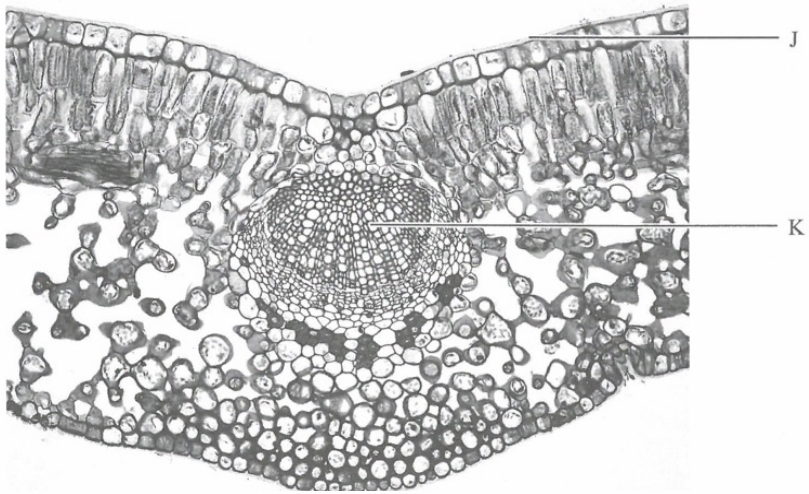
Directions: Questions 28 and 29 refer to the photomicrograph below, which shows a section of a leaf:



28. Which of the following correctly describes the major function of layer J?

A. It reduces water loss.
B. It allows light to pass through.
C. It protects the leaf from infection.
D. It increases the photosynthetic rate.

29. Which of the following substances will move out of the leaf through stomata from cell K in the daytime?

A. water
B. oxygen
C. mineral
D. carbon dioxide

Directions: Questions 30 and 31 refer to the investigation below. Diagram I shows a set-up for measuring the transpiration rate of a leafy shoot under different environmental conditions. For each treatment, the experiment was conducted for three hours. Table II shows the initial and final readings of the water level in different treatments.

Diagram I

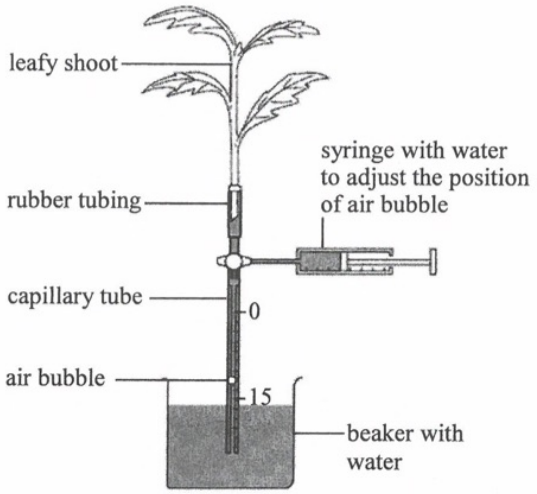


Table II

Treatment	Environmental conditions		Initial reading (cm)	Final reading (cm)
	Light intensity	Humidity		
1	Low	Low	14	7.4
2	Low	High	15	12.5
3	High	Low	15	5.6
4	High	High	14	10.6

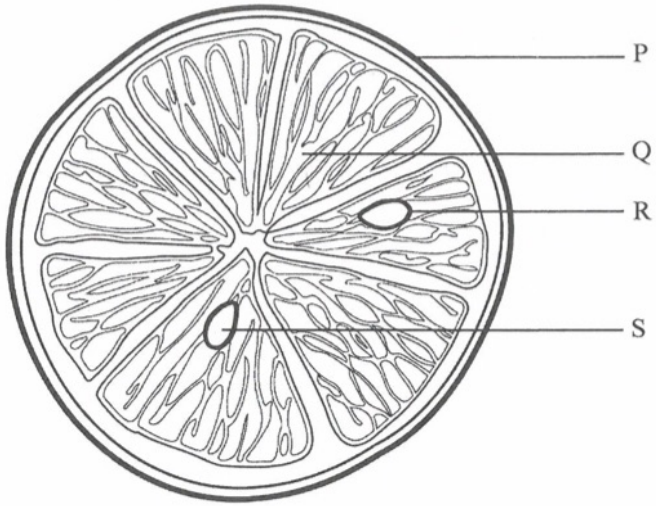
30. In which treatment does the leafy shoot have the highest transpiration rate?

