

THE UNIVERSITY OF MELBOURNE

SEMESTER 1 - ASSESSMENT 2005

DEPARTMENT: BOTANY

SUBJECT NO. 606-201

SUBJECT TITLE: PLANT STRUCTURE AND FUNCTION

EXAM DURATION: 3 hours

READING TIME: 15 *minutes*

This paper has 3 pages including the cover

Authorised Materials:

NO MATERIALS ARE AUTHORISED

Instructions to Invigilators:

Each student should be supplied one exam paper and 2 large script books

The exam paper may leave the examination room

Instructions to Students:

Marks for each question are proportional to the time suggested.

This paper may be held by the Baillieu Library

QUESTION 1 (30 minutes)

Using clearly labelled diagrams, describe the development, structure and function of:

- (a) Endodermis. (10 minutes)
- (b) Sieve tube elements and companion cells. (10 minutes)
- (c) Primary xylem vessels. (10 minutes)

QUESTION 2 (15 minutes)

You take a root from a flowering plant and make a section about one centimetre behind the tip. The cortex consists of thin-walled cells (whose cell walls stain pinkish-purple with Toluidine Blue) that contain large prominent organelles.

- (a) What type of cells are these? (Give reasons for your answer) (5 minutes)
- (b) What is the most likely function of these cells, and how would you determine the properties of the cell organelles that give it this function? (5 minutes)
- (c) What is the likely fate of these cells during subsequent growth of the root? (5 minutes)

QUESTION 3 (15 minutes)

Describe the structure and function of the shoot apical meristem in relation to the initiation of leaf and shoot primordia. To what extent do these early ontogenetic events determine the architecture of the resulting shoot and the whole plant? What other factors influence whole plant architecture? If necessary, use diagrams to illustrate your answer.

QUESTION 4 (36 minutes)

- (a) What is photorespiration and which organelles does it involve? (6 minutes)
- (b) In which sub-cellular compartment is starch synthesized? What is the main role of starch in leaves? (6 minutes)
- (c) Describe the two reactions catalysed by the enzyme ribulose biphosphate carboxylase/oxygenase (Rubisco) and note where they take place. Does Rubisco occur only in photosynthetic organisms? (6 minutes)
- (d) List three groups of photosynthetic organisms that have carbon-concentrating mechanisms. What form of carbon is initially used by these mechanisms? (6 minutes)
- (e) What are the broad functions of respiration in plants? Why is respiration needed in photosynthetic tissues? Why is oxygen needed for respiration? (6 minutes)

- (f) Briefly describe the importance of plasmodesmata in leaf carbon metabolism. (6 minutes)

QUESTION 5 (24 minutes)

The photosynthetic electron transport system converts light energy into chemical energy, most of which is then used to fix CO₂.

- (a) Functionally, what are the differences between photosystem 1 and photosystem 2? (6 minutes)
- (b) Describe the two ways in which protons are effectively pumped into the intrathylakoid space of chloroplasts. (6 minutes)
- (c) Briefly describe how ATP is made in chloroplasts and note the energy source. (6 minutes)
- (d) C₄ plants require about 5 ATPs and 2 NADPHs to fix one molecule of CO₂. Describe how the electron transport system can make ATP and NADPH at this ratio. (6 minutes)

QUESTION 6 (45 minutes)

- (a) What is the difference between a plant macronutrient and a plant micronutrient? (5 minutes)
- (b) What is a Scholander pressure bomb? (5 minutes)
- (c) Why do some plants accumulate selenium? (5 minutes)
- (d) What is cavitation? (5 minutes)
- (e) Why do legumes form root nodules? (5 minutes)
- (f) What is a chelate? (5 minutes)
- (g) Why do some plants have sunken stomata? (5 minutes)
- (h) What is the function of PEP carboxylase in guard cells? (5 minutes)
- (i) Would a mangrove plant be able to transpire on a very humid day (e.g. 95% humidity)? (5 minutes)

QUESTION 7 (15 minutes)

Discuss the substance abscisic acid with regard to its occurrence and function in plants.

END OF EXAM PAPER