

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachment: Graph paper (for Question 9)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספח: נייר מילימטרי (לשאלה 9)

תרגום לאנגלית (3)

Practical Exam in Biology

Reform for Meaningful Learning
Program

בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 1

בעיה 1

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

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Instructions for examinees:

הוראות לנבחן:

א. Duration of the exam: Three hours

א. משך הבחינה: שלוש שעות.

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

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

ג. Special instructions:

ג. הוראות מיוחדות:

- (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 were not as expected.

- (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 1

In this problem, you will examine the fermentation of immobilized yeast.

In this questionnaire, the questions are numbered **1-12**. The point value of each question appears on the left.

Answer all of the questions in the notebook.

Part א — Method for Measuring the Fermentation Rate of Immobilized Yeast

In the experiment that you will perform, you will use yeast immobilized in agar. Agar is a semi-solid (jelly-like) material that allows substances to pass through it. Yeast was added to the agar during its preparation, and after the agar congealed, yeast immobilized in agar was obtained.

The manner in which the immobilized yeast is prepared does not impair the life processes of the yeast cells.

On your table, there is a large Petri dish labeled A and a small Petri dish labeled B. Both dishes contain yeast immobilized in agar. The contents of the dishes differ in the way the immobilized yeast was prepared:

In Dish A, yeast cells that did not undergo any preliminary treatment were added to the agar solution.

In Dish B, yeast cells that were boiled for a long time were added to the agar solution.

You are given a container of sucrose solution, a container labeled "אמבט מים", a thermometer, and two test tubes.

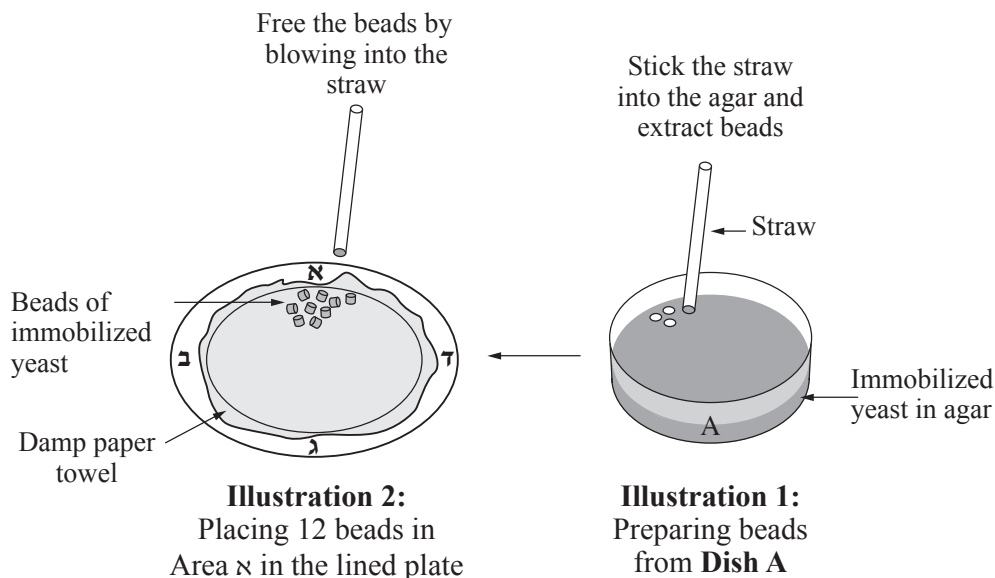
- א. Using a pen for writing on glass, label the upper part of the two test tubes A and B.
- ב. Write "סוכרוז" on a 10 ml pipette.
- ג. Transfer 8 ml of sucrose solution from the container to each of the two test tubes A and B.
- ד. Ask the proctor for hot water and prepare a hot water bath at a temperature in the range 40°C - 45°C .
 - Make sure that the height of the water in the bath is up to the line marked on the bath.
 - Place the two test tubes in the bath.

Read the instructions in Item ה carefully to the end before performing them.

ה. Preparation of beads of yeast immobilized in agar

You are given a drinking straw and a plate lined with a damp paper towel.

- Write the letters א, ב, ג and ד along the upper edge of the plate at equal distances from each other, as shown in Illustration 2 below.



You will use the drinking straw to extract beads of yeast immobilized in agar from Dish A. Do this in the following way:

- Stick the straw into the agar, turn the straw a half-rotation, tilt it sideways a little and remove the straw from the agar (see Illustration 1).
Note: The straw now contains a bead of immobilized yeast.
- Repeat this action two more times, so that there are 3 beads in the straw.

Note: Each time, stick the straw close to the location of the previous time, as shown in Illustration 1.

- Blow into the straw above the lined plate in Area א (next to the letter א) in order to free the beads (see Illustration 2).
- Repeat these actions until Area א in the lined plate contains a total of 12 beads from Dish A.
- Place a lid on Dish A.
- Repeat these actions: Remove 12 beads from Dish B too, and transfer them to Area ב in the lined plate.

- ג. Remove Test Tube A from the bath. Use a small spoon to transfer 10 yeast beads from Area א to the test tube (you may touch the beads gently, if necessary).

Note:

 - If an agar bead falls outside the test tube, insert another bead from the same area of the plate in its place.
 - If one of the beads sticks to the upper part of the test tube, push it gently with the straw towards the liquid, but take care that the straw does not come into contact with the liquid.
 - If some beads do not sink to the bottom of the test tube, call the proctor.

— **Cap** the test tube and return it to the bath.
- ד. Repeat the procedure described in Item ג, using Test Tube B and beads from Area ב.
 - Make sure that the temperature in the bath remains in the range 40°C - 45°C throughout the experiment.
 - Write down the time _____ and wait 7 minutes. While you are waiting, keep track of the number of beads that are floating in the liquid in the test tubes, and note whether bubbles or foam form in the test tubes.
 - Copy the **Hebrew** version of sentences i and ii, below, into your notebook:
 - i Number of beads that floated in Test Tube A: _____,
Bubble or foam formation (+/-): _____.
 - ii Number of beads that floated in Test Tube B: _____,
Bubble or foam formation (+/-): _____.
- ה. After 7 minutes have passed since the time you recorded in Item ד, remove the test tubes from the bath, place them in the test tube rack, and answer Questions 1-2.

Note: If, after 7 minutes, no beads are floating in any of the test tubes, wait an additional 5 minutes.

- (6 points) 1. In your **notebook**, complete sentences i and ii.
If there are beads that rise from the bottom of the test tube, but do not reach the surface of the liquid, record them as floating.

Informative Note: The release of gas bubbles is what causes the beads of immobilized yeast to float and foam to accumulate.

- (4 points) **2.** Use the Informative Note above to explain the results of your measurements. In your answer, refer to the floating of beads at the end of the experiment and to the formation of gas bubbles or foam in the test tubes.
- ו. Remove the caps from Test Tubes A and B and put the test tubes in the trash.
 — Also put Dish B and the beads remaining in the lined plate into the trash.

Part ב — Examination of the Fermentation Rate of Immobilized Yeast

- י. Label four test tubes 1, 2, 3 and 4, on the upper part of each test tube.
 — Label a 10 ml pipette "מים".
- יא. You are given a container of distilled water.
 Use the pipettes "סוכרוז" and "מים" to add sucrose solution and distilled water to each of the test tubes according to the volumes specified in Table 1 below.

Table 1

Test Tube	Sucrose Solution (ml)	Water (ml)
1	8	0
2	4	4
3	3	5
4	0	8

- Gently shake the test tubes 1-4.
- יב. Make sure that the temperature in the bath is in the range 40°C - 45°C.
 Make sure that the height of the water in the bath is up to the line marked on it.
 — Place Test Tubes 1-4 into the water bath that you prepared.

- יג. Using the procedure described for Item ה, prepare 12 more beads of immobilized yeast from Dish A and place them in Area א of the plate lined with a damp paper towel.
- Repeat the procedure and place 12 beads in each of the Areas ב-ד (total — 48 beads).
- יד. Remove Test Tube 1 from the bath. Use a small spoon to gently transfer 10 beads from the pile of beads in Area א into the test tube, and then return it to the water bath.
- Repeat these actions with Test Tubes 2-4 and with beads from Areas ב-ד, respectively.
 - **Cap** all the test tubes 1-4.
- טו. Write down the time _____ and wait 10 minutes. Make sure that the temperature in the bath remains in the range 40°C - 45°C throughout the experiment.
- While you are waiting, answer Question 3. א.
- (10 points) 3. א. In your notebook, make a table to summarize the experimental system (starting with Item י). Your table should **also** include two empty columns to be used for the results of the experiment.
- טז. After 10 minutes have passed since the time you recorded in Item טו, remove all the test tubes 1-4 from the bath and place them in the test tube rack.
- Count the number of floating beads in each of the test tubes, and record the results in the first empty column for results in the table in your notebook.
 - Rank the relative amount of foam that accumulated in each of the test tubes using the following symbols:
 - ++ A lot of foam
 - + A little foam
 - No foam
- Write the ranking in the other empty column for results in the table in your notebook.
- Remove the caps from Test Tubes 1-4.

Answer Questions 3. ב.-8.

- (5 points) 3. ב. Add a heading to each of the columns in the table.
- Add a heading to the table.

- (12 points) 4. Table 2 below contains a list of elements in the experiment that you performed. Copy the **Hebrew** version of Table 2 to **your notebook** and complete the missing information by adding the sign (+) in the appropriate places.

Table 2

Constant factor	The dependent variable	Method of measuring the dependent variable	Method of changing the independent variable	The independent variable	Element of the experiment
					Number of floating beads at the end of the experiment
					Rate of fermentation of immobilized yeast
					Sucrose concentration in Test Tubes 1-4
					Size of beads
					Preparation of dilutions of sucrose solution

- (6 points) 5. א. Explain why the method of measuring the dependent variable that you marked in Table 2 is appropriate for measuring the process you examined in the experiment.
- (4 points) ב. Several factors were held constant during the experiment. Choose one of them and explain why it was important to hold this factor constant during the experiment.
- (6 points) 6. Explain the results of the experiment that you performed.
- (6 points) 7. Test Tube 4 was a control test tube. Explain why it was important to include it in your experiment.

