2) מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את הנחיות ביסודיות, ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 5

In this problem, you will examine the activity of enzymes that digest proteins.

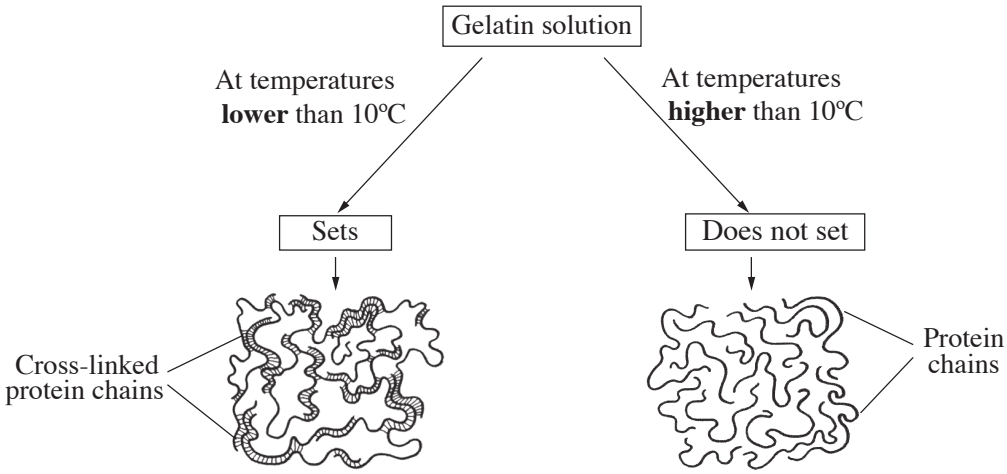
The questions in this exam are numbered **49-60**. The point value of each question appears on the left.

Answer all of the questions inside your notebook.

Part א — Effect of pineapple extract on the protein gelatin

The protein gelatin is used in the food industry in desserts, because at temperatures lower than 10°C gelatin sets to a jellylike texture. At low temperatures, the protein chains cross-link to form a lattice, as shown in Figure 1, and the protein sets to a gel.

Figure 1: Effect of temperature on gelation [קרישה] of a gelatin solution



Preparing pineapple extract

א. Use a pen for marking glass to write 'מיצוי אננס' (pineapple extract) on a test-tube.

ב. On your table you have a mortar and pestle, a knife, a spoon, and a disposable plate with a piece of pineapple on it.
Chop the pineapple into small pieces, and use the spoon to transfer the pineapple pieces and liquid from the plate to the mortar.

ג. You have been given a container with distilled water.
Write 'מים' on a 10 ml pipette. Use the pipette to transfer 5 ml of water to the mortar.
— Crush the pineapple pieces with the pestle.
— Add another 5 ml of water to the mortar, and continue crushing until you have a pulp.

ד. On your table you have a funnel and a piece of gauze. Place the funnel over the מיצוי אננס test-tube, and line the funnel with the gauze.

/continued on page 3/

ה. Use a spoon to transfer the pineapple pulp and liquid into the funnel that is resting on top of the test-tube.

— Add 5 ml of water to the mortar. Use the pestle to mix the remaining pulp with the water, and transfer everything to the funnel.

— Gather up the gauze edges, and squeeze gently to filter out the remaining liquid into the test-tube.

— Throw the gauze into the waste container.

Testing gelatin gelation

ו. You have been given two disposable cups, one inside the other.
Write on the outer cup: 'אמבט ו'.

— Ask the proctor for some hot water, and prepare in the inside cup a water bath with a temperature in the range of 37°C-40°C.
Make sure the water level is at the marked line.

ז. Mark three test-tubes with the letters A, B, C.

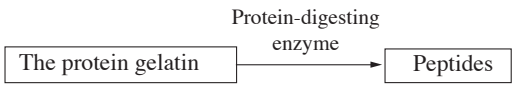
ח. You have been given a container with gelatin solution and a 10 ml pipette. Write 'ג'לטין' on the pipette.

ט. Use the ג'לטין pipette to add 2 ml of the gelatin solution to each of the three test-tubes, A-C.
Note: Withdraw the gelatin solution slowly so that you do not create air bubbles.
Note: If the gelatin solution in the container has set, tell the proctor.

