

Water, the *SPECIAL* Equilibrium

I. PHYSICAL

Characteristics of Water

A. Water **MOLECULES**
are highly **POLAR**.

⦿ B. They are in continuous **MOTION**.

⦿ C. Always **COLLIDING**.

⦿ D. Water is **LESS** dense in the solid phase than in the **LIQUID** phase.

i.e. ice floats in water.

● E. Water has a **HIGHER** melting and boiling point than most other common liquids because of **HYDROGEN** bonding.

● F. Polar and **IONIC** compounds are soluble in water but **NONPOLAR** compounds are not.

II. Transfer of Hydrogen Ions

- A. When some of these polar molecules collide, the **COLLISION** contain enough **ENERGY** that hydrogen **IONS** are **TRANSFERRED** from one molecule to another.

⦿ B. A water molecule that **LOSES** a hydrogen **ION** becomes a negatively charged **HYDROXIDE** ion (OH^-).

⦿ C. A water molecule that **GAINS** a hydrogen ion becomes positively charged **HYDRONIUM** ion (H_3O^+)



● D. The reaction in which two **WATER** molecules **REACTS** to give **IONS**, is the **SELF-IONIZATION** of water.

● E. This reaction can be written as a simple **DISSOCIATION** reaction.



III. Self-Ionization of Water

- A. Self-ionization of water occurs to a very **SMALL** extent.
- B. Self-ionization of water occurs in **PURE** water at 25°C

$[\text{OH}^-] = [\text{H}^+] = 1 \times 10^{-7}$
moles/liter

● C. Any **AQUEOUS** solution in which the hydroxide and hydrogen ions both **EQUAL** 1×10^{-7} moles/liter is described as a **NEUTRAL** solution.

IV. Applying Le Chatelier's Principle

- A. Le Chatelier's principle tells us how a system at **EQUILIBRIUM** reacts to applied stress.

● B. Stress is defined as a **CHANGE** in the temperature or pressure of a system or a change in the concentration of a component.

● C. Our focus will be on changing the **CONCENTRATION** of a solution.

● D. In the equation $\text{HOH} \leftrightarrow \text{H}^+ + \text{OH}^-$ the $[\text{OH}^-]$ and $[\text{H}^+]$ are **INTERDEPENDENT**.

● E. As the concentration of $[\text{OH}^-]$ **INCREASES** the concentration of $[\text{H}^+]$ will decrease and vice versa. $[\text{OH}^-]$ and $[\text{H}^+]$ are **INVERSELY** proportional to each other.

⦿ F. If additional ions are **ADDED** to the solution, the **EQUILIBRIUM** will shift to the other type. This causes more **WATER** molecules to be **FORMED**.

V. Ion Product Constant for Water

● A. In all aqueous solutions the product of $[\text{OH}^-]$ and $[\text{H}^+]$ is:

● $[\text{OH}^-] \times [\text{H}^+] = 1 \times 10^{-14}$
moles/liter²

● B. The above equation is the ion-product **CONSTANT** for water.