

Short answers

※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

1. In plants, photosystems are composed of a Reaction Center and an Antenna Complex (also known as the Light-Harvesting Complex).

(1) What is the primary function of the Antenna Complex? (5 pts)

(2) The Antenna Complex contains various pigments, such as chlorophyll *b* and carotenoids, in addition to chlorophyll *a*. Explain the biological significance of having these accessory pigments. (15 pts)

2. Plant cell expansion is driven by turgor pressure but restricted by the rigidity of the cell wall.

(1) Please describe the "Acid Growth Hypothesis" in detail. (10 pts)

(2) In your explanation, specify the roles of **Auxin**, **Proton pumps**, **pH changes**, and **Expansins**. (10 pts)

3. Oil-rich seeds (e.g., soybean, peanut) convert stored triacylglycerols (lipids) into sucrose during germination to support seedling growth before photosynthesis begins.

(1) Please outline the metabolic pathway of this conversion. You must mention **β -oxidation**, the **Glyoxylate cycle**, and **Gluconeogenesis**. (10 pts)

(2) In which specific organelle does the Glyoxylate cycle take place? (5 pts)

(3) Why is the Glyoxylate cycle necessary for these seeds instead of using the mitochondrial Citric Acid Cycle alone? (5 pts)

4. Angiosperms (flowering plants) and Gymnosperms differ significantly in their vascular tissue structures.

(1) Compare the water-conducting cells in the xylem of Gymnosperms versus Angiosperms. (6 pts)

(2) Compare the sugar-conducting cells (sieve elements) in the phloem of Gymnosperms versus Angiosperms. (6 pts)

(3) Explain how the structural differences in the **xylem** contribute to the higher hydraulic conductivity in Angiosperms. How does this efficient water transport support their competitive advantage in terms of **photosynthetic capacity** (CO_2 assimilation)? (8 pts)

5. Flooding creates a hypoxic (low oxygen) or anoxic environment for plant roots.

(1) Under hypoxic conditions, the root cells shift their energy metabolism from aerobic respiration to **fermentation**. Explain the metabolic necessity of this shift (i.e., why must the cell convert pyruvate to ethanol or lactate?) and compare the ATP yield between aerobic respiration and fermentation. (10 pts)

(2) Apart from metabolic adjustments, plants often develop specific **anatomical or morphological structures** to improve oxygen transport to the roots. Please list **ONE** such structure and explain how it functions. (10 pts)