Logs

Math Review

Definition: $\log(10^x) = x$

$\text{antilog}(x) = 10^x$

Properties of logs

$\log(a^b) = b \log(a)$ $(x^a)^b = x^{a \cdot b}$

$\log(a \cdot b) = \log(a) + \log(b)$ $(x^a)(x^b) = x^{a+b}$

$\log(a/b) = \log(a) - \log(b)$ $(x^a)/(x^b) = x^{a-b}$

pH

pH & pOH

Definitions:

pH = -log [H^+]   or pH = -log[H_3O^+]

pOH = -log [OH^-]

pH

Things to notice:

pH comes from the hydrogen ion, pOH comes from the hydroxide ion.

In both cases it is lower case **p** and upper case for either **H** or **OH**.

[ ] have a very specific meaning in chemistry - the numbers used in the calculations where these brackets appear **must** have units of molarity (moles of solute per liter of solution).

$H^{+}_{(aq)}$ is the same as $H_3O^{+}_{(aq)}$ which is also a "proton in solution"

Water Self Ionization

$HOH_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

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

$K_w = 1.0 \times 10^{-14} M^2$ at room temperatures.

pH + pOH = 14

pH Loop

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

H_3O^+ pH

$[H_3O^+] = 10^{-pH}$

$[H_3O^+] = 1.0 \times 10^{-14}\ M^2 / [OH^-]$

$pOH = 14 - pH$

$[OH^-] = 1.0 \times 10^{-14}\ M^2 / [H_3O^+]$

$pH = 14 - pOH$

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

OH^- pOH

$[OH^-] = 10^{-pOH}$

pH Loop

H_3O^+ → pH: $pH = -\log [H_3O^+]$

pH → H_3O^+: $[H_3O^+] = 10^{-pH}$

OH^- → H_3O^+: $[H_3O^+] = 1.0 \times 10^{-14}\ M^2 / [OH^-]$

H_3O^+ → OH^-: $[OH^-] = 1.0 \times 10^{-14}\ M^2 / [H_3O^+]$

pH → pOH: $pOH = 14 - pH$

pOH → pH: $pH = 14 - pOH$

OH^- → pOH: $pOH = -\log [OH^-]$

pOH → OH^-: $[OH^-] = 10^{-pOH}$

Samples

If the hydrogen ion concentration is $2.67x10^{-4}$ M what is the pH, pOH and hydroxide concentration?

$pH = -log [H^+]$ $pH = -log[2.67x10^{-4}]$

$pH = 3.57$

$pOH = 14 - pH$ $pOH = 14 - 3.57$

$pOH = 10.43$

$[OH^-]$ = antilog -pOH or $[OH^-] = 10^{-pOH}$ $[OH^-] = 10^{-10.43}$

$[OH^-] = 3.75x10^{-11}$ M