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English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשפ"ג, 2023
מספר השאלון: 43386
תרגום לאנגלית (3)

Practical Exam in Biology

בחינת בגרות מעשית בביולוגיה

Problem 5

בעיה 5

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

Instructions for examinees:

א. Duration of the exam: Three hours

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

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

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

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

ג. הוראות מיוחדות:
(1) יש לקרוא את ההנחיות ביסודיות, ולשקול היטב את צעדיכם.
(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 5

In this problem, you will examine factors that affect the process of cellular respiration in yeast.

The questions in this exam are numbered **49–60**. The point value of each question is given on the left.

Write all of your answers in the answer booklet.

Part א — Learning a method of measurement

Step א1: Learning the properties of phenolphthalein indicator

On the table, you have:
- a container of distilled water
- a dropper bottle containing a solution of phenolphthalein
- a test tube containing a basic solution of sodium hydroxide (NaOH) Caution! Avoid skin contact with the basic solution.
- a Pasteur pipette labeled "NaOH"
- a solution of hydrochloric acid (HCl). Caution! Avoid skin contact with the acid solution.

Put on the gloves and safety goggles.

א. Use a glass marking pen to label three test tubes: א, ב, ג.
- Write "מים" on a 10 ml pipette.
- Use the pipette to transfer 3 ml of distilled water to each of the test tubes א, ב, ג.
- Add 2 drops of phenolphtalein solution to each of the three test tubes. Gently shake the test tubes.

ב. Use the "NaOH" Pasteur pipette to add 3 drops of the base NaOH to Test Tube **א** and gently shake the test tube.

ג. Add one drop of HCl acid to Test Tube **ב** and gently shake the test tube.
- Add 3 drops of HCl acid to Test Tube **ג** and gently shake the test tube.

Answer Question **49**.

(5 points) **49.א.** Copy Table 1 below into your **answer booklet.**
Observe the solutions you obtained in the test tubes after adding drops of base or acid. Determine the color of the solution in each of the test tubes and write the color (pink or colorless) in the appropriate place in the table in your answer booklet (in Step I in the table).

Table 1

Step I				Step II
Test Tube	**Volume of NaOH base** (number of drops)	**Volume of HCl acid** (number of drops)	**Color of the resulting solution** (pink/colorless)	**Results: number of drops of NaOH base added until pink color is obtained**
א	3	–	–	–
ב	–	1	–	–
ג	–	3	–	–

(2 points) **ב.** Copy the two sentences below into **your answer booklet** and fill in the missing word in each sentence.

The color of phenolphthalein indicator in a basic environment is _____.

The color of phenolphthalein indicator in an acidic environment is _____.

/continued on page 3/

Step א2: Learning a method for measuring the amount of acid in a solution (titration)

In the next part of the experiment, you will **gradually** add drops of a base to each of the solutions in Test Tubes ב–ג, and you will **count** the drops.

Read the instructions in Items ד–ה before you start carrying them out.

Work carefully and accurately.

ד. Take Test Tube **ב** out of the test tube rack and use the "NaOH" Pasteur pipette to add the basic NaOH solution drop by drop to the test tube. Shake the test tube after you add each drop. **Count the drops** until the solution in Test Tube ב remains a stable pink for 10 seconds – **the color should be as close as possible to the color of the solution obtained in Test Tube א.**

- Put the test tube back in the test tube rack.
- Write the number of drops that you added to Test Tube **ב** in the appropriate place in Table 1 (in Step II in the table) **in your answer booklet**.

ה. Take Test Tube **ג** out of the test tube rack and repeat the procedure described in Item ד with this test tube.

Answer Question **50**.

(4 points) **50.** Explain why each of the test tubes ב–ג requires a **different** number of drops to obtain a color similar to the color of the solution in Test Tube א.

Put Test Tubes א–ג in the waste container.

/continued on page 4/

Part ב – Experiment: The effect of ethanol and glucose on the rate of cellular respiration in yeast

Note 1
Ethanol is a substance that dissolves fats and modifies the spatial structure of proteins.

On the table, you have:

- a Petri dish with yeast fixed in agar
- a short straw
- a plate lined with a damp paper towel
- a test tube containing a 70 % ethanol solution
- a test tube containing a 0.5M solution of glucose

Step ב1: Preparing discs of yeast fixed in agar

You will be preparing discs from the agar in the dish, using a straw, according to the instructions in Item ו below. **Read the instructions to the end and only then carry them out**.

