



ANSWER BOOK

Xylem and the transpiration stream: the pull comes from the top

Plant transport and mineral nutrition · Unit B08

AQA 3.3.4.2 · OCR A 3.1.3 · Edexcel A Topic 4.1-4.4 · CAIE 7.1, 7.2

7 questions · 21 marks

NAVY EDITION

SECTION A · Short, 1 to 2 marks

- A1** **A1** magnesium ions, which sit at the centre of every chlorophyll molecule. **B1** [2]
magnesium travels in the phloem, so a plant running short strips it out of old leaves to supply new growth.
- A2** **A1** the Casparian strip, a band of suberin. [1]
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SECTION B · Standard, 3 to 5 marks

- B1** **B1** water evaporates from the wet cellulose walls of the mesophyll cells into the [5]
leaf air spaces and diffuses out through the stomata. **B1** the water potential of that
mesophyll cell falls, so it draws water osmotically from the cell next to it, and so on back
to the xylem in the vein. **B1** water is therefore pulled out of the xylem vessel, and the
column of water in the vessel is put under tension rather than being pushed from
below. **B1** cohesion, from hydrogen bonding between water molecules, stops the
column pulling apart, so removing a molecule at the leaf draws one in at the root. **A1**
adhesion, from hydrogen bonding between water and the lignified wall, holds the
column against the wall of the narrow vessel.
- B2** **M1** radius is half the diameter, so $r = 0.40 \text{ mm}$. **M1** cross-sectional area = $\pi r^2 =$ [4]
 $\pi \times 0.40^2 = 0.50 \text{ mm}^2$. **M1** volume swept out = $0.50 \times 62 = 31 \text{ mm}^3$. **A1** rate = $31.2 \div 4.0 =$
 $7.8 \text{ mm}^3 \text{ min}^{-1}$, accepting 7.79 with the unit given.
- B3** **B1** on the apoplast route water travels through the cellulose cell walls and the [3]
spaces between them, without entering the cytoplasm of any cell. **B1** on the symplast
route water travels through the cytoplasm, passing from one cell to the next through
plasmodesmata. **A1** the symplast route crosses a plasma membrane at the root hair
cell, while the apoplast route crosses none until the Casparian strip forces water into
the cytoplasm of an endodermal cell.
- B4** **B1** the bubble moves because the cut shoot is drawing water in, so the [3]
quantity measured is the rate of water uptake. **B1** a small fraction of the water taken up
never leaves the shoot: some is a raw material in photosynthesis and some is retained
in cells that are expanding or staying turgid. **A1** uptake therefore slightly exceeds loss,
so the true rate of transpiration was below the figure she recorded.
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B5 **B1** the column in that vessel is no longer continuous, so tension cannot be transmitted through it and it stops carrying water for the rest of the season. **B1** pits are gaps where lignin was not laid down, so water can pass sideways from one vessel into its neighbour. **A1** water detours through the pits into an intact vessel alongside, which is why many narrow vessels survive damage that would cripple a single wide one. [3]