- (6 points) **8.** Researchers performed an experiment similar to that which you performed, but they also added 3 treatments in each of which the sucrose concentration was increased, and in all of them the sucrose concentration was higher than in your experiment.
 Their results: In all 3 treatments, all the beads were floating within 2 minutes. Explain why the same result was obtained in all 3 treatments.

Part 2 — Analysis of Experimental Results: Effect of Magnesium Ions on Yeast Fermentation

Research groups throughout the world are conducting experiments to find the optimal conditions for growing yeast to produce large quantities of ethanol, which is a product of yeast fermentation. Ethanol serves as a substitute for (fossil) fuel. Previous studies found that magnesium ions are essential for enzymatic processes. Researchers grew yeast in two containers with growth mediums that contained substances essential for the proliferation of yeast, including sucrose. The researchers examined the effect of adding magnesium ions to the yeast's growth medium on the concentration of ethanol produced over time. One container held a low concentration of magnesium ions and the other container held a high concentration of magnesium ions. The results of the experiment are shown in Table 3 below.

Table 3

Time from start of experiment (hours)	Concentration of ethanol produced (%)	
	<u>Low</u> concentration of magnesium ions	<u>High</u> concentration of magnesium ions
0	0	0
20	3	5
30	5	8
40	8	11
50	10	13

Answer Questions **9-12**.

- (10 points) **9.** Graph paper has been provided for you in the attachment. Present the experimental results from Table 3 on it in an appropriate graphical form.
- (6 points) **10. א.** Describe the results shown in the graph that you drew.
(7 points) **ב.** Explain the results of the researchers' experiment.
- (6 points) **11.** The growth medium in both containers contained sucrose. Use the results of the experiment you performed in Part ב to explain why sucrose is essential to the formation of ethanol.
- (6 points) **12.** In another experiment, the researchers found that increasing the concentration of magnesium ions increases the growth rate of the yeast. Explain how the results of the experiment that the researchers performed regarding the ethanol concentration (Table 3) help to explain this finding.

Place an examinee sticker and a questionnaire sticker on the attachment that contains the graphic representation.

Return this questionnaire, the notebook and the attachment that contains the graphic representation to the proctor.

Good Luck!

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בהצלחה!

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

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachment: Graph paper (for Question 21)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספח: נייר מילימטרי (לשאלה 21)

תרגום לאנגלית (3)

Practical Exam in Biology

Reform for Meaningful Learning
Program

בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 2

בעיה 2

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

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Instructions for examinees:

הוראות לנבחן:

א. Duration of the exam: Three hours

א. משך הבחינה: שלוש שעות.

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

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

ג. Special instructions:

ג. הוראות מיוחדות:

- (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 were not as expected.

- (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 fermentation of immobilized yeast.

In this questionnaire, the questions are numbered **13-24**. The point value of each question appears on the left.

Answer all of the questions in the notebook.

Part א — Method for Measuring the Fermentation Rate of Immobilized Yeast

In the experiment that you will perform, you will use yeast immobilized in agar. Agar is a semi-solid (jelly-like) material that allows substances to pass through it. Yeast was added to the agar during its preparation, and after the agar congealed, yeast immobilized in agar was obtained.

The manner in which the immobilized yeast is prepared does not impair the life processes of the yeast cells.

On your table, there is a large Petri dish labeled A and a small Petri dish labeled B. Both dishes contain yeast immobilized in agar. The contents of the dishes differ in the way the immobilized yeast was prepared:

In Dish A, yeast cells that did not undergo any preliminary treatment were added to the agar solution.

In Dish B, yeast cells that were boiled for a long time were added to the agar solution.

You are given a container of sucrose solution, a container labeled "אמבט מים", a thermometer, and two test tubes.

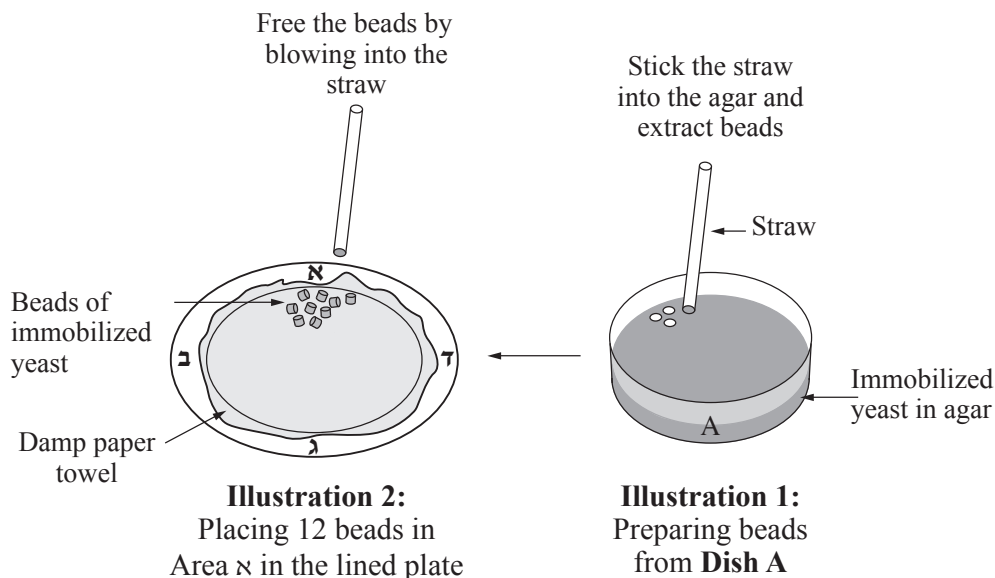
- א. Using a pen for writing on glass, label the upper part of the two test tubes A and B.
- ב. Write "סוכרוז" on a 10 ml pipette.
- ג. Transfer 8 ml of sucrose solution from the container to each of the two test tubes A and B.
- ד. Ask the proctor for hot water and prepare a hot water bath at a temperature in the range 40°C - 45°C.
 - Make sure that the height of the water in the bath is up to the line marked on the bath.
 - Place the two test tubes in the bath.

Read the instructions in Item ה carefully to the end before performing them.

ה. Preparation of beads of yeast immobilized in agar

You are given a drinking straw and a plate lined with a damp paper towel.

- Write the letters א, ב, ג and ד along the upper edge of the plate at equal distances from each other, as shown in Illustration 2 below.



You will use the drinking straw to extract beads of yeast immobilized in agar from Dish A. Do this in the following way:

- Stick the straw into the agar, turn the straw a half-rotation, tilt it sideways a little and remove the straw from the agar (see Illustration 1).
Note: The straw now contains a bead of immobilized yeast.
- Repeat this action two more times, so that there are 3 beads in the straw.

Note: Each time, stick the straw close to the location of the previous time, as shown in Illustration 1.

- Blow into the straw above the lined plate in Area א (next to the letter א) in order to free the beads (see Illustration 2).
- Repeat these actions until Area א in the lined plate contains a total of 12 beads from Dish A.
- Place a lid on Dish A.
- Repeat these actions: Remove 12 beads from Dish B too, and transfer them to Area ב in the lined plate.

- ג. Remove Test Tube A from the bath. Use a small spoon to transfer 10 yeast beads from Area א to the test tube (you may touch the beads gently, if necessary).

Note:

 - If an agar bead falls outside the test tube, insert another bead from the same area of the plate in its place.
 - If one of the beads sticks to the upper part of the test tube, push it gently with the straw towards the liquid, but take care that the straw does not come into contact with the liquid.
 - If some beads do not sink to the bottom of the test tube, call the proctor.

— **Cap** the test tube and return it to the bath.
- ד. Repeat the procedure described in Item ג, using Test Tube B and beads from Area ב.
 - Make sure that the temperature in the bath remains in the range 40°C - 45°C throughout the experiment.
 - Write down the time _____ and wait 7 minutes. While you are waiting, keep track of the number of beads that are floating in the liquid in the test tubes, and note whether bubbles or foam form in the test tubes.
 - Copy the **Hebrew** version of sentences i and ii, below, into your notebook:
 - i Number of beads that floated in Test Tube A: _____,
Bubble or foam formation (+/-): _____.
 - ii Number of beads that floated in Test Tube B: _____,
Bubble or foam formation (+/-): _____.
- ה. 7 minutes after the time you recorded in Item ד, remove the test tubes from the bath, place them in the test tube rack, and answer Questions **13-14**.

Note: If, after 7 minutes, no beads are floating in any of the test tubes, wait an additional 5 minutes.

- (6 points) **13.** In your **notebook**, complete sentences i and ii.
If there are beads that rise from the bottom of the test tube, but do not reach the surface of the liquid, record them as floating.

Informative Note 1: The release of gas bubbles is what causes the beads of immobilized yeast to float and foam to accumulate.

- (4 points) **14.** Use Informative Note 1 above to explain the results of your measurements. In your answer, refer to the floating of beads at the end of the experiment and to the formation of gas bubbles or foam in the test tubes.
- ט. Remove the caps from Test Tubes A and B and leave only Test Tube A in the test tube rack.
- Put Test Tube B, Dish B and the beads remaining in the lined plate into the trash.

Part ב — Examination of the Fermentation Rate of Immobilized Yeast

- י. Label four test tubes 1, 2, 3 and 4, on the upper part of each test tube.
- Label three 10 ml pipettes: label one "מלטוז", the second "לקטוז", and the third "מים".
- יא. You have three solutions of disaccharides [דו-סוכרים]: sucrose, maltose, and lactose.
- Using the corresponding pipettes, transfer 8 ml of a disaccharide solution or water to each of the test tubes 1-4, as specified in Table 1 below.

