

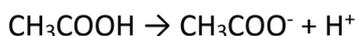
Answer on Question #44006 - Chemistry - Inorganic Chemistry

Question:

What is the concentration of acetic acid and the pH in a solution that is 0.25% ionized?

Answer:

The acetic acid dissociates according to the equation:



The constant of the dissociation:

$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]}$$

For the weak acid, such as acetic, Ostwald's law of dilution can be written in the next form:

$\alpha = \sqrt{\frac{K_a}{c_0}}$, where c_0 is for the initial concentration of acetic acid in the solution and α is for degree of dissociation. In this case the degree of dissociation is the same as degree of ionization, $\alpha = 0.25\%$.

K_a for acetic acid is 1.76×10^{-5} . In this case, c_0 :

$$c_0 = \frac{K_a}{\alpha^2} = \frac{1.76 \times 10^{-5}}{(0.0025)^2} = \frac{1.76 \times 10^{-5}}{6.25 \times 10^{-6}} = 0.282 \times 10 = 2.82 (\text{mol} / \text{L})$$

pH is the negative logarithm of the concentration of H^+ :

$$\text{pH} = -\log([\text{H}^+]);$$

Concentration of H^+ :

$$[\text{H}^+] = \sqrt{K_a \times c_0} = \sqrt{1.76 \times 10^{-5} \times 2.82} = 7.04 \times 10^{-3}$$

And pH equals:

$$\text{pH} = -\log([\text{H}^+]) = -\log(7.04 \times 10^{-3}) = 2.15$$