Question #79016

Using the quadratic equation to calculate [H3O+] in 0.00250 M HNO2, what are the values of a, b, c and x , where a, b, and c are the coefficients in the quadratic equation ax2+bx+c=0, and x is [H3O+]? Recall that Ka=4.5×10−4 .

Express a, b, c, and x numerically separated by commas.

The right answer is 1, 4.5×10^{-4}, -1.125×10^{-6}, 0.0104.

Solution:

As HNO_2 is a weak acid, the formula for calculation concentration of $[H_3O^+]$ is [1]:

$K_\alpha = \frac{x^2}{C_{HA}-x}$, where x – the concentration of $[H_3O^+]$.

After transformation, we will get the next equation:

$$x^2 + K_\alpha * x - C_{HA} * K_\alpha = 0$$

So, a = 1, b = $K_a = 4.5\times10^{-4}$, c = $-C_{HA}*K_a = -4.5\times10^{-4} * 0.0025 = -1.125\times10^{-6}$.

The concentration of $[H_3O^+]$ (x) is equal to:

$$x = \frac{-K_\alpha + \sqrt{K_\alpha + 4 * K_\alpha * C_{HA}}}{2} = 0.0104$$

So, x = 0.0104.

So, the full answer is a = 1, b = 4.5×10^{-4}, c = -1.125×10^{-6}, c = 0.0104.

Reference:

[1] http://www.science.uwaterloo.ca/~cchieh/cact/c123/wkacids.html