

ITEM ONE

In Mbale district, farmers grow Irish potatoes (C3 plants) for both food and income. During a hot dry spell, the potato plants wilted, and many tubers failed to enlarge. Farmers applied mulch and evening irrigation, which helped plants to survive, but the tuber yield remained low. Meanwhile, maize nearby grew vigorously without irrigation.

Tasks:

- (a) Explain why the potato plants produced small tubers despite irrigation and mulching. (10 marks)
- (b) Explain how the features of the maize enabled it to thrive during these harsh conditions. (10 marks)

ITEM TWO

In Mbarara district, farmers grow coffee (**C3 plant**) as a cash crop. During a particularly hot season, many coffee plants shed their leaves prematurely. To control the heat, farmers constructed shade using banana plants, which reduced wilting but resulted in fewer berries. Interestingly, wild weeds like the spider plant (**C4 plant**) nearby thrived well. Analysis revealed that the spider plant had thick fleshy leaves, a waxy cuticle, and stored water in leaf tissues.

Tasks:

- (a) Explain why coffee plants gave few berries despite surviving under shade. (6 marks)
- (b) Explain how the observed features of the spider plant enabled it to thrive under the same conditions. (10 marks)

ITEM THREE

In Masaka district, tomato farmers experienced poor yields due to scorching midday heat and irregular rainfall. To address this, students suggested constructing a greenhouse covered with transparent polythene sheets to protect crops from excessive heat while conserving water however the tomatoes still produced poor yields. Meanwhile, the students carried out a laboratory investigation to study stomatal behavior in tomato leaves. They prepared epidermal peels and immersed them in different sucrose solutions. They observed that in dilute sucrose solution the stomata opened, while in concentrated sucrose solution the stomata closed. Later, while monitoring

tomato growth in the greenhouse, the students recorded low rates of photosynthesis even though light intensity inside was high. This puzzled both the students and the farmers, who wondered what could be limiting the process.

Tasks:

- (a) Based on the epidermal peel observations, what role does sucrose concentration play in regulating stomatal behavior?
- (b) Imagine you are part of a student group advising farmers on greenhouse construction, explain the efficiency of materials discussed for successful tomato growth? (4 marks)
- (c) Suggest what could have limited photosynthesis in the greenhouse despite high light intensity. (5 marks)

ITEM FOUR

In Luwero district, Senior 6 Biology students carried out an experiment to investigate the effect of carbon dioxide concentration on the rate of photosynthesis in an aquatic plant (Elodea). The plant was placed in water under a lamp at constant light intensity and temperature. Sodium bicarbonate was added in increasing amounts to vary the CO₂ concentration. The students counted oxygen bubbles released per minute as a measure of the photosynthetic rate.

Their results were as follows:

CO ₂ concentration (%)	Oxygen bubbles per minute
0.01	5
0.03	15
0.05	25
0.08	25
0.10	25

After analyzing the table, some students concluded that the rate of photosynthesis stopped increasing because the plant had reached its maximum capacity. Others argued that another environmental factor must have become limiting. The teacher asked the class to carefully study the results and make reasoned conclusions.

Tasks:

- (a) What general relationship between carbon dioxide concentration and rate of photosynthesis is shown by the results? (4 marks)
- (b) Why did the rate of photosynthesis fail to increase beyond 0.05% CO₂

concentration, even when more was supplied? (4 marks)

(c) If the students wanted to further increase the rate of photosynthesis, which factor could they adjust in the experiment, and why? (2 marks)

ITEM FIVE

In Kalungu district, farmers grew tomatoes (C3) and maize (C4) in a greenhouse during a hot, dry season. Tomato leaves were monitored for stomatal behavior and photosynthetic activity. Epidermal peels showed that stomata opened in dilute sucrose solutions but closed in concentrated solutions. Students also measured photosynthesis rates using oxygen bubble production from leaf samples under varying light intensity and CO₂ concentration. They observed that oxygen release increased with light and CO₂ up to a certain point, then plateaued. Some tomato leaves appeared slightly wilted despite irrigation and high light, while maize inside the greenhouse remained healthy.

Tasks:

(a) Explain the effect of sucrose concentration on tomato stomata and its significance to plant during harsh conditions (5 marks)

(b) Explain the observed trend in photosynthetic rates with changing CO₂ levels? (5 marks)

(c) Suggest why some tomato leaves appeared slightly wilted despite optimal irrigation and light. (5 marks)

(d) Explain why Maize optimally maximized the prevailing conditions to thrive. (5 marks)