CHEMISTRY DAILY PLAN

Class: **Date:**

Subject: ***pH and pOH*** **Time:**

HYDRONIUM OR HYDROXONIUM ION, H_3O^+

Hydrogen ion, H^+, is a lone proton. Because of its very small size and quite high positive charge, hydrogen ions are surrounded by negative charge centers of water molecules. Thus, hydrogen ions in water are in the form of $[H(H_2O)_n]^+$, which is called hydronium or hydroxonium ion. Here n shows the number of water molecules surrounding a hydrogen ion. Recent evidence suggests that the value of n = 4, corresponding a formula $H^+(H_2O)_4$ or H_9O_4. However in general we shall speak of the hydrogen ion and use the symbol H^+, or H_3O^+ interchangeably, but keep in mind that experiments favor the formula H_9O_4.

pH and pOH

The concentrations of H^+ and OH^- in aqueous solutions are very small exponential numbers in general. To express the $[H^+]$ and $[OH^-]$ of a solution a more convenient way was developed by Soren Sorensen in 1909. He defined pH as the negative logarithm of the $[H^+]$ of the solution. Or

$$pH = -\log [H^+]$$

In pure water $[H^+] = 1 \times 10^{-7}$ M and pH = $-\log 10^{-7} = 7$. pOH is defined as the negative logarithm of the $[OH^-]$.

$$pOH = -\log [OH^-]$$

The pOH of pure water is: pOH = $-\log [OH^-] = -\log 10^{-7} = 7$, pOH = 7

For a given solution,

$$pH + pOH = 14$$

The same result may be obtained by using the formula above.

Example 1: Calculation of pH

Calculate the pH and pOH of the solutions given below.

a) A solution with a $[H^+] = 1 \times 10^{-x}$ M log 1 = 0

b) A solution with a $[H^+] = 1.5 \times 10^{-3}$ M log 1.5 = 0.18

c) A solution with a $[OH^-] = 3 \times 10^{-4}$ M log 3 = 0.48

d) A solution with a $[OH^-] = 9 \times 10^{-12}$ M log 9 = 0.95

Solution :

a) pH = $-\log 1 \times 10^{-x}$ pH = $-(\log 1 + \log 10^{-x}) = -(0 - x) = x$
pH + pOH = 14, pOH = 14 – pH$\Rightarrow$ pOH = 14 - x

b) pH = $-\log (1.5 \times 10^{-3}) = 3 - \log 1.5 = 3\text{-}0.18 = 2.82 \Rightarrow$ pOH = 14 - 2.82 = 11.18

Problem in the Class:

1. A sample of vinegar has a pH of 3. Calculate the [H+], [OH-] and pOH of the solution.