Table 1

Test Tube	Type of solution
1	Sucrose
2	Maltose
3	Lactose
4	Water

- יב. Make sure that the temperature in the bath is in the range 40°C - 45°C. Make sure that the height of the water in the bath is up to the line marked on the bath.
- Place Test Tubes 1-4 into the water bath that you prepared.

- יג. Using the procedure described for Item ה, prepare 12 more beads of immobilized yeast from Dish A and place them in Area א of the plate lined with a damp paper towel.
- Repeat the procedure and place 12 beads in each of Areas ב-ד (total — 48 beads).
- יד. Remove Test Tube 1 from the bath. Use a small spoon to gently transfer 10 beads from the pile of beads in Area א into the test tube, and then return it to the water bath.
- Repeat these actions with Test Tubes 2 to 4 and with beads from Areas ב to ד, respectively.
 - **Cap** all the test tubes 1-4.
- טו. Write down the time _____ and wait 20 minutes. Make sure that the temperature in the bath remains in the range of 40°C - 45°C throughout the entire experiment. While you are waiting, perform the instructions in Item טז.
- טז. Tracking the beads in the test tubes
During the experiment, track the number of beads that are floating 10 minutes, 15 minutes, and 20 minutes after the time you recorded in Item טו, and record the results in Table 2 **below**.
- During the first 10 minutes that you are waiting, answer Question **15. א**.

(5 points) **15. א.** In your notebook, make a table to summarize the experiment (starting with Item י) and its results.

Table 2

Test Tube	Number of beads floating after —			Bubble or foam formation after 20 minutes (+/-)
	10 minutes	15 minutes	20 minutes	
1				
2				
3				
4				

- Fill in the appropriate columns in Table 2 with the results you obtained 10 minutes and 15 minutes after the time you recorded in Item טו.

- יז. 20 minutes after the time you recorded in Item טו, remove all the test tubes 1-4 from the bath and place them in the test tube rack.
- Record in Table 2 all the results obtained: the number of beads that floated and whether or not bubbles or foam formed.
 - Remove the caps from Test Tubes 1-4.

Answer Questions **15.ג. - 18.**

- (10 points) **15.ג. (1)** Copy all the results you recorded in Table 2 to the table in your **notebook**.
- (2)** Add a heading to each of the columns in the table.
- Add a heading to the table.

- (12 points) **16.** Table 3 below lists elements of the experiment that you performed. Copy the **Hebrew** version of Table 3 to **your notebook** and complete the missing information by adding the sign (+) in the appropriate places.

Table 3

Constant factor	Method of measuring the dependent variable	Dependent variable	Independent variable	Element of the experiment
				Number of beads floating at the end of the experiment
				Different types of disaccharides
				Bead size
				Fermentation rate of immobilized yeast
				Bath temperature

- (6 points) **17. א.** Explain why the method for measuring the dependent variable that you marked in Table 3 was appropriate for measuring the process you examined in the experiment.
- (4 points) **א.** Several factors were kept constant during the experiment. Choose one of them and explain why it was important to keep this specific factor constant during the experiment.
- (6 points) **18.** Test Tube 4 was a control test tube. Explain why it was important to include it in your experiment.

Glucose Test

- יח. You have two glucose test strips. The color of the square on the strip changes from yellow to green in the presence of glucose. The darker the green color is, the higher the glucose concentration in the solution being checked.
Write "A" on one strip and "סוכרוז" on the other strip.
- יט. Dip Strip A in the liquid of Test Tube A in the test tube rack from Part א. Remove the strip and place it on the tray.
— Dip the "סוכרוז" strip in the sucrose solution that is on your table. Remove the strip and place it on the tray.

Informative Note 2:

- Disaccharides such as sucrose do not penetrate yeast cells.
- Yeast releases into the solution special enzymes that break down **some** of the disaccharides into monosaccharides. These monosaccharides do penetrate the yeast cells.

Answer Questions **19-20**.

- (1 point) **19. א.** Copy the Hebrew version of the two statements i and ii below to your notebook, and complete them in **your notebook** based on the colors obtained on the strips.
- i The liquid in Test Tube A
(contains/does not contain) _____ glucose.
- ii The sucrose solution
(contains/does not contain) _____ glucose.
- (5 points) **א.** Use Informative Note 2 to explain the results of the test for presence of glucose that you recorded in Item א.
- (6 points) **20.** Explain the results of the experiment you performed (in Items יח-יט). In your answer, refer also to your answers to Question 19.

Part 2 — Analysis of Experimental Results: Effect of Magnesium Ions on Yeast Fermentation

Research groups throughout the world are conducting experiments to find the optimal conditions for growing yeast to produce large quantities of ethanol, which is a product of yeast fermentation. Ethanol serves as a substitute for (fossil) fuel. Previous studies found that magnesium ions are essential for enzymatic processes. Researchers grew yeast in two containers with growth mediums that contained substances essential for the proliferation of yeast, including sucrose. The researchers examined the effect of adding magnesium ions to the yeast's growth medium on the concentration of ethanol produced over time. One container held a low concentration of magnesium ions and the other container held a high concentration of magnesium ions. The results of the experiment are shown in Table 4 below.

Table 4

Time from start of experiment (hours)	Concentration of ethanol produced (%)	
	<u>Low</u> concentration of magnesium ions	<u>High</u> concentration of magnesium ions
0	0	0
20	3	5
30	5	8
40	8	11
50	10	13

Answer Questions **21-24**.

- (10 points) **21.** Graph paper has been provided for you in the attachment. Present the experimental results from Table 4 on it in an appropriate graphical form.
- (6 points) **22. א.** Describe the results shown in the graph that you drew.
- (7 points) **ב.** Explain the results of the researchers' experiment.

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

- (6 points) **23.** The growth medium in both containers contained sucrose. Use the results of the experiment you performed in Part ב to explain why sucrose is essential to the formation of ethanol.
- (6 points) **24.** In another experiment, the researchers found that increasing the concentration of magnesium ions increases the growth rate of the yeast. Explain how the results of the experiment that the researchers performed regarding the ethanol concentration (Table 4) help to explain this finding.

Place an examinee sticker and a questionnaire sticker on the attachment that contains the graphic representation.

Return this questionnaire, the notebook and the attachment that contains the graphic representation to the proctor.

Good Luck!

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בְּהַצְלָחָה!

זכוֹת הַיוֹצְרִים שְׁמוּרָה לַמְדִּינָה יִשְׂרָאֵל.
אֵין לְהַעֲתִיק אוֹ לְפָרְסָם אֶלָּא בְּרִשּׁוֹת מִשְׁרַד הַחִינוּךְ.

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachment: Graph paper (for Question 33)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספח: נייר מילימטרי (לשאלה 33)

תרגום לאנגלית (3)

Practical Exam in Biology

Reform for Meaningful Learning
Program

בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 3

בעיה 3

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

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Instructions for examinees:

הוראות לנבחן:

א. Duration of the exam: Three hours

א. משך הבחינה: שלוש שעות.

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

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

ג. Special instructions:

ג. הוראות מיוחדות:

- (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 were not as expected.

- (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 fermentation of immobilized yeast.

In this questionnaire, the questions are numbered **25-36**. The point value of each question appears on the left.

Answer all of the questions in the notebook.

Part א — Method for Measuring the Fermentation Rate of Immobilized Yeast

In the experiment that you will perform, you will use yeast immobilized in agar. Agar is a semi-solid (jelly-like) material that allows substances to pass through it. Yeast was added to the agar during its preparation, and after the agar congealed, yeast immobilized in agar was obtained.

The manner in which the immobilized yeast is prepared does not impair the life processes of the yeast cells.

On your table, there is a large Petri dish labeled A and a small Petri dish labeled B. Both dishes contain yeast immobilized in agar. The contents of the dishes differ in the way the immobilized yeast was prepared:

In Dish A, yeast cells that did not undergo any preliminary treatment were added to the agar solution.

In Dish B, yeast cells that were boiled for a long time were added to the agar solution.

You are given a container of sucrose solution, a container labeled "אמבט I", a thermometer, and two test tubes.

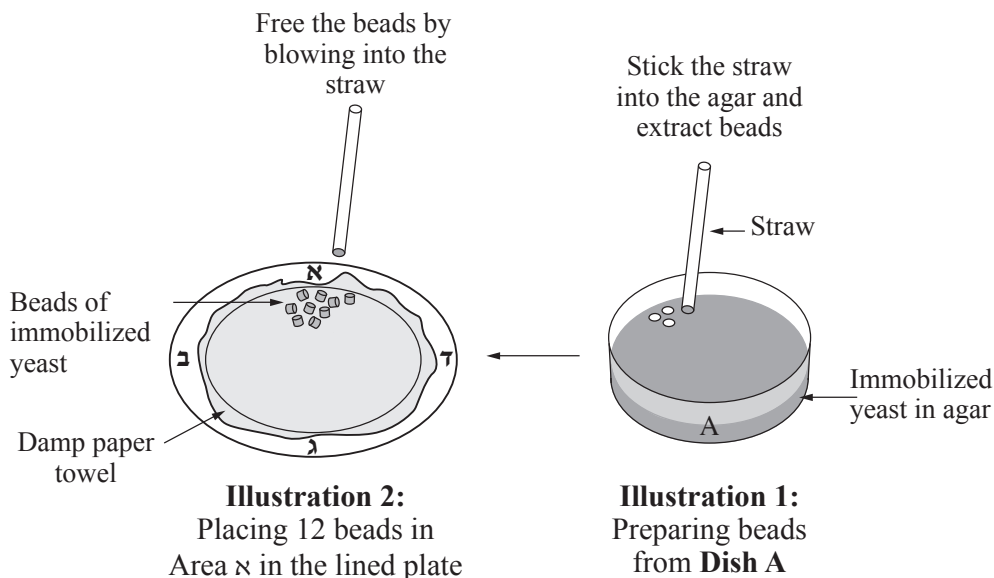
- א. Using a pen for writing on glass, label the upper part of the two test tubes A and B.
- ב. Write "סוכרוז" on a 10 ml pipette.
- ג. Transfer 8 ml of sucrose solution from the container to each of the two test tubes A and B.
- ד. Ask the proctor for hot water and prepare a hot water bath at a temperature in the range 40°C - 45°C .
 - Make sure that the height of the water in the bath is up to the line marked on the bath.
 - Place the two test tubes in the bath.

