

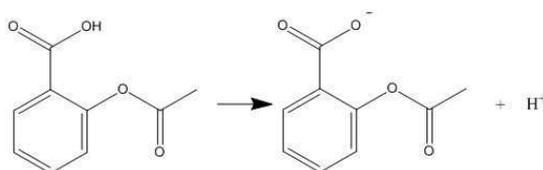
Answer on the question #58044, Chemistry / General Chemistry

Question:

You are studying aspirin and its acid base properties. You find that 1.00L of a 0.500 M solution of aspirin has a pH of 1.86. You are interested in learning about the % dissociation in a buffered solution of aspirin so you make a new 1.0L solution containing 0.500 moles of aspirin and 0.35 moles of the sodium salt of aspirin. What will the % dissociation be in the new buffered solution?

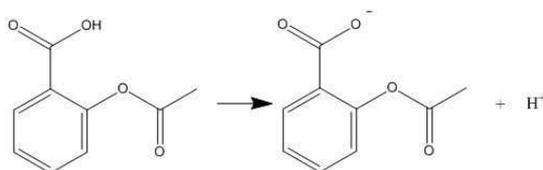
Solution:

From the data about pH and total concentration of the acid, one can calculate the equilibrium constant of aspirin dissociation.



$$K = \frac{[H^+][asp^-]}{[Hasp]} = \frac{[H^+]^2}{c^0(Hasp) - [H^+]} = \frac{10^{-2pH}}{0.5 - 10^{-pH}} = 3.92 \cdot 10^{-4} \text{ mol L}^{-1}$$

Then, we can use this constant to calculate the equilibrium concentration of hydrogen ions in buffer solution. For this we apply the following scheme:



$c^0 / \frac{\text{mol}}{\text{L}}$	0.5	0.35	-
$\Delta c / \frac{\text{mol}}{\text{L}}$	- x	+ x	+ x
$[c] / \frac{\text{mol}}{\text{L}}$	0.5 - x	0.35 + x	x

$$K = \frac{[H^+][asp^-]}{[Hasp]}$$

$$K = \frac{(0.35 + x)x}{(0.5 - x)}$$

$$x^2 + (0.35 + K)x - 0.5K = 0$$

Solving quadratic equation, we get x :

$$x = 5.58 \cdot 10^{-4}$$

Then, equilibrium concentration of hydrogen ions is:

$$[H^+] = 5.58 \cdot 10^{-4} \text{ mol L}^{-1}$$

Dissociation percentage is the ratio between the concentration of hydrogen ions and concentration of undissociated species:

$$\alpha = \frac{[H^+]}{[HA]} \cdot 100\% = \frac{5.58 \cdot 10^{-4}}{0.5 - 5.58 \cdot 10^{-4}} \cdot 100\% = 0.11\%$$

Answer: 0.11%