Answer on Question # 69909, Chemistry, General Chemistry

Lactic acid, CH3CHOHCOOH, is a monoprotic,weak acid that is produced by muscle activity. It is also produced from milk by the action of bacteria. What is the pH of a 0.12 mol/L solution of lactic acid if the acid dissociation constant(Ka)is 1.3 x 10-4?What does it mean that it is a "weak"acid?

Solution

Weak acids don't dissociate completely in the solutions – there is always some amount of unionized molecules.

$$CH_3CHOHCOOH \leftrightarrow H^+ + CH_3CHOHCOO^-$$

The acid dissociation constant:

$$\boldsymbol{K_A = \frac{[H^+][CH_3CHOHCOO^-]}{[CH_3CHOHCOOH]}}$$

The ICE table:

	$CH_3CHOHCOOH$	↔	H^+	$CH_3CHOHCOO^-$
(I)	0.12 M		0	0
(C)	$-x$		$+x$	$+x$
(E)	$0.12 - x$		x	x

Substitution of these values into the K_A equation:

$$1.3\times10^{-4} = \frac{x\times x}{0.12 - x}$$

$$1.3\times10^{-4} = \frac{x^2}{0.12 - x}$$

As the K_A is three orders of magnitude smaller than the concentration of the acid, we can use the approximation:

$$1.3\times10^{-4} \approx \frac{x^2}{0.12}$$
$$x^2 \approx 0.156\times10^{-4}$$
$$x \approx \sqrt{0.156\times10^{-4}} \approx 3.95\times10^{-3}$$
$$[H^+] = 3.95\times10^{-3}$$
$$pH = -\log[H^+] = -\log[3.95\times10^{-3}] = 2.40$$

Answer: $pH = 2.40$