Figure 1: Preparing discs of yeast fixed in agar

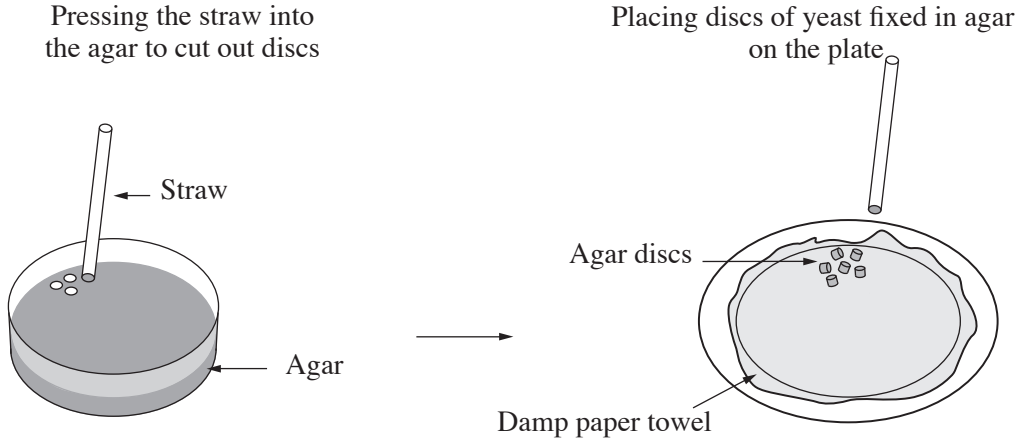

Figure 1א:
Preparing discs from the agar

Figure 1ב:
Placing discs on the plate

ו. Hold the straw and press it into the agar until it reaches the bottom of the dish (see Figure 1א). Give the straw a half turn, tilt it slightly, and pull it out of the agar. Note: There is a disc of agar inside the straw now.

– Repeat the procedure two more times so that you have 3 discs inside the straw.

– Now remove the discs from the straw and place them on the lined plate, as follows:
Hold the straw in the middle and squeeze it with your fingers. Continue squeezing a few more times, every time moving your fingers a little further down the straw. By squeezing the straw, you will push the agar discs down the straw until they are released onto the plate.

– Repeat the procedure until you have 40 discs on the plate.

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Note 2
Agar is a substance with a jello-like texture that is not harmful to yeast cells. When discs of yeast fixed in agar are soaked in a solution, the agar allows the passage of substances from the external solution into the yeast cells and from the yeast to the solution.

ז. Label four test tubes:1, 2, 3, 4. Mark them on the upper part of each test tube, close to the rim.

ח. Write"אתנול" on a 10 ml pipette.

Based on the information in Table 2 below:

– Use the "מים" pipette (from Part א) to add distilled water to Test Tubes 1–4.

– Use the "אתנול" pipette to add only ethanol to Test Tube 4.

Table 2

Test Tube	**Volume of distilled water** (ml)	**Volume of 70 % ethanol solution** (ml)
1	5	0
2	9	0
3	9	0
4	0	4.5

ט. On the table, you have a container labeled "אמבט מים" [water bath], a container with tap water, a thermometer, and caps for the test tubes.

– Ask the lab teacher for hot water and prepare a water bath with a temperature between 38°C–42°C.

– Use tap water from the container labeled "מי ברז" if necessary. Check that the water level in the water bath reaches the line marked on the outside or inside of the water bath. If the water level in the water bath is above the marked line, pour the excess water into the waste container.

י. Use a spoon to carefully place 8 discs of yeast fixed in agar in each of Test Tubes 1–4. Be careful not to squash the discs. Do not add broken discs (that were damaged during the preparation process) to the test tubes.

יא. **Cap** the test tubes and put them into the water bath.

– Write the time ————————; wait 6 minutes.

– While you are waiting, carry out the instructions in Item יב, and check that the water bath temperature remains within range, adjusting it if necessary.

יב. Write "גלוקוז 1" on a 10 ml pipette.

– Write "גלוקוז 2", "גלוקוז 3", and "גלוקוז 4" on three 1 ml pipettes.

יג. 6 minutes from the time you recorded in Item יא, remove the test tubes from the water bath, shake them gently, and place them in the test tube rack.

