Ionization of Water-Kw

Recall- H_2O is amphoteric (both acid + base)

$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)}$

$K_{eq} = \frac{[H_3O^+][OH^-]}{[H_2O][H_2O]}$ ← Constant

New constant - $K_w = [H_3O^+][OH^-]$ for all dilute solutions

$K_w = (1.0\times10^{-7})(1.0\times10^{-7})$ 1.0×10^{-7} mol/L in pure water.

$= 1.0 \times 10^{-14}$

Example- What is $[OH^-]$ of a solution with pH = 2.5 ?

i) $pH = -\log[H_3O^+]$

$2.5 = -\log[H_3O^+]$

$-2.5 = \log[H_3O^+]$

$10^{-2.5} = 10^{\log[H_3O^+]}$

$0.0032 = [H_3O^+]$

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

$\frac{1.0\times10^{-14}}{0.0032} = \frac{0.0032\times[OH^-]}{0.0032}$

$3.1\times10^{-12} = [OH^-]$

Text quest. P.566 # 13, 14

#12(b) NaOH 1.1 mol/L

↓

$[OH^-] = 1.1$ mol/L

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

$\frac{1.0\times10^{-14}}{1.1} = \frac{x\ (1.1)}{1.1}$ $x = 9.1\times10^{-12}$ mol/L

Example- Weak acids- bases

An acid, HX, has $K_a = 4.6\times10^{-8}$

What is $[OH^-]$ if $[HX] = 0.10$ mol/L

(i) $HX + H_2O \rightleftharpoons H_3O^+ + X^-$

	HX	H_2O	H_3O^+	X^-
I	0.10		0	0
C	−x		x	x
E	0.10−x		x	x

$K_a = \frac{[H_3O^+][X^-]}{HX}$

$4.6\times10^{-8} = \frac{x(x)}{0.10-x}$ assume...

$4.6\times10^{-8}\times0.10 = x^2$

$\sqrt{4.6\times10^{-9}} = \sqrt{x^2}$

$6.8\times10^{-5} = x = [H_3O^+]$

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

$1.0\times10^{-14} = 6.8\times10^{-5}[OH^-]$

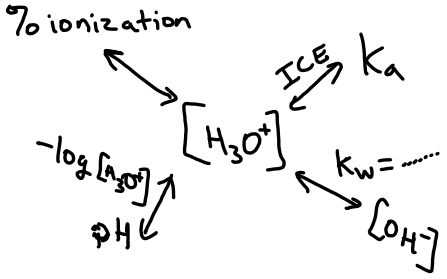
$\frac{1.0\times10^{-14}}{6.8\times10^{-5}} = [OH^-]$

$1.5\times10^{-10} = [OH^-]$

Worksheet: #5, 6

Text: p.591 #5-11, p.595 #11

Ionization Constant Problems-Map



Read- Acid/Base indicators P. 599