8. Transport in plants

8.3 Transpiration

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates unless indicated in the question

1 **(a)** A student investigated the effect of windspeed on the rate of transpiration.

The student placed a fan at different distances from a plant shoot and measured the distance the air bubble moved in three minutes.

The distance the air bubble moved can be used to calculate the rate of water uptake, which is equivalent to the rate of transpiration.

Fig. 5.1 shows the apparatus the student used.

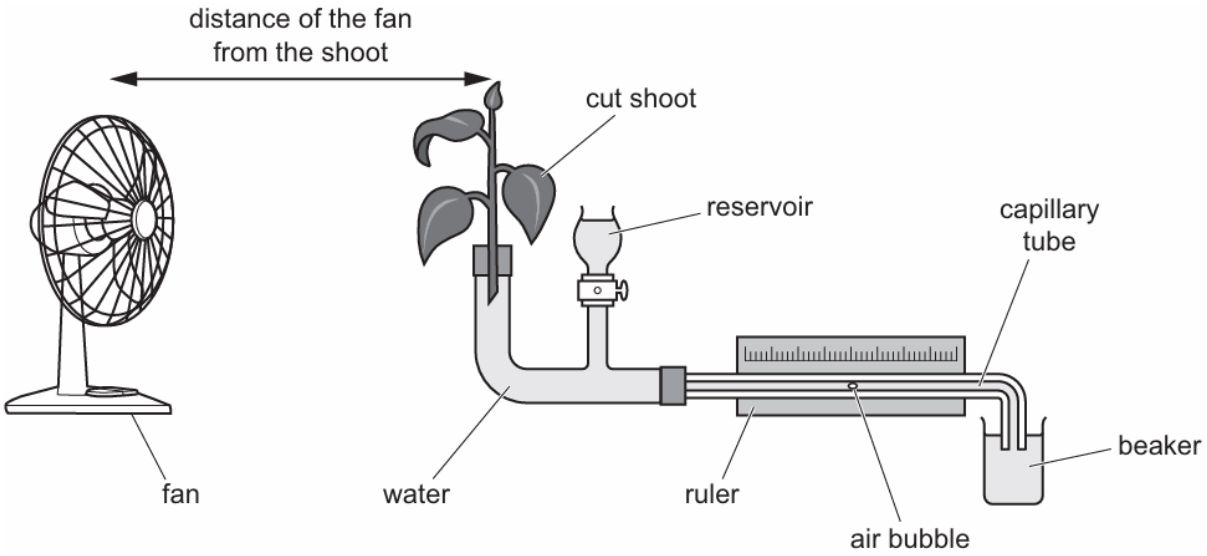

Fig. 5.1

Table 5.1 shows their results.

Table 5.1

distance of the fan from the shoot / m	distance travelled by the air bubble in three minutes / mm	rate of water uptake / mm per second
0.3	26	0.14
0.4	25	0.14
0.5	23	0.13
0.6	20	
0.7	19	0.11
0.8	16	0.09

(i) Calculate the rate of water uptake when the fan is 0.6 m from the plant shoot.

Give your answer to **two** decimal places.

Space for working.

..... mm per second [2]

(ii) Using the information in Fig. 5.1 and Table 5.1, complete the sentences by writing a word or phrase in the spaces to describe the results.

As the fan is moved further away from the shoot, the windspeed .....

and the ..... moved by the air bubble decreased.

During transpiration water evaporates from the surfaces of the

..... cells into the air spaces inside the leaf. The water vapour

diffuses out of the leaf through the ..... . This causes

water to move through the capillary tube causing the air bubble to

move towards ..... .

[5]

(iii) State **one other** factor that affects the rate of transpiration.

..... [1]

(b) State **two** uses of water in a plant.

1 .....

2 .....

[2]

2 **(a)** Complete the sentences about transpiration using words from the list.

Each word may be used **once** or not at all.

decomposition **evaporation** **mesophyll**

phloem **root hair cells** **stomata**

Transpiration is the loss of water vapour from leaves.

Water moves from the surface of ..... cells into the air spaces by

..... .

Then the water vapour diffuses out of the leaf through the ..... .

[3]

(b) A student investigated transpiration.

Fig. 3.1 is a diagram of the apparatus used in the investigation.