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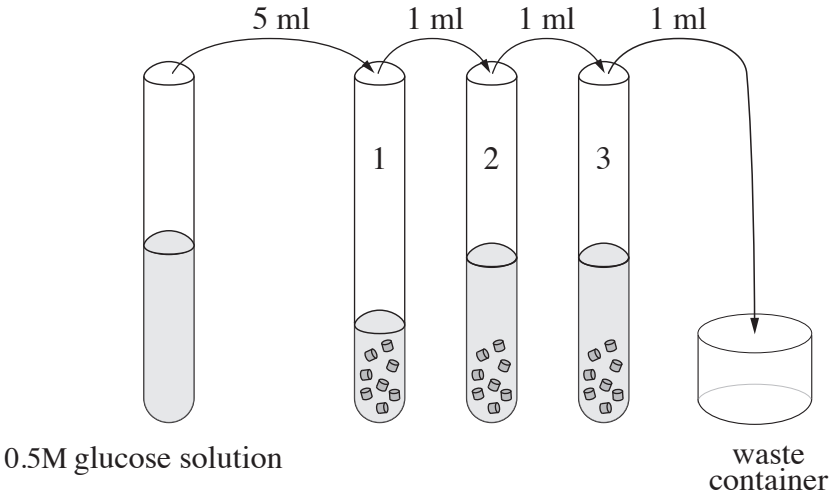
יד. **Read the instructions in this item before you start carrying them out.**

You have been given a 0.5M solution of glucose. You will be preparing solutions with different concentrations of glucose according to the following instructions:

- Use the "גלוקוז 1" pipette to transfer 4.5 ml of 0.5 M glucose solution to Test Tube **4**. Gently shake Test Tube 4.
- Use the "גלוקוז 1" pipette to transfer 5 ml of 0.5 M glucose solution to Test Tube **1** (see Figure 2). Gently shake Test Tube 1 to mix the solution.
- Use the "גלוקוז 2" pipette to transfer 1 ml of solution from Test Tube **1** to Test Tube **2** (see Figure 2). Gently shake Test Tube 2.
- Use the "גלוקוז 3" pipette to transfer 1 ml of solution from Test Tube **2** to Test Tube **3** (see Figure 2). Gently shake Test Tube 3.
- Use the "גלוקוז 4" pipette to transfer 1 ml of solution from Test Tube **3** to the waste container (see Figure 2).

Figure 2: Preparing glucose solutions of different concentrations



טו. **Cap** Test Tubes 1–4 again and gently shake them to mix the solutions.

- Make sure that the numbers marked on the test tubes have not been erased and write them again if necessary.

טז. Check that the water bath temperature is kept within the range of 38°C–42°C and adjust it if necessary.

- Put Test Tubes 1–4 into the water bath.
- Write down the time: ————————, and wait 10 minutes.
- While you are waiting, carry out the instructions in Item יז below and read Item יח (without carrying out any action).

  Check that the water bath temperature is within the range.

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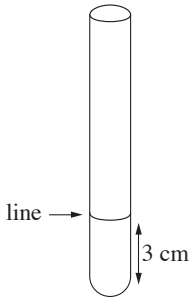
יז. Label four empty test tubes: A, B, C, D.

– Use a ruler to mark a line on each of Test Tubes A–D, 3 cm from the bottom of the test tube (see Figure 3).

Figure 3 : Marking Test Tubes A–D



– Put Test Tubes A–D in the test tube rack in the row closest to you.

– On the table, you have new Pasteur pipettes; label them 1A, 2B, 3C, 4D.

יח. 10 minutes after the time you recorded in Item טז, take Test Tubes 1–4 out of the water bath and put them in the test tube rack in the following order:
Place Test Tube 1 behind Test Tube A, Test Tube 2 behind Test Tube B, and Test Tubes 3 and 4 behind Test Tube C and D, respectively.

יט. Use the Pasteur pipette 1A to transfer the solution from Test Tube 1 to Test Tube A up to the line marked on the test tube.

– Repeat the procedure with Pasteur pipette 2B to transfer solution from Test Tube 2 to Test Tube B.

– Repeat the procedure with the appropriate Pasteur pipettes and with Test Tubes 3 and C, and 4 and D, respectively.

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Step ב2: Testing the relative amount of acid in each of Test Tubes A–D

Note 3
The reaction between carbon dioxide (CO_2) and water forms an acid (carbonic acid).

כ. Add 2 drops of phenolphthalein to each of Test Tubes A–D.

Read the instructions in Item כא before you carry them out.

כא. Take Test Tube A out of the test tube rack.

