

# 9.1 Transport in the Xylem of Plants

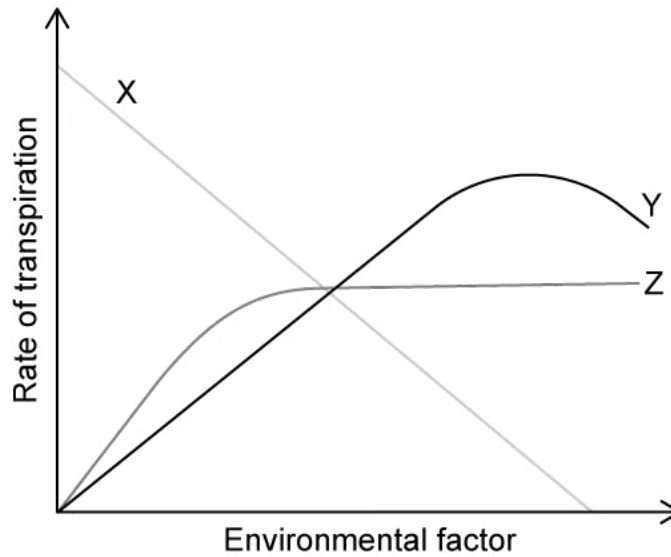
## Question Paper

Course	DP IB Biology
Section	9. Plant Biology (HL Only)
Topic	9.1 Transport in the Xylem of Plants
Difficulty	Hard

**Time allowed:** 90  
**Score:** /67  
**Percentage:** /100

**Question 1a**

a)  
The graph shows the effect of three different environmental factors on the rate of transpiration in a terrestrial plant.



i) Identify which environmental conditions may be represented by the lines X, Y and Z.

X	
Y	
Z	

[3 marks]

ii) Explain the reasons for your choice.

[3 marks]

[6 marks]

### Question 1b

b)  
Explain why the trend shown by line Y in the graph at part a), could result in decreased growth of a terrestrial plant.

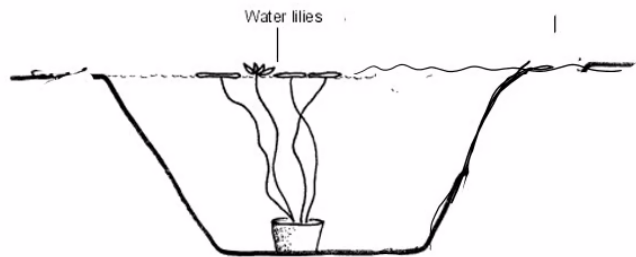
[3 marks]

[3 marks]

### Question 1c

c)  
Hydrophytes are aquatic plants which are adapted to living in very wet environments.

Water lilies are an example of a hydrophyte which has evolved to show higher rates of transpiration in order to support their growth in garden ponds.



Some adaptations of water lilies include the following:

- A thinner or absent waxy cuticle
- Stomata on the upper side of the leaf
- Large flat leaves

Use the image above and your knowledge of plant leaf structure and transpiration to explain how these adaptations may help to maximise the rate of transpiration in hydrophytes.

[3 marks]

[3 marks]

### Question 1d

d)

Terrestrial plants will often not survive if they are surrounded by water in the same way as the hydrophytes described in part **c**). Flooding of crop fields has become a severe problem in the US with detrimental effects on the growth of crop plants such as potatoes and beans. Crops growing in flooded soil are unable to absorb sufficient amounts of water through their roots, leading to wilting of their leaves.

Explain why, in the event of a flood, the uptake of water into the root cells may be reduced.

[3 marks]

[3 marks]

### Question 1e

e)

