

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 1

בעיה 1

יש לרשום את מספר תעודת הזהות שלך כאן:

Write your ID number here:

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Instructions:

הוראות:

א. Duration of the exam: Three hours

א. משך הבחינה: שלוש שעות.

ב. Material that may be used during the exam:

ב. חומר עזר מותר בשימוש:

- (1) Calculator
- (2) Hebrew-foreign language / foreign language-
Hebrew dictionary

- (1) מחשבון
- (2) 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 you obtained, even if they are not as expected.

- (1) יש לקרוא את ההנחיות ביסודיות, ולשקול היטב את הצעדים.
- (2) יש לרשום בעט את כל התצפיות והתשובות (גם סרטונים).
- (3) יש לבסס את התשובות על תצפיותיכם ועל התוצאות שקיבלתם, גם אם הן אינן תואמות את הצפוי.

Write in the exam booklet only. Write the word "טיוטה" at the top of each page you use as a draft page. If you write any draft material outside the exam booklet, your exam may be disqualified.

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

Good Luck!

בהצלחה!

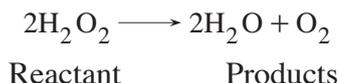
Problem 1

In this problem, you will be learning about the activity of the enzyme catalase in the cells of different plants.

The questions in this exam are numbered **1–12**. The point value of each question is given on the left of each question.

Answer all of the questions in the answer booklet.

Under certain conditions, the compound H_2O_2 , hydrogen peroxide, breaks down into water and oxygen according to the reaction:



When oxygen is released in an aqueous environment, bubbles form in the liquid, and when they accumulate, they form a layer of foam on the surface of the liquid.

Part א — Learning a method of testing the process of hydrogen peroxide [מי חמצן] decomposition

Put on the gloves and safety goggles.

On the table, you have:

- a test tube labeled "קטלאז" containing 1 ml of catalase solution
- a plate labeled "0%" containing lentil seedlings (which were germinated in distilled water)
- a container of soapy water [מי סבון]
- a container labeled "מי חמצן לחלק א" containing hydrogen peroxide solution
- a container of distilled water

- א. Use a glass marking pen to write "עדשים" [lentils] on an empty test tube.
- Choose 10 lentil seedlings from the plate labeled "0%" and transfer them to a mortar.
 - Use the pestle to crush the seedlings slightly, and then use a spoon to transfer the crushed lentils to the test tube labeled "עדשים".
- ב. Write "מים" [water] on an empty test tube.
- Write "מים" on a 1 ml pipette, and use this pipette to transfer 1 ml of distilled water to the "מים" test tube.

Note: In Item ג you will add soapy water to the test tubes. To prevent bubbles from forming while adding the soapy water to the test tubes, hold the tip of the pipette against the wall of the test tube and only then gradually release the soapy water.

- ג. Write "מי סבון" on a 5 ml pipette, and use it to add 4 ml of soapy water to each of the three test tubes labeled: קטלאז, עדשים, מים.

Notes:

- The soap will stabilize the gas bubbles formed during the reaction.
 - The soap solution is of a low concentration and does not interfere with protein activity.
- ד. Write "מי חמצן" on a 1 ml pipette and use this pipette to add 1 ml of hydrogen peroxide solution to each of the three labeled test tubes.

Do this in the same way that you added the soapy water to the test tubes in Item ג.

Write down the time _____ and wait for about 5 minutes.

While you are waiting, answer Question 1.

(6 points) 1. א. Draw a table (Table 1) **in your answer booklet** summarizing the experiment setup you prepared in Items א-ד.

Add a column to the table for recording the results.

(3 points) ב. Write suitable headings for the table and for each column.

ה. About 5 minutes after the time you noted in Item ד, check if bubbles have formed in the test tubes or if foam has formed, and mark "+" or "-" in the appropriate boxes in the table **in your answer booklet**.

Answer Question 2.

