Answer on Question #67054, Chemistry, General Chemistry

0.4 mol of acetic acid and x mol of sodium acetate are dissolved in enough water to provide 1.0 L of a buffer system. How much sodium acetate must be added to provide a buffer system with where pH=4.1.

Solution:

Acetate buffer system consists of week organic acetic acid and salt of this acid:

$CH_3COOH + CH_3COONa$

The pH value of buffer solution equals

$pH = pKa + \lg \frac{C(CH3COONa)}{C(CH3OOH)}$, where $pKa = -\lg Ka$ (Ka is dissociation constant of acetic acid; $pKa = -\lg 1.74 \cdot 10^{-5} = 4.76$)

Using given data, we can calculate the ratio $\frac{C(CH3COONa)}{C(CH3OOH)}$:

$\lg \frac{C(CH3COONa)}{C(CH3OOH)} = pH - pKa = 4.1 - 4.76 = -0.66$

So:

$\frac{C(CH3COONa)}{C(CH3OOH)} = 0.219$ (1)

We can determine the molar concentration of acetic acid, using formula:

$C(CH_3COOH) = \frac{n}{V}$, where n is number of moles; V is volume.

That's why:

$C(CH_3COOH) = \frac{0.4}{1.0} = 0.4$ (mol)

According to equation (1):

$\frac{C(CH3COONa)}{0.4} = 0.219$

Where $C(CH_3COONa) = 0.219 \cdot 0.4 = 0.0876$ (mol/L)

Thus, number of moles of sodium acetate:

$n(CH_3COONa) = C(CH_3COONa) \cdot V = 0.0876 \cdot 1.0 = 0.0876$ (mol)

Answer: $n(CH_3COONa) = 0.0876$ (mol).