

1.1 WATER

Learning outcomes:

At the end of this topic, students should be able to:

- Illustrate the structure of water molecule.
- State the properties of water.

a) Illustrate the structure and state the properties of water molecules

Exercise 1.1 (a): Draw the structure of water molecules. Use the information given to label and complete the structure of a water molecule.

Exercise 1.1 (b): Fill in the blanks below to complete the explanation of water structure.



Key:

Covalent
bond
104.5 °
δ⁺
δ⁺
2δ⁻
Oxygen
atom
Hydrogen
atom

STRUCTURE OF WATER

Consists of _____ oxygen atom and two hydrogen atoms.

The three atoms of water molecule form wide _____ shaped structure.

Two hydrogen atoms joined to the oxygen atom by _____

bond. Thus, one water molecule, has two covalent bonds.

The bond angle in water molecule between two covalent bonds is 104.5 °.

Water is **polar molecule**.

Universal Solvent

- Defined as a molecule that carry an _____ distribution of electrical charge such as the opposite ends of the molecule have opposite charge.
- The oxygen region of molecule has a _____ (δ⁻) and each hydrogen has a partial positive charge (δ⁺).
- This unequal sharing of electrons occurs where oxygen atom is more electronegative than hydrogen.
- The polarity of the water molecule can attract other _____ molecules (hydrophilic or water-loving substances e.g. sugar, salt) but it _____ non-polar molecules (hydrophobic or water-hating substances) e.g. oil.
- Polarity of water molecule allows it to form hydrogen bonds with each other. One water molecule able to form _____ hydrogen bonds with another four water molecules.

b) State the properties of water.

Properties of Water

1. _____

2. LOW viscosity

3. High specific HEAT CAPACITY

4. _____

5. High SURFACE TENSION

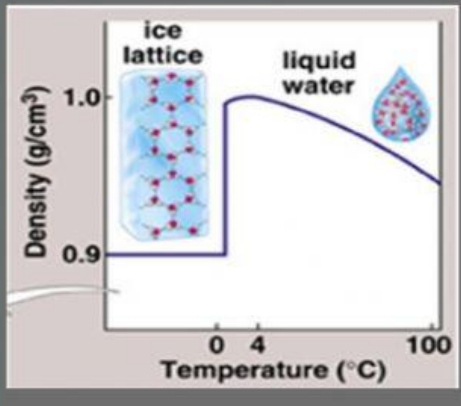
6. Maximum density at 4°C

➤ Describe the properties of water and its importance.

No.	Properties of Water	Description
1.	_____	➤ Solvent is dissolving agent of a solution. ➤ Water is a _____ molecule; that makes it suitable as universal solvent for ions (e.g. Na^+ and Cl^-) and polar molecules. ➤ Example : NaCl can dissolve in water ➤ Oxygen atoms of water are attracted to the positively charged _____ ions while, ➤ Hydrogen atoms of water are attracted to the negatively charged chloride ions. The salt NaCl dissolves in water. ➤ Water molecules gather around the Na^+ and Cl^- to form _____ separating them from one another. ➤ Pulling these ions away from the salt crystal ➤ Causes these ions to separate & dissolve.

		Importance of universal solvent: _____ for most solutes - Provides an aqueous medium for biochemical reactions. - Serves as the body's major transport medium e.g. in blood capillaries and xylem.
2.	_____	➤ Viscosity is a measure of _____ to flow. ➤ Water has low viscosity because hydrogen bonds between water molecules are being continually broken & reformed. ➤ The less viscous of the fluid the greater its movement (fluidity). Importance of low viscosity: _____ - Foods could move easily down the alimentary canal. - Synovial fluid within the joints reduces _____ between bone surfaces, thus enables free easy movement. - Blood and lymph flow easily in the circulatory system.
3.	_____ _____	Definition: The amount of heat must be _____, to raise the temperature of 1g of water, by 1°C, per calorie (cal) or 1 cal/g/°C.

		➤ Large amount of _____ is needed to increase the temperature of 1g of water by 1°C. ➤ As water absorb heat, _____ bonds between water molecules are broken. ➤ Only after hydrogen bonds are broken does heat absorption increase the motion of water molecules, thus the temperature of water increase. Importance of high specific heat capacity: • Acts as _____ buffer to prevent sudden body temperature changes in cells of organisms. • Allow ocean to _____ relatively constant temperature.
4.	_____ _____	Definition: Quantity of heat must be _____ for 1g of water to vaporize liquid to _____. ➤ Large amount of heat/energy is used to _____ the hydrogen bonds that link individual water molecule. Importance of high latent heat of vaporization: 💧 _____ effect; ✓ _____ of water in sweat on skin or in transpiration from green leaves or panting in animals e.g. dog.
5.	_____ _____	Definition: A measure of how _____ it is to break the surface of a liquid. ➤ The stronger the bonds between the molecules in liquid, the _____ the surface tension. ➤ Surface tension is related to _____ forces between water molecules. ➤ In the body of water, water molecules within are attracted _____ by cohesion.

		➤ At the air-water interface, cohesive force only from interior. ➤ Thus, the _____ attraction causes the inwardly forces that cause high surface tension at the surface of water. Importance of high surface tension: • Many small organisms rely on surface tension to settle on water. E.g.: _____ • Helps in _____ of water in plants.
6.	<i>How do aquatic organisms in ponds and lakes can survive in liquid water during the winter</i> ○ Water achieves its highest density at _____. • Therefore, ice (0°C) is less dense than water and floats on top of water. • Water _____ on top of lakes and insulates the layers below from further cooling and freezing. • Thus allowing life forms to thrive in the water beneath the ice.	➤ Water achieves its highest density at 4° C.  ➤ Therefore, ice (0°C) is _____ than water and floats on top of water. ➤ Water is the only substances whose solid form is less dense than its liquid form. 