

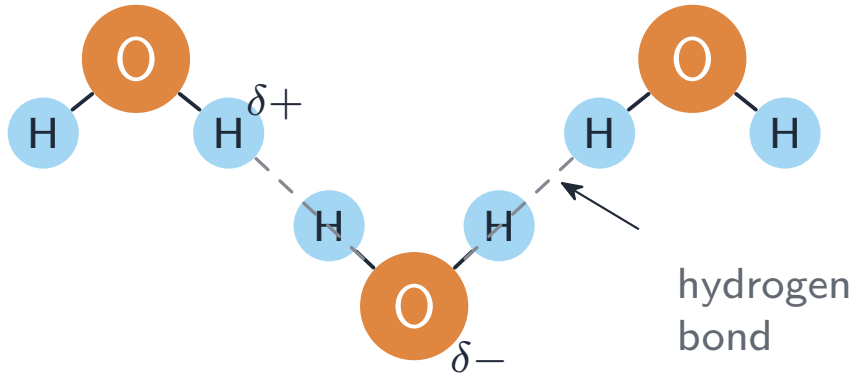
Exercise walk-through

2.4

Water

A-Level Biology

Water



Water is **polar**, so molecules attract by **hydrogen bonds**.
This explains:

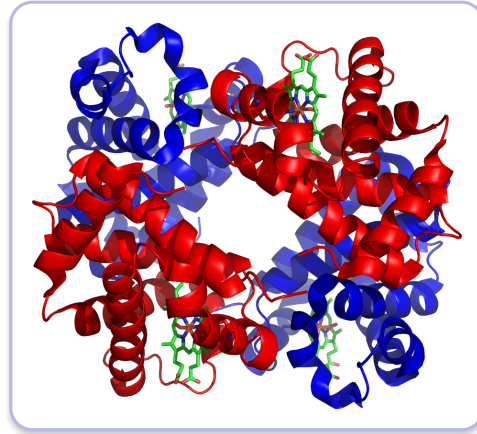
- a good **solvent**
- high **specific heat capacity** – steady temperature
- high **latent heat** – cooling by evaporation

The properties of water that matter to life

solvent	action	many substances dissolve in it – which lets reactions happen and lets substances be transported
high specific heat capacity		so cells and habitats change temperature slowly
latent heat of vaporisation		a lot of energy is needed to evaporate water, so evaporation cools effectively – sweating, transpiration
cohesion		water molecules stick together, giving the unbroken column in xylem and surface tension
density of ice		ice is less dense , so it floats and insulates the water beneath
a metabolite		water is a reactant in hydrolysis and in photosynthesis, not only a medium

Every one of these follows from **hydrogen bonding** between polar molecules. Name the cause before listing the consequences.

Haemoglobin – a globular protein



A real haemoglobin molecule, worked out from X-ray data. Count them: two alpha chains (red), two beta chains (blue), and one green haem group held in each – so four oxygen molecules in total

Exam tips

- Learn each **food test** as reagent + positive result + colour change (Benedict's → brick-red; iodine → blue-black; biuret → purple; emulsion → white).
- Benedict's detects **reducing** sugars; for a non-reducing sugar you must **hydrolyse with acid first**, then re-test.
- Name the bond precisely: **glycosidic** (carbohydrates), **ester** (lipids), **peptide** (proteins) – all made by **condensation** (water removed).
- Link structure to function: cellulose (straight chains, H-bonds → strong), glycogen/starch (branched/coiled → compact store).
- For proteins, name the bond at each level: primary (peptide), secondary (hydrogen), tertiary (R-group interactions), quaternary.

Exercises 2.1·3.1

2.1 State which atom in a water molecule is slightly negative, and which is slightly positive. [2]

2.2 Name the property of water that allows it to act as a transport medium in blood. [1]

3.1 Explain how a hydrogen bond forms between two water molecules. [2]

Exercises 2.1·3.1

2.1 State which atom in a water molecule is slightly negative, and which is slightly positive. [2]

2.1

- oxygen is slightly negative ($\delta-$); the hydrogens are slightly positive ($\delta+$)
-

2.2 Name the property of water that allows it to act as a transport medium in blood. [1]

2.2

- solvent action / it is a (good) solvent
-

3.1 Explain how a hydrogen bond forms between two water molecules. [2]

3.1

- the $\delta+$ hydrogen of one water molecule is attracted to the $\delta-$ oxygen of another; this attraction is the hydrogen bond

Exercise 3.2 (a)

3.2 Water has a high specific heat capacity.

(a) Explain, in terms of hydrogen bonds, why water's temperature changes only slowly.[2]

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(a) Explain, in terms of hydrogen bonds, why water's temperature changes only slowly.[2]

(a)

- energy must be absorbed to break/loosen many hydrogen bonds before the molecules move faster, so the temperature rises only slowly

Exercise 3.2 (b)

3.2 Water has a high specific heat capacity.

(b) Explain why this property is useful to living organisms.

[1]

Exercise 3.2 (b)

3.2 Water has a high specific heat capacity.

(b) Explain why this property is useful to living organisms.

[1]

(b)

- it keeps the temperature of cells/organisms or aquatic habitats stable

Exercise 3.3

3.3 When an animal sweats, water evaporates from its skin and the animal cools down. Use the idea of **latent heat of vaporisation** and hydrogen bonds to explain why evaporation has a strong cooling effect. [3]

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3.3

- evaporation needs much energy to break the hydrogen bonds holding water molecules together; this energy (latent heat) is taken from the skin/body, so the body loses heat and cools