Answer on Question #50111 – Chemistry – Physical Chemistry

In a buffer solution of 1 L there are 0.1 mole of CH_3COOH and 0.005 mole of CH_3COONa. In this solution 0.08 g of NaOH is mixed. What is thr pH of the solution after mixing base? K_a of CH_3COOH is 1.8×10^{-5}.

Solution:

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

$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$

$CH_3COONa \rightarrow Na^+ + CH_3COO^-$

$$K_a = \frac{[H^+] \times [CH_3COO^-]}{[CH_3COOH]}$$

$$c = \frac{n}{V}$$

$$n = \frac{m}{M_r} = \frac{0.08\ g}{40\ {}^{g}/_{mol}} = 0.002\ mol$$

Lets $[H^+]=x$, then $[CH_3COOH]=c_0-x$

$[CH_3COO^-]=x+y$, y is part of anions from salt.

$$K_a = \frac{x \times (x+y)}{c_0 - x}$$

$$x^2 + (K_a + y) \times x - K_a \times c_0 = 0$$

Before adding base:

$$c_0 = \frac{0.1}{1} = 0.1\ M$$

$$y = \frac{0.005}{1} = 0.005\ M$$

So,

$$x^2 + (0.000018 + 0.005) \times x - 0.000018 \times 0.1 = 0$$

$$x^2 + 0.005018 \times x - 0.0000018 = 0$$

$$D = 0.005018^2 + 4 \times 1 \times 0.0000018 = 0.000032380324$$

$$x = \frac{-0.005018 + \sqrt{0.000032380324}}{2 \times 1} = 0.0003361856$$

$[H^+]=0.0003361856$ M

$$pH = -\log_{10}[H^+] = -\log_{10} 0.0003361856 = 3.47$$

After adding base:

$$c_0 = \frac{0.1 - 0.002}{1} = \frac{0.098}{1} = 0.098\ M$$

$$y = \frac{0.005 + 0.002}{1} = \frac{0.007}{1} = 0.007\ M$$

So,

$$x^2 + (0.000018 + 0.007) \times x - 0.000018 \times 0.098 = 0$$

$$x^2 + 0.007018 \times x - 0.000001764 = 0$$

$$D = 0.007018^2 + 4 \times 1 \times 0.000001764 = 0.000056308324$$

$$x = \frac{-0.007018 + \sqrt{0.000056308324}}{2 \times 1} = 0.0002429439$$

$[H^+]=0.0003361856$ M

$$pH = -\log_{10}[H^+] = -\log_{10} 0.0002429439 = 3.61$$

Answer:

After adding of base pH=3.61