State of Israel
Ministry of Education
Type of exam: *Bagrut*
Exam date: Summer 2022
Exam number: 43386
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשפ"ב, 2022
מספר השאלון: 43386
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 3

בעיה 3

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

Instructions:

א. Duration of the exam: Three hours

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

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

הוראות:

א. משך הבחינה: שלוש שעות.

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

ג. הוראות מיוחדות:
(1) יש לקרוא את ההנחיות ביסודיות, ולשקול היטב את הצעדים.
(2) יש לרשום בעֵט את כל התצפיות והתשובות (גם סרטוטים).
(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 3

In this problem, you will be learning about the activity of the enzyme catalase from cells of various plant.

The questions in this exam are numbered **25–36**. 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 [מי חמצן], decomposes into water and oxygen according to the reaction: $2H_2O_2 \longrightarrow 2H_2O + O_2$

Reactant Products

When the gas 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 decomposition

Put on the gloves and safety goggles.

On the table, you have:
- a test tube labeled "קטלאז" containing 1 ml of a solution of the enzyme catalase
- a plate containing a quarter of a slice of kohlrabi in a bag, labeled "חלק א"
- 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 "מים" [water] on an empty test tube.
- Write "מים" on a 1 ml pipette and use this pipette to transfer 1 ml distilled water to the test tube labeled "מים".

ב. Write "קולרבי" [kohlrabi] on an empty test tube.
- Use a grater to carefully grate some of the kohlrabi slice over the plate.
- Transfer a quarter spoon of the grated kohlrabi from the plate to the test tube labeled "קולרבי".
- Use the pipette labeled "מים" to push the grated kohlrabi down to the bottom of the test tube.

Note: In Item ג you will add soapy water solution to the test tubes. To prevent soap 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 the soapy water solution to each of the three test tubes labeled: קטלאז, קולרבי, 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.

/continued on page 3/

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 solution to the test tubes in Item ג.
Write down the time _____ and wait for about 5 minutes.

While you are waiting, answer Question **25**.

(6 points) **25.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 liquid in the test tubes or if foam has formed over the liquid, and mark "+" or "–" in the appropriate boxes in the table **in your answer booklet**.

Answer Question **26**.

(5 points) **26.א.** Suggest an explanation for the results you obtained in <u>each</u> 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 "קולרבי" test tube would have been, if the hydrogen peroxide solution you added had been more concentrated. **Explain** your answer.

ו. Place the piece of kohlrabi you used, the remaining grated kohlrabi, and the three test tubes in the waste container.

Part ב — Experiment: testing the activity of the enzyme catalase from kohlrabi

<u>Step ב1 — Prepare salt solutions with different concentrations</u>

On your table there are three small beakers, a container of a 4% solution of the salt sodium chloride ($NaC\ell$) and a kohlrabi slice in a plastic bag labeled "קולרבי חלק ב" [kohlrabi Part ב].

ז. Mark the beakers: 1, 2, 3.

— On your table you have two 10 ml pipettes. Mark one pipette "תמיסת מלח" [salt solution] and the other "מים" [water].

— Use the appropriate pipettes to transfer distilled water and 4% salt solution to beakers 1-3, as described in Table 2.

Table 2

Beaker	**Volume of distilled water** (ml)	**Volume of 4% salt solution** (ml)	**Final concentration of salt solution** (%)
1	20	–	
2	10	10	
3	–	20	

/continued on page 4/

Step ב2 — Preparing kohlrabi cylinders

ח. On the table you have a corer [קודח פקקים] and a swab.

— Place the kohlrabi slice flat side down on a paper towel.

— Use the corer to prepare 12 kohlrabi cylinders [גלילים] as follows:
Holding the corer perpendicular to the slice of kohlrabi, press the wide end of the corer into the slice to punch out a cylinder, as shown in figure 1א. Then pull the corer out, and use the inside part of the corer (or the swab) to extract the cylinder you created.

