TABLE 1 K_w at Selected Temperatures

Temperature (°C)	K_w
0	1.2×10^{-15}
10	3.0×10^{-15}
25	1.0×10^{-14}
50	5.3×10^{-14}

constant mathematical product is called the *ionization constant of water*, K_w, and is expressed by the following equation.

$$K_w = [H_3O^+][OH^-]$$

For example, in water and dilute aqueous solutions at 25°C, the following relationship is valid.

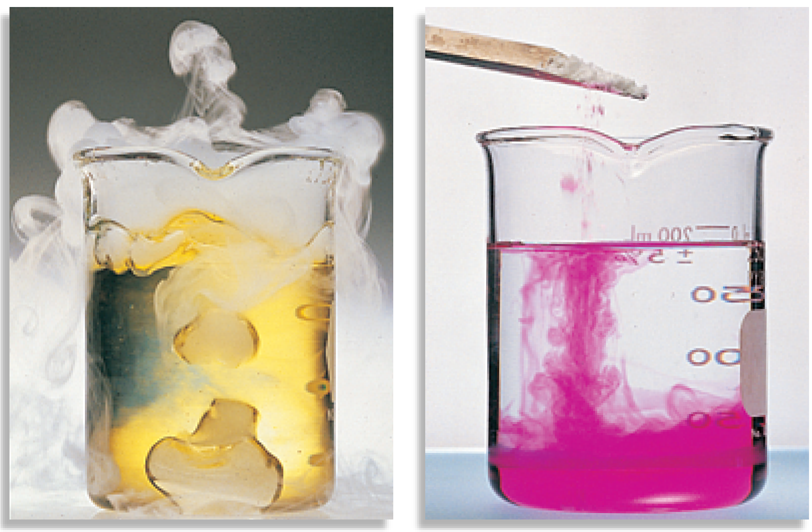
$$K_w = [H_3O^+][OH^-] = (1.0 \times 10^{-7})(1.0 \times 10^{-7}) = 1.0 \times 10^{-14}$$

The ionization of water increases as temperature increases. Therefore, the ion product, K_w, also increases as temperature increases, as shown in **Table 1.** However, at any given temperature K_w is always a constant value. The value 1.0×10^{-14} is assumed to be constant within the ordinary range of room temperatures. In this chapter, you can assume that these conditions are present unless otherwise stated.

Neutral, Acidic, and Basic Solutions

Because the hydronium ion and hydroxide ion concentrations are the same in pure water, it is *neutral.* In fact, any solution in which $[H_3O^+] = [OH^-]$ is neutral. Recall from Chapter 14 that acids increase the concentration of H_3O^+ in aqueous solutions, as shown in **Figure 2a.** Solutions in which the $[H_3O^+]$ is greater than the $[OH^-]$ are *acidic.* Bases increase the concentration of OH^- in aqueous solutions, as shown in **Figure 2b.** In *basic* solutions, the $[OH^-]$ is greater than the $[H_3O^+]$.

As stated earlier, the $[H_3O^+]$ and the $[OH^-]$ of a neutral solution at 25°C both equal 1.0×10^{-7} M. Therefore, if the $[H_3O^+]$ is increased to greater than 1.0×10^{-7} M, the solution becomes acidic. A solution containing 1.0×10^{-5} mol H_3O^+ ion/L at 25°C is acidic because 1.0×10^{-5} is greater than 1.0×10^{-7}. If the $[OH^-]$ is increased to greater than 1.0×10^{-7} M, the solution becomes basic. A solution containing 1.0×10^{-4} mol OH^- ions/L at 25°C is basic because 1.0×10^{-4} is greater than 1.0×10^{-7}.



(a) (b)

FIGURE 2 (a) Addition of dry ice, carbon dioxide, to water increases the $[H_3O^+]$, which is shown by the color change of the indicator bromthymol blue to yellow. The white mist is formed by condensation of water vapor because the dry ice is cold. (b) Addition of sodium peroxide to water increases the $[OH^-]$, which is shown by the color change of the indicator phenolphthalein to pink.