K_a for butyric Acid is 2×10^{-5}. Calc. pH & Hydroxyl conc $[OH^-]$ of 0.2 M aq. soln of sodium butyrate.

Soln

$$C_3H_7COO^- + H_2O \rightleftharpoons CH_3H_7COOH + OH^- \quad \text{(Hydrolysis)}$$

$(0.2-x)$ $\quad x \quad x$

$$K_h = \frac{x^2}{0.2-x} = \frac{x^2}{0.2} \Rightarrow K_h = \frac{K_w}{K_a} \Rightarrow \frac{K_w}{K_a} = \frac{x^2}{0.2}$$

$$\frac{10^{-14}}{2\times10^{-5}} = \frac{x^2}{0.2} \Rightarrow x = 10^{-5}\ mol\ L^{-1}$$

$$[OH^-] = 10^{-5}\ M$$

$$[H^+] = \frac{K_w}{OH} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$$

$$pH = -\log[H^+] = \boxed{9}$$