

**Practical Exam
in Biology**

**בחינת בגרות מעשית
בביולוגיה**

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

ב. Material that may be used during the exam:
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 answers in pen (including sketches).
- (3) Base your answers on the results presented in the exam paper.

הוראות לנבחן:

א. משך הבחינה: שלוש שעות.

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

ג. הוראות מיוחדות:

- (1) קרא את ההנחיות ביסודיות, ושקול היטב את צעדיך.
- (2) רשום בעט את כל תשובותיך (גם סרטוטים).
- (3) בסס את תשובותיך על התוצאות המוצגות בשאלון.

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.

כתוב במחברת הבחינה בלבד. רשום "טיוטה" בראש כל עמוד המשמש טיוטה. כתיבת טיוטה בדפים שאינם במחברת הבחינה עלולה לגרום לפסילת הבחינה.

Good Luck!

בהצלחה!

Practical Exam in Biology

In this problem, you will examine the process of photosynthesis and the processes that are associated with it.

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 your answer booklet.

Part א — Comparing quantities of chlorophyll in leaves of wheat seedlings [נבטים] that grew under different light conditions

Experiment 1

- א. Students sprouted wheat seeds [זרעים] in the dark. After one day the seeds germinated and the seedlings were divided into four groups.

The seedlings in each group grew under the same environmental conditions, except for the duration of exposure to light.

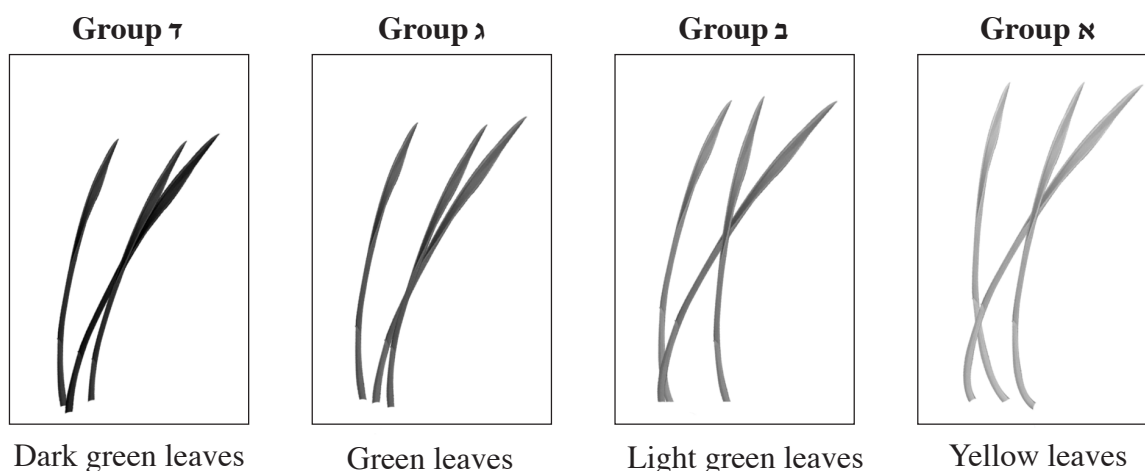
Group א — The seedlings grew in the dark for 8 days.

Group ב — The seedlings grew in the dark. They were exposed to light of constant intensity for the last 2 hours of the eighth day.

Group ג — The seedlings grew in the dark. The seedlings were exposed to light of constant intensity for the last 6 hours of the eighth day.

Group ד — The seedlings grew under light of constant intensity for 8 days

- ב. The pictures below show leaves from each group of wheat seedlings after 8 days.



- ג. After the students grew the seedlings for 8 days they performed the following steps:
- Weighed 10 leaves from Group א.
 - After weighing the leaves, they cut them up and crushed them in a mortar.
 - Added to the mortar an ethanol solution, which dissolves the pigments in the leaves and then again crushed the shredded leaves.
 - Filtered the pulp [הרסק] through a gauze and obtained an extract [מיצוי].
 - Checked the intensity of the green color in the extract using an instrument (a spectrophotometer). Based on the intensity of the color obtained, they calculated the concentration of chlorophyll in the extract.
- ד. The students repeated these steps with 10 leaves from each of the groups ב-ד. The chlorophyll concentrations that were measured in each of the extracts are listed below:
- In the Group א leaf extract — 0.00 mg/ml of extract/gram of leaf
In the Group ב leaf extract — 0.01 mg/ml of extract/gram of leaf
In the Group ג leaf extract — 0.04 mg/ml of extract/gram of leaf
In the Group ד leaf extract — 0.17 mg/ml of extract/gram of leaf