Read the instructions in Item ה carefully to the end before performing them.

ה. Preparation of beads of yeast immobilized in agar

You are given a drinking straw and a plate lined with a damp paper towel.

- Write the letters א, ב, ג and ד along the upper edge of the plate at equal distances from each other, as shown in Illustration 2 below.



You will use the drinking straw to extract beads of yeast immobilized in agar from Dish A. Do this in the following way:

- Stick the straw into the agar, turn the straw a half-rotation, tilt it sideways a little and remove the straw from the agar (see Illustration 1).
Note: The straw now contains a bead of immobilized yeast.
- Repeat this action two more times, so that there are 3 beads in the straw.

Note: Each time, stick the straw close to the location of the previous time, as shown in Illustration 1.

- Blow into the straw above the lined plate in Area א (next to the letter א) in order to free the beads (see Illustration 2).
- Repeat these actions until Area א in the lined plate contains a total of 12 beads from Dish A.
- Place a lid on Dish A.
- Repeat these actions: Remove 12 beads from Dish B too, and transfer them to Area ב in the lined plate.

- ג. Remove Test Tube A from the bath. Use a small spoon to transfer 10 yeast beads from Area א to the test tube (you may touch the beads gently, if necessary).

Note:

 - If an agar bead falls outside the test tube, insert another bead from the same area of the plate in its place.
 - If one of the beads sticks to the upper part of the test tube, push it gently with the straw towards the liquid, but take care that the straw does not come into contact with the liquid.
 - If some beads do not sink to the bottom of the test tube, call the proctor.

— **Cap** the test tube and return it to the bath.
- ד. Repeat the procedure described in Item ג, using Test Tube B and beads from Area ב.
 - Make sure that the temperature in the bath remains in the range 40°C - 45°C throughout the experiment.
 - Write down the time _____ and wait 7 minutes. While you are waiting, keep track of the number of beads that are floating in the liquid in the test tubes, and note whether bubbles or foam form in the test tubes.
 - Copy the **Hebrew** version of sentences i and ii, below, into your notebook:
 - i Number of beads that floated in Test Tube A: _____,
Bubble or foam formation (+/-): _____.
 - ii Number of beads that floated in Test Tube B: _____,
Bubble or foam formation (+/-): _____.
- ה. 7 minutes after the time you recorded in Item ד, remove the test tubes from the bath, place them in the test tube rack, and answer Questions **25-26**.

Note: If, after 7 minutes, no beads are floating in any of the test tubes, wait an additional 5 minutes.

- (6 points) **25.** In your **notebook**, complete sentences i and ii.
If there are beads that rise from the bottom of the test tube, but do not reach the surface of the liquid, record them as floating.

Informative Note: The release of gas bubbles is what causes the beads of immobilized yeast to float and foam to accumulate.

- (4 points) **26.** Use the Informative Note above to explain the results of your measurements. In your answer, refer to the floating of beads at the end of the experiment and to the formation of gas bubbles or foam in the test tubes.
- ו. Remove the caps from Test Tubes A and B and put the test tubes in the trash.
 — Also put Dish B and the beads remaining in the lined plate into the trash.

Answer Question **27.**

- (6 points) **27.** In an experiment similar to the one you performed, a student used agar beads in which the yeast concentration was higher than in your experiment. Estimate whether the beads floated after a longer or shorter time than in your experiment. Explain your answer.

Part ב — Examination of the Fermentation Rate of Immobilized Yeast

- י. Label four test tubes 1, 2, 3 and 4, on the upper part of each test tube.
 — Label a 10 ml pipette "מים".
 — Transfer 10 ml of distilled water to each of the test tubes.
- יא. Using the procedure described for Item ה, prepare 12 more beads of immobilized yeast from Dish A and place them in Area א of the plate lined with a damp paper towel.
 — Repeat the procedure and place 12 beads in each of the Areas ב to ד (total — 48 beads).
- יב. Use a small spoon to gently transfer 10 beads from the pile of beads in Area א into Test Tube 1.
 — Repeat this action with Test Tubes 2 to 4 and with beads from Areas ב to ד, respectively.

Preliminary treatment of immobilized yeast beads

For items ג and ד, you must work according to a timetable. Read all the instructions before you begin working.

- ג. You have 2 large disposable cups placed one inside the other and labeled "אמבט". Without separating the cups, prepare a bath of hot water in the temperature range 60°C - 65°C .
- Make sure that the height of the water in the bath is up to the line marked on the cup.
 - Place Test Tubes 2-4 into this bath. Leave Test Tube 1 in the test tube rack.
Make sure that the temperature in the bath remains in the range 60°C - 65°C throughout the preliminary treatment.
 - Write down the time _____.
- ד. You must remove Test Tubes 2-4 from the bath and place them in the test tube rack according to the timetable specified in Table 1 below.
Note: Time 0 in the table is the time you recorded in Item ג.

Table 1

Test Tube	Immersion time at 60°C - 65°C (minutes)
1	0
2	2
3	5
4	10

Performing the experiment

- ה. Add hot water to I אמבט, which you used in Part א. Make sure that the temperature in the bath remains in the range 40°C - 45°C throughout the entire experiment.
- Make sure that the height of the water in the bath is up to the line marked on the bath.
- ו. You have 4 small disposable cups. Label them 1-4.
- Pour the contents of Test Tube 1, including the beads, into Cup 1.
 - Repeat this action for each of the test tubes 2-4, and pour the contents of each test tube into Cups 2-4, respectively.

- יז. Label four more test tubes א, ב, ג, ד on the upper part of each test tube.
- Using the pipette labeled "סוכרוז", transfer 8 ml of sucrose solution to each of the test tubes א-ד.
 - Place the test tubes א-ד into I אמבט, in which the temperature range is 40°C - 45°C.
- יח. Remove Test Tube א from the bath. Using the spoon, gently transfer 10 beads from Cup 1 to the test tube without the liquid, and return the test tube to the bath.
- Repeat these actions with the beads in Cups 2 to 4 and Test Tubes ב to ד, respectively.
 - **Cap** all the test tubes א-ד.
- יט. Write down the time _____ and wait 10 minutes.
- While you are waiting, answer Question **28. א**.

(10 points) **28. א.** In your notebook, make a table to summarize the experimental system (starting with Item י). Your table should **also** include two empty columns to be used for the results of the experiment.

- כ. 10 minutes after the time you recorded in Item יט, remove all the test tubes א-ד from the bath and place them in the test tube rack.
- Count the number of floating beads in each of the test tubes, and record the results in the first empty column for results in the table in your notebook.
 - Rank the relative amount of foam that accumulated in each of the test tubes using the following symbols:
 - ++ A lot of foam
 - + A little foam
 - No foam
- Write this ranking in the other empty column for results in the table in your notebook.
- Remove the caps from Test Tubes א-ד.

Answer Questions **28. ב.-32.**

- (5 points) **28. ב.** Add a heading to each of the columns in the table.
- Add a heading to the table.

- (12 points) **29.** Table 2 below contains a list of elements in the experiment that you performed. Copy the **Hebrew** version of Table 2 to **your notebook** and complete the missing information by adding the sign (+) in the appropriate places.

Table 2

Constant factor	Method of measuring the dependent variable	The dependent variable	The independent variable	Element of the experiment
				Number of floating beads at the end of the experiment
				Size of beads
				Rate of fermentation of immobilized yeast
				Temperature in I אִמְבֵּט (40°C - 45°C)
				Immersion time in II אִמְבֵּט (60°C - 65°C)

- (6 points) **30. א.** Explain why the method of measuring the dependent variable that you marked in Table 2 is appropriate for measuring the process you examined in the experiment.
- (4 points) **ב.** Several factors were held constant during the experiment. Choose one of them and explain why it was important to hold this specific factor constant during the experiment.
- (6 points) **31.** Explain the results of the experiment that you performed.
- (6 points) **32.** Test Tube א was a control test tube. Explain why it was important to include it in your experiment.

Part 3 — Analysis of Experimental Results: Effect of Magnesium Ions on Yeast Fermentation

Research groups throughout the world are conducting experiments to find the optimal conditions for growing yeast to produce large quantities of ethanol, which is a product of yeast fermentation. Ethanol serves as a substitute for (fossil) fuel. Previous studies found that magnesium ions are essential for enzymatic processes. Researchers grew yeast in two containers with growth mediums that contained substances essential for the proliferation of yeast, including sucrose. The researchers examined the effect of adding magnesium ions to the yeast's growth medium on the concentration of ethanol produced over time. One container held a low concentration of magnesium ions and the other container held a high concentration of magnesium ions. The results of the experiment are shown in Table 3 below.

Table 3

Time from start of experiment (hours)	Concentration of ethanol produced (%)	
	<u>Low</u> concentration of magnesium ions	<u>High</u> concentration of magnesium ions
0	0	0
20	3	5
30	5	8
40	8	11
50	10	13

Answer Questions **33-36**.

- (10 points) **33.** Graph paper has been provided for you in the attachment. Present the experimental results from Table 3 on this paper in an appropriate graphical form.
- (6 points) **34. א.** Describe the results shown in the graph that you drew.
- (7 points) **ב.** Explain the results of the researchers' experiment.

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

- (6 points) **35.** The growth medium in both containers contained sucrose. Explain why sucrose is essential to the formation of ethanol.
- (6 points) **36.** In another experiment, the researchers found that increasing the concentration of magnesium ions increases the growth rate of the yeast. Explain how the results of the experiment that the researchers performed regarding the ethanol concentration (Table 3) help to explain this finding.

Place an examinee sticker and a questionnaire sticker on the attachment that contains the graphic representation.

Return this questionnaire, the notebook and the attachment that contains the graphic representation to the proctor.

