pH Calculations

To a small but measurable degree, water undergoes self-ionization:

$$H_20(\ell) + H_20(\ell) \rightarrow H_30^+(aq) + OH^-(aq)$$

The use of brackets is a way of abbreviating "molar concentration." Thus, $[H^+]$ can be read, "the concentration of hydrogen ion in moles per liter. [OH-] can be read, "the concentration of hydroxide ion in moles per liter.

At 25°C, $[H^+] = 1.0 \times 10^{-7}$ moles H^+ per liter of solution
$[OH^-] = 1.0 \times 10^{-7}$ moles OH^- per liter of solution

Ionization Constant for Water (K_W)

1. $K_W = [H^+][OH^-] = (1.0 \times 10^{-7})(1.0 \times 10^{-7}) = 1.0 \times 10^{-14}$
2. K_W is a constant at ordinary ranges of room temperatures

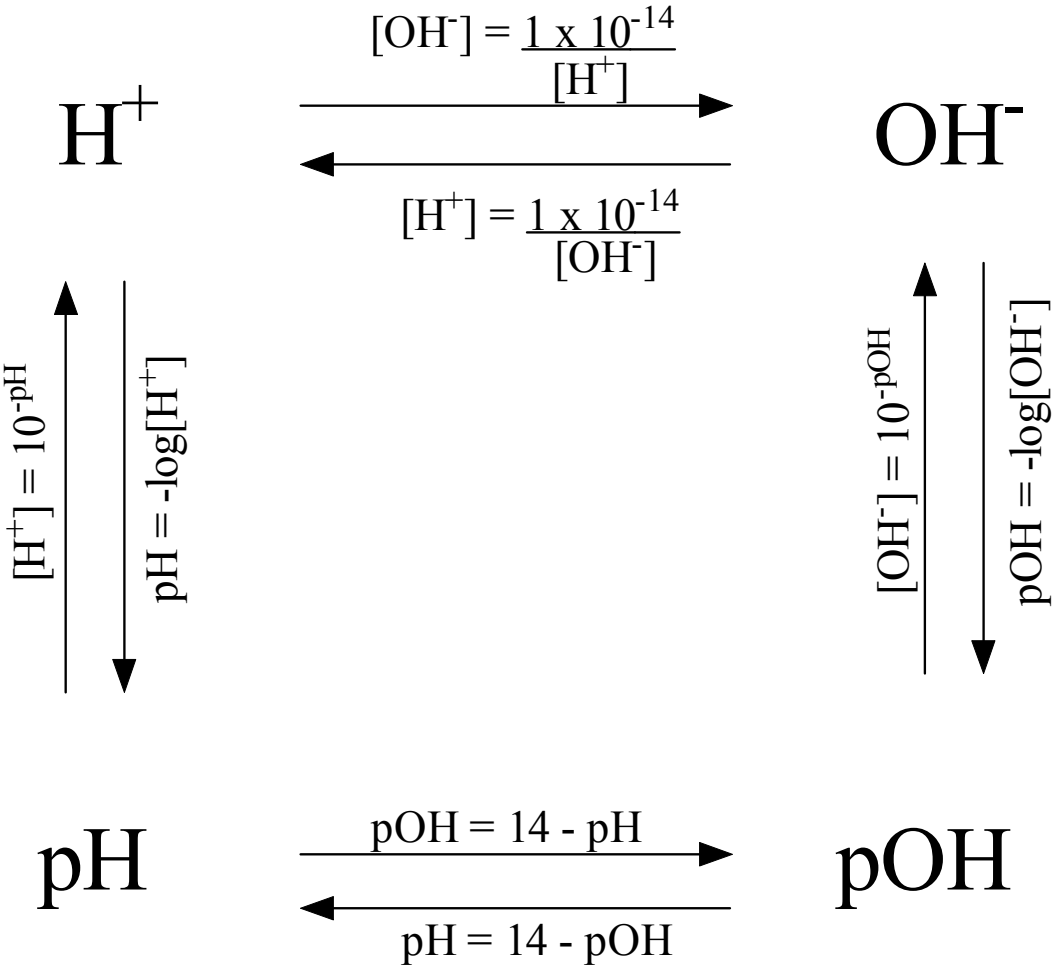
pH is the negative of the common logarithm of the hydrogen ion concentration

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

pOH is the negative of the common logarithm of the hydroxide ion concentration

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

$$pH + pOH = 14.0$$



Problems

$[H^+]$ and $[OH^-]$

1. Calculate $[H^+]$ of a solution whose $[OH^-] = 1 \times 10^{-5}$ M
2. Calculate [OH-] of a solution whose $[H^+] = 1 \times 10^{-2}$ M
3. Calculate $[H^+]$ of a solution whose $[OH^-] = 2.5 \times 10^{-4}$ M
4. Calculate $[OH^-]$ of a solution whose $[H^+] = 0.00375$ M

$[H^+]$ and pH

1. Calculate the pH of a solution whose $[H^+] = 1 \times 10^{-6}$ M
2. Calculate the pH of a solution whose $[H^+] = 9.65 \times 10^{-3}$ M
3. Calculate the $[H^+]$ of a solution whose pH = 2.68
4. Calculate the $[H^+]$ of a solution whose pH = 11.93

$[OH^-]$ and pOH

1. Calculate the pOH of a solution whose $[OH^-] = 1 \times 10^{-11}$ M
2. Calculate the pOH of a solution whose $[OH^-] = 7.24 \times 10^{-3}$ M
3. Calculate the $[OH^-]$ of a solution whose pOH = 4.00
4. Calculate the $[OH^-]$ of a solution whose pOH = 1.14

pH and pOH

1. Calculate the pOH of a solution whose pH = 6.00
2. Calculate the pOH of a solution whose pH = 9.78
3. Calculate the pH of a solution whose pOH = 12.00
4. Calculate the pH of a solution whose pOH = 3.88

pH and $[OH^-]$

1. Calculate the pH of a solution whose $[OH^-] = 1 \times 10^{-11}$ M
2. Calculate the pH of a solution whose $[OH^-] = 0.0000046$ M
3. Calculate the $[OH^-]$ of a solution whose pH = 3.00
4. Calculate the $[OH^-]$ of a solution whose pH = 10.62

pOH and $[H^+]$

1. Calculate the pOH of a solution whose $[H^+] = 1 \times 10^{-1}$ M
2. Calculate the pOH of a solution whose $[H^+] = 5.55 \times 10^{-5}$ M
3. Calculate the $[H^+]$ of a solution whose pOH = 8.00
4. Calculate the $[H^+]$ of a solution whose pOH = 9.87