Answer questions 1 and 2

- (6 points) 1. א. Draw a table (Table 1) in your answer booklet and use it to summarize the setup and results of Experiment 1 (Items א-ד).
- (3 points) ב. Give the table a suitable title and the table columns suitable headings.
- (5 points) 2. א. The main pigment in the extracts is chlorophyll. What environmental condition do leaves of wheat seedlings require to produce chlorophyll?
Base your answer on the results of the experiment.
- (5 points) ב. The seedlings in Group א grew in the dark for 8 hours. Can we expect such seedlings to continue developing into mature plants in the dark? Explain your answer.

Part ב — Measuring some processes that take place in wheat seedlings

Experiment 2

Researchers grew wheat seedlings in the dark for 8 days and then they transferred them to the light. Right after taking the seedlings out of the dark (Day 0), the researchers selected 10 leaves and prepared an extract from them. They measured the intensity of the green color in the extract and calculated the concentration of chlorophyll in the leaves (using the method described in Part א).

The researchers repeated these steps on each of the following days (1-4).

In addition, right after removing the seedlings from the dark (Day 0), they selected 10 intact leaves. They put the leaves in a transparent container with a solution of sodium bicarbonate, which is a source of carbon dioxide (CO_2) for leaves. The researchers measured the concentration of dissolved oxygen in the solution with an oxygen meter at the start of the experiment, and then capped the container. Next, the researchers exposed the container to light of constant intensity for 10 minutes, and then again they measured the concentration of dissolved oxygen in the solution. They calculated the difference between the oxygen concentration after 10 minutes and the initial oxygen concentration. The researchers repeated these steps on each of the following days (Day 1-4). The results of Experiment 2 are shown in Table 2 below.

Table 2

Number of days after exposing the seedlings to light	Chlorophyll concentration in leaves (mg/ml extract/gram leaf)	Change in concentration of oxygen dissolved in the solution after 10 minutes of light (micromole/gram leaf/minute)
0	0.00	- 0.5 (Note: This value is negative)
1	0.06	1.5
2	0.12	3.3
3	0.15	4.5
4	0.16	4.7

Answer questions 3-10.

- (3 points) 3. א. You will be asked to describe the association between chlorophyll concentration in the leaves and the change in oxygen concentration in the container using a graphical representation, based on the results shown in Table 2.
- (7 points) ב. What type of graphical representation is most suited to describing the results, a continuous graph or a bar diagram? Explain your answer.
- (5 points) ג. In your answer booklet, use the correct graphical representation to describe the association between **chlorophyll concentration** in the leaves and the change in oxygen concentration in the container.
- (5 points) ד. Describe the results of the experiment according to the graphical representation.

- (4 points) **4.** Consider the following four answers (i-iv) to these questions: What is the independent variable in Experiment 2 (Table 2)? How was it modified?
 Copy the correct answer **to your answer booklet**.
- i. The independent variable is the different number of days that the seedlings were exposed to light. It was modified by changing the concentration of chlorophyll in the leaves.
 - ii. The independent variable is the concentration of chlorophyll in the leaves. It was modified by changing the number of days that the seedlings were exposed to light.
 - iii. The independent variable is the concentration of dissolved oxygen in the solution. It was modified by changing the light intensity.
 - iv. The independent variable is the concentration of dissolved oxygen in the solution. It was modified by changing the concentration of chlorophyll in the leaves.
- (4 points) **5.** **א.** What is the dependent variable in Experiment 2?
- (4 points) **ב.** Explain why the measurement method is suitable for measuring the dependent variable.
- (4 points) **6.** **א.** Explain the result obtained in Experiment 2 with the seedlings which grew only in the dark (Day 0).
- (3 points) **ב.** Explain why it is important to also include in the experiment seedlings which grew only in the dark.
- (5 points) **7.** **א.** Explain the results obtained in Experiment 2 with the seedlings which were exposed to light (Days 1-4).
- (4 points) **ב.** A student suggested adding to the experiment a transparent container with a solution of sodium carbonate and no leaves, and to measure the change in concentration of dissolved oxygen in the solution after 10 minutes of exposure to light.
 Explain the importance of this measurement.
- (5 points) **8.** **א.** In Experiment 2 all the containers were exposed to light of constant intensity. Explain why it is important to keep this factor constant in the experiment setup.
- (4 points) **ב.** List an additional factor (besides light intensity and number of leaves) that was kept constant in Experiment 2. Explain why it is important to keep this specific factor constant in the experiment setup.
- (4 points) **ג.** Explain why 10 leaves were tested in each measurement and why testing one leaf would not have been enough.
- (4 points) **9.** Researchers repeated Experiments 1 and 2 but decided to also measure the rate of carbon dioxide (CO₂) absorption in the seedling leaves.
 The results that were obtained: The highest rate of carbon dioxide absorption by leaves was measured in the seedling of Group 7 in Experiment 1 and in the seedlings exposed to light for 4 days (Day 4) in Experiment 2.
 Suggest an explanation for both these results.
- (4 points) **10.** The seedlings of a number of plant species that grow in the wild under stones (in the dark) develop long stems and their leaves are free of chlorophyll.
 Based on your answer in Question 2.ב., explain the advantage to the plant of growing long stems in the dark.