י. You have been given three 1 ml pipettes. Write 'טריפסין' on one pipette, 'מיצוי אננס' on the second, and 'מים' on the third.

Informational note: Trypsin is an enzyme that catalyzes the digestion of various proteins, including the protein gelatin, into small chains called peptides. Peptides do not set at temperatures lower than 10°C.

Figure 2: Enzyme digestion of gelatin into peptides



יא. You have been given a test-tube with the enzyme trypsin. Use the pipette labeled טריפסין to transfer 1 ml of the trypsin solution to Test-Tube A.

— Use the מיצוי אננס pipette to transfer 1 ml of the pineapple extract you prepared to Test-Tube B.

— Use the מים pipette to transfer 1 ml of water to Test-Tube C.

— Mix the contents of each test-tube by shaking it gently.

/continued on page 4/

יב. Make sure that the temperature in the bath labeled אמבט 1 which you prepared in Item ו is in the range of 37°C-40°C, and adjust if necessary.
— Place the three test-tubes A-C in the bath labeled אמבט 1.
— Record the time _____, and wait 5 minutes.
— While you are waiting, follow the instructions in Item יג.

יג. On your table you have a container with cold water labeled אמבט 2. Ask the proctor for 5 ice cubes, and put them in this bath.
Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some water from the bath into the waste container until the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.

יד. When 5 minutes have passed since the time you recorded in Item יב, transfer all three test-tubes A-C into the bath אמבט 2.
— Record the time _____, and wait 8 minutes.
While you are waiting answer Question **49.א.**

(5 points) **49. א.** **In your notebook,** draw a Table 1 for the experiment you performed. Start with Item ט. In the table, include a column for recording results.

טו. 8 minutes from the time you wrote down in Item יד, take Test-Tube C out of אמבט 2, and tilt it carefully to see if the solution has set.
(i) If the solution in Test-Tube C has not set, return the test-tube to אמבט 2 and wait a further 5 minutes.
After waiting, check whether the solution in Test-Tube C has set, and follow the instructions in Sub-Item (ii).
— If the solution has not set, ask the proctor for help.
(ii) If the solution in Test-Tube C has set, put Test-Tube C in the rack, and take Test-Tubes A and B out of אמבט 2 and place them in the rack.

Answer questions **49.ב - 50**.

(4 points) **49. ב.** In the results column of Table 1 in **your notebook**, record whether the solution in the test-tubes "set" or "did not set".
— Give the results column a title.

(3 points) **50. א.** Explain why it was important to keep Test-Tubes A-C in אמבט 1.

(6 points) **ב.** Explain the results you obtained in the three test-tubes A-C. In your explanation, use the Informational Note on page 3, and Figures 1 and 2.

טז. Transfer only the three test-tubes A-C to the waste container.

/continued on page 5/

Part ב — The experiment: Activity of a pineapple-extract enzyme

Preparing diluted pineapple extract

יז. You will now dilute the pineapple extract that you prepared in Part א, as follows:

— Write 'מיצוי אננס מהול' on a test-tube.

— Use the 'מיצוי אננס' pipette to transfer 2 ml of the pineapple extract solution that you prepared in Part א to the test-tube.

— Use the מים pipette to transfer 8 ml of distilled water to the test-tube.

— Gently shake the test-tube to mix its contents.

Answer Question **51**.

(5 points) **51.** Calculate the concentration of diluted pineapple extract which you prepared.

Note: The concentration of pineapple extract that you prepared in Item ה will count as 100%.

Preparing pineapple-extract solutions with different pH levels

יח. Label five test-tubes with the numbers 1-5.

יט. You have been given three dropper bottles with:

- hydrochloric acid ($HC\ell$)
- sodium hydroxide (NaOH) solution
- distilled water

Transfer drops of hydrochloric acid, sodium hydroxide, and distilled water to each of the test-tubes 1-5, according to Table 2, below:

Table 2

Test-tube	Volume of hydrochloric acid (drops)	Volume of sodium hydroxide (drops)	Volume of water (drops)
1	0	0	10
2	2	0	8
3	0	2	8
4	0	10	0
5	0	0	10

/continued on page 6/

כ. Write 'מיצוי אננס מהול' on a 1 ml pipette.

