Answer on Question #83024, Chemistry/ General Chemistry

Determine the pH change when 0.091 mol HCl is added to 1.00 L of a buffer solution that is 0.488 M in CH3COOH and 0.310 M in CH3COO-.

pH after addition − pH before addition = pH change =

Solution

$CH_3COOH \leftrightarrow CH_3COO^- + H^+$

To answer this question we should use Henderson-Hasselbalch equation:

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

Where pH is the concentration of $[H^+]$

pK_a is the acid dissociation constant

$\frac{[A^-]}{[HA]}$ is the ratio of the concentrations of the conjugate base and starting acid.

Before addition:

$$pH(before\ addition) = pK_a + log\left(\frac{[A^-]}{[HA]}\right) = pK_a + log\left(\frac{0.310}{0.488}\right) = pK_a - 0.197$$

After addition:

Concentartion of HCl added is 0.091 mol/1 L = 0.091 M

As we add a strong acid we make an assumption that all moles of conjugate base react with this acid to give a new concentration of $[CH_3COO^-]$ = 0.310-0.091 = 0.219 M and additional concentration of CH_3COOH is formed $[CH_3COOH]$ = 0.488+0.091=0.579 M

$$pH(ater\ addition) = pK_a + log\left(\frac{[A^-]}{[HA]}\right) = pK_a + log\left(\frac{0.310 - 0.091}{0.488 + 0.091}\right) = pK_a - 0.422$$

pH change = pH(after addition) − pH (before addition) = $pK_a - 0.422 - (pK_a - 0.197) = pK_a - 0.422 - pK_a + 0.197 = -0.225$ pH units

Answer: pH change = -0.225 PH units