

## Answer on the question #56311 - Chemistry - General Chemistry

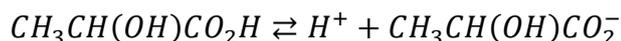
### Question:

Some lactic acid ( $C_3H_6O_3$ , MW 90.8 g mol<sup>-1</sup>) was dissolved in 250 mL of H<sub>2</sub>O to give a pH of 5.3.

How much lactic acid (in grams) was used to make this solution?

### Solution:

Lactic acid dissociation can be written this way:



Equilibrium constant of this reaction is:

$$K = \frac{[H^+][CH_3CH(OH)CO_2^-]}{[CH_3CH(OH)CO_2H]} = 1.38 \cdot 10^{-4}$$

One can note, that the equilibrium concentrations of hydrogen ion and lactate anion should be equal. Using this statement and the definition of pH value, we derive:

$$K = \frac{[H^+]^2}{[CH_3CH(OH)CO_2H]} = \frac{10^{-2pH}}{[CH_3CH(OH)CO_2H]} = 1.38 \cdot 10^{-4}$$

Then, the concentration of the undissociated lactic acid is:

$$[CH_3CH(OH)CO_2H] = \frac{10^{-2pH}}{1.38 \cdot 10^{-4}} = \frac{10^{-2 \cdot 5.3}}{1.38 \cdot 10^{-4}} = 1.82 \cdot 10^{-7} \text{ mol L}^{-1}$$

Then, the initial concentration of lactic acid is the sum of the equilibrium concentrations of undissociated and dissociated acid species:

$$\begin{aligned} c_0(CH_3CH(OH)CO_2H) &= [CH_3CH(OH)CO_2H] + [CH_3CH(OH)CO_2^-] \\ &= [CH_3CH(OH)CO_2H] + [H^+] = 1.82 \cdot 10^{-7} + 10^{-pH} = 5.2 \cdot 10^{-6} \text{ mol L}^{-1} \end{aligned}$$

The number of the moles of the lactic acid, dissolved in water, is:

$$n = c_0 \cdot V = 5.2 \cdot 10^{-6} \cdot 0.25 = 1.3 \cdot 10^{-6} \text{ mol}$$

And the mass is the product of molar mass and number of the moles:

$$m = n \cdot M = 1.3 \cdot 10^{-6} \cdot 90.8 = 0.12 \text{ mg}$$

**Answer:** 0.12 mg