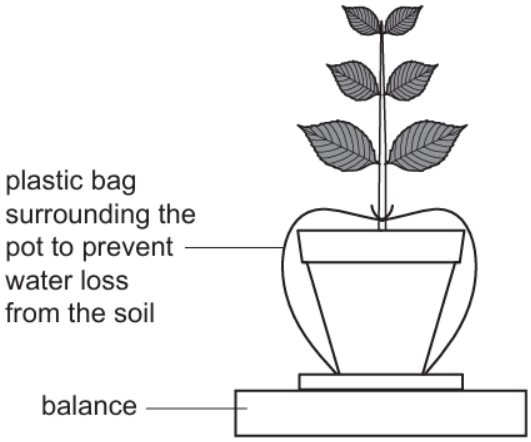

Fig. 3.1

- The student watered the plant before the investigation started.
- She measured the mass of water lost every five minutes.
- The mass of water lost represents the rate of transpiration.
- She took measurements in still air and with a fan moving air past the plant.
- She plotted her results on a graph as lines labelled **A** and **B**.

Fig. 3.2 shows the results.

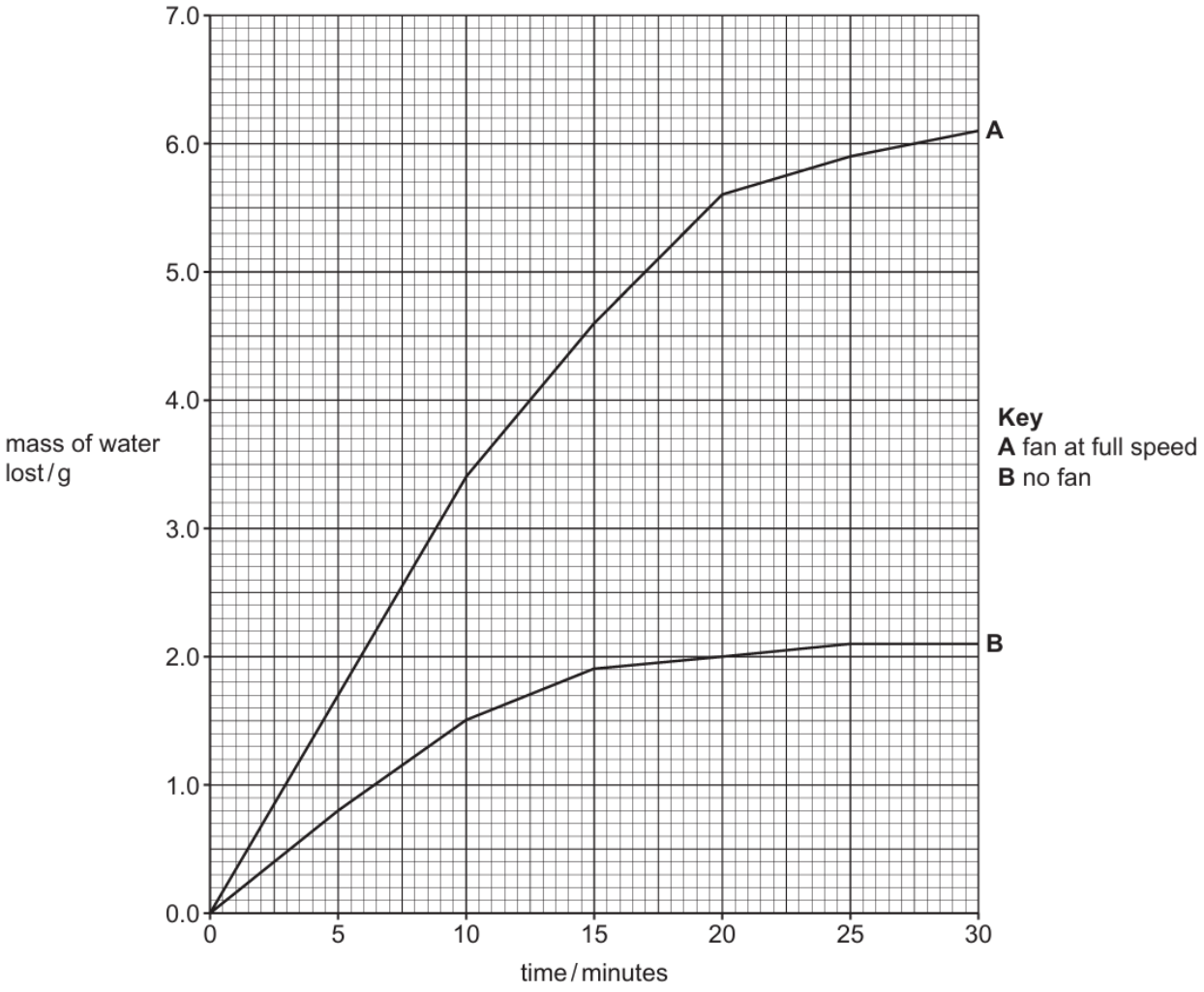

Fig. 3.2

(i) Calculate the difference in the mass of water lost between the results for **A** and the results for **B** at **30** minutes.

