Exercise walk-through

Structure of Water and Hydrogen Bonding ▪ 1.1

eXercise

You must be able to

- explain that water is **polar** 极性 and forms **hydrogen bonds** 氢键
- link hydrogen bonding to cohesion, adhesion, high specific heat, and being a solvent
- connect each property to a biological role

Method — Polarity and hydrogen bonds

Water's oxygen pulls electrons more strongly than its hydrogens, giving a slightly negative O and slightly positive H (**polar**). These opposite charges attract, forming **hydrogen bonds** between water molecules.

Method — Cohesion and adhesion

Cohesion (water sticking to water) gives surface tension and lets water columns rise in plants; **adhesion** (water sticking to other surfaces) helps water climb narrow tubes (capillary action).

Method — High specific heat

Hydrogen bonds resist temperature change, so water has a **high specific heat** — it stabilizes the temperature of cells, organisms, and habitats.

Method — Universal solvent

Because it is polar, water dissolves polar and ionic substances (a **solvent**), so most biological reactions happen in aqueous solution.

Practice 2.1 ▪ 1 mark

Why is water described as polar?

Solution 2.1

Worked steps

Its oxygen pulls electrons more strongly, giving a slightly negative O and slightly positive H (uneven charge) B1.

Practice 2.2 ▪ 1 mark

Name the bond that forms between two water molecules.

Solution 2.2

Method: Polarity and hydrogen bonds

Worked steps

A hydrogen bond B1.

Practice 2.3 ▪ 1 mark

State one biological benefit of water's high specific heat.

Solution 2.3

Method: High specific heat

Worked steps

It stabilizes the temperature of cells/organisms/habitats (resists rapid temperature change) B1.

Exam-style 3.1 ▪ 1 mark

Water can dissolve many substances because it is

A nonpolar

B polar

C acidic

D a gas

Solution 3.1

Method: Universal solvent

A nonpolar

B polar ✓

C acidic

D a gas

Worked steps

B — polar.

Exam-style 3.2 ▪ 2 marks

Water rises up the xylem of a tall tree.
(a) Name the two properties of water involved.
(b) Explain how hydrogen bonding causes cohesion.

Solution 3.2

Worked steps

(a) Cohesion and adhesion B1 B1. (b) Water molecules are polar, so the slightly positive H of one attracts the slightly negative O of another, holding the molecules together M1 A1.

Exam-style 3.3 ▪ 2 marks

Explain how water's high specific heat helps organisms survive changes in environmental temperature.

Solution 3.3

Method: High specific heat

Worked steps

Hydrogen bonds absorb a lot of energy before the temperature rises, so water (and the organisms in it) warms and cools slowly, buffering them against sudden temperature swings M1 A1.