THE OPEN UNIVERSITY OF SRI LANKA
B. Sc / B. Ed DEGREE PROGRAMME
BOTANY – LEVEL 4

BYU4300: PLANT PHYSIOLOGY
FINAL EXAMINATION 2024/2025

DURATION: THREE (02) HOURS

Date: April 30, 2025 Time: 9.30 am -11.30 am + 10 min for reading

There are two (2) parts in this paper with six (6) questions in four (4) pages. Each part comprises of three (3) questions. You have to answer FOUR (4) questions, selecting at least TWO (2) questions from each part.

Part 1

1. **Questions here are based on the following figure adopted from a research publication [Peanut Science (19845) 11:31-35].**
   The graphs below indicate the trends observed at the cellular level of a peanut cultivar when watering was stopped. There were two types of water regimes on which these plants used to grow. Both of these water supply regimes; irrigated [•] and non-irrigated [o], were curtailed to induce water stress. (Clue: turgor = pressure potential)

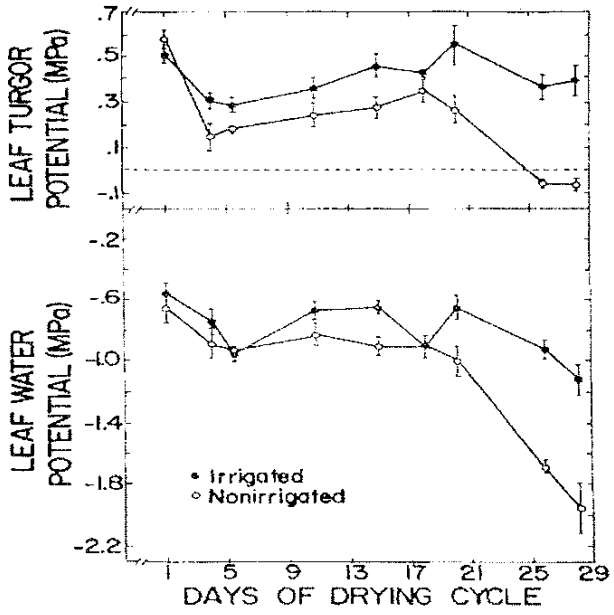

Fig. 2. Leaf turgor potentials (upper) and leaf water potentials (lower) of irrigated and nonirrigated peanut plants during a 28-day drying cycle imposed at Gainesville, Florida, in 1981. Vertical bars represent the standard error of the mean.

A. Explain what water potential and turgor potential are. (10 marks)

B. Interpret the trends in the above graph in detail. (20 marks)

C. Calculate the osmotic potential and complete the table below (copy to your answer script with proper units). (25 marks)

Day	Water potential		Turgor pressure		Osmotic potenial	
	Irrigated	non-irrigated	Irrigated	non-irrigated	Irrigated	non-irrigated
1						
17						
29						

D. Map the pathway of a water molecule that reaches to leaf from the soil using a fully labelled diagram. (20 marks)

E. Deduce the possible causes of those plants grown in irrigated water to maintain high leaf water potential and turgor pressure. (25 marks)

2. **The following questions are based on the graph shown below from a publication** (*Plant Physiol. Vol. 162, 2013*)**.** This graph indicates the carbon dioxide assimilation at the different light regimes. Read the figure description carefully to understand what the numbers 1 to 5 in the graph represent.