Figure 1

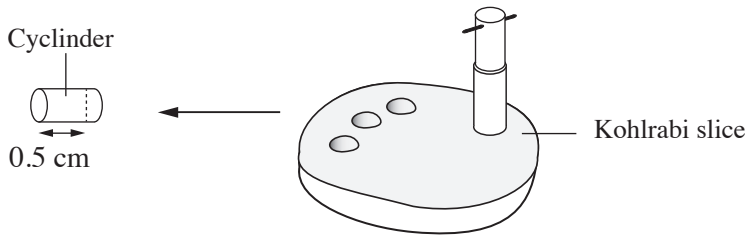

Figure 1ב: Trimming the cylinder **Figure 1א: Punching out kohlrabi cylinders**

— Place the kohlrabi cylinders on a paper towel.

— Repeat these steps until you have 12 cylinders.

Note: If a cylinder is damaged, prepare a new one.

ט. Use the cylinders you prepared to make 12 kohlrabi cylinders that are each 0.5 cm long.
Do as follows:

— Using a ruler, trim the ends of the kohlrabi cylinders with a knife to a length of 0.5 cm (see figure 1ב).

— Repeat the procedure with the remaining cylinders until you have 12 cylinders that are 0.5 cm long.

— Place the remaining cylinders and the slice of kohlrabi in the waste container.

י. On the table you have a beaker with water labeled "מי שטיפה" [rinsing water].
Use a spoon to transfer all the cylinders to the beaker of rinsing water, and gently mix the water and the cylinders.

— Remove the cylinders and place them on a paper towel.

— Use a spoon to transfer 4 kohlrabi cylinders to each of the beakers 1-3.

— Write down the time _____ and wait at least 10 minutes.

While you are waiting, read Note 1, and answer Question **27.**

Note 1:
The salt sodium chloride ($NaC\ell$) breaks down into ions in an aqueous solution. The sodium ions penetrate the cells and affect the spatial structure of the proteins.

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Answer Question **27**.

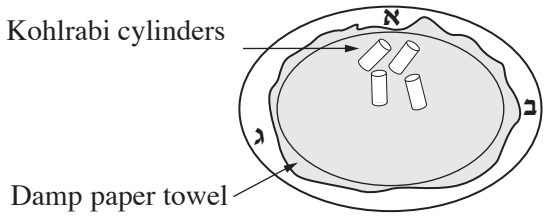
(2 points) **27**. Calculate the final concentrations of the salt solutions in <u>each</u> of the beakers 1-3, and write down the concentrations in the correct places in Table 2 on page 3 of your exam paper.

<u>Note</u>: The concentration of the salt solution that you used is 4%.

יא. On the table you have a plate lined with a damp paper towel, and the areas א, ב, ג are marked on the rim of the plate.

— When 10 minutes have passed from the time you recorded in Item י, take a spoon and remove the kohlrabi cylinders from Beaker **1** and put them in area **א** of the lined plate (see Figure 2).

Figure 2: Laying kohlrabi cylinders on the lined plate



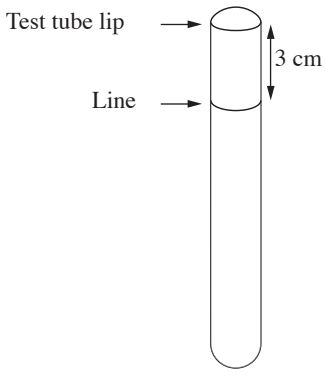
— In the same way remove the cylinders from beakers **2, 3** and put them in their corresponding areas **ב**, **ג** on the plate, respectively.

<u>Step 3ב — Testing the activity of the enzyme catalase in kohlrabi</u>

יב. Label three empty test tubes: א, ב, ג. 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-ג** (see Figure 3).

Figure 3: Experimental test tube



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 into <u>each</u> of the test tubes **א-ג** up to the marked line.

/continued on page 6/

יג. Copy the concentrations of the salt solutions in which the kohlrabi cylinders were soaked, from Table 2 to the appropriate column in the **reference table** (page 7).

Note: In Items טו–יד you will place kohlrabi cylinders on the surface of the liquid in the experimental test tubes. In some cases, the cylinder will sink and then float up to the surface again. Measure the length of time (in seconds) from the moment you put the cylinder into the test tube until the cylinder floats up to the surface again. Write the results in the **reference table**.

— Take three measurements for each of the test tubes.

— To simplify your time calculations, make sure to place each cylinder 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 kohlrabi cylinders float because gas bubbles are released.

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

יד. Use a spoon to transfer one kohlrabi cylinder from area **א** on the plate to test tube **א** which contains hydrogen peroxide.