Good Luck!

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בְּהַצְלָחָה!

זכוֹת הַיוֹצְרִים שְׂמוּרָה לַמְּדִינָה יִשְׂרָאֵל.
אֵין לְהַעֲתִיק אוֹ לְפַרְסֵם אֶלָּא בְּרִשּׁוֹת מִשְׁרַד הַחִינוּךְ.

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachments: Color scale (for Question 41)

Graph paper (for Question 46)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספחים: סולם צבעים (לשאלה 41)

נייר מילמטרי (לשאלה 46)

תרגום לאנגלית (3)

Practical Exam in Biology

Reform for Meaningful Learning
Program

בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 4

בעיה 4

רשום את מספר תעודת הזהות שלך כאן:

Write your ID number here:

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Instructions for examinees

א. Duration of the exam: Three hours

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

ב. Material that may be used during the exam:

A Hebrew-foreign language / foreign language-
Hebrew dictionary

ב. חומר עזר מותר בשימוש:

מילון עברי-לועזי / לועזי-עברי.

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 were not as expected.

ג. הוראות מיוחדות:

- (1) קרא את ההנחיות ביסודיות, ושקול היטב את צעריך.
- (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

For this problem, you will examine processes that occur during the ripening of bananas.

In this questionnaire, the questions are numbered **37-48**. The point value of each question is written on the left.

Answer all of the questions in the notebook.

The banana is harvested when it is still unripe and its peel is green. The harvested fruit is kept in storage until it is marketed. During and after storage, the fruit gradually ripens: its peel changes from green to yellow, and afterwards black spots appear on the peel.

Additional changes occur in the ripening fruit: for example, the fruit becomes softer and sweeter, and its unripe taste disappears. In the cells of the ripening fruit, the rate of cellular respiration increases, and processes of synthesis and decomposition occur in which phosphate (זרח, Pi) also participates.

Part א — Comparison Between an Unripe Banana and a Ripe Banana

You have two plates, each of which contains two slices of banana: a slice of unripe banana whose peel is green and a slice of ripe banana whose peel is yellow-black, a 1 ml pipette, a test tube containing a solution of phenolphthalein phosphate, a vial of an iodine solution (I_2/KI), and a vial of a basic solution.

א. Using a pen that writes on glass, label the plates "1" and "2".

On each of the plates, write "בוטר" next to each of the unripe banana slices, and write "בשלה" next to each of the ripe banana slices.

- Write "פ.פ.פ" on the 1 ml pipette.
- Drip 0.5 ml of the phenolphthalein phosphate (פ.פ.פ) solution on each of the slices on Plate **1**.
- Write down the time: _____.

Wait at least 10 minutes. While you are waiting, carry out the instructions in Items ב and ג, and answer Questions **37-38**.

- ב. Remove the peel from each of the slices on Plate **2**, and put the peels in the trash.
 - Mash the ripe banana with a fork, and move the resulting paste to one side of the plate, next to the label "בשלה".
 - Wipe the fork with a paper towel, mash the unripe banana, and move the resulting paste to the other side of the plate, next to the label "בוסר".

Informative Note 1:

An iodine solution that is yellow-brown reacts with starch, and the resulting color is blue-black.

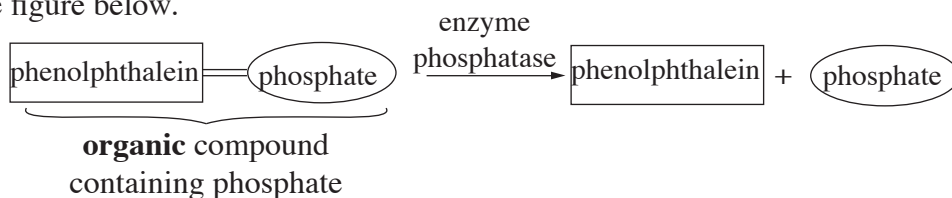
- ג. Add 10 drops of iodine solution to the ripe banana paste and 10 drops to the unripe banana paste on Plate **2**.
Examine the changes in the color of the paste after the addition of the iodine, and answer Question **37 immediately**.

- (5 points) **37.** The change in color of the paste is a result of a reaction between iodine and starch.
Rank the relative amount of starch in the paste using these symbols:
- +++ Large amount of starch
 - ++ Medium amount of starch
 - + Small amount of starch
 - No starch
- Copy the two statements i and ii into **your notebook**, and complete them using the results of the examination.
- i Relative amount of starch in the unripe banana: ____
 - ii Relative amount of starch in the ripe banana: ____

Answer Question **38**.

- (5 points) **38. א.** Starch, in contrast to glucose, does not have a sweet taste. Using the results of the experiment performed on Plate **2**, explain the increase in sweetness of bananas as they ripen.
- (3 points) **ב.** The bananas you have are seedless, but the fruit of the wild banana plant does have seeds.
Explain the advantage of increased fruit sweetness for wild banana plants.

Banana cells contain the enzyme phosphatase, which catalyzes the breakdown of organic compounds that contain phosphate. Phenolphthalein phosphate, which you dripped on the banana slices, is an organic compound containing phosphate and is colorless. This compound is not found naturally in cells, but the enzyme phosphatase, which is naturally present in cells, catalyzes this compound's decomposition, too, into phenolphthalein and phosphate (זרחת, P_i), as shown in the figure below.



Informative Note 2:

The reaction product phenolphthalein is colorless, but in a basic environment, its color changes to pink-violet. The higher the concentration of the phenolphthalein, the darker the violet color will be.

7. At least 10 minutes after the time you wrote down in Item 8, add 4 drops of basic solution to each of the banana slices on Plate 1, and examine the intensity of the pink-violet color in each of the slices.

Note: Avoid touching the basic solution.

Answer Question 39.

- (5 points) **39.** Based on the information in the figure above and in Informative Note 2, rank the relative activity of phosphatase using the following symbols:

- +++ Large amount of activity
- ++ Medium amount of activity
- + Low amount of activity
- No activity

Copy the two statements i and ii into **your notebook** and complete them using the results of the examination.

- i Relative activity of the enzyme phosphatase in the unripe banana: _____
- ii Relative activity of the enzyme phosphatase in the ripe banana: _____

Part ב – Enzyme Phosphatase Activity in an Extract from Ripe Banana Cells

Preparation of an extract from banana cells

You are provided with a plate labeled "בננה לחלק ב" containing a ripe banana, a cup labeled "רסק", a container of distilled water, a 10 ml pipette, a funnel, 3 pieces of gauze, and a container labeled "מיצוי".

- ה. Mash the banana on the plate with the fork.
 - Label the 10 ml pipette "מים" and use it to transfer 10 ml of distilled water to the banana paste.
 - Continue mashing the banana until no lumps are left in the paste.
 - Use a spoon to transfer all the paste and liquids to the "רסק" cup.
- ו. Add distilled water to the cup labeled "רסק" until the liquid in the cup reaches the line marked on the cup.
 - Stir the diluted paste well.
- ז. Place the funnel into the container labeled "מיצוי".
 - Unfold the 3 pieces of gauze, until each piece has two layers, and place them open on top of each other.
Line the funnel with the unfolded pieces of gauze (3 x 2 layers).
 - Use the spoon to mix the diluted paste well.
 - Transfer the diluted paste to the lined funnel that is on top of the container.
 - Wait until most of the liquid has filtered through the gauze into the container. **Do not squeeze out the gauze!**
 - Place the funnel, the gauze, and the remaining paste in the trash.

Note: As time passes, the color of the extract gradually changes to light brown. This change does not interfere with the rest of the experiment.

Examining the activity of the enzyme phosphatase

You are given a container labeled "אמבט", a 1 ml pipette, and a 2 ml (or 5 ml) pipette.

- ח. Label five test tubes with the letters א, ב, ג, ד, ה, on the upper part of each test tube.
- Label the 1 ml pipette "מיצוי", and label the 2 ml (or 5 ml) pipette "מים".
 - Use the pipettes "מיצוי" and "מים" to add banana extract and distilled water to each of the test tubes א-ה, according to the volumes specified in Table 1 below.

Table 1

Test Tube	Volume of Extract (מ"ל)	Volume of Distilled Water (מ"ל)
א	2	0
ב	1	1
ג	0.5	1.5
ד	0.2	1.8
ה	0	2

- ט. Ask the proctor for hot water, and prepare a bath with a water temperature in the range 35°C - 37°C .
- י. Using the pipette labeled "פ.פ.פ", add 0.5 ml of the phenolphthalein phosphate solution to each of the test tubes א-ה.
- Gently shake the test tubes.
- יא. Place the test tubes א-ה in the bath, and write down the time: _____
- יב. Wait 10 minutes. Make sure that the water temperature in the bath stays in the range 35°C - 37°C .
- While waiting, answer Question 40. א.

- (6 points) **40. א.** In your notebook, make a table and summarize the experiment that you performed (starting with Item ח) in the table. **Also** include in the table two empty columns: Column I and Column II, to be used for the results of the experiment.

- ג. After 10 minutes have passed since the time you recorded in Item ב, transfer the test tubes from the bath to the test tube rack.
- Add 2 drops of basic solution to each of the test tubes.
 - Gently shake the test tubes.

Answer Questions 40. ב.- 45.

- (4 points) 40. ב. Write down the color obtained in each of the test tubes in Column I of the table in your notebook.

You have an attachment: **Color Scale** ["סולם צבעים"]. It shows a set of rectangles, each with a different shade of color. Each shade is given a value (in relative units) that represents the concentration of phenolphthalein.

Note: For the value 0 of phenolphthalein, there is **also** a light brown rectangle, which represents the color of the extract after the change that occurs in it over time. This color change is **not** connected to the process being examined.

- (4 points) 41. א. Compare the color of the liquid in Test Tube א to the shades on the color scale, and record the appropriate value of the relative concentration of phenolphthalein in Column II of the table in your notebook.

Note: If necessary, you may use intermediate values, such as 4.5.

— Repeat for Test Tubes ב-ה.