(5 points) 2. א. Suggest an explanation for the results you obtained in each of the three test tubes. Use the introduction to Part א to help you with your answer.

(4 points) ב. **Hypothesize** what the results in the "עדשים" test tube would have been, if the hydrogen peroxide solution had been more concentrated. **Explain** your answer.

ג. Place the three test tubes you used in the waste container.

Part ב — Experiment: testing the activity of the enzyme catalase extracted from the cells of lentil seedlings

ה. On your table you have three dishes with lentil seedlings. The lentil seeds were germinated in the dark for two days in solutions of the salt sodium chloride (NaCl), whose concentrations were 0%, 2%, and 4%. Each dish is marked with the concentration of the salt solution in which the seedlings were germinated. The 0% solution is distilled water.

Note: The dishes contain seedlings and swollen seeds. Both can be used in this experiment. The term "seedlings" [נבטים] will now be used to refer to both germinated seedlings and swollen seeds.

Note 1:

The salt sodium chloride (NaCl) breaks down into ions in an aqueous solution. The sodium ions penetrate the cells and affect the spatial structure of proteins.

Answer Question 3.

(4 points) 3. A student was given a flask containing 10 ml of 10% salt solution.

The student added 30 ml of distilled water to the flask. What is the concentration of the solution obtained? Show detailed calculations.

Step 1ב — Preparing lentil seedlings extracts

On the table you have a container with a buffer solution and a container with water for rinsing.

- ז. — Label each of the three test tubes with one of the concentrations marked on the germination plates: "0%", "2%", or "4%".
- ח. — Write "בופר" [buffer] on a 10 ml pipette.
- ט. Use the "בופר" pipette to transfer 15 ml of buffer solution to a mortar.
 - Use a spoon to transfer 20 seedlings from the "0%" plate to the mortar.
 - Use the pestle to crush the seedlings in the mortar for about one minute until an extract is obtained.
- י. On the table you have a funnel and pieces of gauze. Line the funnel with one piece of (folded) gauze and place the tip of the funnel in the "0%" test tube.
 - Transfer the extract from the mortar to the funnel, and wait until a filtrate is obtained in the test tube. Do not squeeze the gauze.

Note: If the liquid does not pass from the funnel to the test tube, lift the funnel up slightly without removing the tip from the test tube, and wait until the liquid does pass into the test tube.

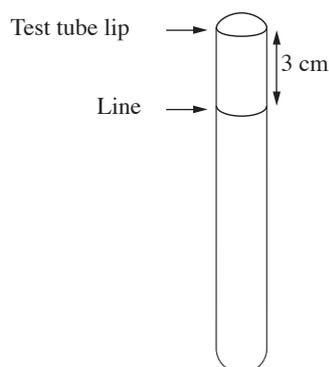
- Discard the gauze with the remains of the seedlings into the waste container.
 - Rinse the funnel and pestle and mortar over the waste container with some of the rinsing water.
- יא. Repeat the procedure described in Items ט→ using the lentil seedlings on the "2%" plate and the "2%" test tube.
 - יב. Repeat the procedure described in Items ט→ using the lentil seedlings on the "4%" plate and the "4%" test tube.

Step 2א — Testing the activity of the enzyme catalase in lentil seedling extract

On the table you have tweezers [מלקטת] and a container with small discs of absorbent paper.

- יג. Label four empty test tubes: א, ב, ג and ד. These test tubes will be experimental test tubes.
Use a ruler to mark a line 3 cm from the lip of each of the test tubes א–ד (see Figure 1).

Figure 1: Experimental test tube



- יד. Ask the proctor for some hydrogen peroxide solution labeled "מי חמצן לחלק ב" ["hydrogen peroxide solution for Part ב"].
Carry out the following steps over the waste container.
 - Pour hydrogen peroxide (for חלק ב) into each of the test tubes א–ג up to the line marked on the test tube.
 - Pour distilled water from the distilled water container into test tube ד up to the line marked on the test tube.

Note:

The exam continues on page 6.

