

A Qualitative Look at pH Using the Henderson-Hasselbalch Equation

We will use Acetic acid, $pK_a = 4.74$, for our examples.



$$pH = pK_a + \log [HA] / [A^-]$$

When $[CH_3CO_2H] = [CH_3CO_2^-]$

$$pH = 4.74 + \log [CH_3CO_2H] / [CH_3CO_2^-]$$

$$pH = 4.74 + \log 1$$

$$pH = 4.74 + 0 = 4.74, \text{ thus } pH = pK_a$$

When $[CH_3CO_2H] > [CH_3CO_2^-]$

$$pH = 4.74 + \log [CH_3CO_2H] / [CH_3CO_2^-]$$

$pH = 4.74 + \log$ of a number less than 1 or <0 is “negative”

$$pH = 4.74 - \text{some number}$$

$pH < 4.74$, thus when we have more HA than A^- the pH will decrease

When $[CH_3CO_2H] < [CH_3CO_2^-]$

$$pH = 4.74 + \log [CH_3CO_2H] / [CH_3CO_2^-]$$

$pH = 4.74 + \log$ of a number greater than 1 or >0 is “positive”

$$pH = 4.74 + \text{some number}$$

$pH > 4.74$, thus when we have more A^- than HA the pH will increase