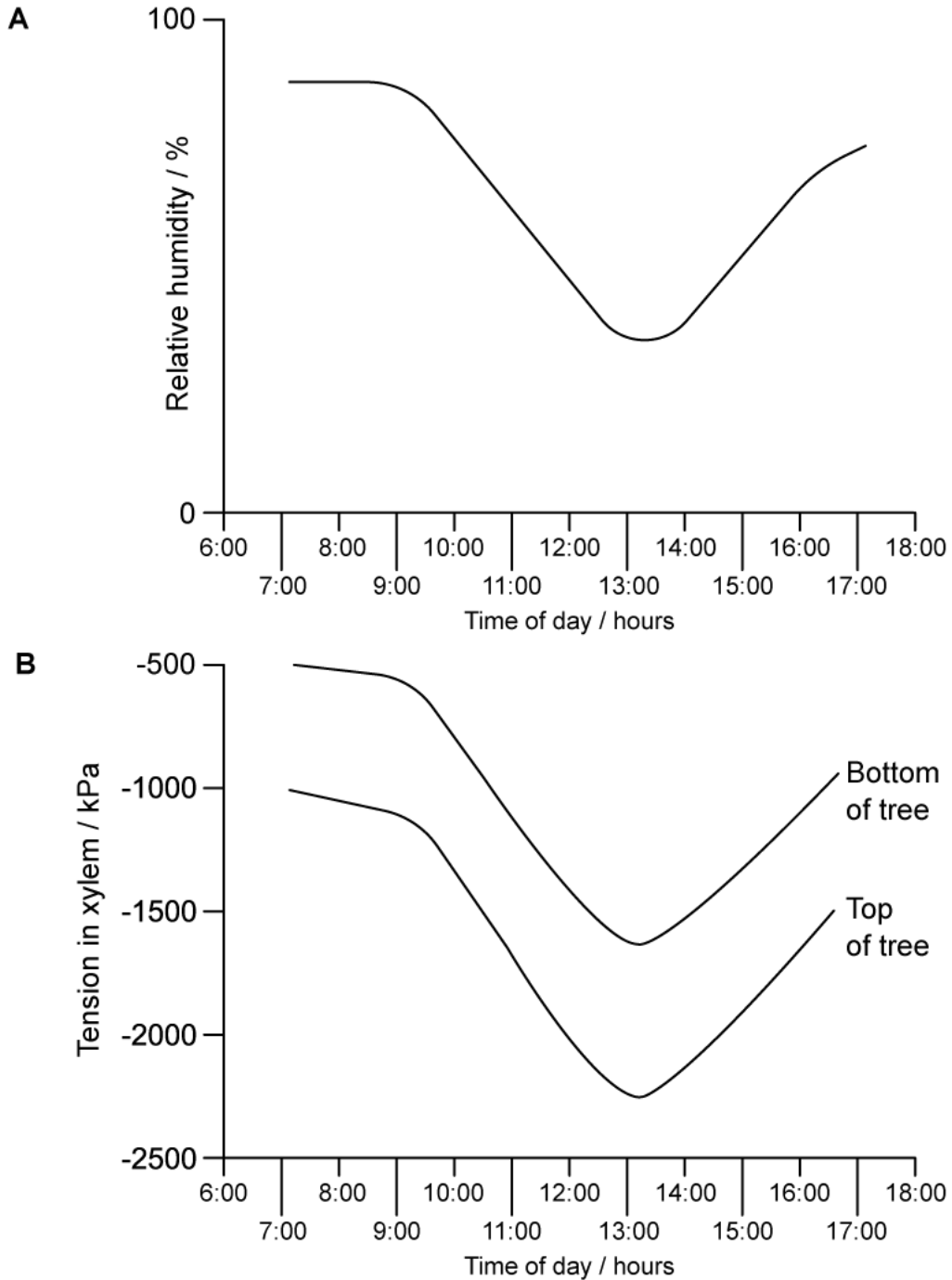
Suggest what effect flooding may have on the rate of transpiration in crop plants.

[2 marks]

[2 marks]

**Question 2a**

a)  
The effect of humidity on the transpiration stream within the xylem of an oak tree was investigated, the results are displayed in the graphs below.



Describe how the trends shown in graph **A** compare with the trends shown in graph **B**.

[4 marks]

[4 marks]

## Question 2b

b)  
Outline how the changes in humidity lead to the changes in water tension measured in the xylem at the top of the tree.

[4 marks]

[4 marks]

### Question 2c

c)  
During the investigation, the scientist also measured the diameter of the tree trunk, the results can be seen in the table below:

Time	Circumference of the trunk (cm)
7:00	97.5
9:00	97.4
11:00	96.5
13:00	95.7
15:00	95.7
17:00	96.3
19:00	97.3
21:00	97.4
23:00	97.5

Explain how this data and the data in the graphs from part **a)** support the cohesion-tension theory.

[4 marks]

[4 marks]

### Question 2d

d)  
The scientist who carried out the investigation in part **a)** concluded from his data that water moves through the xylem through the cohesion tension mechanism.