— Write the exact time (minutes and seconds) in the reference table **immediately**, in the column marked "Start time" of Measurement I in test tube א.

Note: If the cylinder does not sink, use the swab to gently push the cylinder into the liquid.

טו. Watch the movement of the cylinder in the test tube, and measure the time from the moment the cylinder is inserted into the liquid in the test tube until it floats back up to the surface.

This time interval will be referred to as the **floating time**.

— Write the exact time at which the cylinder reaches the surface in the reference table, in the column marked "Finish time" of Measurement I.

— When you have finished measuring, use the tweezers from your table to remove the cylinder from test tube **א**, and discard it into the waste container.

— Wipe the spoon and the tips of the tweezers with a paper towel.

Notes:

— Even if the cylinder does not sink to the bottom of the test tube, measure the time from the moment of inserting the cylinder into the test tube until it floats back up to the surface.

— If the cylinder does not sink at all (even though you tried to push it down), write in the "floating time" column: 0 seconds.

— If the cylinder 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 reference table. If the cylinder does not float on the first two measurements, do not take another measurement.

— If the cylinder stays at the bottom of the test tube, there is no need to remove it.

/continued on page 7/

Reference table

			Cylinder floating time								
			Measurement I			Measurement II			Measurement III		
Experimental test tube	**Concentration of salt solution in which the kohlrabi cylinders were soaked** (%)	**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		+									

טז. Repeat the procedure described in Items טו–יד with another kohlrabi cylinder from area **א**, and write down the start time and finish time of the measurement in the reference table (Measurement II).

— Repeat the procedure described in Items טו–יד using another kohlrabi cylinder from area **א** (Measurement III).

יז. Repeat the procedure described in Items טז–יד using kohlrabi cylinders from area **ב** on the plate and the experimental test tube **ב**.

— Repeat the procedure described in Items טז–יד using kohlrabi cylinders from area **ג** on the plate and the experimental test tube **ג**.

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

יח. Calculate the cylinder floating time in seconds: the difference between the start time and finish time for each of the measurements I-III in all the test tubes.

— Write down the results of your calculations in the reference table, in the appropriate places in the "floating time" columns.

/continued on page 8/

יט. Copy Table 3 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 3 in your **answer booklet**.

Table 3

	A	B	C			
Experimental test tube	**Concentration of salt solution in which the kohlrabi cylinders were soaked** (%)	**Hydrogen peroxide in experimental test tube**	**Results: Cylinder floating time** (duration in seconds)			**Calculation results: Average floating time** (duration in seconds)
			Measurement I	**Measurement II**	**Measurement III**	
א						
ב						
ג						

Answer questions **28-33**.

(8 points) **28.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 3 in your **answer booklet**.

— If there are measurements in which the cylinder did not float back up to the surface, do not include them when calculating the average.

— If, when taking measurements for a particular experimental test tube, none of the cylinders floated back to the surface, write "Did not float" as the calculation result.

(5 points) **ב.** You took three measurements for each of the test tubes א-ג.
Explain why it was important to repeat the measurements in this experiment.

(3 points) **29.א.** Write a heading for Table 3 in your **answer booklet**.

(3 points) **ב.** What is the independent variable in the experiment you conducted in Part ב?

(3 points) **30.א.** What is the dependent variable in the experiment you conducted in Part ב?

(5 points) **ב.** Explain why measuring the cylinder's floating time is an appropriate way of measuring the dependent variable.

(6 points) **31.** Suggest an explanation for the results of the experiment, using the information in Note 1 on page 4.

/continued on page 9/

(4 points) **32. א.** The experiment you conducted in Part ב included a control procedure. What is a control procedure? Why is this control procedure important in this experiment?

A student suggested carrying out an additional control procedure for this experiment in which experimental test tube ד contains distilled water and not hydrogen peroxide. A kohlrabi cylinder soaked in distilled water is placed in the experimental test tube (as in beaker 1).

(2 points) **ב.** Hypothesize whether the cylinder in the test tube will sink or float. Explain your answer.

(3 points) **ג.** Why is the control procedure suggested by the student important?
Below are four possible answers. Choose the correct answer and **copy it into your answer booklet**.