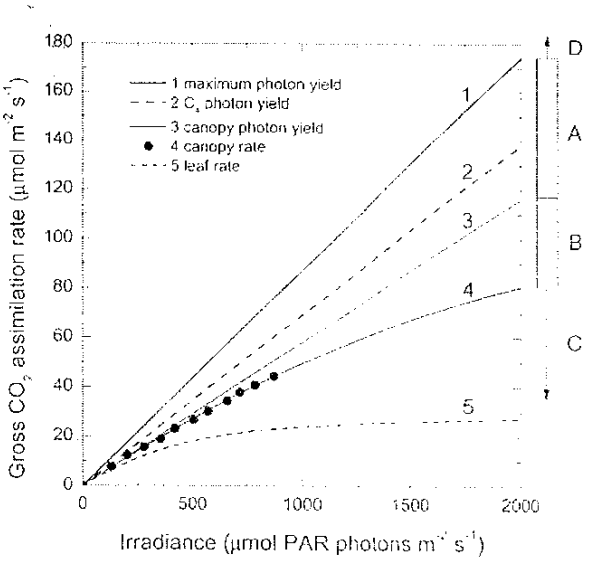

Figure 2. Canopy gross CO_2 assimilation rate as a function of irradiance. Data measured with a wheat crop (Evans and Farquhar, 1991) are as follows: leaf area index, 7.1; leaf temperature, 22°C; ambient CO_2 partial pressure, 340 mbar. Lines are as follows: 1, maximum photon yield for C3 plants ***in the absence of photorespiration*** (0.088 mol of CO_2 per mol of PAR photons); 2, maximum photon yield for C4 plants (0.069); 3, photon yield for C3 plants in normal atmosphere (0.058); 4, response curve for gross canopy CO_2 assimilation; 5, response curve for a single wheat leaf.

A. What do you think is the objective of this experiment? (10 marks)

B. Explain the method used to obtain curve 1 in the graph. (20 marks)

C. Explain how photorespiration is prevented in C4 plants using appropriate diagrams. (20 marks)

D. How do the major limiting factors of photosynthesis affect the experiment given above? (30 marks)

E. Briefly explain how the CAM plants avoid photorespiration. (20 marks)

3. **The following questions are based on the excerpt of the abstract from the article published in the** *Plant Physiology*, Volume 47, Issue 6, June 1971, Pages 821–827

The earliest visible responses of spinach plants (*Spinacia oleracea* L., cv. Savoy Hybrid 612) transferred from short to long days (8 hours of high-intensity light supplemented with 16 hours of low-intensity illumination from incandescent lamps) were upright leaf orientation and increased elongation of the petioles. The effect of long days on growth rate was direct; i.e., there was no after-effect if the plants were transferred to short days. Gibberellin A3 applied to plants under short days had an effect similar to that of long days, whereas application of the growth retardant AMO-1618 [2′-isopropyl-4′-(trimethylammonium chloride)-5′-methylphenyl piperidinel-carboxylate] under long days caused a growth habit typical of short-day conditions. *Gibberellin A3 caused more stem growth in plants under long days in which the endogenous gibberellin content had been reduced by AMO-1618 than in plants under short days not treated with the growth retardant.*

A. Illustrate the growth habit of spinach plants under the following conditions, based on the experiment described: when i) grown in short days, and ii) after transferring to the long day condition in the above experiment. (20 marks)

B. Illustrate the growth habit of spinach plants treated with GA3 and AMO-1618. (15 marks)

C. Explain the meaning of the italicized sentence in the above abstract. (20 marks)

D. Briefly explain the role of plant hormones in stomatal closure. (20 marks)

E. Discuss the effects of plant hormones on the tropic movements in plants. (25 marks)

Part 2

4. Write a newspaper article to create awareness among farmers on plant transpiration. Include the following points: an overview of the mechanisms involved in transpiration, the importance of transpiration for plant health and crop productivity, key factors that influence the rate of transpiration, and methods farmers can use to control or manage transpiration in their crops. (100 marks)

5. Glycolysis and Kreb's cycle are the main pathways of respiration. Yet, there are alternative pathways of respiration which serve as the sources of intermediates of metabolism.

I. Discuss the above statement. (50 marks)

II. Explain briefly how the temperature, oxygen concentration, inorganic salts and wounding and mechanical stimuli affect the rate of respiration. (50 marks)

6. Explain the following observations using your knowledge of plant physiology. (20 marks /section)

   a. Unexpected rainfall in February and March 2025 will lead to an increase in rice imports to Sri Lanka.
   b. A seed sample of a species that is exposed to 50 ^{0}C in a dry state retains viability, whereas another seed sample from the same batch, exposed to 45 ^{0}C without drying, loses viability.
   c. It is not totally correct to say that the greenness of the plants is due to the reflection of the green wavelength.
   d. A farmer who grew plants from the seeds of his previous crop complained of a poor harvest.
   e. Farmers spray auxin-based herbicides to induce tillering in rice.