.....g [1]

(ii) Calculate the percentage increase in water loss shown for **A** between **10** minutes and **20** minutes.

Give your answer to the nearest whole number.

Space for working.

.....%
[3]

(iii) The student repeated the investigation using the fan at **half-speed**.

Draw a line **on Fig. 3.2** to show the result you would expect when the fan is at half-speed.
[2]

(c) State **one** factor, other than wind speed, that affects the rate of transpiration.

..... [1]

[Total: 10]

3 **(c)** Transpiration is the loss of water vapour from leaves.

State **two** environmental factors that affect the rate of transpiration.

1 .....

2 .....
[2]

4 **(b)** **(i)** Complete the definition of the term transpiration.

Transpiration is the loss of water vapour from plant leaves by

..... of water at the surfaces of .....

cells, followed by diffusion of water vapour through the ..... .

[3]

(ii) Fig. 1.2 is a graph showing the effect of temperature on the rate of transpiration from the upper and lower surfaces of leaves.

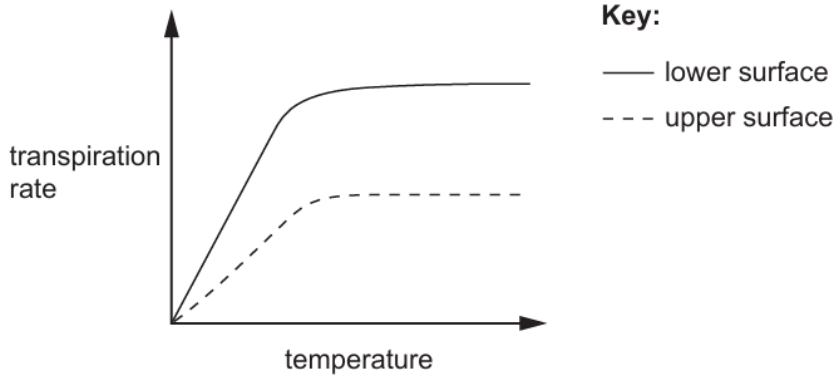

Fig. 1.2

State **two** conclusions for the data shown in Fig. 1.2.

1 .....

.....

.....

2 .....

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.....

[2]

(c) State the effect of increasing humidity on the rate of transpiration. **(extended only)**

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..... [1]

5 **(a)** Define the term *transpiration* by completing the sentences.

Transpiration is the loss of water vapour from plant leaves by .....

of water at the surfaces of the mesophyll cells followed by ..... of

water vapour through the ..... .

[3]

(b) A student investigated the volume of water lost in one hour by different species of plants at different temperatures.

Fig. 5.1 shows the results.