- To prove that the cylinder's floating time can be more than 120 seconds
- To prove that the cylinder's floating is also affected by the presence of the enzyme catalase
- To prove that the cylinder's floating time is affected by its size
- To prove that the cylinder's floating is also affected by the presence of hydrogen peroxide in the solution

(2 points) **33. א.** Name <u>two</u> factors that remained constant in the experiment you carried out.

(4 points) **ב.** Choose <u>one</u> of the factors you named and explain why it is important to keep this **specific** factor constant in the experiment.

[Note: The exam continues on the next page.]

/continued on page 10/

Part ג — 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 4 below.

Table 4

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) **34.א.** **(1)** What type of graphical representation is most suited to describing the results shown in Table 4, a continuous graph or a bar diagram? Explain your answer.

(2) Draw a suitable graphical representation of the results in Table 4 in **your answer booklet**.

(6 points) **ב.** Describe the results of Experiment 1, based on the graphical representation.

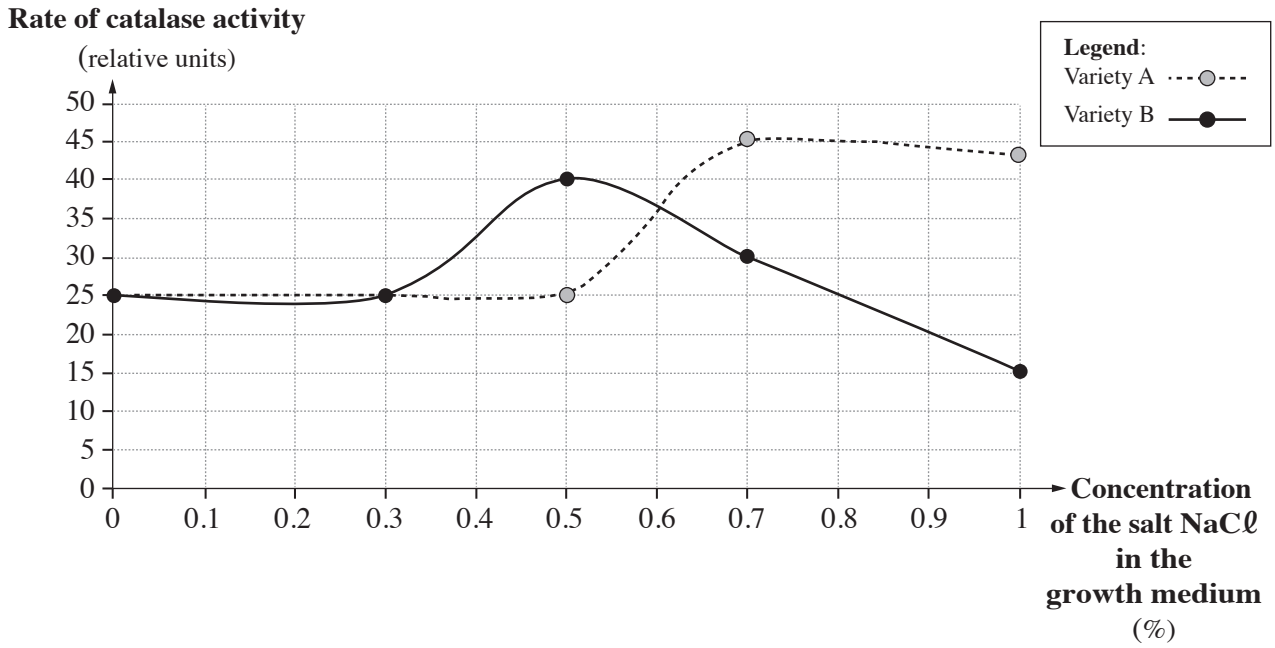
/continued on page 11/

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) **35.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) **ב.** Explain your answers in Item א regarding <u>each</u> of the two varieties, based on the results of Experiments 1 and 2 conducted by the researchers.

(4 points) **36.א.** Use your answer to Question **31** to suggest <u>one</u> reason for the difference between the results of the experiment you conducted in Part ב and the results obtained for the **adapted** variety in the researchers' Experiment 2.

(5 points) **ב.** **List** an additional effect of soil salinity on plants, aside from the effect described in Note 1 on page 4. **Explain** how this effect impacts the plants.

Give the proctor your exam paper and your answer booklet.

Good Luck!