Note: In Items טו–טז you will place paper discs on the surface of the liquid in the experimental test tubes. In some cases, the disc will sink and then float up to the surface again. Measure the length of time (in seconds) from the moment you put the disc into the test tube until the disc floats up to the surface again. Write the results in the **Reference table** (page 7).

- Take three measurements for each of the test tubes.
- To simplify your time calculations, make sure to place each disc into the liquid, according to the instructions below, when the clock shows a whole minute, for example:

10 : 05 : 00 .
(hour) (minutes) (seconds)

Note 2:

The discs float to the top because gas bubbles are released.

In Items טו–טז you will have to work quickly and efficiently. **First read the instructions and notes for these items and only then carry them out.**

- טו. Use the tweezers to pick up one paper disc, dip it entirely in the seedling extract solution in the "0%" test tube, and remove it from the test tube (do not release the disc from the tweezers).
- Use the tweezers to place the disc into experimental test tube α containing hydrogen peroxide, and release it onto the surface of the liquid.
 - Write the exact time (minutes and seconds) in the reference table **immediately**, in the column marked "Start" of Measurement I in test tube α .

Note: If the disc does not sink, use a wooden toothpick from your table to gently push the disc into the liquid.

- טז. Watch the movement of the disc, and measure the time from the moment the disc is inserted into the liquid until it floats back up to the surface of the liquid. This time interval will be referred to as the **floating time**.
- Write the exact time at which the disc reached the surface in the reference table, in the column marked "Finish" of Measurement I.
 - When you have finished measuring, remove the disc from test tube α with the toothpick, and discard the disc into the waste container.
 - Wipe the tip of the toothpick and the tips of the tweezers with a paper towel.

Notes:

- Even if the disc does not sink to the bottom of the test tube, measure the time from inserting the disc into the test tube until it floats back up to the surface.
- If the disc does not sink at all (even though you tried to push it down), write in the "floating time" column of the reference table: 0 seconds.
- If the disc is still resting at the bottom of the test tube after 2 minutes (120 seconds), stop measuring the time and write "Did not float" in the "Floating time" column. If the disc does not float on the first two measurements, do not take another measurement.
- If the disc stays at the bottom of the test tube, there is no need to remove it.

Reference table

			Disc floating time								
			Measurement I			Measurement II			Measurement III		
Experimental test tube	Concentration of salt solution in which lentils were germinated (%)	Hydrogen peroxide in experimental test tube (- / +)	Start time	Finish time	Floating time (duration in seconds)	Start time	Finish time	Floating time (duration in seconds)	Start time	Finish time	Floating time (duration in seconds)
א		+									
ב		+									
ג		+									
ד		-									

- יז. Repeat the procedure described in Items טו-זט with another paper disc dipped in the 0% test tube, and write down the measurement start time and finish time (Measurement II) in the reference table.
- Repeat the procedure described in Items טו-זט using another paper disc dipped in the 0% test tube (Measurement III).
- יח. Repeat the procedure described in Items טו-זי using discs that have been dipped in the lentil seedling extract in the "2%" test tube and the experimental test tube א containing hydrogen peroxide.
- Repeat the procedure described in Items טו-זי using discs that have been dipped in the lentil seedling extract in the "4%" test tube and the experimental test tube ג containing hydrogen peroxide.
 - Repeat the procedure described in Items טו-זי using discs that have been dipped in the lentil seedling extract in the "0%" test tube and the experimental test tube ד containing distilled water.

You do not need gloves and safety goggles for the rest of the exam, so you can take them off now.

- ט. Calculate the disc floating time in seconds: the difference between the start time and finish time for each of the measurements I-III of all the test tubes.
- Write down the results of your calculations in the reference table, in the appropriate boxes of the "Floating time" columns.
- י. Write down the concentration of the salt solutions in which the lentils were germinated in the appropriate column of the reference table.