כא. Use the 'מיצוי אננס מהול' pipette and the 'מים' pipette to transfer diluted pineapple extract and water to each of the test-tubes 1-5, as listed in Table 3, columns א and ב.

Table 3

	א	ב	ג	ד	ה	ו
Test-tube	Volume of diluted pineapple extract (ml)	Volume of water (ml)	Volume of gelatin solution (ml)	pH	Results: Degree of gelation at a temperature lower than 10°C (set/partially set/did not set)	Results: Volume of peptide solution (product of gelatin digestion) (ml)
1	0	1				
2	1	0				
3	1	0				
4	1	0				
5	1	0				

כב. Use the pipette labeled ג'לטין to transfer 2 ml of gelatin solution to each of the test-tubes 1-5.
— Gently shake each test-tube to mix its contents.

כג. Make sure that the temperature in the bath אמבט 1 is in the range of 37°C-40°C.
— Place the test-tubes 1-5 in the bath labeled אמבט 1.
— Record the time _____, and wait 5 minutes.
While you are waiting follow the instructions in Item כד-כה.

כד. You have been given tweezers and pH indicator sticks. Use the tweezers to handle the pH indicator sticks, and measure the pH in each of the test-tubes 1-5. Record the pH levels in the correct places in Table 3 in your **exam booklet**.

כה. Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some of the water in the bath into the waste container so that the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.
— 5 minutes after the time you recorded in Item כג, transfer the test-tubes 1-5 to the bath אמבט 2.
— Record the time _____, and wait 8 minutes.
While you are waiting, answer Question **52.א.**

(11 points) **52. א.** Copy Table 3 to **your notebook**.
— Fill in the missing information in Column ג.

/continued on page 7/

כו. 8 minutes after the time you recorded in Item כה, take Test-Tube 1 out of the bath אמבט 2 and tilt it carefully so that you can see if the solution has set.

(i) If the solution in Test-Tube 1 has not set, return the test-tube to אמבט 2 and wait a further 5 minutes.
After waiting, check whether the solution in Test-Tube 1 has set, and follow the instructions in Sub-Item (ii).

(ii) If the solution in Test-Tube 1 has set, record the degree of gelation in Table 3 Column ה in **your notebook**, and return the test-tube to the bath אמבט 2.
— Repeat this procedure with the four test-tubes 2-5, and return them to the bath אמבט 2.

Checking the degree of gelatin digestion into peptides

Read Items כז-כט carefully before you follow the instructions.

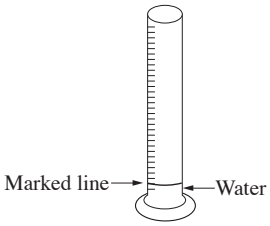
In each of the test-tubes 1-5 you will measure the amount of liquid that did not set.

Note: This liquid is the product of digesting gelatin into peptides.

כז. Use the pipette labeled מים to fill your graduated cylinder up to the marked line (see Figure 3).

— Place a funnel on the graduated cylinder.

Figure 3: Graduated cylinder with marking



כח. Take Test-Tube 1 out of the bath labeled אמבט 2, and wipe the outside of the test-tube.

— Invert Test-Tube 1 over the funnel and shake it to pour the liquid that did not set (the peptide solution) into the graduated cylinder.

— Check the volume (in ml) of the liquid that was **added** to the graduated cylinder above the marked line.

— Record the result in the correct place in Table 3 in **your notebook**. If all the gelatin has set and no liquid was added to the graduated cylinder, record the result as 0.

— Empty the liquid in the graduated cylinder into the waste container.

/continued on page 8/

כט. Repeat the procedure in Items כז and כח with the four test-tubes 2-5, and record each result in Table 3 in **your notebook**. Note: The differences between the volumes of liquid that were added to the graduated cylinder may be small.

Answer Questions **52.ב-56**.

(4 points) **52** **ב.** Give a title to Table 3 in your notebook.

(5 points) **53.** What is the independent variable in the experiment you conducted?

(5 points) **54.** **א.** What is the dependent variable in the experiment you conducted? Of the four answers, I-IV, shown below, copy the correct one to your notebook.

