

Chapter 8 : Water

Water (H_2O) is essential for life and is often called the **universal solvent** because it dissolves many substances.

1. Dissolution of Salts in Water

- When salts dissolve in water, they break into **ions** and spread throughout the liquid.
- Example: **Sodium chloride (NaCl) dissolving in water**



2. Water – The Universal Solvent

- Water dissolves most **solids, liquids, and gases**, making it the **universal solvent**.
- This property helps in biological processes, digestion, and industrial applications.

3. Solutions, Suspensions, and Colloids

Type	Definition	Example
Solution	A homogeneous mixture where solute is completely dissolved in solvent.	Sugar in water
Suspension	A heterogeneous mixture where solid particles do not dissolve and settle down over time.	Sand in water
Colloid	A mixture where tiny particles are evenly spread but do not settle down.	Milk, fog

4. Types of Solutions

Type	Definition
Unsaturated Solution	Can dissolve more solute at a given temperature.
Saturated Solution	Cannot dissolve any more solute at that temperature.
Supersaturated Solution	Contains more dissolved solute than it normally can at a given temperature (unstable).

5. Water of Crystallization

- **Some salts contain water molecules** in their solid structure, known as **water of crystallization**.
- Example: **Copper sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) is blue due to water of crystallization**.
- On heating, it loses water and turns white:



6. Hydrated and Anhydrous Substances, Hygroscopic Substances

- **Hydrated Substances:** Contain water of crystallization. (*e.g., $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$*)
- **Anhydrous Substances:** Do not contain water. (*e.g., CuSO_4 without water is white*)
- **Hygroscopic Substances:** Absorb moisture from the air. (*e.g., Silica gel, concentrated sulfuric acid*)

7. Reactivity of Metals with Water

Metal	Reaction with Cold Water	Reaction with Hot Water	Reaction with Steam
Sodium (Na)	Reacts violently, forms $\text{NaOH} + \text{H}_2$	—	—
Magnesium (Mg)	No reaction	Forms $\text{Mg}(\text{OH})_2 + \text{H}_2$	Forms $\text{MgO} + \text{H}_2$
Iron (Fe)	No reaction	No reaction	Forms $\text{Fe}_3\text{O}_4 + \text{H}_2$

- **Highly reactive metals like Na & K react explosively** with water.
- **Less reactive metals like Fe react only with steam.**

8. Hard and Soft Water

Type	Definition	Disadvantages
Soft Water	Forms lather easily with soap.	No disadvantages.
Hard Water	Contains dissolved Ca^{2+} and Mg^{2+} ions, does not form lather easily.	Wastes soap, forms scales in pipes and boilers.

9. Methods to Soften Hard Water

- ✓ **Boiling:** Removes temporary hardness by precipitating CaCO_3 & Mg(OH)_2 .
 - ✓ **Washing Soda (Na_2CO_3):** Converts Ca^{2+} and Mg^{2+} into insoluble carbonates.
 - ✓ **Ion Exchange Method:** Uses resins to replace $\text{Ca}^{2+}/\text{Mg}^{2+}$ with Na^+ (advanced method).
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