

**AS Level Biology A**  
**H020/02** Depth in biology

**Question Set 16**

1. An investigation was carried out into the loss of water from a leafy shoot. The apparatus used is shown in Fig. 1.1.

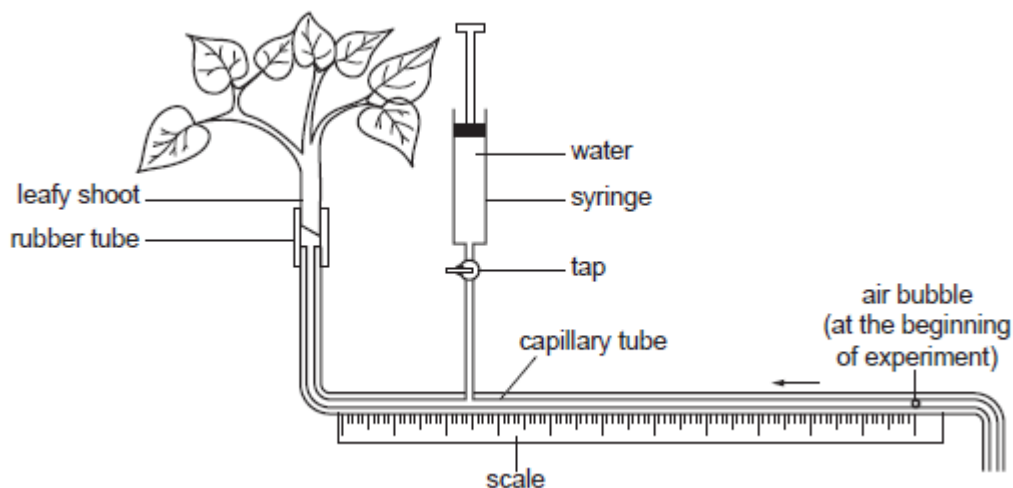


Fig. 1.1

- (a) (i) State what assumption is made when using this apparatus to measure the rate of transpiration. [1]

**Water uptake is equal to water loss due to transpiration.**

- (ii)\* There must be no air in the apparatus in Fig. 1.1 for it to work correctly.

Describe and explain the precautions that need to be taken when setting up and using the apparatus in Fig. 1.1 to ensure that no air is present. [6]

**When setting up the apparatus, the leafy shoot should be cut underwater to ensure air bubbles do not become trapped in the xylem. The apparatus should also be kept underwater when inserting the shoot tip into the rubber tubing. The shoot tip should be an exact fit for the rubber tubing and joints should be sealed tight using grease e.g. vaseline. These steps ensure that no air enters the shoot, maintaining a continuous water column. When using the apparatus, the open capillary tube should remain submerged in a beaker of water to prevent the formation of new air bubbles. The bubble should not be allowed to move past the scale to ensure it does not enter into the xylem and a syringe should be used to manually control bubble movement. A clamp stand should be used to support the shoot to prevent it from bending or snapping and air entering the xylem.**

- (b) A student obtained replicate readings for the movement of the air bubble during five minutes in three different conditions. The results are shown in Table 1.1.

Condition	Distance moved by bubble in 5 minutes (mm)						
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Mean
In still air	89	84	86	87	85	86	86.2
With an electric fan	142	139	144	138	139	141	140.5
In still air and lower leaf surface covered with petroleum jelly	32	28	31	57	27	29	34.0

Table 1.1

- (i) Identify an anomalous reading in the data and evaluate the extent to which it has affected the mean that has been calculated. [3]

Trial 4, data reading '57' is anomalous. With this data value, the mean is 34.0 whereas without this reading the mean is 29.4. Although it has increased the mean by 4.6, the mean value for 'in still air with petroleum jelly' is still significantly lower than the mean values for the other two conditions so the student's conclusions will remain the same. Thus, it is not hugely significant. However, as the anomaly has increased the mean value by 15.6%, it should be removed.

- (ii) Suggest a reason for the reading that you identified as anomalous in (i). [1]

A sudden rise in air movement.

- (iii) The internal diameter of the capillary tubing was 0.7 mm.

Table 1.2 shows the mean rate of transpiration in each of the experimental conditions.

Condition	Mean rate of transpiration (mm <sup>3</sup> min <sup>-1</sup> )
In still air	
With an electric fan	10.81
In still air and lower leaf surface covered with petroleum jelly	2.62

Table 1.2

Calculate the mean rate of transpiration for the leafy shoot in still air.

Use the formula: Volume of a cylinder =  $\pi r^2 l$

$$\pi \times 0.35^2 \times \left(\frac{86.2}{5}\right) = 6.63 \text{ mm}^3 \text{ min}^{-1}$$

rate of transpiration = ..... 6.63 mm<sup>3</sup>min<sup>-1</sup> ..... mm<sup>3</sup> min<sup>-1</sup> [3]

- (iv) The control experiment in this investigation was to measure the mean rate of transpiration in still air.

Explain why the control experiment is carried out in this investigation.

[1]

**To provide a value that the results of the manipulated conditions can be compared with so as to determine their effects.**

- (c) Another student suggested using an alternative apparatus for measuring the rate of transpiration of a leafy shoot. Fig. 1.2 shows this apparatus.

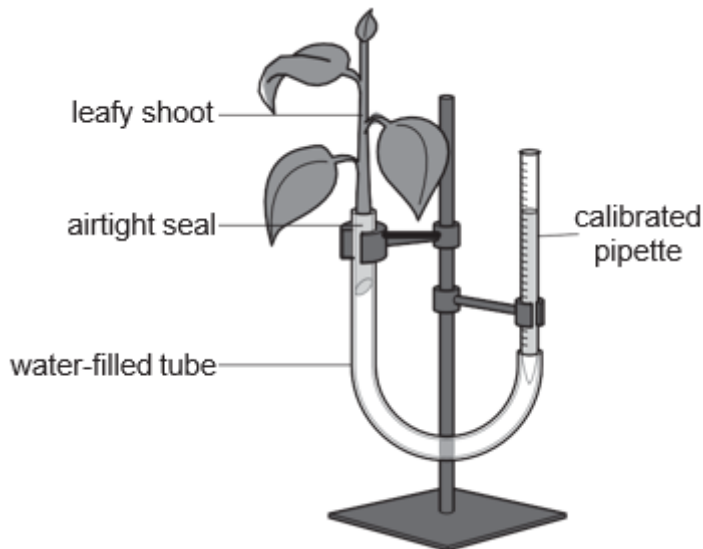


Fig. 1.2

The student stated that this apparatus would be an improvement on the apparatus shown in Fig. 1.1 because the volume of water taken up could be measured directly.

Suggest why it might be considered better to use a capillary tube rather than a calibrated pipette to measure water uptake.

**Capillary tube has smaller divisions. It can measure the volume of water taken up more accurately, reducing uncertainty with regard to measurement.**

[1]

- (d) The student wanted to compare the rates of transpiration of the two leafy shoots shown in Fig. 1.3.



Fig. 1.3

Describe how the student could ensure that a valid comparison could be made between the two leafy shoots.

[2]

**Calculate the surface area of leaf for both shoots, measure the rate of transpiration and determine the rate of transpiration per unit area.**

**Total Marks for Question Set 16: 18**

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