

Transport in plants

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Exchange and transport
Topic	Transport in plants
Booklet	Question Paper 1

Time allowed: 80 minutes

Score: /59

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

The downy birch tree, *Betula pubescens*, produces varying numbers of leaf hairs.

These hairs are between 200 μm and 500 μm long in response to different environmental conditions.

(a) State the **pattern** of variation shown by leaf hair density.

[1]

(b) Leaf hair density can be measured in the laboratory.

Outline a practical method that could be used to determine the density of hairs on the underside of a leaf.

[3]

(c) A group of students investigated the relationship between the distance of different trees from a river and the mean leaf hair density.

Table 25 shows the results of their investigation.

Distance from river (m)	Rank of distance	Mean leaf hair density (number mm ⁻²)	Rank of hair density	Difference in ranks (<i>d</i>)	Difference squared (<i>d</i> ²)
9.1	4	33.1			
13.7	1	34.8			
5.5	7	11.3			
0.3	10	3.4			
5.4	8	27.3			
11.5	3	30.3			
1.7	9	6.3			
6.0	6	22.9			
11.9	2	5.7			
6.8	5	23.2			

Table 25

(i) Complete Table 25 by calculating the difference between the ranks and then squaring the difference.

[Answer on Table 25]

[2]

(ii) Use the formula below to calculate Spearman's rank correlation coefficient for this data.

$$r_s = 1 - \frac{6Rd^2}{n(n^2 - 1)}$$

[2]

(d) The students concluded that there is a positive correlation between distance of the tree from the river and mean leaf hair density.

(i) Suggest reasons for this positive correlation. [2]

(ii) For this investigation, the students randomly selected leaves from ten downy birch trees at varying distances from the river.

Suggest **three** ways in which the students could improve the validity of their sampling method.

[3]

(e) Another group of students repeated this investigation and calculated $r_s = 0.589$. The critical value of r_s at the 5% level for 9 degrees of freedom is 0.600.

They concluded that their results showed a weak positive correlation between leaf hair density and distance of the tree from the river.

Evaluate the conclusion of this group of students.

[2]

[Total: 15]

Question 2

- (a) A group of students wanted to observe the position of xylem vessels in the leaf stalks (petioles) of celery.

Describe a procedure they could use to do this.

[2]

- (b) Water Starwort is a hydrophyte belonging to the genus *Callitriche*. It is an aquatic plant which has its stems fully submerged in water.

Cholla is a cactus belonging to the genus *Cylindropuntia*. It can grow over 4 metres tall.

In the space provided below, give **one** way in which you would expect the walls of the xylem vessels in the stems of Water Starwort and the walls of xylem vessels in the stems of Cholla, to differ from those of a herbaceous dicotyledonous plant growing in a deciduous woodland.

Water Starwort

Cholla

[2]

- (c) Xylem and phloem are two vascular tissues found in plants.

State **one** similarity and **two** differences between the structure of xylem and phloem.

[3]

[Total: 7]

Question 3

The following statements summarise the results from experiments designed to discover more about the translocation of organic materials in the phloem.

A	Any increase in the sugar content of leaves is followed by a similar change in the sieve tube contents in the stem.
B	The rate of transport increases with increasing temperature, reaching a maximum at 25 °C before decreasing at higher temperatures.
C	Translocation stops when stems are treated with a substance that inhibits respiration.
D	Sugars can be transported both up and down the plant.
E	Aphids can be used to sample phloem sap.
F	Roots, young leaves and growing fruits will import sugars.

(a) State all the letters that provide evidence for the following conclusions: **[4]**

Translocation is an active process.

Sugars are translocated from source to sink.

(b) Explain how mass flow of the phloem sap occurs in plants with a vascular system. **[3]**

[Total: 7]

Question 4

Fig. 4.1 shows a potometer, a piece of apparatus used for estimating the rate of transpiration.