I. degree of gelation of the gelatin solution
II. volume of gelatin solution
III. concentration of pineapple extract
IV. activity level of the protein-digesting enzyme

(6 points) **ב.** How was the dependent variable measured?
— Explain how this measuring method is suited to measuring the dependent variable.

(5 points) **55.** **א.** In the experiment you conducted, the concentration of the pineapple extract in Test-Tubes 2-5 is constant. Explain why it was important to keep this specific factor constant in this experiment.

(3 points) **ב.** List one other factor that was kept constant in this experiment.

(6 points) **56.** What conclusion can you draw from the results you obtained in Test-Tubes 2-5?

/continued on page 9/

Part ג — Analysis of experimental results: Pest-control in crops using the fungus Beauveria bassiana

Certain insects can damage crops. Increasing awareness of the need to protect the environment and human health has led scientists to search for environmentally-friendly ways to control pests. One such method uses the fungus B. bassiana.

This fungus produces protein-digesting enzymes that break down the insects' hard shell, which is composed of polysaccharides [רב־סוכר] and protein.

By enzymatically breaking down insects' shells, the fungus is able to penetrate their body and then secrete toxins that kill the insects.

Experiment 1

Researchers exposed two groups of insects to a liquid that contained cells of one of two strains of fungus. Each group of insects was exposed to a different strain of fungus. The researchers checked insect mortality rate in both groups for 18 days.

The results of this experiment are shown in Table 4, below.

Table 4

Time from exposure (days)	Insect mortality rate (%)	
	Fungus Strain א	Fungus Strain ב
4	15	30
8	35	60
12	45	90
16	60	97
18	62	97

Answer Questions **57-58**.

(3 points) **57. א.** Present in graphical form the experimental results shown in Table 4. What type of graphical representation is best suited to describing the results, a continuous graph or a column diagram? Explain your answer.

(7 points) **ב.** You have been given graph paper in the attachment. Use it to draw a suitable graphical representation of the results shown in Table 4.

(Note: Questions 58-60 are on the next page.)

/continued on page 10/

(6 points) **58.** **א.** Describe the results represented in the graph.

(5 points) **ב.** In a control group (not shown in Table 4), the researchers checked the mortality rate of insects that were maintained under the same conditions but were not exposed to Strain א or Strain ב fungi. Explain the importance of this control group.

The researchers wanted to discover the reason for the differences in insect mortality rate in Experiment 1 (Table 4). To do so, they conducted Experiment 2.

Experiment 2

Researchers cultured each of the two fungus strains, separately, on culture mediums that contained gelatin. They measured the level of gelatin digestion in the presence of each of the fungus strains.

In Experiment 2, they found that gelatin digestion in the presence of Strain ב was greater than the degree of digestion in the presence of Strain א.

Answer Questions **59-60.**

(6 points) **59.** Based on the introduction to Part ג and the findings of Experiment 2, explain the results of Experiment 1.

(5 points) **60.** The pineapple enzymes that digest protein are enclosed in organelles, and are not loose in the cytoplasm.
Based on the experiment you conducted in Part א and the results of the study you read about in Part ג, explain how keeping these enzymes inside organelles benefits the pineapple cells.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return the exam booklet, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck! **בהצלחה!**

State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2018
Exam number: 43386
Attachment: Graph paper (for Question 69)
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשע"ח, 2018
מספר השאלון: 43386
נספח: נייר מילימטרי (לשאלה 69)
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 6

בעיה 6

רשום את מספר תעודת הזהות שלך כאן:
Write your ID number here:

Instructions for examinees:

א. Duration of the exam: Three hours

ב. Material that may be used during the exam:
(1) Calculator
(2) Hebrew-foreign language / foreign language-Hebrew dictionary

ג. Special instructions:
(1) Read the instructions carefully, and think carefully before each step.
(2) Write all of your observations and answers in pen (including sketches).
(3) Base your answers on your observations and on the results that you obtained, even if they were not as expected.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. חומר עזר מותר בשימוש:
(1) מחשבון
(2) מילון עברי-לועזי / לועזי-עברי

ג. הוראות מיוחדות:
(1) קרא את הנחיות ביסודיות, ושקול היטב את צעדיך.
(2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטוטים).
(3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 6

In this problem, you will examine the activity of enzymes that digest proteins.