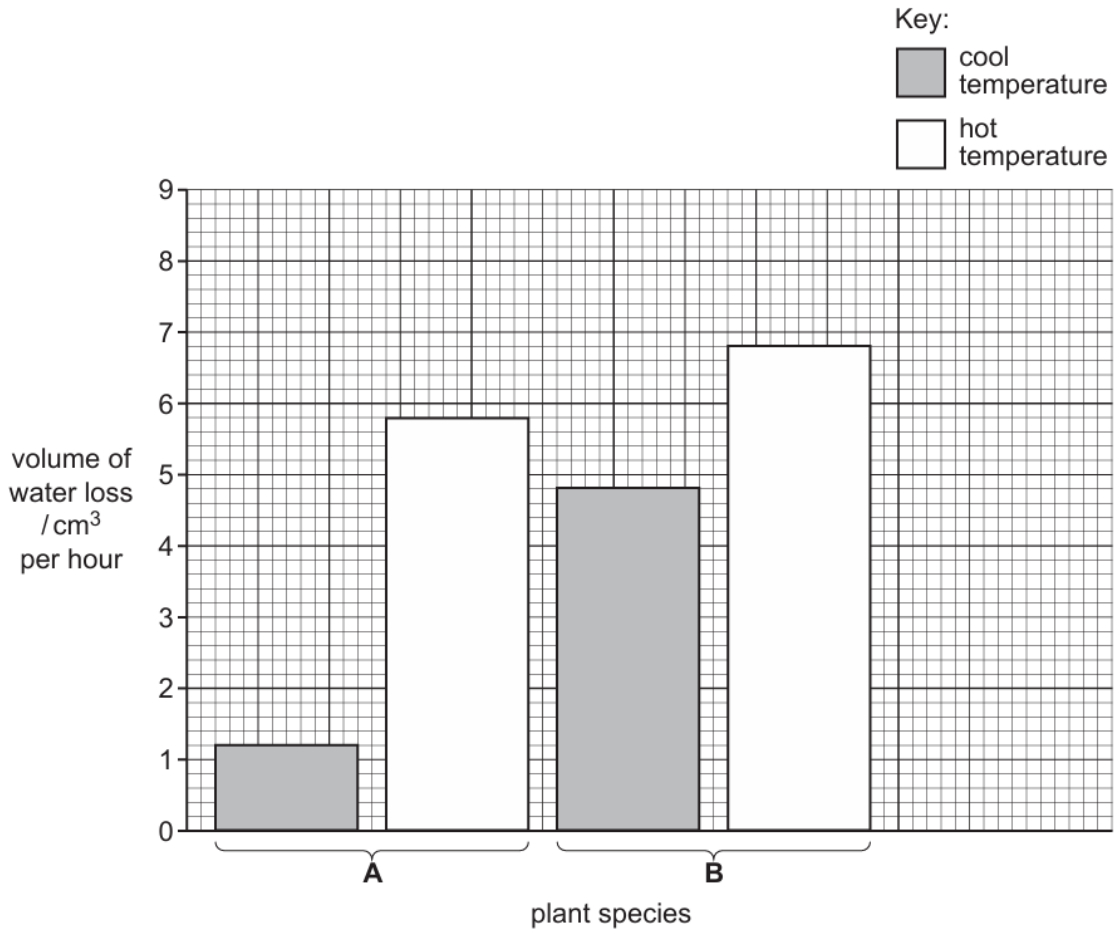

Fig. 5.1

Compare the volume of water loss in species **A** and species **B**.

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.....

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..... [3]

(c) The investigation was repeated with increased humidity.

The temperature was cool. **(extended only)**

Draw **one** additional bar **on Fig. 5.1**, for species **B** only, to show the expected result. [1]

6 **(a)** Complete the sentences by placing appropriate words in the spaces to give a definition of transpiration.

In transpiration water is lost from the ..... of a plant.

The water ..... from the surface of the .....

cells and water vapour is produced.

The water vapour moves by ..... out of the plant through pores

called ..... .

[5]

(b) Complete Table 7.1 by

- stating **two** environmental conditions that affect the rate of transpiration
- stating how a **decrease** in each environmental condition affects the rate of transpiration.

Table 7.1

environmental condition	effect of a decrease on the rate of transpiration

[4]

[Total: 9]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

7 Fig. 5.1 is a graph showing the effect of temperature on the rate of transpiration from the upper and lower surfaces of a leaf that is provided with a constant supply of water.

