Exam Papers Practice

9.1 Transport in the Xylem of Plants

Mark Schemes

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

To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

The correct answer is **B** because higher humidity levels, lower temperatures, less air movement and lower light intensities all result in lower transpiration rates.

- **A** is incorrect, as a **low humidity** means the air surrounding the leaf surface is **not saturated** with **water vapour**, which makes water more likely to evaporate out of the leaf (due to the concentration gradient between the inside of the leaf and the outside)
- **C** is incorrect, as higher temperatures result in more evaporation from the leaf. However, don't forget that **very high temperatures** can actually **reduce transpiration rates**, as the stomata close to prevent excess water loss
- **D** is incorrect, as wind carries water molecules **away from the leaf surface**, increasing the concentration gradient and causing more water vapour to diffuse out

2

The correct answer is **C** because the force of attraction between water molecules is known as cohesion. In this model, cohesion is occurring between water molecules within the capillary tube.

- **A** is incorrect, as translocation is the biological term used to describe the **transport of organic solutes** in the **phloem** tissue
- **B** is incorrect, as hydrostatic pressure gradients occur in the **phloem** and are generated by the active transport of sucrose into the **sieve tube elements**, raising the solute concentration in the sieve tube and causing water to follow the sucrose by osmosis
- **D** is incorrect, as adhesion does not occur between water molecules but instead refers to the attraction **between water molecules and a surface**, such as the hydrophilic surface of the cell walls on the interior of xylem vessels or, in this model, the inner glass surface of the capillary tube

3

The correct answer is **B**.

As water **evaporates** from a leaf, water is drawn from the nearest **xylem vessels** to **replace** the water lost by evaporation. This water loss from the xylem vessels generates a **low pressure** within the xylem, which creates a **pulling force** throughout the xylem vessels that is **transmitted**, via **cohesion** between water molecules, through the stem of the plant and to the ends of the xylem in the roots. This is known as **transpiration-pull** and it allows water to be moved upwards through the plant, against the force of gravity. This continuous upwards flow of water in the xylem vessels of plants is known as the **transpiration stream**.

4

The correct answer is **B**.

- **A** and **C** are incorrect, as the transport of organic compounds from source to sink occurs in phloem sieve tubes
- **D** is incorrect, as it is phloem sieve tubes that are closely associated with companion cells, not xylem vessels

5

The correct answer is **D**.

In transverse sections of most plant stems and roots, the **xylem vessels** are located closer to the **centre** of the stem or root, with **phloem tissue** located closer towards the **outer edge** of the stem or root.

6

The correct answer is **A** because this is not an adaptation found in xerophytes and it is incorrect to say that air moisture is absorbed at night.

- **B** is an adaptation commonly found in **cacti** - the spines reduce their **leaf surface area** and this results in less water loss
- **C** is a more general adaptation found in many xerophytes
- **D** is an adaptation found in **marram grass** (*Ammophila arenaria*). The rolled-up leaves reduce the **exposure of leaf surfaces to the wind** and creates a **humid space** inside each rolled-up leaf, reducing water loss by evaporation

7

The correct answer is **D**.

The uptake of water is a **passive process** and occurs by **osmosis** as a result of the **active transport of mineral ions into root cells**. Mineral ion uptake **raises the solute concentration**, or osmolarity of the **root cells**, causing water to move (by osmosis) from an area of **lower osmolarity** in the **soil** to an area of **higher osmolarity** inside the **root cell**.

8

The correct answer is **B**.

Although potometers can be used to **estimate transpiration rates** in plants, they technically measure the **rate of water uptake** rather than the rate of transpiration, as a small amount of the water taken up by a plant will be used in **photosynthesis**.

9

The correct answer is **A** because an increase in temperature increases the rate of transpiration as **water molecules evaporate out of the leaf at a faster rate**. However, if the temperature gets **too high** the **stomata close** to prevent excess water loss, which **dramatically reduces the rate of transpiration**.

- **B** is incorrect, as transpiration rates decrease with increasing humidity
- **C** is incorrect, as transpiration rates increase with increasing air movement (wind speed) but then **level off** (at which point other factors are **limiting** the rate of transpiration)
- **D** is incorrect for the same reason - transpiration rates increase with increasing light intensity but then level off once a certain intensity of light is reached

10

The correct answer is **D** because the question asks how mineral ions move **towards** the root, not how they **enter** the root. The **mass flow of water** through the free spaces in the cellulose cell walls (the **apoplast pathway** of water movement) ensures a continuous delivery of fresh **soil solution** (containing mineral ions) to the root hair cell plasma membranes.

- **A** is incorrect, as **translocation** is the biological term used to describe the **transport of organic solutes** in the **phloem** tissue
- **B** is incorrect, as mineral ions are actively transported **into** root cells by the action of **specific transporter proteins** in their cell surface membranes
- **C** is incorrect, as **osmosis** is how **water uptake** into roots occurs