A. 1
B. 2
C. 3
D. 4

31. According to the results of the investigation, which of the following changes in environmental conditions will lead to a greater reduction in the transpiration rate of the leafy shoot?

A. At low humidity condition, adjust the light intensity from high to low.
B. At high humidity condition, adjust the light intensity from high to low.
C. At low light intensity, adjust the humidity from low to high.
D. At high light intensity, adjust the humidity from low to high.

Directions: Questions 32 to 34 refer to the following diagram which shows a section of a fruit:



32. Which of the following structures is developed from the ovum?

A. P
B. Q
C. R
D. S

33. Which of the following pairs of structures have the same genetic composition?

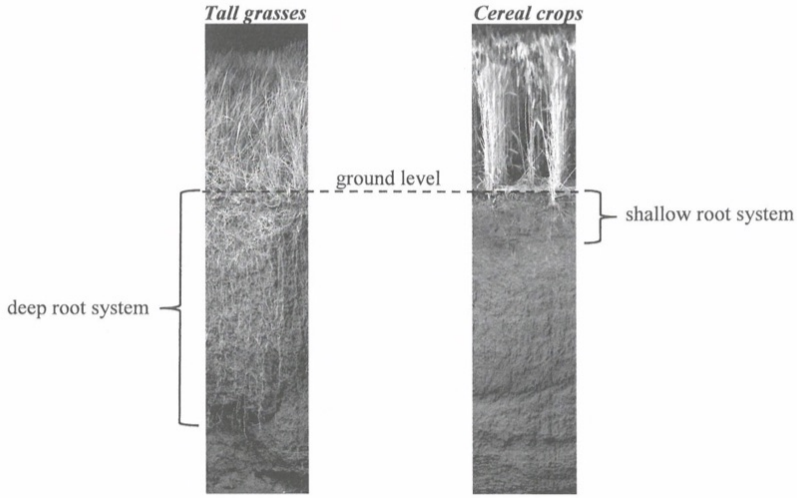
(1) P and Q
(2) Q and R
(3) R and S

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

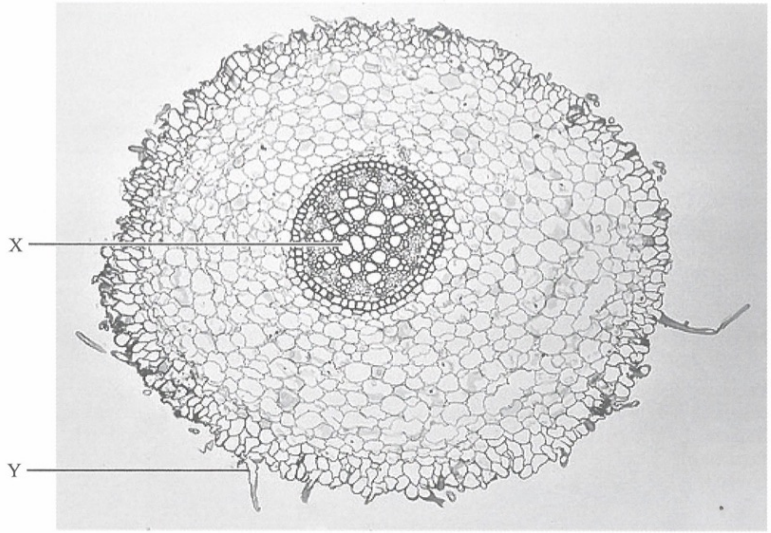
34. Which of the following statements correctly describes the major role of Q?

A. It protects the seeds by acting as a cushion.
B. It provides nutrients to the seeds for germination.
C. It helps seed dispersal by attracting animals to eat the fruit.
D. It allows the seeds to survive through adverse conditions by storing food.

8. Tall grasses and cereal crops belong to the same family and share a common ancestor. Cereal crops have been artificially selected for agriculture and their seeds harvested as food. The roots of the tall grasses in grasslands range in depth from 1.5 m to 4.5 m while those of cereal crops rarely exceed 1 m. The photographs below show the root depths of tall grasses and cereal crops under the same magnification:



(b) The photomicrograph below shows the cross-section of the root of a cereal crop:



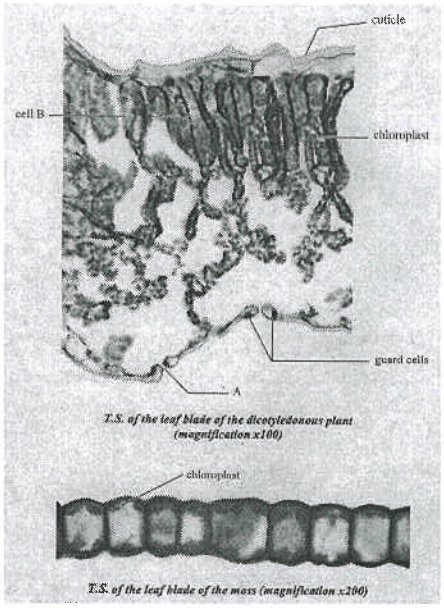
(i) Complete the table below to show how an observable feature of the structures X and Y is related to its function. (4 marks)

	Observable feature	Function
X		
Y		

(ii) Explain how water is transported from structure Y to structure X. (3 marks)

CE- 2002

2. (b) The photomicrographs below show part of the transverse section of the leaf blade of a terrestrial dicotyledonous plant and that of a moss:



(i) (1) Name structure A. (1)

(2) Explain one way in which A contributes to the function of cell B under bright sunlight. (2)

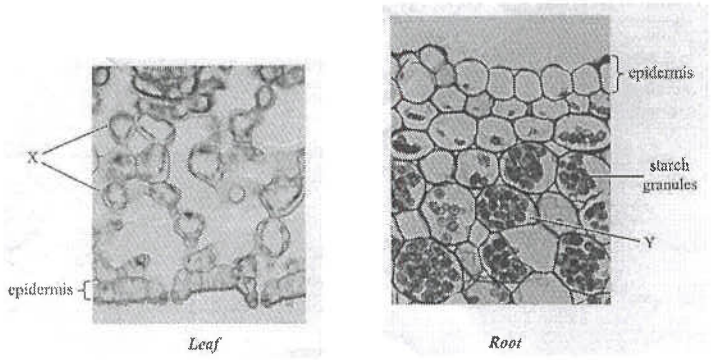
(ii) The moss above is restricted to damp and shady environments and it is often covered with a thin film of water.

(1) With reference to the leaf structures shown in the two photomicrographs, suggest two reasons why the moss cannot grow well in dry environments. (4)

(2) Describe how the moss leaf obtains oxygen from the atmosphere at night. (3)

CE - 2004

4. (c) The photomicrograph below show the sections of a leaf and a root :



(i) What is the significance of the following features ?
(1) the presence of cuticle on the leaf epidermis (1)
(2) the absence of cuticle on the root epidermis (1)

(ii) With reference to one feature shown in the photomicrograph, explain how gaseous exchange can occur at the leaf epidermis. (2)

(iii) Describe how the activity of cell type X leads to the storage of starch granules in cell type Y. (4)

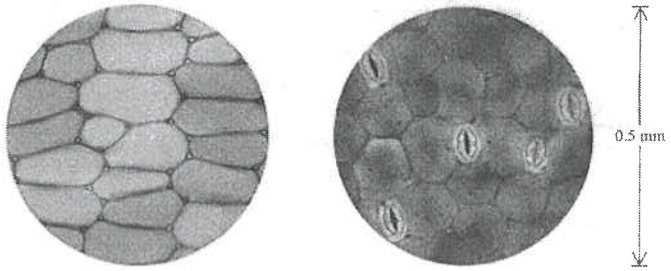
(iv) The table below shows the concentration of certain minerals in the soil water and the cell sap of the root epidermal cells:

	Concentration (mmol dm^{-3})		
	Potassium	Sodium	Chloride
Soil water	0.1	1.1	1.3
Cell sap of root	93.0	51.0	58.0

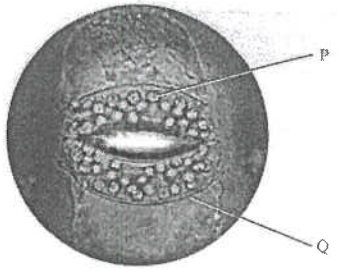
According to these data, what mechanism is probably used by the root to absorb minerals from the soil water ? Explain your answer based on the information provided. (3)

CE - 2005

9. (b) Mary examined the epidermis of the leaf of a land plant under the microscope. The photomicrographs below show the appearance of the upper and lower epidermis under different magnification:



1. Upper epidermis (low power) 2. Lower epidermis (low power)



3. Lower epidermis (high power)

(i) Using the information provided in photomicrograph 2, calculate the stomatal density (i.e. number of stomata per unit area) of the lower epidermis. (2)
(Take $\pi = 3.14$)