- (5 points) 42. א. Add appropriate headings to all the columns in the table.
- Add a heading to the table.

- (6 points) 42. א. What was the independent variable in the experiment you performed?

- (6 points) 42. ב. What was the dependent variable in the experiment?

- (4 points) 43. א. In the experiment you performed, Test Tube ה was a control test tube. Explain why it was important to include it in the experiment.

- (3 points) 43. ב. Suggest a treatment that could be added to the experiment to prove that the pink color is not a result of a reaction between the extract that you prepared and the basic solution. In your answer, describe the result you would expect to get from your proposed treatment.

/continued on page 8/

- (5 points) **44. א.** What can we conclude from the results of the experiment?
- (6 points) **ב.** Explain how the results of your experiment support this conclusion.
- (3 points) **45. א.** List three factors that stayed constant in the experiment that you performed.
- (4 points) **ב.** Choose one of the factors that you listed, and explain why it was important to leave this specific factor constant in the experiment that you performed.

Part ג – Analysis of Research Results: The Difference in Phosphatase Activity in Bananas at Different Degrees of Ripeness

Researchers stored at a fixed temperature a large number of unripe bananas whose peels were green. During storage, the bananas ripened and the color of the peel changed. The researchers defined the degree of ripeness according to the color of the peel. They wanted to examine how the rate of activity of the enzyme phosphatase changes at different degrees of ripeness.

At each time interval, the researchers took samples from 10 bananas that were at the same stage of ripeness, prepared extracts from them, and examined the rate of activity of the enzyme phosphatase in them.

The results of the experiment are detailed in Table 2 below.

Table 2

Degree of Ripeness According to Color of Peel	Average Rate of Phosphatase Activity (micromols of product/minute/gram of fruit)
Dark green	2
Green with a little yellow	4
Yellow with a little green	8
Yellow	10
Yellow with a few black spots	13
Yellow with many black spots	17

Answer Questions **46-48**.

- 46.** You are to present the experimental results shown in Table 2 in graphic form.
- (3 points) **א.** What type of graphical representation is most appropriate to describe the results - a continuous graph or a bar graph? Explain your answer.
- (7 points) **ב.** Graph paper has been provided for you in the attachment. Present the results from Table 2 on it in an appropriate graphic form.
- (4 points) **ג.** Do the results you obtained in Part **א** (Question **39**) match the results obtained by the researchers, with respect to the activity of the phosphatase? Explain.
- (3 points) **47. א.** The phosphate produced in cells from the activity of the enzyme phosphatase is an essential structural component of various compounds. Name three compounds found in cells, which are organic and contain phosphate.
- (3 points) **ב.** Choose one of the compounds you named in Item **א** and explain its importance to cell activity.
- (6 points) **48.** During the banana's ripening process, the rate of cellular respiration increases. Sometimes there is a need to slow down the ripening process that occurs in storage. Suggest one possible way to change storage conditions, so as to slow down the ripening process. Explain your suggestion.

Place an examinee sticker and a questionnaire sticker on the attachment that contains the graphic representation.

Return this questionnaire, the notebook and the attachment that contains the graphic representation to the proctor.

Good luck!

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בהצלחה!

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

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachments: Color scale (for Question 53)

Graph paper (for Question 58)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספחים: סולם צבעים (לשאלה 53)

נייר מילימטרי (לשאלה 58)

תרגום לאנגלית (3)

Practical Exam in Biology

Reform for Meaningful Learning
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בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 5

בעיה 5

רשום את מספר תעודת הזהות שלך כאן:

Write your ID number here:

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Instructions for examinees

א. Duration of the exam: Three hours

הוראות לנבחן

א. משך הבחינה: שלוש שעות.

ב. Material that may be used during the exam:

A Hebrew-foreign language / foreign language-
Hebrew dictionary

ב. חומר עזר מותר בשימוש:

מילון עברי-לועזי / לועזי-עברי.

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 and diagrams).
- (3) Base your answers on your observations and the results that you obtained, even if they were not as expected.

ג. הוראות מיוחדות:

- (1) קרא את ההנחיות ביסודיות, ושקול היטב את צעדך.
- (2) רשום בֶּעֱט את כל תצפיותיך ותשובותיך (גם סרטטים וציורים).
- (3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 5

For this problem, you will examine processes that occur during the ripening of bananas.

In this questionnaire, the questions are numbered **49-60**. The point value of each question is written on the left.

Answer all of the questions in the notebook.

The banana is harvested when it is still unripe and its peel is green. The harvested fruit is kept in storage until it is marketed. During and after storage, the fruit gradually ripens: its peel changes color from green to yellow, and afterwards black spots appear on the peel.

Additional changes occur in the ripening fruit: for example, the fruit becomes softer and sweeter, and its unripe taste disappears. In the cells of the ripening fruit, the rate of cellular respiration increases, and processes of synthesis and decomposition occur in which phosphate (זרחת, Pi) also participates.

Part א — Comparison Between an Unripe Banana and a Ripe Banana

You have two plates, in each of which there are two slices of banana: a slice of unripe banana whose peel is green and a slice of ripe banana whose peel is yellow-black, a Pasteur pipette, a test tube containing a solution of phenolphthalein phosphate, a vial of an iodine solution (I_2/KI), and a vial of a basic solution.

- א. Using a pen that writes on glass, label the plates "1" and "2".
On each of the plates, write "בוסר" next to each of the unripe banana slices, and write "בשלה" next to each of the ripe banana slices.
- Write "פ.פ.פ." on the Pasteur pipette.
 - Drip 15 drops of the phenolphthalein phosphate (פ.פ.פ.) solution onto each of the slices on Plate **1**.
 - Write down the time: _____.
- Wait at least 10 minutes. While you are waiting, carry out the instructions in Items ב and ג, and answer Questions **49-50**.

- ב. Remove the peel from each of the slices on Plate 2, and put the peels in the trash.
 - Mash the ripe banana with a fork, and move the resulting paste to one side of the plate, next to the label "בשלה".
 - Wipe the fork with a paper towel, mash the unripe banana, and move the resulting paste to the other side of the plate, next to the label "בוסר".

Informative Note 1:

An iodine solution that is yellow-brown reacts with starch, and the resulting color is blue-black.

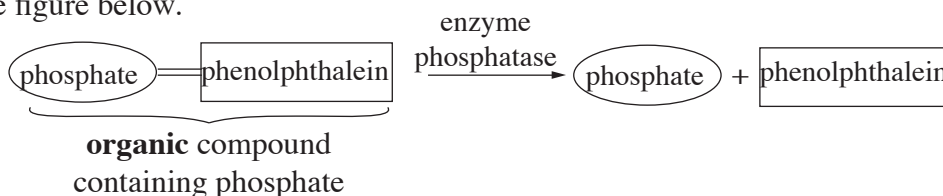
- ג. Add 10 drops of iodine solution to the ripe banana paste and 10 drops to the unripe banana paste on Plate 2.
Examine the changes in the color of the paste after the addition of the iodine, and answer Question 49 **immediately**.

- (5 points) **49.** The change in color of the paste is a result of a reaction between iodine and starch.
Rank the relative amount of starch in the paste using these symbols:
- +++ Large amount of starch
 - ++ Medium amount of starch
 - + Small amount of starch
 - No starch
- Copy the **Hebrew version** of the two statements i and ii into **your notebook**, and complete them using the results of your observation.
- i Relative amount of starch in the unripe banana: ____.
 - ii Relative amount of starch in the ripe banana: ____.

Answer Question 50.

- (5 points) **50. א.** Unlike glucose, starch does not have a sweet taste.
Using the results of the experiment performed on Plate 2, explain the increase in sweetness of bananas as they ripen.
- (3 points) **ב.** The bananas you have are seedless, but the fruit of the wild banana plant does have seeds.
Explain the advantage of this increase in fruit sweetness for wild banana plants.

Banana cells contain the enzyme phosphatase, which catalyzes the breakdown of organic compounds that contain phosphate. Phenolphthalein phosphate, which you dripped on the banana slices, is an organic compound containing phosphate and is colorless. This compound is not found naturally in cells, but the enzyme phosphatase, which is naturally present in cells, catalyzes this compound's decomposition, too, into phenolphthalein and phosphate (זרחת, P_i), as shown in the figure below.



Informative Note 2:

The reaction product phenolphthalein is colorless, but in a basic environment, its color changes to pink-violet. The higher the concentration of phenolphthalein, the darker the violet color will be.

- ד. At least 10 minutes after the time you wrote down in Item א, drip 4 drops of basic solution onto each of the banana slices on Plate 1, and examine the intensity of the pink-violet color of each of the slices.

Note: Avoid touching the basic solution.

Answer Question 51.

- (5 points) **51.** Based on the information in the figure above and in Informative Note 2, rank the relative activity of phosphatase using the following symbols:

- +++ High level of activity
- ++ Medium level of activity
- + Low level of activity
- No activity

Copy the **Hebrew version** of the two statements i and ii into **your notebook** and complete them using the results of your observation.

- i Relative activity of the enzyme phosphatase in the unripe banana: _____.
- ii Relative activity of the enzyme phosphatase in the ripe banana: _____.

— Put Plate 1 and Plate 2 in the trash.

/continued on page 5/

Part ב – Enzyme Phosphatase Activity in an Extract from Ripe Banana Cells

Preparing an extract from banana cells

You are provided with a plate labeled "בננה לחלק ב" containing a ripe banana, a cup labeled "רסק", a container of distilled water, a 10 ml pipette, a funnel, 3 pieces of gauze, and a container labeled "מיצוי".