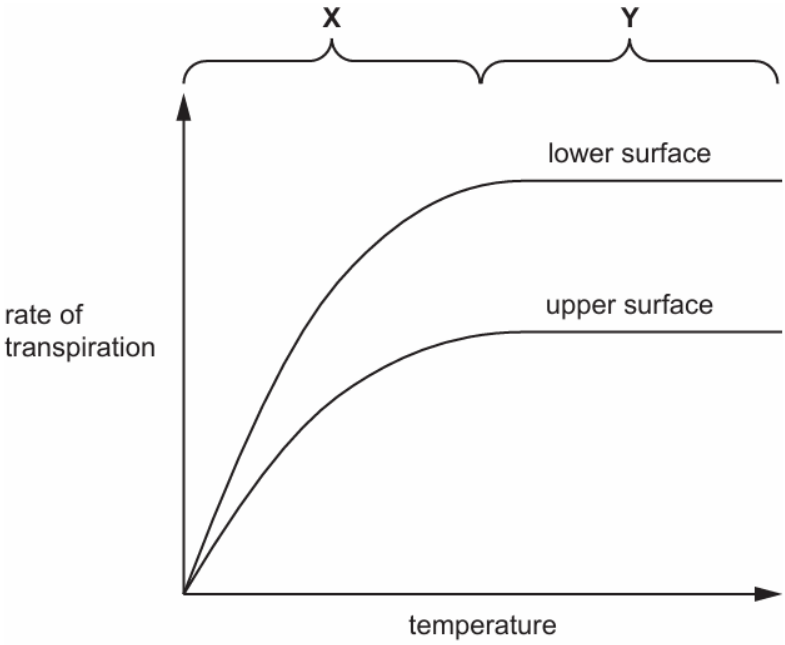

Fig. 5.1

(a) Describe the results shown in Fig. 5.1.

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..... [3]

(b) Explain reasons for the shape of the graph for the **upper** surface of the leaf at **X** and at **Y** in Fig. 5.1. **(extended only)**

at **X** .....

.....

.....

.....

.....

at **Y** .....

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[4]

(c) Suggest how the structure of the lower surface differs from the upper surface of the leaf used in this investigation.

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..... [1]

8 **(c)** Describe how water moves through a plant from the soil to the air spaces in a leaf. **(extended only)**

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..... [4]

9 **(a)** Fig. 3.1 shows some apparatus that was used to investigate water loss from a leafy shoot.

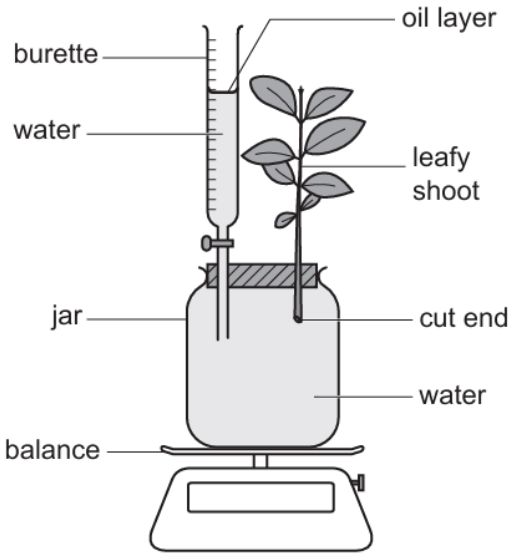

Fig. 3.1

(i) State the name of the process by which leafy shoots lose water.

..... [1]

(ii) Before the leafy shoot is inserted into the jar shown in Fig. 3.1, it must be recut under water.

Suggest why the end of the leafy shoot was cut under water.

.....

.....

..... [1]

(iii) State the purpose of the oil layer on top of the water in the burette.

.....

.....

..... [1]

(iv) Using the information in Fig. 3.1, describe **one** method that can be used to determine how much water is lost from the leafy shoot.

.....

.....

..... [1]

(b) The apparatus shown in Fig. 3.1 was used to investigate the effect of temperature on the rate of water loss in a species of plant. The results are shown in Fig. 3.2.

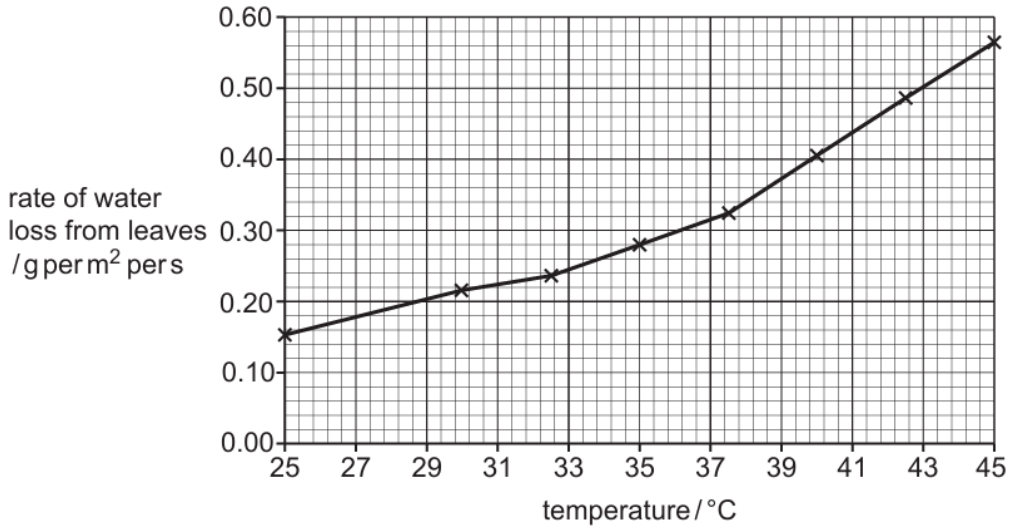

Fig. 3.2

(i) Using the information in Fig. 3.2, calculate how much water would be lost from 1 m^2 of leaves in 12 hours if the plants were kept at 35 °C. Include the unit.