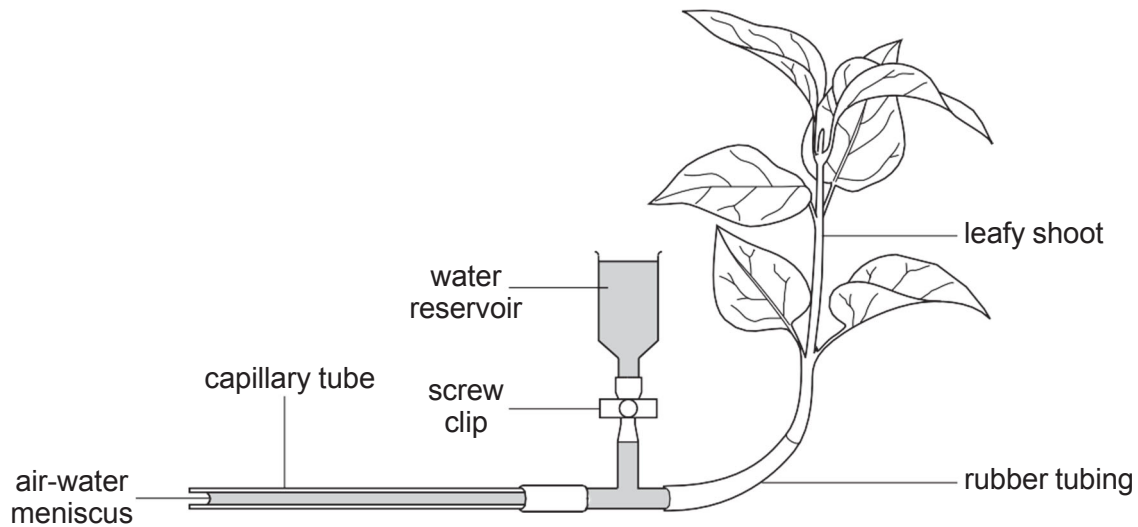


Fig. 4.1

- (a) State **one** essential component of the apparatus, not shown in Fig. 4.1, that must be added before any results can be recorded.

[1]

- (b) Describe **three** steps a student should take when **setting up** the potometer to ensure that the apparatus works correctly.

[3]

- (c) A student used the apparatus shown in Fig. 4.1 to investigate how transpiration rates vary during the day. The student placed the potometer on a window ledge in the laboratory and estimated the rate of transpiration four times during the day.

The results are shown in Table 4.1.

Table 4.1

time of day	rate of transpiration (arbitrary units)			
	replicate 1	replicate 2	replicate 3	mean
10.00	32	29	31	30.7
12.00	37	35	38	36.7
14.00	23	26	25	24.7
16.00	25	27	24	

- (i) Calculate the mean value for the rate of transpiration at 16.00 hours.
Give your answer to **one decimal place**. [1]
- (ii) Explain why, for each time of the day, the student carried out three replicates to calculate a mean. [2]
- (iii) Suggest **two** possible reasons, other than light and temperature, why the rate of transpiration was **lower** in the afternoon than in the morning. [2]
- (iv) Explain why the potometer only gives an **estimate** of the rate of transpiration. [2]

[Total: 11]

Question 5

(a) Complete the following paragraph about the loss of water from plants. [4]

The loss of water from the aerial parts of a plant is known as

The majority of water is lost from the leaves. Water is transported up the stem in the

..... and passes into the mesophyll cells of the leaf by

..... . Water evaporates from the surface of these cells. The

water vapour diffuses out of the air spaces in the leaf through the

..... .

(b) (i) Explain why water loss from the leaves of a plant is unavoidable. [2]

(ii) Name the **type** of plant adapted to reduce water loss from its leaves. [1]

(iii) State **and** explain **two** adaptations of leaves that reduce evaporation.



In your answer, you should use appropriate technical terms, spelt correctly.

[5]

[Total: 12]

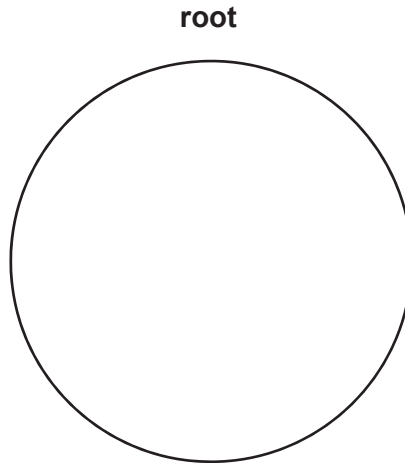
Question 6

Translocation is the movement of the products of photosynthesis within a plant.

Translocation occurs in the phloem and involves sources and sinks.

- (a) Using the outline below, draw in the position of the phloem in the root of a dicotyledonous plant.

[1]



- (b) Research using carbon dioxide containing a radioactive label, C^{14} , has revealed the following evidence about the mechanism of translocation:

- A. labelled carbon can be observed in the phloem soon after being supplied to a well-lit plant;
- B. the rate of movement of sugars in the phloem is many times faster than could be achieved by diffusion alone.

Different research has revealed that:

- C. an insect such as an aphid feeds by inserting its proboscis (mouth parts) into the phloem;
- D. the pH of the phloem companion cells is lower than surrounding cells;
- E. the phloem companion cells contain many mitochondria.

Using the letters **A**, **B**, **C**, **D** and **E**, select **two** pieces of evidence from the list above which support the theory that translocation occurs in the phloem.

[2]

(c) State what is meant by the terms *source* and *sink*. [2]

(d) When the bark is removed from a tree, the phloem is also removed. If a complete ring of bark is removed, the tree trunk can be seen to swell above the cut.

Suggest **two** reasons why the trunk swells above the cut. [2]

[Total: 7]