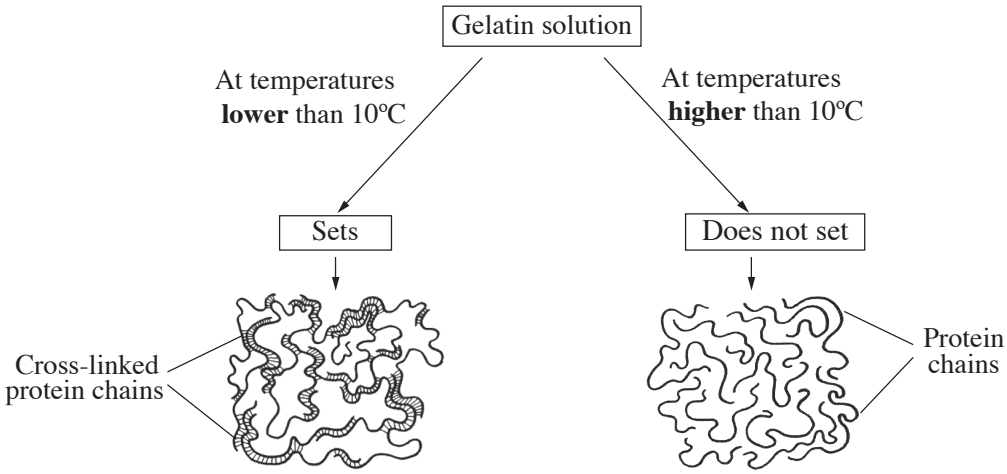
The questions in this exam are numbered **61-72**. The point value of each question appears on the left.

Answer all of the questions inside your notebook.

Part א — Effect of pineapple extract on the protein gelatin

The protein gelatin is used in the food industry in desserts, because at temperatures lower than 10°C gelatin sets to a jellylike texture. At low temperatures, the protein chains cross-link to form a lattice, as shown in Figure 1, and the protein sets to a gel.

Figure 1: Effect of temperature on gelation [קרישה] of a gelatin solution



Preparing pineapple extract

א. Use a pen for marking glass to write 'מיצוי אננס' (pineapple extract) on a test-tube.

ב. On your table you have a mortar and pestle, a knife, a spoon, and a disposable plate with a piece of pineapple on it.
Chop the pineapple into small pieces, and use the spoon to transfer the pineapple pieces and liquid from the plate to the mortar.

ג. You have been given a container with distilled water.
Write 'מים' on a 10 ml pipette. Use the pipette to transfer 5 ml of water to the mortar.
— Crush the pineapple pieces with the pestle.
— Add another 5 ml of water to the mortar, and continue crushing until you have a pulp.

ד. On your table you have a funnel and a piece of gauze. Place the funnel over the מיצוי אננס test-tube, and line the funnel with the gauze.

/continued on page 3/

ה. Use a spoon to transfer the pineapple pulp and liquid into the funnel that is resting on top of the test-tube.

— Add 5 ml of water to the mortar. Use the pestle to mix the remaining pulp with the water, and transfer everything to the funnel.

— Gather up the gauze edges, and squeeze gently to filter out the remaining liquid into the test-tube.

— Discard the gauze in the waste container.

Testing gelatin gelation

ו. You have been given two disposable cups, one inside the other.
Write on the outer cup: 'אמבט ו'.

— Ask the proctor for some hot water, and prepare in the inside cup a water bath with a temperature in the range of 37°C-40°C.
Make sure the bath water level is at the marked line.

ז. Mark three test-tubes with the letters A, B, C.

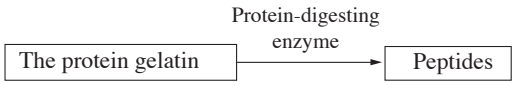
ח. You have been given a container with gelatin solution and a 10 ml pipette. Write 'ג'לטין' on the pipette.

ט. Use the ג'לטין pipette to transfer 2 ml of the gelatin solution to each of the three test-tubes, A-C.
Note: Withdraw the gelatin solution slowly so that you do not create air bubbles.
Note: If the gelatin solution in the container has set, tell the proctor.

י. You have been given three 1 ml pipettes. Write 'טריפסין' on one pipette, 'מיצוי אננס' on the second, and 'מים' on the third.