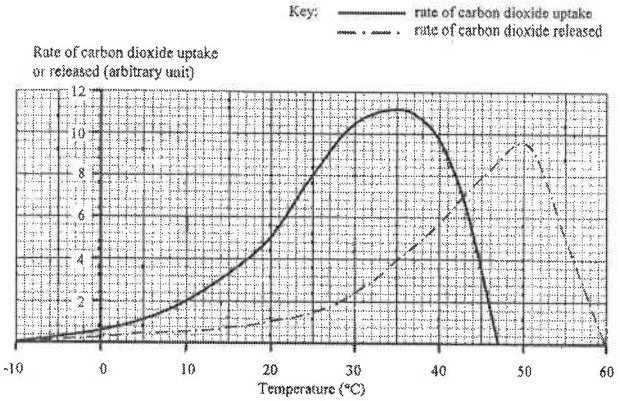
(ii) Compare the stomatal density of the upper and lower epidermis of the leaf. Explain the significance of this pattern of stomatal distribution to the plant when it is under direct sunlight. (3)

(iii) Name structures P and Q. (2)

(iv) Under certain conditions, the stomata of the leaves may become closed during daytime. Explain how this would affect the rate of photosynthesis of the plant. (2)

CE - 2008

10. (b) In a study about the growth of a crop plant in a greenhouse, the rate of carbon dioxide uptake by photosynthesis and the rate of carbon dioxide released by respiration at different temperatures were determined. The results are shown in the graph below.



(i) With reference to the above graph, describe the effect of temperature on the rate of carbon dioxide uptake. (2)

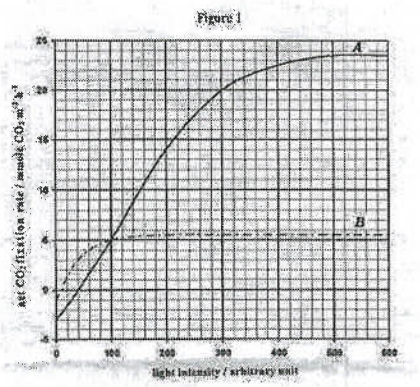
(ii) Account for the change in the biomass of the crop plant if it is cultivated at 45°C for several days. (3)

(iii) Find out the optimum temperature for the production of this crop. (1)

(iv) Explain how the plant may avoid overheating on a hot sunny day when the soil is well-watered. (3)

AL - 1997 1B

10. (a) Figure 1 presents the results of an experiment about the effect of light intensity on the net CO_2 fixation rate of two flowering plants A and B. This experiment was conducted in a greenhouse under controlled conditions.



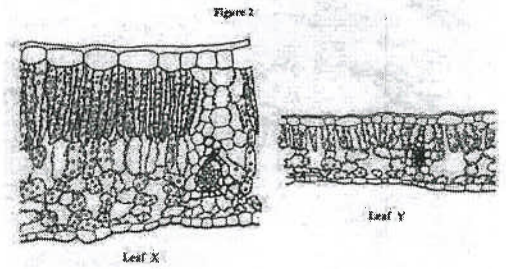
(i) State *two* variables that must be kept constant to achieve the aim of this experiment. (1)

(ii) What is meant by net CO_2 fixation ? (1)

(iii) Account for the net CO_2 fixation rate of plants A and B at light intensities below 40 arbitrary units. (3)

(iv) Compare the net CO_2 fixation rate of plants A and B at light intensities above 40 arbitrary units. (4)

(b) Figure 2 shows the cross sections of two different leaves, X and Y, taken from the same tree. They are of equal magnification and are at the same stage of maturity.



(i) State the structural differences between the photosynthetic tissue(s) of these two leaves. (1½)

AL - 2009 2B

4. (b) Unlike mammals, flowering plants do not have a specialized system for oxygen transport. Explain why flowering plants can still survive. (5)

Past Papers Marking Scheme – Nutrition and gas exchange in plants

CE - 2002 Q.2 (b)

(i) (1) stoma 1

(2) It allows carbon dioxide to enter the leaf 1
for photosynthesis in cell B 1

(ii) (1) The moss leaf has no cuticle / no waterproof covering 1
And it is one-cell thick 1
so the surface area to volume ratio is large 1
This would lead to a high rate of water loss from the plant / so the moss would become dehydrated easily in dry environment 1

(2) Atmospheric oxygen dissolves into the water film on the moss leaf 1
and then diffuse in 1
through the entire surface of the leaf 1

OR

At night, moss cells carry respiration only thus lower the oxygen concentration in the cells 1
Atmospheric oxygen dissolves into the water film on the moss leaf 1
and diffused into the leaf 1

