IB Biology A1.1 Water Worksheet 04 - Adhesion and Capillary Action

Trimester assessment practice with IB-style multiple choice, short answer, data response / case study, and extended response.

Level	Focus	Recommended time	Total marks
SL core / HL compatible	A1.1.4 - Adhesion to polar materials; capillary action in soil and plant tissues	35 to 40 minutes	25

Instructions: Answer all questions. Use precise biological vocabulary. Working should be shown where calculation or reasoning is required. These worksheets are original IB-style practice materials for classroom use.

Question mix: 4 multiple choice questions, 3 short-answer questions, 1 data response / case study question, and 1 extended response.

Section A - Multiple choice

Choose the best answer for each question. [1 mark each]

Q1. Adhesion is best defined as the attraction between water and ... [1]

A. only other water molecules

B. non-polar molecules only

C. a different polar or charged material

D. air molecules

Q2. Which material in plant xylem walls helps water adhere by hydrogen bonding? [1]

A. Starch

B. Cellulose

C. Triglyceride

D. DNA

Q3. Capillary action is strongest in ... [1]

A. wide tubes

B. narrow spaces

C. hydrophobic channels

D. vacuoles only

Q4. Root hairs are effective for water uptake because they ... [1]

A. destroy capillary action

B. grow into tiny water-filled spaces between soil particles

C. remove all ions from the soil

D. convert adhesion into osmosis

Section B - Short answer

Q5. Distinguish between cohesion and adhesion using an example from plant water transport. [4]

Q6. Explain how adhesion helps prevent a xylem water column from falling down the vessel. [3]

Q7. Describe one way capillary action in soil benefits plants. [3]

Section C - Data response / case study

A student placed capillary tubes of different internal diameters into dyed water and measured the height of the liquid column after 10 minutes.

Internal diameter of tube (mm)	Height of dyed water rise (mm)
0.5	44
1.0	23
2.0	12
4.0	6

Q8. Use the results to explain capillary action. [6]

(a) Describe the relationship between tube diameter and rise of water. [2]

(b) Explain the molecular basis of this trend. [2]

(c) Explain why root hairs benefit from water moving in narrow spaces. [2]

Section D - Extended response

Q9. Explain how adhesion and cohesion work together to move water from soil into and through plants. [8]

Responses should mention soil, root hairs and xylem.

Answer key and marking guidance

Award credit for scientifically accurate equivalent wording unless the markscheme specifies otherwise.

Section A answers

Question	Answer	Guidance
Q1	C	Adhesion refers to attraction between water and other polar / charged substances.
Q2	B	Cellulose is polar and can interact with water.
Q3	B	In narrow tubes or channels, adhesion and cohesion can pull water upward effectively.
Q4	B	Root hairs access microscopic soil channels where water is retained.

Section B guidance

Q5. Distinguish between cohesion and adhesion using an example from plant water transport. [4]

Award up to [2] for each distinction. Cohesion = attraction between water molecules, helping a continuous column form in xylem. Adhesion = attraction between water and xylem wall / cellulose, helping water remain attached to the wall and resist gravity.

Q6. Explain how adhesion helps prevent a xylem water column from falling down the vessel. [3]

Award [1] for each valid point up to [3]. Water molecules adhere to cellulose in xylem walls; this helps anchor the column to the vessel wall; when tension is not pulling strongly, adhesion reduces the tendency of the water column to slide downward under gravity.

Q7. Describe one way capillary action in soil benefits plants. [3]

Award [1] for each valid point up to [3]. Water moves through microscopic soil channels; water adheres to polar soil particles; cohesion pulls more water along; root hairs can then absorb this water from spaces that appear dry to the eye.

Section C guidance

Q8. Use the results to explain capillary action. [6]

Award marks as indicated. (a) Award up to [2]. As tube diameter decreases, the height of water rise increases / inverse relationship. (b) Award up to [2]. Water adheres to the polar tube surface; cohesion pulls other water molecules upward; the effect is more noticeable in narrow tubes because wall effects are proportionally greater. (c) Award up to [2]. Soil contains narrow channels; root hairs enter these spaces and can absorb capillary-held water effectively.

Section D guidance

Q9. Explain how adhesion and cohesion work together to move water from soil into and through plants. [8]

Indicative content includes: water adheres to soil particles and xylem walls; capillary action occurs in narrow channels because adhesion pulls water upward; cohesion links water molecules to one another; root hairs absorb water from microscopic soil spaces; in xylem, cohesion maintains a continuous column while adhesion stabilizes it against the wall; transpiration creates tension that pulls the column upward; both forces are consequences of water's polarity.

Extended response markband

Marks	Descriptor
0	No relevant biological knowledge or no creditworthy response.
1-2	Limited knowledge. A few isolated facts may be stated but links to the question are weak or unclear.
3-4	Some correct biological ideas are included. Explanation is partial and may lack precision or development.
5-6	Clear understanding with relevant biological detail. Uses appropriate terminology and links most ideas to the question.
7-8	Accurate, well-structured and comprehensive response. Ideas are logically linked and supported with relevant examples or applications.