Informational note 1: Trypsin is an enzyme that catalyzes the digestion of various proteins, including the protein gelatin, into short chains called peptides. Peptides do not set at temperatures lower than 10°C.

Figure 2: Enzyme digestion of gelatin into peptides



יא. You have been given a test-tube with the enzyme trypsin. Use the pipette labeled טריפסין to transfer 1 ml of the trypsin solution to Test-Tube A.

— Use the מיצוי אננס pipette to transfer 1 ml of the pineapple extract you prepared to Test-Tube B.

— Use the מים pipette to transfer 1 ml of water to Test-Tube C.

— Mix the contents of each test-tube by shaking it gently.

/continued on page 4/

יב. Make sure that the temperature in the bath labeled אמבט 1 which you prepared in Item ו is in the range of 37°C-40°C, and adjust if necessary.
— Place the three test-tubes A-C in the bath labeled אמבט 1.
— Record the time _____, and wait 5 minutes.
— While you are waiting, follow the instructions in Item יג.

יג. On your table you have a container with cold water labeled אמבט 2. Ask the proctor for 5 ice cubes, and put them in this bath.
Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some water from the bath into the waste container until the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.

יד. When 5 minutes have passed since the time you recorded in Item יב, transfer all three test-tubes A-C into the bath אמבט 2.
— Record the time _____, and wait 8 minutes.
While you are waiting, answer Question **61.א.**

(5 points) **61. א.** **In your notebook,** draw a Table 1 for the experiment you performed. Start with Item ט. In the table, include a column for recording results.

טו. 8 minutes from the time you wrote down in Item יד, take Test-Tube C out of אמבט 2, and tilt it carefully to see if the solution has set.
(i) If the solution in Test-Tube C has not set, return the test-tube to אמבט 2 and wait a further 5 minutes.
After waiting, check whether the solution in Test-Tube C has set, and follow the instructions in Sub-Item (ii).
— If the solution has not set, ask the proctor for help.
(ii) If the solution in Test-Tube C has set, put Test-Tube C in the rack, and take Test-Tubes A and B out of אמבט 2 and place them in the rack.

Answer questions **61.ב - 62**.

(4 points) **61. ב.** In the results column of Table 1 in **your notebook**, record whether the solution in the test-tubes "set" or "did not set".
— Give the results column a title.

(3 points) **62. א.** Explain why it was important to keep Test-Tubes A-C in אמבט 1.

(6 points) **ב.** Explain the results you obtained in the three test-tubes A-C. In your explanation, use Informational Note 1, Figure 1, and Figure 2.

טז. Transfer only the three test-tubes A-C to the waste container.

/continued on page 5/

Part ב — The experiment: Inhibiting activity of a pineapple-extract enzyme

Preparing solutions of copper sulfate with different concentrations

Informational note 2: Copper sulfate inhibits the activity of the protein-digesting enzyme.

יז. Mark two test-tubes with the letters a, b.

יח. You have been given a container with distilled water, a container with a 2% solution of copper sulfate, and a 10 ml מים pipette.

— Write 'נחושת גפרתית 2%' on a 1 ml pipette and 'נחושת גפרתית מהולה' on another 1 ml pipette.

— Use the נחושת גפרתית 2% and מים pipettes to transfer copper sulfate solution and water to Test-Tube a, according to Table 2.

— Gently shake the test-tube to mix its contents.

— Use the נחושת גפרתית מהולה and מים pipettes to transfer diluted copper sulfate solution and water **from Test-Tube a** to Test-Tube b, according to Table 2.

Table 2

Test-Tube	**Volume of copper sulfate solution**	**Volume of water** (ml)	**Concentration of copper sulfate solution**
a	1 ml of 2% copper sulfate solution	9	
b	1 ml of copper sulfate solution **from Test-Tube a**	9	

Answer Question **63**.

(6 points) **63.** Calculate the concentration of copper sulfate obtained in Test-Tubes a and b. Write the result of your calculation in Table 2 in the **exam booklet**.

יט. Mark 5 test-tubes with the numbers 1-5.

כ. Use the מיצוי אננס pipette to transfer 1 ml of the pineapple extract that you prepared in Part א to each of the test-tubes 1-4.