CE- 2004 Q.4 (c)

(i) (1) Presence of cuticle helps to reduce water loss/transpiration of the leaf 1
(2) Absence of cuticle allows water movement / gaseous exchange to occur freely at the root epidermis 1

(ii) The leaf epidermis has stomata 1 +
which allow diffusion / free movement of gases 1

(iii) Cell type X carries out photosynthesis 1
to produce sugar 1
which will be transported through the phloem to the root 1
The sugar will then be converted to starch in cell type Y 1

(iv) Active transport 1
Because the mineral concentration in the cell sap is higher than that in the soil water 1
thus the minerals are absorbed against a concentration gradient 1

CE - 2005 Q.9 (b)

(i) Stomatal density of lower epidermis = $\frac{5}{3.14x(0.25)^2}$ mm^{-2} 1

$= 25.48\ mm^{-2}$ 1

(ii) The upper epidermis has a lower stomatal density than the lower epidermis / the upper epidermis has no stomata while the lower epidermis has stomata 1
This helps to reduce water loss/the rate of transpiration of the leaf 1
because the temperature at the upper epidermis is higher when the plant is under direct sunlight 1

(iii) P : chloroplast Q : cell wall 1,1

(iv) The closure of the stomata limits the diffusion / intake of CO_2 into the leaf 1
Thus the rate of photosynthesis of the plant is reduced 1

CE - 2008 Q.10 (b)

(i) Below 35°C (-10 - 35°C), the rate of carbon dioxide uptake increases with the increase in temperature 1
Above 35°C (35-47°C), the rate of carbon dioxide uptake decreases 1

(ii) The biomass will decrease 1
because the rate of respiration is faster than the rate of photosynthesis 1
There is a net consumption of food / organic matter 1

(iii) 30-32°C 1

(iv) When there is light, stomata of the plant open 1
When air temperature is high, transpiration is fast 1
A lot of water evaporates from mesophyll cell surface and carries heat away 1

AL - 1997 1B

10. (a) (i) temperature (½)
carbon dioxide concentration / supply (½)

(ii) amount of carbon dioxide fixed in photosynthesis less carbon dioxide released from respiration / photosynthesis carbon dioxide fixation less carbon dioxide released from respiration 1

(iii) For both plants A and B, light intensity increases, rate of net carbon dioxide fixation increase (½) as light is the limiting factor (½)

Plant A:
- no/negative net carbon dioxide fixation occurs (½) because its rate of respiration exceeds its rate of photosynthesis (½) which is very slow.

Plant B:
- at light intensity below 10 units, no net CO_2 fixation occurs (½), because its rate of respiration exceeds its rate of photosynthesis (½)
- between 10 and 40 units, net CO_2 fixation occurs (½), because photosynthetic CO_2 fixation exceeds respiratory CO_2 production (½)

(iv) - between 40-100 arbitrary intensity units : A has a slower rate of net CO_2 fixation than B / B has a higher rate of net CO_2 fixation than A 1
- at 100 arbitrary intensity units, the rate of net CO_2 fixation for A and B is the same (½)
- between 100-500 arbitrary units, the rate of net CO_2 fixation for A increases with increasing light intensity (½) and is higher than that of B (½). The rate of net CO_2 fixation for B reaches a maximum (½) / 5-6 mmole CO_2 m^{-2} h^{-1}, and stays unchanged despite of further increases in light intensity (½)
- between 500-600 arbitrary intensity units, the rate of net CO_2 fixation for A reaches a maximum (½) / 23-24 CO_2 m^{-2} h^{-1}, and stays unchanged despite of further increases in light intensity (½)

(b) (i) X = longer / larger palisade cells (½) and 2 layers of palisade cells, only 1 layer in Y (½), denser / more chloroplasts in both mesophyll / photosynthetic tissues (½)

AL - 2009 2B

4. (b) • transport of oxygen by diffusion can suffice the needs of plant cells (1) because (1)

- > the metabolic rate of plant cells is relatively low (1)
- > in the presence of light, photosynthetic tissues can provide oxygen (1) which can be provided to the nearby respiring tissues by diffusion
- > in flowering plants, oxygen can be readily obtained from the environment at different parts of the plant body (1), including the stomata of the leaves (1) / lenticels of the woody stem and surface of root hairs (1) (max. 2)
- > distance of diffusion of gases between the plant surface and the underlying layers of living cells is relatively short (1)
- > interconnecting intercellular air spaces provide passages for / offer little resistance to gas diffusion (1)

} (max. 4)