AP BIOLOGY • EXERCISE SHEET

1.1 Structure of Water and Hydrogen Bonding

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **water and hydrogen bonding** —the properties that support life.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

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.

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).

High specific heat

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

Universal solvent

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

2 Practice

Now apply the methods above.

2.1 Why is water described as polar? [1]

2.2 Name the bond that forms between two water molecules. [1]

2.3 State one biological benefit of water's high specific heat. [1]

3 Exam-style questions

3.1 Water can dissolve many substances because it is [1]

- **A** nonpolar
- **B** polar
- **C** acidic
- **D** a gas

3.2 Water rises up the xylem of a tall tree.

(a) Name the two properties of water involved. [2]

(b) Explain how hydrogen bonding causes cohesion. [2]

3.3 Explain how water's high specific heat helps organisms survive changes in environmental temperature. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **1.1 Structure of Water and Hydrogen Bonding** lesson on the **Learn** page;
- read the **Structure of Water and Hydrogen Bonding** section of the AP Biology handout on the **Know** page.

Solutions

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

2.2 A hydrogen bond.

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

3.1 B —polar.

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

3.3 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.