Key Equations, Numerical Relationships

1. $[H^+][HO^-] = 1.00 \times 10^{-14}$

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

$[H^+] = 10^{-pH}$ (on calculator, enter -pH, then punch the **10^x** button)

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

$[OH^-] = 10^{-pOH}$ (on calculator, enter -pOH, then punch the **10^x** button)

3. $pH + pOH = 14$

$pH = 14 - pOH$

weak acid problems

$K_a = [H^+][A^-]/[HA]$ but when HA is placed in water, $[H^+] = [A^-]$ so:

4. $K_a = [H^+]^2/[HA]$ (simplified version)

and Note: Routinely $[H^+]$ will be given or required in terms of pH

5. $[H^+] = \sqrt{[HA]_{init} K_a}$ (simplified version)

(Note: Equations 4 and 5 are simplified versions, assuming percent ionization is less than 5% so that $[HA]_{eq} = [HA]_{initial}$)

6. Nonsimplified version, in case % ionization exceeds 5%:

$K_a = [H^+]^2/\{[HA] - [H^+]\}$ Requires quadratic equation

Quadratic Equation: for $ax^2 + bx + c = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

weak base problems

$K_b = [BH^+][OH^-]/[B]$ but when B is placed in water, $[BH^+] = [OH^-]$ so:

7. $K_b = [OH^-]^2/[B]$ (simplified version)

and

8. $[OH^-] = \sqrt{[B]_{init} K_b}$ (simplified version)

Note: Routinely $[OH^-]$ will be given or required in terms of pH so you will need to go between pH, pOH, and $[OH^-]$

(Note: Equations 6 and 7 are simplified versions, assuming percent ionization is less than 5%. If that isn't true, a quadratic equation solution will be required. See equation 6 for the acid analog.)

$pK_a = -\log K_a$

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9. $K_a K_b = 10^{-14}$ for a conjugate acid/base pair.

Note: This relationship is routinely used when a K value for your acid or base is not provided, but the K value for it's conjugate is. So get it indirectly.)

Simple Acid-Base Concept Map
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