1. 3-nitrophenol, $O_2NC_6H_4OH$, is a monoprotic weak acid with a $pK_a = 8.37$. The salt, sodium 3-nitropenolate, $Na^+O_2NC_6H_4O^-$, is dissolved in water to make a solution with a molarity of 0.024 M. It is desired to know the pH of the solution. $K_w = 1.0 \times 10^{-14}$.

Quadratic equation for $ax^2 + bx + c = 0$ $\quad x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Sodium 3-nitropenolate, $Na^+O_2NC_6H_4O^-$, will dissociate into Na^+ and $O_2NC_6H_4O^-$ in water and we can abbreviate $O_2NC_6H_4O^-$ as A^-. A^- is the conjugate base of a weak acid, so will react as a base in water: $\quad A^- + H_2O \leftrightarrow HA + OH^-$ *and we can solve by setting up an ICE table:*

init.	*0.024*	*0*	*0*
change	*-x*	*+x*	*+x*
equil	*0.024 – x*	*x*	*x*
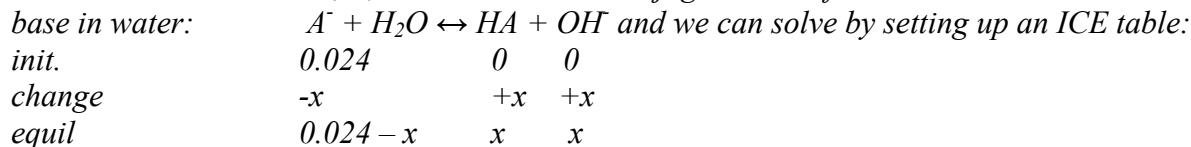
The equilibrium constant for the above reaction is $K_b = K_w/K_a = 10^{-14}/10^{-8.37} = 2.34 \times 10^{-6}$
Now we can set up the equation: $K_b = [HA][OH^-]/[A^-] = x^2/(0.024 – x)$
This can be simplified by assuming $x << 0.024$ (we need to check this later)
$2.34 \times 10^{-6} = x^2/0.024$ or $x = [(2.34 \times 10^{-6})(0.024)]^{0.5} = 2.37 \times 10^{-4}$ M (which is $<< 0.024$)
*$pH = 14 – pOH = 14 + log(2.37 \times 10^{-4}$ M$) = $ **10.38**