Part 1 — Changes in quantity of starch in cress [תורנית] leaves

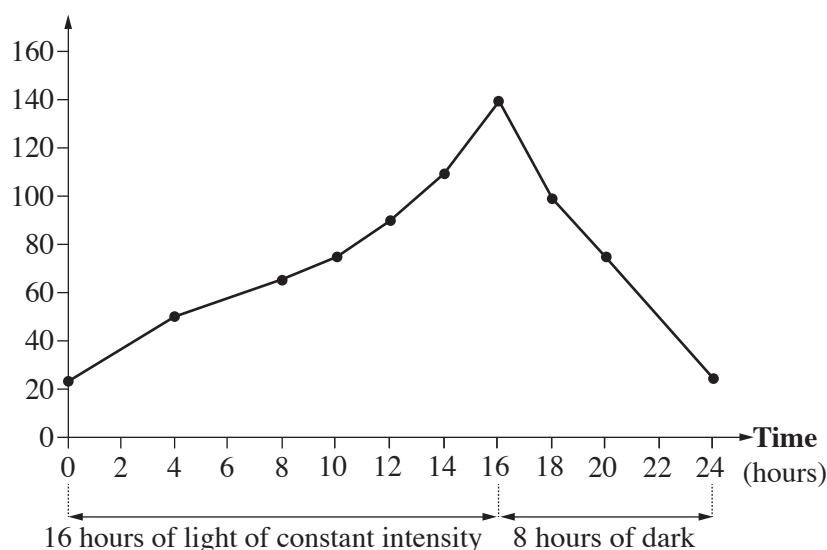
Researchers grew cress plants — whose leaves are green - in a greenhouse. Over a 24-hour period, the plants were exposed to light in the following way:

16 hours of light of constant intensity and 8 hours of dark. The other environmental factors were kept constant.

Every few hours the researchers took a sample of leaves and measured the quantity of starch in them. The experimental results over 24 hours are shown in the graph below.

Changes in quantity of starch in the leaves in the light and in the dark

Quantity of Starch
(micromole/gram leaf)



- (5 points) 11. א. Explain why the quantity of starch in the leaves changed during the hours of light.
- (5 points) ב. During the hours of dark the quantity of starch in the leaves decreases.
- (1) Explain why.
 - (2) Explain the importance of the decrease in the quantity of starch to the processes in the plant.

Geophytes [גאופיטים] are plants whose storage organs are underground (for example, a tuber or bulb).

- (3 points) 12. א. In some geophytes (such as the Drimia [חצב]) metabolism [חילוף חומרים] in their storage organs also takes place in the dry season when the plant has no leaves. These storage organs contain starch. What change takes place in the quantity of starch in these organs during the dry season? Explain your answer.
- (4 points) ב. Starch is a polysaccharide [רב-סוכר]. Explain the advantage of storing starch compared to storing disaccharides [דן-סוכרים] or monosaccharides [חד-סוכרים].

Give the proctor your exam paper and your answer booklet.

Good Luck!

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בהצלחה!

זכות היוצרים שמורה למדינת ישראל.
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