- כא. Copy Table 2 below into your **answer booklet**. For an easier fit, you may rotate the page to draw the table.
- Copy the data you wrote in the reference table into Columns A, B, and C of Table 2 in your **answer booklet**.

Table 2

Experimental test tube	A	B	C			Calculation results: Average floating time (seconds)
	Concentration of salt solution in which lentils were germinated (%)	Hydrogen peroxide in experimental test tube (- / +)	Results: Disc floating time (seconds)			
			Measurement I	Measurement II	Measurement III	
א						
ב						
ג						
ד						

Answer questions 4-9.

- (8 points) 4. א. For each of the test tubes, calculate the average floating time of the three measurements I-III.
 Write the results of your calculations in the appropriate boxes in Table 2 in your **answer booklet**.
- If there are measurements in which the disc did not float to the surface again, do not include them when calculating the average.
 - If, when taking measurements for a particular experimental test tube, none of the discs floated back to the surface, write "Did not float" as the calculation result.
- (5 points) א. You took three measurements for each of the test tubes א–ד.
 Explain why it was important to repeat the measurements in this experiment.
- (3 points) 5. א. Write a heading for Table 2 in your **answer booklet**.
- (3 points) א. What is the independent variable in the experiment you conducted in Part ב?
- (3 points) 6. א. What is the dependent variable in the experiment you conducted in Part ב?
- (5 points) א. Explain why measuring the disc's floating time is an appropriate way of measuring the dependent variable.
- (6 points) 7. Suggest an explanation for the results of the experiment, using the information in Note 1 on page 3.

- (3 points) 8. א. The procedure in test tube 7 is a control procedure. Why is this control procedure important in this experiment?
Below are four possible answers.
Choose the correct answer and **copy it into your answer booklet**.
- to prove that the disc's floating time can be more than 120 seconds
 - to prove that the disc's floating time is affected by the amount of extract on the disc
 - to prove that the disc's floating is also affected by the presence of catalase
 - to prove that the disc's floating is also affected by the presence of hydrogen peroxide in the solution
- (4 points) ג. The experiment you conducted in Part 2 had an additional control procedure. What was it?
Why was it important to include this additional control procedure in the experiment too?
- (2 points) 9. א. Name two factors that remained constant in the experiment you carried out.
- (4 points) ג. Choose one of the factors you named and explain why it was important to keep this **specific** factor constant in the experiment.

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

Part 3 – Analyzing research results: Adaptations of Bermuda grass [צמח היבלית] to its habitat

When farmland is irrigated with treated waste water [מי קולחין], the salt concentration in the soil increases. An additional cause of high soil salinity is a high level of evaporation of water from the soil. High soil salinity is one of the abiotic factors that affect the development of plants.

Researchers have found varieties of Bermuda grass that are adapted to saline conditions, in other words, they can grow in soils that contain a high concentration of salts. Understanding the mechanisms by which plants adapt to saline soil conditions will be useful in developing plants that can grow in these conditions.

Experiment 1:

The researchers cultivated two varieties of Bermuda grass, Variety A and Variety B, of the same age in solutions of different concentrations of the salt NaCl .

After three weeks, they prepared extracts of both grass varieties and measured the concentration of hydrogen peroxide (H_2O_2) in the extracts. Hydrogen peroxide is a by-product of cellular respiration and is toxic to cells.

The results of the experiment are shown in Table 3 below.

Table 3

Concentration of the salt NaCl in the growth medium (%)	Concentration of hydrogen peroxide in the extract (relative units)	
	Variety A	Variety B
0	2.5	2.5
0.3	2.3	2.5
0.5	2.5	2.7
0.7	2.3	3.5
1.0	2.4	4.7