- ה. Mash the banana on the plate with the fork.
 - Label the 10 ml pipette "מים" and use it to transfer 10 ml of distilled water to the banana paste.
 - Continue mashing the banana until no lumps are left in the paste.
 - Use a spoon to transfer all the paste and liquids to the "רסק" cup.
- ו. Add distilled water to the cup labeled "רסק", until the liquid in the cup reaches the line marked on the cup.
 - Stir the diluted paste well.
- ז. Place the funnel onto the container labeled "מיצוי".
 - Unfold the 3 pieces of gauze, until each piece has two layers, and place them, unfolded, on top of each other.
Line the funnel with the unfolded pieces of gauze (3 x 2 layers).
 - Use the spoon to mix the diluted paste well.
 - Transfer the diluted paste to the lined funnel that is on top of the container.
 - Wait until most of the liquid has filtered through the gauze into the container. **Do not squeeze out the gauze!**
 - Put the funnel, the gauze, and the remaining paste in the trash.

Note: As time passes, the color of the extract gradually changes to light brown. This change does not interfere with the rest of the experiment.

Examining the activity of the enzyme phosphatase

You are given a container labeled "אמבט", two 2 ml (or 5 ml) pipettes, and a Pasteur pipette.

- ה. Label six test tubes with the letters א, ב, ג, ד, ה, ו, on the upper part of each test tube.
 - Label a 2 ml (or 5 ml) pipette "מיצי", and transfer 2 ml of banana extract to each of the test tubes א-ה. **Do not add** extract to Test Tube ו.
 - Label the other 2 ml (or 5 ml) pipette "מים" and transfer 2 ml of water to Test Tube ו.
- ו. Label the Pasteur pipette "מים", and add drops of distilled water to each of the test tubes, according to the volumes specified in Table 1 below.

Table 1

Test Tube	Volume of Distilled Water (drops)	Volume of Phenolphthalein Phosphate (drops)
א	0	10
ב	6	4
ג	8	2
ד	9	1
ה	10	0
ו	0	10

- ז. Ask the proctor for hot water, and prepare a bath with a water temperature in the range 35°C - 37°C.
- ח. Using the Pasteur pipette labeled "פ.פ.פ.", add drops of the phenolphthalein phosphate solution to each of the test tubes ו-א, according to the volumes specified in Table 1.
 - Gently shake the test tubes.
- ט. Place the test tubes ו-א in the bath, and write down the time: _____. Wait 10 minutes. Make sure that the water temperature in the bath remains in the range 35°C - 37°C.
 - While waiting, answer Question 52. א.

(6 points) **52. א.** In your notebook, make a table and summarize in it the experiment that you performed (starting with Item ח).
Also include in the table two empty columns: Column I and Column II, to be used for the results of the experiment.

ג. 10 minutes after the time you recorded in Item יב, transfer the test tubes from the bath to the test tube rack.

- Add 2 drops of base solution to each of the test tubes.
- Gently shake the test tubes.

Answer Questions **52. ב.- 57.**

(4 points) **52. ב.** Write down the color obtained in each of the test tubes in Column I of the table in your notebook.

You have an attachment: **Color Scale** ["סולם צבעים"]. It shows a set of rectangles, each a different shade of color. Each shade is given a value (in relative units) that represents the concentration of phenolphthalein.

Note: For the value 0 of phenolphthalein, there is **also** a light brown rectangle, which represents the color of the extract after the change that occurs in it over time. This color change is **not** connected to the process being examined.

(4 points) **53. א.** Compare the color of the liquid in Test Tube א to the shades on the color scale, and record the appropriate value of the relative concentration of phenolphthalein in Column II of the table in your notebook.

Note: If necessary, you may use intermediate values, such as 4.5.

- Repeat for Test Tubes ב-ו.

(5 points) **ב.** Add appropriate headings to all the columns in the table.
 — Add a heading to the table.

(6 points) **54. א.** What is the independent variable in the experiment you performed?

(6 points) **ב.** What is the dependent variable in your experiment?

(7 points) **55.** In the experiment you performed, Test Tubes ה and ו are control test tubes. Explain why it is important to include each one of them in the experiment. /continued on page 8/

- (5 points) **56. א.** What can we conclude from the results of the experiment?
- (6 points) **א.** Explain how the results of your experiment support this conclusion.
- (3 points) **57. א.** List three factors that remained constant in the experiment that you performed.
- (4 points) **א.** Choose one of the factors that you listed, and explain why it was important to leave this specific factor constant in the experiment that you performed.

Part 2 – Analysis of Research Results: The Change in Phosphatase Activity in Bananas During Storage

Researchers stored a large number of unripe bananas whose peels were green at a constant temperature. During storage, the bananas ripened and the color of their peels changed till they became yellow with black spots. The researchers wanted to examine how the rate of activity of the enzyme phosphatase changes during storage. At each time interval (see below), the researchers took samples from 10 bananas, prepared extracts from them, and examined the rate of activity of the enzyme phosphatase in them.

The results of the experiment are detailed in Table 2 below.

Table 2

Days in Storage	Average Phosphatase Activity Rate (micromoles of product/hour/gram of fruit)
0	1
1	1.5
2	3
3	6
5	11
7	15

Answer Questions **58-60**.

- 58.** You are asked to present the experimental results shown in Table 2 in graphical form.
- (3 points) **א.** What type of graphical representation is most appropriate to describe the results — a continuous graph or a bar graph?
Explain your answer.
- (7 points) **ב.** Graph paper has been provided for you in the attachment. Present the results from Table 2 on it in an appropriate graphical form.
- (4 points) **ג.** Do the results you obtained in Part א (Question **51**) match the results obtained by the researchers, with respect to the activity of the phosphatase? Explain.
- (3 points) **59. א.** The phosphate produced in cells from the activity of the enzyme phosphatase is an essential structural component of various compounds.
Name three compounds that are found in cells and are organic and contain phosphate.
- (3 points) **ב.** Choose one of the compounds you named in Item א and explain its importance to cell activity.
- (6 points) **60.** During the banana's ripening process, the rate of cellular respiration increases. Sometimes it is desired to slow down the ripening process that occurs in storage.
Suggest one possible way to change storage conditions, so as to slow down the ripening process.
Explain your suggestion.

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

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

Good Luck!

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בהצלחה!

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

State of Israel
Ministry of Education

Type of exam: *Bagrut*
Exam date: Summer 2017

Exam number: 43386

Attachments: Color scale (for Question 65)

Graph paper (for Question 70)

English translation (3)

מדינת ישראל

משרד החינוך

סוג הבחינה: בגרות

מועד הבחינה: קיץ תשע"ז, 2017

מספר השאלון: 43386

נספחים: סולם צבעים (לשאלה 65)

נייר מילימטרי (לשאלה 70)

תרגום לאנגלית (3)

Practical Exam in Biology

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בחינת בגרות מעשית בביולוגיה

על פי תכנית הרפורמה
ללמידה משמעותית

Problem 6

בעיה 6

רשום את מספר תעודת הזהות שלך כאן:

Write your ID number here:

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Instructions for examinees

א. Duration of the exam: Three hours

הוראות לנבחן

א. משך הבחינה: שלוש שעות.

ב. Material that may be used during the exam:

A Hebrew-foreign language / foreign language-
Hebrew dictionary

ב. חומר עזר מותר בשימוש:

מילון עברי-לועזי / לועזי-עברי.

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 were not as expected.

ג. הוראות מיוחדות:

- (1) קרא את ההנחיות ביסודיות, ושקול היטב את צעריך.
- (2) רשום בעט את כל תצפיותיך ותשובותיך (גם סרטטים).
- (3) בסס את תשובותיך על תצפיותיך ועל התוצאות שקיבלת, גם אם הן אינן תואמות את הצפוי.

Good Luck!

בהצלחה!

Problem 6

For this problem, you will examine processes that occur during the ripening of bananas.

In this questionnaire, the questions are numbered **61-72**. The point value of each question is written on the left.

Answer all of the questions in the notebook.

The banana is harvested when it is still unripe and its peel is green. The harvested fruit is kept in storage until it is marketed. During and after storage, the fruit gradually ripens: its peel changes color from green to yellow, and afterwards black spots appear on the peel.

Additional changes occur in the ripening fruit: for example, the fruit becomes softer and sweeter, and its unripe taste disappears. In the cells of the ripening fruit, the rate of cellular respiration increases, and processes of synthesis and decomposition occur in which phosphate (זרחת, Pi) also participates.

Part א — Comparison Between an Unripe Banana and a Ripe Banana

You have two plates, each of which contains two slices of banana: a slice of unripe banana whose peel is green and a slice of ripe banana whose peel is yellow-black, a 1 ml pipette, a test tube containing a solution of phenolphthalein phosphate, a vial of an iodine solution (I_2/KI), a test tube of a basic solution, and a Pasteur pipette.

א. Using a pen that writes on glass, label the plates "1" and "2".

On each of the plates, write "בוסר" next to each of the unripe banana slices, and write "בשלה" next to each of the ripe banana slices.

- Write "פ.פ.פ." on the 1 ml pipette.
- Drip 0.5 ml of the phenolphthalein phosphate (פ.פ.פ.) solution onto each of the slices on Plate **1**.
- Write down the time: _____.

Wait at least 10 minutes. While you are waiting, carry out the instructions in Items ב and ג and answer Questions **61-62**.

- ב. Remove the peel from each of the slices on Plate **2**, and put the peels in the trash.
- Mash the ripe banana with a fork, and move the resulting paste to one side of the plate, next to the label "בשלה".
 - Wipe the fork with a paper towel, mash the unripe banana, and move the resulting paste to the other side of the plate, next to the label "בוסר".

Informative Note 1:

An iodine solution that is yellow-brown reacts with starch, and the resulting color is blue-black.

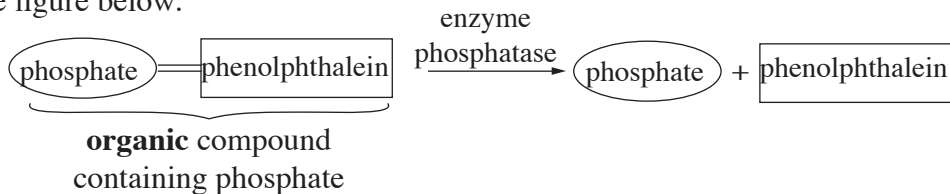
- ג. Add 10 drops of iodine solution to the ripe banana paste and 10 drops to the unripe banana paste on Plate **2**.
Examine the changes in the color of the paste after the addition of the iodine, and answer Question **61 immediately**.

