IB Biology A1.1 Water Worksheet 03 - Cohesion, Surface Tension and Xylem Transport

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	A1.1.3 - Cohesion of water molecules; surface tension; water transport under tension in xylem	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. Cohesion in water refers to the attraction between ... [1]

A. water molecules and cellulose

B. molecules of the same substance

C. water molecules and ions

D. non-polar molecules only

Q2. Surface tension is greatest at the water surface because ... [1]

A. there are no water molecules below the surface

B. molecules at the surface are pulled equally in all directions

C. molecules at the surface are not balanced by water molecules above them

D. air molecules form hydrogen bonds with water

Q3. Water moves upward in xylem primarily because transpiration creates ... [1]

A. high pressure at the leaf

B. tension / low pressure at the top of the water column

C. adhesion between minerals

D. air bubbles throughout the xylem

Q4. When water freezes, hydrogen bonds become ... [1]

A. completely absent

B. locked into a more stable arrangement

C. ionic

D. stronger than covalent bonds

Section B - Short answer

Q5. Explain how surface tension allows some organisms to use the water surface as a habitat. [3]

Q6. Describe the role of stomata and transpiration in moving water up the xylem. [4]

Q7. Explain why liquid water and ice show different behavior even though both contain hydrogen bonds. [3]

Section C - Data response / case study

Students measured water uptake by identical leafy shoots placed in different environmental conditions.

Condition	Mean water uptake ($cm^3\ h^{-1}$)
Still air	1.8
Moving air	3.9
High humidity	1.2
Moving air + petroleum jelly on lower leaf surface	0.6

Q8. Interpret the data in relation to cohesion and transpiration. [6]

(a) Identify the condition with the greatest water uptake. [1]

(b) Explain why moving air increased water uptake. [2]

(c) Explain why petroleum jelly on the lower leaf surface greatly reduced water uptake. [3]

Section D - Extended response

Q9. Explain the consequences of cohesion for both plant water transport and life at the water surface. [8]

Use examples from both plants and organisms living at the water surface.

Answer key and marking guidance

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

Section A answers

Question	Answer	Guidance
Q1	B	Cohesion is attraction between molecules of the same substance - here, water molecules.
Q2	C	Surface molecules experience unbalanced inward forces because there is no water above them.
Q3	B	Transpiration creates tension that pulls a continuous cohesive water column upward.
Q4	B	Reduced molecular motion allows hydrogen bonds to stabilize in ice.

Section B guidance

Q5. Explain how surface tension allows some organisms to use the water surface as a habitat. [3]

Award [1] for each valid point up to [3]. Surface molecules are strongly cohesive to those beside and below them; this creates a resistant surface layer; small organisms with low mass / large surface area of contact can avoid breaking the surface and therefore stand or move on it.

Q6. Describe the role of stomata and transpiration in moving water up the xylem. [4]

Award [1] for each valid point up to [4]. Water evaporates from leaf surfaces through stomata; this creates a low-pressure region / tension in the leaf; tension pulls on water in the xylem; cohesive water molecules move upward together as a continuous column; water lost from leaves is replaced by water entering from the roots.

Q7. Explain why liquid water and ice show different behavior even though both contain hydrogen bonds. [3]

Award [1] for each valid point up to [3]. In ice, molecular motion is lower and hydrogen bonds are held in a fixed arrangement; in liquid water, molecules move more and hydrogen bonds are temporary / continuously forming and breaking; this allows liquid flow while still maintaining cohesion.

Section C guidance

Q8. Interpret the data in relation to cohesion and transpiration. [6]

Award marks as indicated. (a) [1] Moving air. (b) Award up to [2]. Moving air removes water vapor from around the leaf; this increases the diffusion gradient for evaporation / transpiration; more evaporation raises tension in the xylem. (c) Award up to [3]. Petroleum jelly blocks stomata / reduces evaporation; less transpiration means weaker tension at the top of the xylem; with less pulling force, the cohesive water column moves upward more slowly.

Section D guidance

Q9. Explain the consequences of cohesion for both plant water transport and life at the water surface. [8]

Indicative content includes: hydrogen bonding causes water molecules to cohere; at the surface, cohesion creates surface tension; organisms such as water striders can exploit this habitat if they do not break the surface; in plants, transpiration creates tension in leaves; cohesive molecules form a continuous water column in xylem; the column is pulled upward from roots to leaves; without cohesion the column would break and transport would fail.

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.