What is the hydrogen ion concentration of a buffer solution that is 0.05 M in acetic acid and 0.1 M in sodium acetate. (The K_a for acetic acid is $1.8 \times 10-5$)

Acetic acid ionizes and sodium acetate completely dissociates.

$$HC_2H_3O_2 \rightarrow H^+ + C_2H_3O_2^-$$

 $NaC_2H_3O_2 \rightarrow Na^+ + C_2H_3O_2^-$

The solution is a buffer solution since it is composed of a weak acid and a salt of the weak acid. The hydrogen ion concentration of such a buffer is calculated using the following.

$$K_a == \frac{(H^{positive}) \cdot (A^{negative})}{HA}$$

(A-) is the concentration of the salt of the acid and (HA) is the concentration of the Acid.We also know that the K_a is 1.8 x 10-5.

$$A^{\text{negative}} := 0.1$$

$$HA := 0.05$$

$$K_a := 1.8 \cdot 10^{-5}$$

$$\text{linsolve} \left(K_a == \frac{\left(H^{\text{positive}} \right) \cdot \left(A^{\text{negative}} \right)}{HA}, H^{\text{positive}} \right) = 9e-06$$

We now know the hydrogen ion concentration which is 9 x 10-6 M.