Derivation of Henderson-Hasselbalch Equation

Note Title 7/24/2008

A generic weak acid, HA, reacting with water.

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

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$\frac{[HA]}{[A^-]} \times K_a = \frac{[H_3O^+][A^-]}{[HA]} \times \frac{[HA]}{[A^-]}$$

$$[H_3O^+] = K_a \times \frac{[HA]}{[A^-]}$$

$$-\log\left([H_3O^+]\right) = -\log\left(K_a \times \frac{[HA]}{[A^-]}\right)$$

$$pH = -\log K_a + -\log\frac{[HA]}{[A^-]}$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

for Buffers

$$pH = pK_a + \log\frac{[base]}{[acid]}$$

Henderson-Hasselbalch Equation

must be conjugate pairs

↑ used for buffer solutions →

$$pOH = pK_b + \log\frac{[acid]}{[base]}$$