- (5 points) **61.** The change in color of the paste is a result of a reaction between iodine and starch.
Rank the relative amount of starch in the paste using these symbols:
- +++ Large amount of starch
 - ++ Medium amount of starch
 - + Small amount of starch
 - No starch
- Copy the **Hebrew version** of the two statements i and ii into **your notebook**, and complete them using the results of your observation.
- i Relative amount of starch in the unripe banana: ____.
 - ii Relative amount of starch in the ripe banana: ____.

Answer Question **62**.

- (5 points) **62. א.** Unlike glucose, starch does not have a sweet taste.
Using the results of the experiment performed on Plate **2**, explain the increase in sweetness of bananas as they ripen.
- (3 points) **ב.** The bananas you have are seedless, but the fruit of the wild banana plant does have seeds.
Explain the advantage of the increase in fruit sweetness for wild banana plants.

Banana cells contain the enzyme phosphatase, which catalyzes the breakdown of organic compounds that contain phosphate. Phenolphthalein phosphate, which you dripped on the banana slices, is an organic compound containing phosphate and is colorless. This compound is not found naturally in cells, but the enzyme phosphatase, which is naturally present in cells, catalyzes this compound's decomposition, too, into phenolphthalein and phosphate (זָרָחָה, P_i), as shown in the figure below.



Informative Note 2:

The reaction product phenolphthalein is colorless, but in a basic environment, its color changes to pink-violet. The higher the concentration of phenolphthalein, the darker the violet color will be.

ד. Write "בסיס" on a Pasteur pipette.

At least 10 minutes after the time you wrote down in Item א, drip 5 drops of basic solution onto each of the banana slices on Plate 1, and examine the intensity of the pink-violet color of each of the slices.

Note: Avoid touching the basic solution.

Answer Question 63.

(5 points) **63.** Based on the information in the figure above and in Informative Note 2, rank the relative activity of phosphatase using the following symbols:

- +++ High level of activity
- ++ Medium level of activity
- + Low level of activity
- No activity

Copy the Hebrew version of the two statements i and ii into **your notebook** and complete them using the results of your observation.

- i Relative activity of the enzyme phosphatase in the unripe banana: _____.
- ii Relative activity of the enzyme phosphatase in the ripe banana: _____.

— Put Plate 1 and Plate 2 in the trash.

/continued on page 5/

Part ב – Enzyme Phosphatase Activity in an Extract from Ripe Banana Cells

Preparing an extract from banana cells

You are provided with a plate labeled "בננה לחלק ב" containing a ripe banana, a cup labeled "רסק", a container of distilled water, a 10 ml pipette, a funnel, 3 pieces of gauze, and a container labeled "מיצוי".

- ה. Mash the banana on the plate with the fork.
 - Label the 10 ml pipette "מים" and use it to transfer 10 ml of distilled water to the banana paste.
 - Continue mashing the banana until no lumps are left in the paste.
 - Use a spoon to transfer all the paste and liquids to the "רסק" cup.
- ו. Add distilled water to the cup labeled "רסק", until the volume of liquid in the cup reaches the line marked on the cup.
 - Stir the diluted paste well.
- ז. Place the funnel onto the container labeled "מיצוי".
 - Unfold the 3 pieces of gauze, until each piece has two layers, and place them, unfolded, on top of each other. Line the funnel with the unfolded pieces of gauze (3 x 2 layers).
 - Use the spoon to mix the diluted paste well.
 - Transfer the diluted paste to the lined funnel that is on top of the container.
 - Wait until most of the liquid has filtered through the gauze into the container. **Do not squeeze out the gauze!**
 - Put the funnel, the gauze, and the remaining paste in the trash.

Note: As time passes, the color of the extract gradually changes to light brown. This change does not interfere with the rest of the experiment.

Examining the activity of the enzyme phosphatase

You are given a container labeled "אמבט", a test tube containing an acidic solution, a 2 ml (or 5 ml) pipette, a 1 ml pipette, and two Pasteur pipettes.

- ח. Label four test tubes with the letters א, ב, ג, ד, on the upper part of each test tube.
 - Label the 2 ml (or 5 ml) pipette "מיצוי", and transfer 2 ml of banana extract to each of the test tubes.
- ט. Label one Pasteur pipette "מים" and the other Pasteur pipette "חומצה".
 - Add drops of water and of acid to each of the test tubes א-ד according to the volumes specified in Table 1 below.
 - Using the Pasteur pipette labeled "בסיס", add drops of base solution to the test tubes ג-ד according to the volumes specified in Table 1.

Note: Avoid contact with the acid and base solutions.

Table 1

Test Tube	Volume of Acid Solution (drops)	Volume of Distilled Water (drops)	Volume of Base Solution (drops)
א	6	—	—
ב	—	6	—
ג	—	5	1
ד	—	3	3

- י. Gently shake the test tubes.
 - Using pH test strips, test the pH level in each of the solutions, and record the results of your tests:
 pH level in Test Tube א: _____
 pH level in Test Tube ב: _____
 pH level in Test Tube ג: _____
 pH level in Test Tube ד: _____
- יא. Ask the proctor for hot water, and prepare a bath with a water temperature in the range 35°C - 37°C.
- יב. Using the pipette labeled "פ.פ.פ", add 0.5 ml of the phenolphthalein phosphate solution to each of the test tubes.
 - Gently shake the test tubes.
- יג. Place the test tubes א-ד in the bath, and write down the time: _____.

- יד. Wait 10 minutes. Make sure that the water temperature in the bath remains in the range 35°C - 37°C .
- While waiting, answer Question **64. א.**

(9 points) **64. א.** In your notebook, make a table and summarize the experiment that you performed (starting with Item ח) in the table. Include the results of the tests you performed in Item י in the table and **also** two empty columns: Column I and Column II, to be used for the results of the experiment.

- טו. 10 minutes after the time you recorded in Item יג, transfer the test tubes from the bath to the test tube rack.
- Add 4 drops of base solution to each of the test tubes.
Read Informative Note 2 again.
 - Gently shake the test tubes.

Answer Questions **64. ב. - 69.**

(4 points) **64. ב.** Write down the color obtained in each of the test tubes in Column I of the table in your notebook.

You have an attachment: **Color Scale** ["סולם צבעים"]. It shows a set of rectangles, each with a different shade of color. Each shade is given a value (in relative units) that represents the concentration of phenolphthalein.

Note: For the value 0 of phenolphthalein, there is **also** a light brown rectangle, which represents the color of the extract after the change that occurs in it over time. This color change is **not** connected to the process being examined.

(4 points) **65. א.** Compare the color of the liquid in Test Tube א to the shades on the color scale, and record the appropriate value for the relative concentration of phenolphthalein in Column II of the table in your notebook.

Note: If necessary, you may use intermediate values, such as 4.5.

- Repeat for Test Tubes ב-ד.

(6 points) **ב.** Add appropriate headings to all the columns in the table.

- Add a heading to the table.

(6 points) **66. א.** What is the independent variable in your experiment?

(6 points) **ב.** What is the dependent variable in your experiment?

- (8 points) **67.** It has been found that the pH level in plant cell cytoplasm is 7.4, whereas in the vacuole, the pH level is 5.4. Where would you expect phosphatase enzyme activity to be higher in plant cells — in the cytoplasm or in the vacuole? Base your answer on the results of the experiment you performed in Part ב.
- (3 points) **68. א.** List three factors that were kept constant in the experiment that you performed.
- (4 points) **ב.** Choose one of the factors that you listed, and explain why it was important to keep this specific factor constant in the experiment that you performed.
- (6 points) **69.** A research laboratory performed an experiment similar to the one you performed. In it, they tested extracts that were prepared from 10 bananas at the same stage of ripening. Explain what is the advantage of drawing a conclusion from the experiment performed in the research laboratory.

Part ג – Analysis of Research Results: The Difference in Phosphatase Activity in Bananas at Different Degrees of Ripeness

Researchers stored a large number of unripe bananas whose peels were green at a constant temperature. During storage, the bananas ripened and the color of their peels changed. The researchers defined the degree of ripeness according to the color of the peel. They wanted to examine how the rate of activity of the enzyme phosphatase changes at different degrees of ripeness.

At each time interval, the researchers took samples from 10 bananas that were at the same stage of ripeness, prepared extracts from them, and examined the rate of phosphatase activity in them. The results of the experiment are detailed in Table 2 below.

Table 2

Degree of Ripeness According to Color of Peel	Average Rate of Phosphatase Activity (micromoles of product/minute/gram of fruit)
Dark green	2
Green with a little yellow	4
Yellow with a little green	8
Yellow	10
Yellow with a few black spots	13
Yellow with many black spots	17

/continued on page 9/

Answer Questions **70-72**.

- 70.** You are asked to present the experimental results shown in Table 2 in graphical form.
- (3 points) **א.** What type of graphical representation is most appropriate to describe the results — a continuous graph or a bar graph?
Explain your answer.
- (7 points) **ב.** Graph paper has been provided for you in the attachment. Present the results from Table 2 on it in an appropriate graphical form.
- (4 points) **ג.** Do the results you obtained in Part א (Question **63**) match the results obtained by the researchers, with respect to the activity of the phosphatase? Explain.
- (3 points) **71. א.** The phosphate produced in cells from the activity of the enzyme phosphatase is an essential structural component of various compounds.
Name three compounds that are found in cells and are organic and contain phosphate.
- (3 points) **ב.** Choose one of the compounds you named in Item א and explain its importance to cell activity.
- (6 points) **72.** During the banana's ripening process, the rate of cellular respiration increases. Sometimes it is desired to slow down the ripening process that occurs in storage.
Suggest one possible way to change storage conditions, so as to slow down the ripening process.
Explain your suggestion.

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

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

Good luck!

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