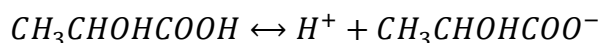


Answer on Question # 69909, Chemistry, General Chemistry

Lactic acid, $\text{CH}_3\text{CHOHCOOH}$, 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 (K_A) is 1.3×10^{-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.



The acid dissociation constant:

$$K_A = \frac{[\text{H}^+][\text{CH}_3\text{CHOHCOO}^-]}{[\text{CH}_3\text{CHOHCOOH}]}$$

The ICE table:

| | $\text{CH}_3\text{CHOHCOOH}$ | \leftrightarrow | H^+ | $\text{CH}_3\text{CHOHCOO}^-$ |
|-----|------------------------------|-------------------|--------------|-------------------------------|
| (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:

$$1.3 \times 10^{-4} = \frac{x \times x}{0.12 - x}$$

$$1.3 \times 10^{-4} = \frac{x^2}{0.12 - x}$$

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

$$1.3 \times 10^{-4} \approx \frac{x^2}{0.12}$$

$$x^2 \approx 0.156 \times 10^{-4}$$

$$x \approx \sqrt{0.156 \times 10^{-4}} \approx 3.95 \times 10^{-3}$$

$$[\text{H}^+] = 3.95 \times 10^{-3}$$

$$\text{pH} = -\log[\text{H}^+] = -\log[3.95 \times 10^{-3}] = 2.40$$

Answer: pH = 2.40