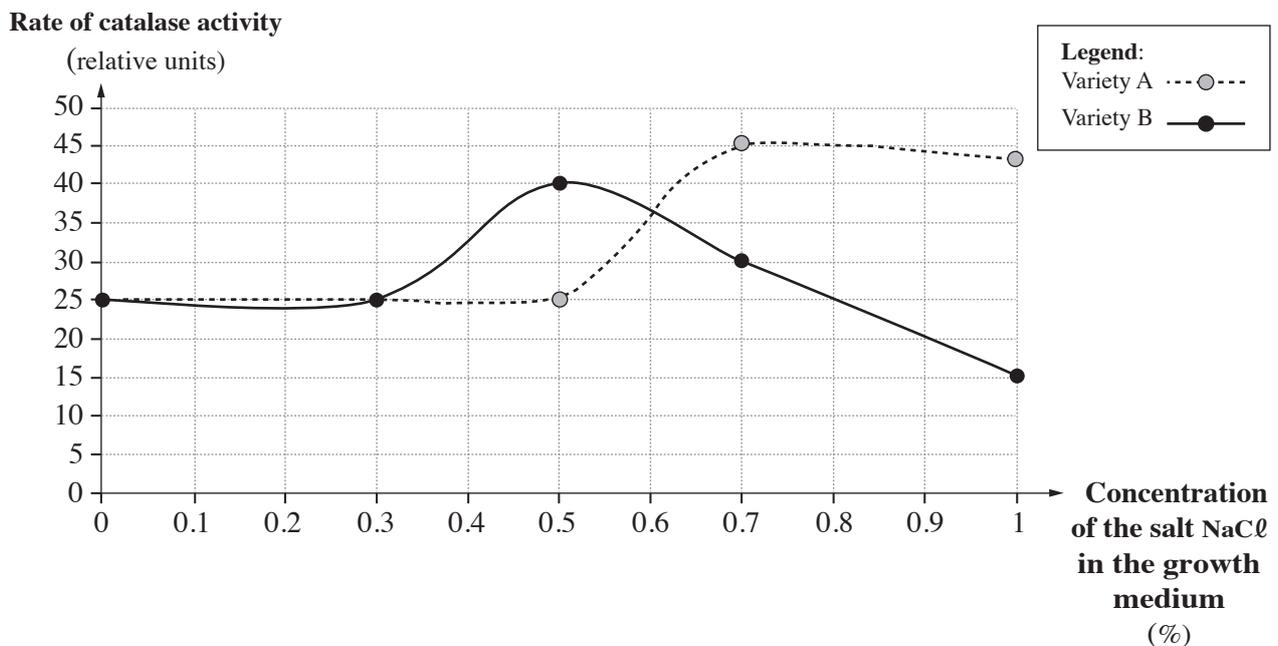
- (10 points) **10.א.** (1) What type of graphical representation is most suited to describing the results shown in Table 3, a continuous graph or a bar diagram? Explain your answer.
(2) Draw a suitable graphical representation of the results in Table 3 in **your answer booklet**.
- (6 points) **א.** Describe the results of Experiment 1, based on the graphical representation.

Experiment 2:

The researchers examined the activity rate of the enzyme catalase in both varieties of Bermuda grass that they had grown.

The results of the experiment are shown in the graph below.

The effect of salinity on the rate of catalase activity in two varieties of Bermuda grass



- (2 points) 11. א. Use the information given in the description of Experiment 1 on page 10 and the results of Experiments 1 and 2 carried out by the researchers to determine which variety of Bermuda grass, Variety A or B, is adapted to growing in saline conditions of 0.7% salt and above, and which variety is not adapted to these saline conditions.
- (5 points) א. Explain your answers in Item א regarding each of the two varieties, based on the results of Experiments 1 and 2 conducted by the researchers.
- (4 points) 12. א. Use your answer to Question 7 to suggest one reason for the difference between the results of the experiment you conducted in Part א and the results obtained for the **adapted** variety in the researchers' Experiment 2.
- (5 points) א. **List** an additional effect of soil salinity on plants, aside from the effect described in Note 1 on page 3. **Explain** how this effect impacts the plants.

Give the proctor your exam paper and your answer booklet.

Good Luck!

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בהצלחה!

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