— Use the מים pipette to add 1 ml of distilled water to Test-Tube 5.

/continued on page 6/

כא. **Read each instruction carefully before you perform it.**

Note: Following the instructions below, you will transfer either a certain concentration of copper sulfate or water to each of the test-tubes 1-5. Use a clean Pasteur pipette for each transfer, and place each used pipette in the waste container.

You have been given four Pasteur pipettes.

— Use a Pasteur pipette to transfer 2 drops from the container marked 2% נחושת גפרתית to Test-Tube **1**.

— Transfer 2 drops of copper sulfate solution from Test-Tube a to Test-Tube **2**.

— Transfer 2 drops of copper sulfate solution from Test-Tube b to Test-Tube **3**.

— Transfer 2 drops of distilled water to each of the test-tubes **4** and **5**.

— Mix the contents of each test-tube by shaking it gently.

כב. Use the ג'לטין pipette to transfer 2 ml of the gelatin solution to each of the five test-tubes 1-5.

— Gently shake the test-tubes to mix their contents.

כג. Make sure that the temperature in the bath אמבט 1 is in the range of 37°C-40°C.

— Place the test-tubes 1-5 in the bath labeled אמבט 1.

— Record the time _____, and wait 5 minutes.

— While you are waiting, follow the instructions in Item כד.

כד. Make sure that the temperature in the bath אמבט 2 is lower than 10°C. If the temperature is higher than 10°C, pour out some of the water in the bath into the waste container until the water level is at the marked line. Ask the proctor for more ice cubes and add them to the bath.

— 5 minutes after the time you recorded in Item כג, transfer the test-tubes 1-5 to the bath אמבט 2.

— Record the time _____, and wait 8 minutes.
While you are waiting, answer Question **64.א**.

/continued on page 7/

(10 points) **64.** **א.** Copy Table 3 to **your notebook**.

(1) Copy the concentrations you calculated in Question **63** (Table 2 in the exam booklet) to the correct places in Table 3, Column א, in **your notebook**.

(2) Fill in the missing information in Column ד.

Table 3

	א	ב	ג	ד	ה	ו
Test-tube	Initial concentration of copper sulfate solution	Volume of pineapple extract (ml)	Water volume (ml)	Volume of gelatin solution (ml)	Results: Degree of gelation at temperature lower than 10°C (set/partly set/not set)	Results: Volume of peptide solution (product of gelatin digestion) (ml)
1	2	1	0			
2		1	0			
3		1	0			
4	0	1	0			
5	0	0	1			

כה. 8 minutes after the time you recorded in Item כד, take Test-Tube 5 out of the bath 2 אמבט and tilt it carefully so that you can see whether the solution has set.

(i) If the solution in Test-Tube 5 has not set, return the test-tube to 2 אמבט and wait a further 5 minutes.

After waiting, check whether the solution in Test-Tube 5 has set, and follow the instructions in Sub-Item (ii).

(ii) If the solution in Test-Tube 5 has set, record the degree of gelation in Table 3, Column ה, in **your notebook**, and return the test-tube to the bath 2 אמבט.

— Repeat this procedure with the four test-tubes 1-4, and return them to the bath 2 אמבט.

/continued on page 8/

Checking the degree of gelatin digestion into peptides

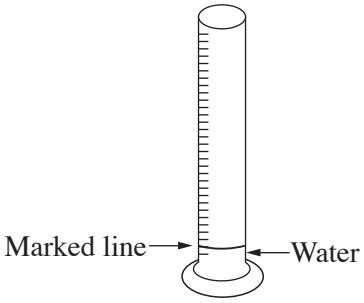
Read Items כו-כח carefully before you follow the instructions.

In each of the test-tubes 1-5 you will measure the amount of liquid that did not set.

Note: This liquid is the product of digesting gelatin into peptides.

כו. Use the מים pipette to fill your graduated cylinder up to the marked line (see Figure 3).
— Place a funnel on the graduated cylinder.

Figure 3: Graduated cylinder with marking



כז. Take Test-Tube 1 out of the bath labeled אמבט 2, and wipe the outside of the test-tube.
— Invert Test-Tube 1 over the funnel and shake it to pour the liquid that did not set (the peptide solution) into the graduated cylinder.
— Check the volume (in ml) of the liquid that was **added** to the graduated cylinder above the marked line.
— Record the result in the correct place in Table 3 in **your notebook**. If all the gelatin has set and no liquid was added to the graduated cylinder, record the result as 0.
— Empty the liquid in the graduated cylinder into the waste container.