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[3]

(ii) Using the information in Fig. 3.2, describe **and** explain the effect of increasing temperature on the rate of water loss in this species of plant. **(extended only)**

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..... [5]

(c) The apparatus shown in Fig. 3.1 can also be used to investigate the effects of changing humidity on water loss in plants.

(i) Suggest why the mass of water in the apparatus does **not** change when the leafy shoot is kept at 100% relative humidity. **(extended only)**

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..... [2]

(ii) Even at extremely low relative humidities the leafy shoot did not wilt.

Explain why the leafy shoot shown in Fig. 3.1 did **not** wilt. **(extended only)**

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..... [1]

(iii) The investigation on the effect of temperature was done at a relative humidity of 20%.

The investigation was repeated at a relative humidity of 80% and all other conditions were kept the same.

Predict how the water loss will differ from the trend shown in Fig. 3.2.

Sketch your prediction **on Fig. 3.2**. **(extended only)**

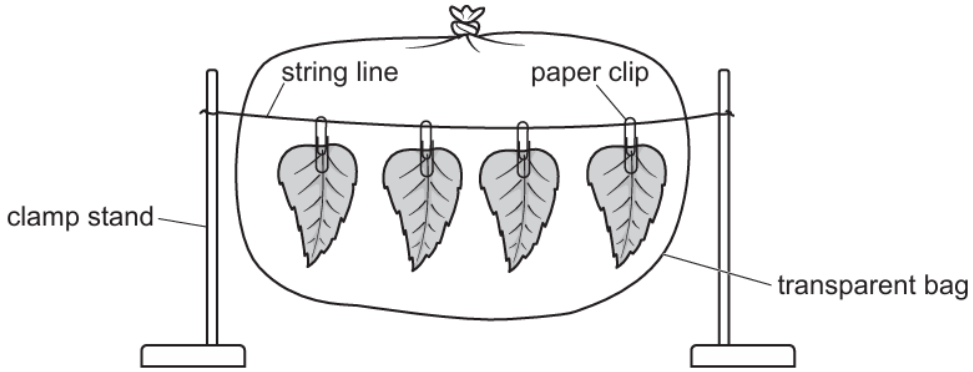
[1]

10 **(a)** Some students set up the apparatus shown in Fig. 6.1 to compare transpiration in two sets of leaves.

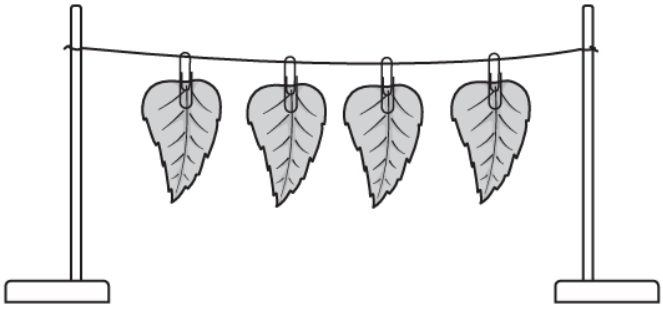
Set **A** was kept in a transparent bag and set **B** was left in the open air.

All other conditions were kept constant.

The mass of the leaves in each set was measured at the start of the investigation and after five hours.



set **A**



set **B**

Fig. 6.1

(i) Predict the results for this investigation. **(extended only)**

Explain the reason for your prediction.

prediction .....

.....

explanation .....

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[3]

(ii) Explain how transpiration occurred in the leaves shown in Fig. 6.1. **(extended only)**

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..... [3]

(iii) The students needed two additional pieces of apparatus to take measurements so that they could calculate the rate of transpiration from their results.

State the **two** additional pieces of apparatus the students needed to take the measurements.

1 .....

2 .....