– Use the "NaOH" Pasteur pipette to add basic NaOH solution drop by drop to Test Tube A, shaking the test tube after you add each drop. **Count the drops** until the solution remains a stable pink for 10 seconds.

Note: The intensity of the pink color you obtained here may be weak compared to the color you obtained in Part א of the experiment.

– Write the number of drops of NaOH base you added to Test Tube A: _____ drops.

Note: After you put the test tube back in the test tube rack, the color of the solution in the test tube may change; ignore this change.

כב. Repeat the procedure you carried out in Item כא with Test Tubes B, C and D, and count the drops you add until the solution remains a stable pink – **the color should be as close as possible to the color of the solution obtained in Test Tube A**.

Write the number of drops that you added in Test Tube B: _____ drops;
in Test Tube C: _____ drops;
in Test Tube D: _____ drops.

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

Answer Questions **51-57**.

(6 points) **51**. **Calculate** the concentration of glucose in each of the solutions in Test Tubes 1–3 from Item יד at the stage when each test tube contained 10 ml of solution (before you removed some solution from the test tube).

Calculate the concentration of glucose in the solution in Test Tube 4 from Item יד when the test tube contained 9 ml.

Note: the concentration of glucose in the solution you transferred to Test Tubes 1 and 4 is 0.5 M.

Write the results of your calculations in your answer booklet.

Provide detailed calculations for Test Tubes 1 and 2 only.

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

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(7 points) **52.** **א.** Below is a list of four of the components of the experiment you conducted in Part ב. **Copy them into your answer booklet.**

For each component write **in your answer booklet** whether it is a constant factor or a dependent variable or a method for measuring the dependent variable.

Components of the experiment:

- number of drops of NaOH base required for the color of the solution to turn pink
- cellular respiration rate in yeast fixed in agar
- temperature of water in the water bath
- number of drops of phenolphthalein

(3 points) **ב.** The presence of ethanol in the test tubes is an independent variable in the experiment you conducted.

What is the other independent variable in the experiment?

(13 points) **53.** **א.** In your **answer booklet**, draw a table summarizing the experiment setup and the results. Your table should include only the following components:

- glucose concentration (Question 51)
- volume of ethanol solution (Table 2)
- presence of discs of yeast (Item י)
- experiment results in Test Tubes A–D (Items כא–כב).

(4 points) **ב.** – Give the table a title.

– Give a heading to each column in the table.

(4 points) **54.** You added 8 discs of yeast fixed in agar to each of the solutions in the experiment. Explain why it was important that the number of discs **specifically** was a constant factor in the experiment.

(6 points) **55.** **א.** Suggest an explanation for the results of the experiment you obtained in each of the test tubes A–C. In your answer refer to the information given in Notes 1 and 3 and also to the measurement method.

(4 points) **ב.** Suggest an explanation for the difference between the result you obtained in Test Tube D and the result you obtained in Test Tube A. In your answer refer also to the information given in Notes 1 and 3.

56. A student suggested adding a control treatment to the experiment setup – a test tube containing **only** 9 ml of water and 8 discs of yeast (with no added glucose solution).

(4 points) **א.** Hypothesize whether the number of drops of base required to obtain a pink color in the solution taken from this test tube would be smaller than, equal to, or greater than the number of drops you added to Test Tube A (Item כא). Explain your hypothesis.

(3 points) **ב.** Explain the importance of adding this control treatment to the experiment setup.

(4 points) **57.** Students who carried out the same experiment you conducted (in Part ב) argued that the effect of ethanol on cellular respiration rate would be similar in all living organisms. Is the students' argument correct? Explain your answer.

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Part ג – Analyzing the results of an experiment: the effect of ethanol concentration on yeast reproduction

Ethanol is one of the products of the fermentation process that occurs in yeast. Ethanol is very important in the wine industry, and is also used as biofuel, disinfectant, etc.

Ethanol at certain concentrations in the yeast's environment limits the rate of processes in the yeast cells, and their reproduction rate also slows down.

Many researchers are looking for a strain of yeast that can survive in an environment with a high ethanol concentration and reproduce rapidly.

Experiment 1

Researchers added various concentrations of ethanol to a liquid culture medium containing yeast. They tested the reproduction rate of two yeast strains for 48 hours.

Table 3 below shows data on the reproduction rate of yeast in solutions containing different concentrations of ethanol.