כח. Repeat the procedure in Items כו and כז with the four test-tubes 2-5, and record the results in Table 3 in **your notebook**. Note: The differences between the volumes of liquid that were added to the graduated cylinder may be small.

Answer Questions **64.ב-68**.

(4 points) **64** **ב.** Give a title to Table 3 in your notebook.

(5 points) **65.** What is the independent variable in the experiment you conducted?

/continued on page 9/

(5 points) **66.** **א.** What is the dependent variable in the experiment you conducted? Of the four answers, I-IV, shown below, copy the correct one to your notebook.

I. degree of gelation of the gelatin solution
II. concentration of pineapple extract
III. activity level of the protein-digesting enzyme
IV. volume of gelatin solution

(6 points) **ב.** How was the dependent variable measured?

— Explain how this measuring method is suited to measuring the dependent variable.

(5 points) **67.** **א.** In the experiment you conducted, the concentration of the gelatin solution in Test-Tubes 1-4 is constant. Explain why it was important to keep this specific factor constant in this experiment.

(3 points) **ב.** List one other factor that was kept constant in this experiment.

(6 points) **68.** What conclusion can you draw from the results obtained in Test-Tubes 1-4?

/continued on page 10/

Part ג — Analysis of experimental results: Pest-control in crops using the fungus Beauveria bassiana

Certain insects can damage crops. Increasing awareness of the need to protect the environment and human health has led scientists to search for environmentally-friendly ways to control pests. One such method uses the fungus B. bassiana.

This fungus produces protein-digesting enzymes that break down the insects' hard shell, which is composed of polysaccharides [רַב־סוכר] and protein.

By enzymatically breaking down insects' shells, the fungus is able to penetrate their body and then secrete toxins that kill the insects.

Experiment 1

Researchers exposed two groups of insects to a liquid that contained cells of one of two strains of fungus. Each group of insects was exposed to a different strain of fungus. The researchers checked insect mortality rate in both groups for 18 days.

The results of this experiment are shown in Table 4, below.

Table 4

Time from exposure (days)	Insect mortality rate (%)	
	Fungus Strain א	Fungus Strain ב
4	15	30
8	35	60
12	45	90
16	60	97
18	62	97

Answer Questions **69-70**.

(3 points) **69. א.** Present in graphical form the experimental results shown in Table 4. What type of graphical representation is best suited to describing the results, a continuous graph or a column diagram? Explain your answer.

(7 points) **ב.** You have been given graph paper in the attachment. Use it to draw a suitable graphical representation of the results shown in Table 4.

(Note: Questions 70-72 are on the next page.)

/continued on page 11/

(6 points) **70.** **א.** Describe the results represented in the graph.

(5 points) **ב.** In a control group (not shown in Table 4), the researchers checked the mortality rate of insects that were maintained under the same conditions but were not exposed to Strain א or Strain ב fungi. Explain the importance of this control group.

The researchers wanted to discover the reason for the differences in insect mortality rate in Experiment 1 (Table 4). To do so, they conducted Experiment 2.

Experiment 2

Researchers cultured each of the two fungus strains, separately, on culture mediums that contained gelatin. They measured the level of gelatin digestion in the presence of each of the fungus strains. In Experiment 2, they found that gelatin digestion in the presence of Strain ב was greater than the degree of digestion in the presence of Strain א.

Answer Questions **71-72.**

(6 points) **71.** Based on the introduction to Part ג and the findings of Experiment 2, explain the results of Experiment 1.

(5 points) **72.** The pineapple enzymes that digest protein are enclosed in organelles, and are not loose in the cytoplasm.
Based on the experiment you conducted in Part א and the results of the study you read about in Part ג, explain how keeping these enzymes inside organelles benefits the pineapple cells.

Place an examinee sticker and an exam sticker on the attachment that contains the graphical representation.

Return the exam booklet, the notebook, and the attachment that contains the graphical representation to the proctor.

Good Luck!

בהצלחה!