[2]

(b) Fig. 6.2 shows the positions of the different tissues in part of a dicotyledonous leaf.

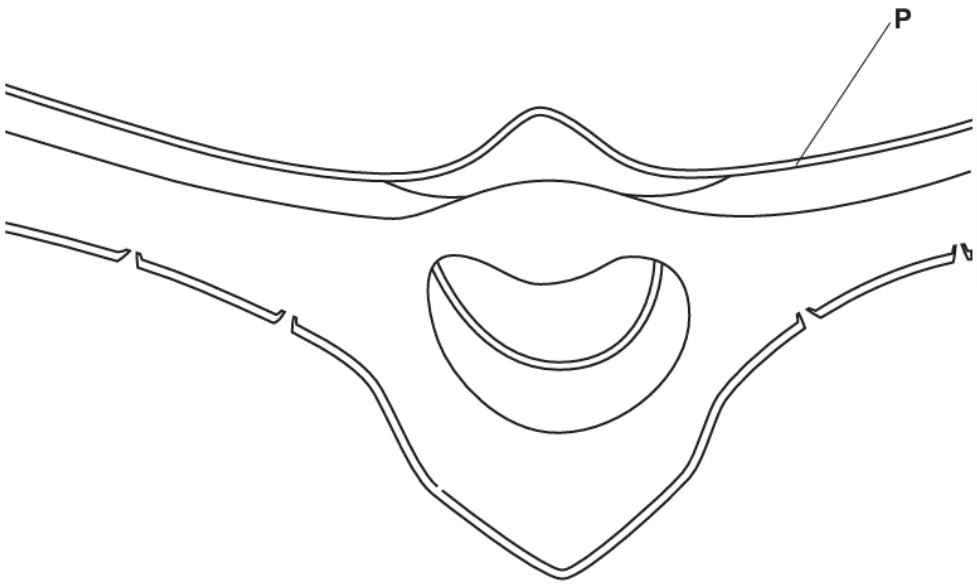

Fig. 6.2

Identify the tissues described in Table 6.1 by:

- drawing label lines with the corresponding letter on Fig. 6.2 **and**
- stating the name of each tissue in Table 6.1.

The label, line and name of the tissue for letter **P** has been completed for you on Fig. 6.2 and in Table 6.1.

Table 6.1

letter	description	name of the tissue
P	a protective transparent layer that allows light to reach the inner tissues	upper epidermis
Q	conducts water from the stem	
R	contains many interconnected air spaces	
S	transports sucrose and amino acids	
T	traps the most light energy to synthesise carbohydrates	

[4]

11 **(b)** Water absorbed by the roots moves through the stem and enters the leaves. Most of this water is lost in transpiration.

Explain how the internal structure of leaves results in the loss of large quantities of water in transpiration. **(extended only)**

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.....[3]

12 Aphids are insects that feed on the phloem sap in plants.

Fig. 3.1 shows a diagram of an aphid with its mouth parts inserted into the stem of a plant.

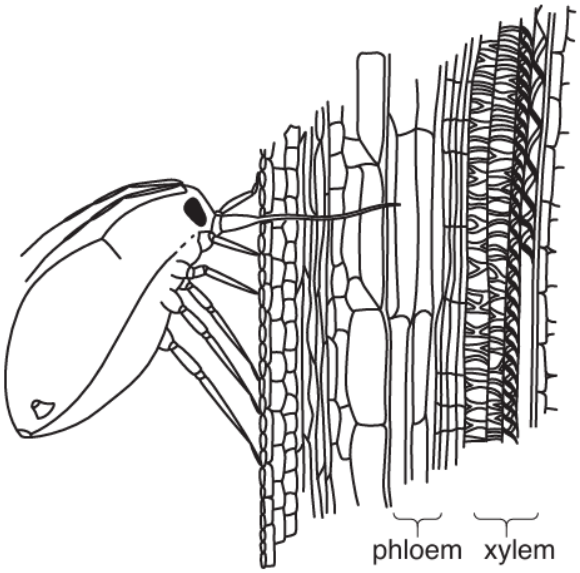

Fig. 3.1

(b) Fig. 3.1 shows some of the features of xylem.