Table 3

	Reproduction rate of yeast (relative units)	
Concentration of ethanol (%)	**Strain A**	**Strain B**
0	1.9	2.0
4	1.9	2.1
8	1.3	1.8
10	0.7	1.6
12	0.2	1.3
16	0.0	0.5

Answer Question **58**.

(10 points) **58. א. (1)** What type of graphical representation is best suited to describe the results shown in Table 3 – a line 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) **ב.** Describe the results of Experiment 1, based on your graphical representation.

(3 points) **ג.** **Determine** which of the two strains – Strain A or Strain B – is more resistant to the effects of ethanol. **Explain** your answer. Base your answer on the results shown in the graph you drew.

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

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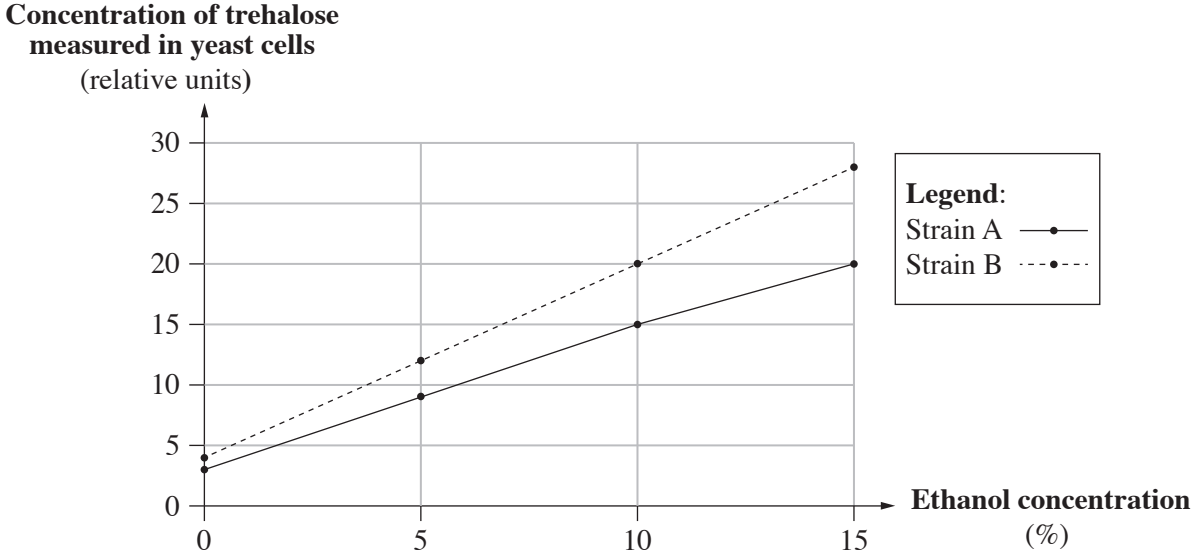
Experiment 2

Yeast cells contain a sugar – trehalose – which serves as a storage compound. Studies found that the presence of trehalose in yeast cells protects them from the damage caused by ethanol to cell membranes and proteins.

Researchers grew yeast of both strains in solutions containing ethanol at different concentrations. After a while, they measured the concentration of trehalose in the yeast cells.

The results are shown in Graph 2.

Graph 2: Effect of concentration of ethanol in the solution on the concentration of trehalose in yeast cells



Answer Questions **59–60**.

(5 points) **59**. Based on the results shown in Graph 2 and the information about the sugar trehalose, explain the results for Strain B shown in the graph you drew (in Question 58).

Yeasts cells contain an enzyme that catalyzes the synthesis of the sugar trehalose from monosaccharides, and another enzyme that catalyzes the breakdown of trehalose into monosaccharides. These enzymes are active in the cell according to the concentrations of ethanol in and around the cell.

In both yeast strains, the researchers tested the activity of the enzyme that catalyzes the breakdown of the cell's trehalose into monosaccharides.

They found that in a 10 % ethanol solution, the activity rate of the enzyme that catalyzes the breakdown of trehalose was lower in Strain B than in Strain A, but the reproduction rate was higher in Strain B than in Strain A.

(4 points) **60. א.** Explain why in a 10% ethanol solution, the low activity rate of the enzyme that catalyzes the breakdown of trehalose allows a higher reproduction rate in Strain B compared to Stain A.

(3 points) **ב.** Explain how protecting the cell membrane in an environment containing ethanol allows yeast cells to maintain homeostasis.

Give the lab teacher your exam paper and your answer booklet.

Good Luck!