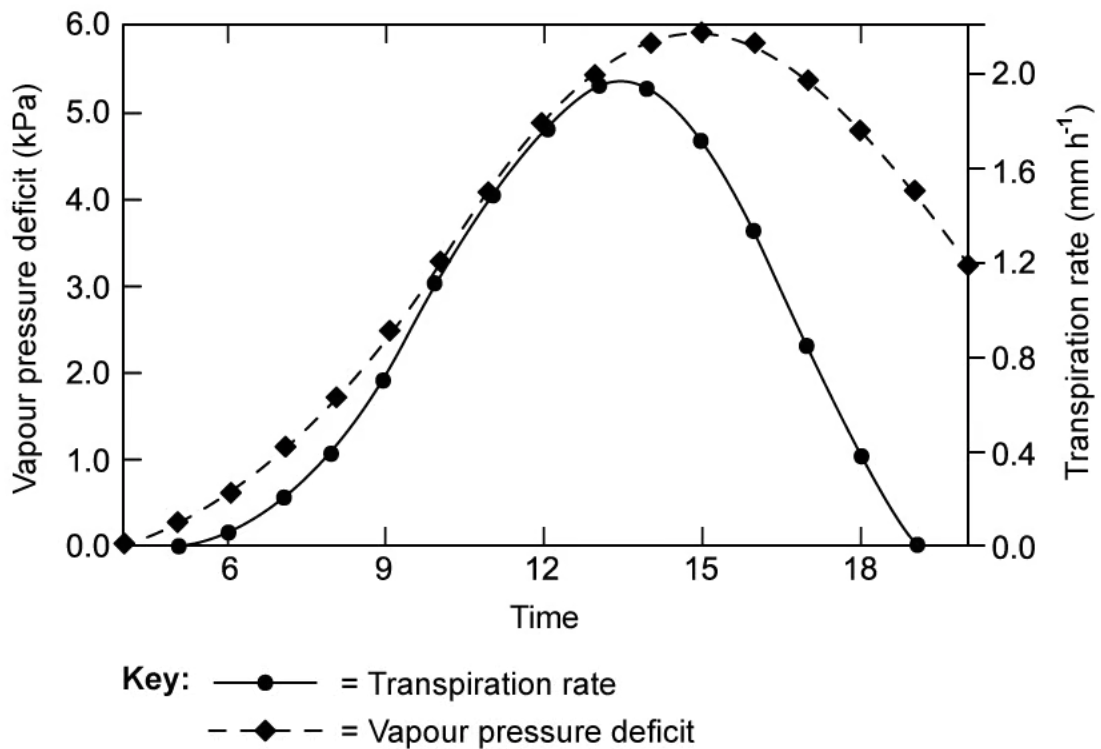
Evaluate his conclusion based on the validity of the evidence provided by the results of this investigation.

[5 marks]

[5 marks]

**Question 3a**

a)  
The graph shows the relationship between vapour pressure deficit and the rate of transpiration in wheat plants.



Vapour pressure deficit (VPD) is the difference between the amount of moisture in the air and how much moisture the air can hold when its saturated.

Using this information, state whether a high vapour pressure deficit would indicate that air humidity was high or low.

[1 mark]

[1 mark]



### Question 3b

b)

With reference to the data shown in the graph from part **a)**, explain the effect that VPD has on transpiration of wheat between 6:00 and 12:00.

[3 marks]

[3 marks]

### Question 3c

c)

Explain the pattern seen in the results from part **a)** between 13:00 and 18:00.

[2 marks]

[2 marks]

### Question 3d

d)

Suggest how information about vapour pressure deficit may be useful for growers of wheat plants.

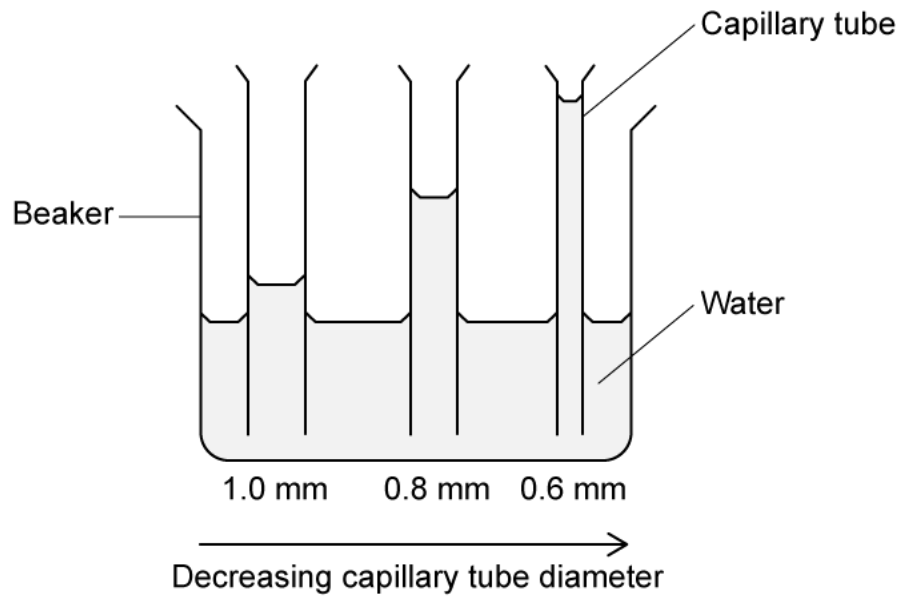
[3 marks]

[3 marks]

**Question 4a**

a)  
Some students were investigating the effect of capillary tube diameter on the uptake of water by capillary action.

They set up three capillary tubes with diameters of 0.6 mm, 0.8 mm and 1.0 mm and measured the distance moved by water in 30 seconds. Their results can be seen below:



Explain the observations made by the students.