Describe how xylem is adapted for its functions. **(extended only)**

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..... [6]

13 Fig. 3.1 shows a photomicrograph of a section of a root.

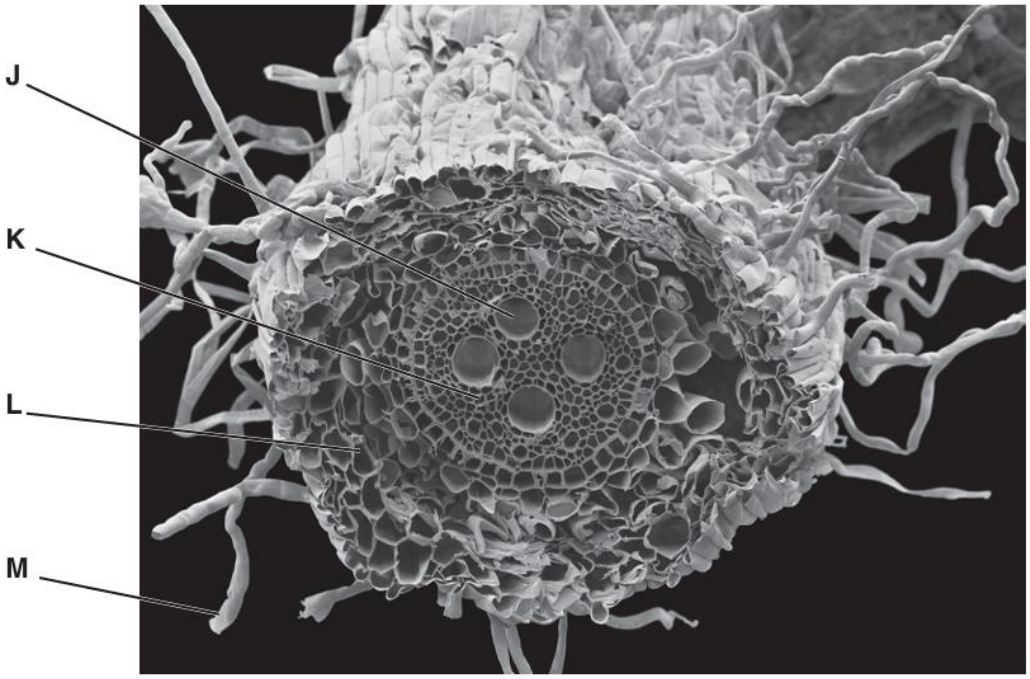

Fig. 3.1

(a) Structure **J** is a xylem vessel.

The xylem vessels conduct water from the roots to the stems.

State the features of xylem vessels that enable them to conduct water. **(extended only)**

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.....[3]

(b) Describe the pathway of water from outside the root to the xylem vessels (**J**) at the centre of the root. Use the letters in Fig. 3.1 in your answer.

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.....[5]

14 **(a)** Fig. 3.1 is a photomicrograph of some xylem vessels.

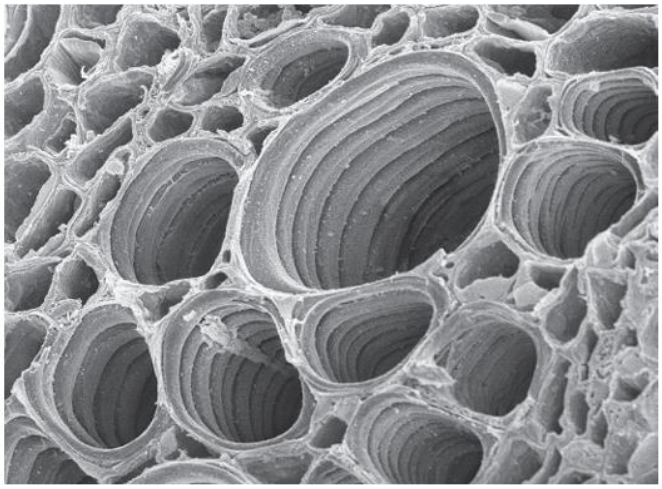

Fig. 3.1

(i) State **one** structural feature of xylem vessels and explain how this is related to the function of water transport. **(extended only)**

feature .....

.....

explanation .....

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.....

.....

[2]

(ii) Explain the mechanism that is responsible for the movement of water in xylem vessels.

(extended only)

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..... [4]

(iii) State **one** role of xylem vessels **other than** transport.

..... [1]

(b) The rate of transpiration is affected by several factors including the temperature and the humidity of the air.

State **and** explain the effect of an increase in temperature on the rate of transpiration. **(extended only)**

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..... [3]