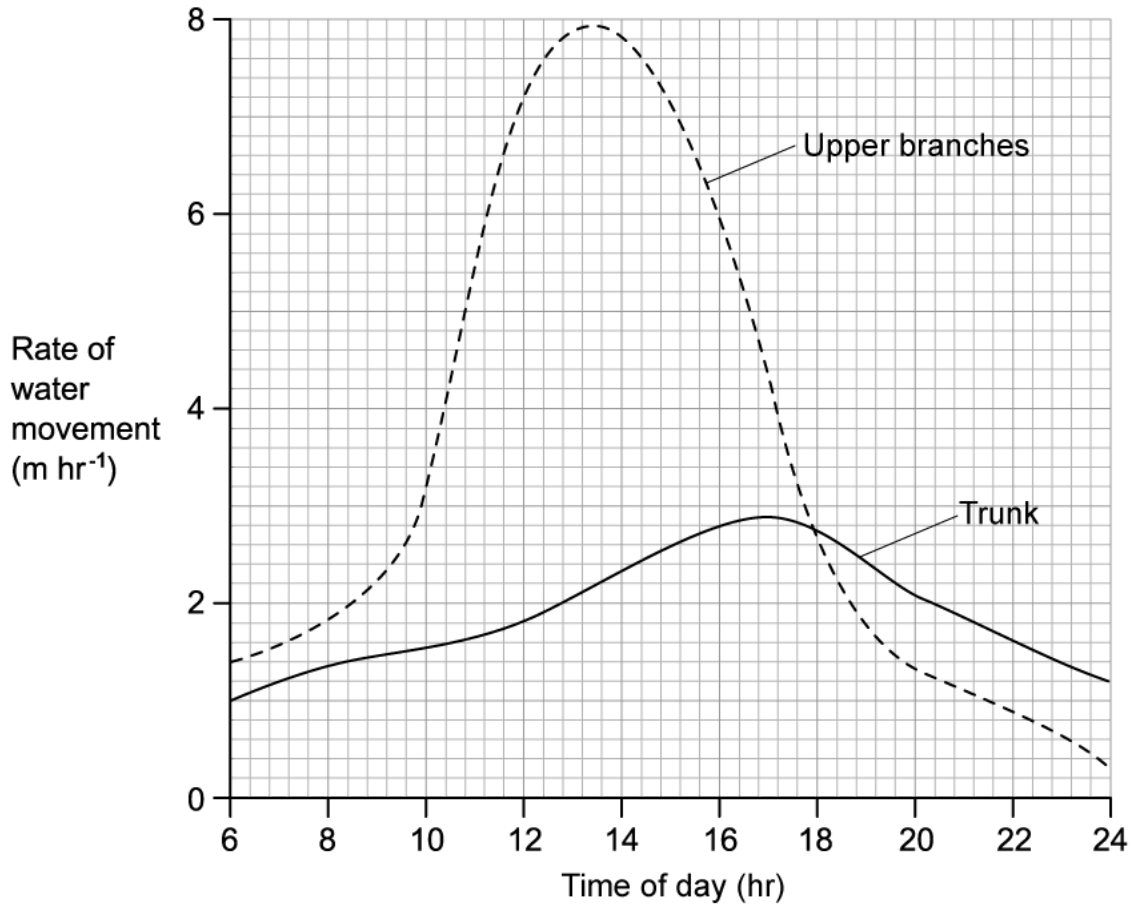
[2 marks]

[2 marks]

**Question 4b**

b)

The graph shows the differences in water movement in the xylem of a tree. The measurements were taken in the branches at the top of the tree and in the trunk of the tree.



Using ideas illustrated by the capillary model in part **a**), explain the results shown in the graph.

[2 marks]

[2 marks]

**Question 4c**

c)

Identify a limitation of using capillary tubing as a model to represent the movement of water through the xylem.

[2 marks]

[2 marks]

### Question 4d

d)

The students set up a potometer with a 0.8 mm diameter capillary tube to measure the rate of transpiration in a branch removed from a tree. Over a period of 30 minutes, the students noted that the bubble moved 13.7 cm.

Calculate the rate of transpiration shown by the leaf in  $\text{mm}^3\text{hr}^{-1}$ . Use the equation  $\pi r^2$  to calculate the area of a circle.

[3 marks]

[3 marks]

### Question 5a

*One mark is available for clarity of communication throughout this question.*

a)

Describe the pressure changes which occur in the xylem as a result of water moving through the transpiration stream.

[4 marks]

[4 marks]

### Question 5b

b)

Compare and contrast the different adaptations of xerophytes and halophytes.

[7 marks]

[7 marks]

### Question 5c

c)

Outline the routes that water can take from the soil, through the root cortex to the xylem.

[4 marks]

[4 marks]

