TYPE 1 (conj. ACID of a weak base)
(only the SALT of a weak base is put in solution)

For a salt, BHX, of the weak base (B) in water:

$$BHX\ (s)\ +\ H_2O\ \longrightarrow\ BH^+\ +\ X^-$$ (100% ionization!!!, and X^- is some anion of a strong acid - it does nothing)

Note that BH^+ behaves EXACTLY like a weak acid in water (a Type 1 problem for acids) and the equilibria is

$$BH^+\ +\ H_2O\ \rightleftharpoons\ H_3O^+\ +\ B\qquad —or—\qquad BH^+\ \rightleftharpoons\ H^+\ +\ B$$

$$K_a = \frac{[H^+][B]}{[BH^+]}$$

member K_a for BH^+ must be calculated from K_b for B: $\qquad K_a = \dfrac{K_w}{K_b}$

Now let C_{BH_+} be the analytical concentration (label) of the conjugate acid, BH^+ :
Our Equilibrium "Chart"

	[BH⁺]	**[H⁺]**	**[B]**
initial	C_{BH+}	0	0
change	-x	+x	+x
final	C_{BH+} - x	X	x

$$K_a = \frac{x^2}{\left(C_{BH^+} - x\right)}\qquad\qquad\textbf{Equation 3.1}$$

$$K_a C_{BH^+} - K_a(x) = x^2$$

$$0 = x^2 + K_a(x) - K_a C_{BH^+}$$

$$\boxed{[H^+] = [B] = x = \frac{-K_a + \sqrt{K_a^2 + 4K_a C_{BH^+}}}{2}}$$

This equation is the <u>exact</u> solution for calculating the $[H^+]$ for any solution made by mixing a concentration of ONLY a conjugate weak acid, BH^+, in water.

If we are using a REASONABLE concentration for BH^+ (somewhere between 1.0 M and 0.05 M) AND K_a is small enough (say less than 10^{-4}) we can make the following assumption:

$$C_{BH+} - x \cong C_{BH+} \qquad \text{all this is saying is that } x \text{ is so small compared to } C_{BH+}, \text{ it doesn't change it}$$

$$K_a = \frac{x^2}{C_{BH^+}}$$

and solving:

$$[H^+] = [B] = x = \sqrt{K_a C_{BH^+}} \qquad \textbf{Equation 3.2}$$

This equation is the <u>approximate</u> solution for calculating the $[H^+]$ for any conjugate acid, BH^+, of the weak base, B, where $K_b < 10^{-4}$. Although it's approximate, it will be close enough (accurate to 2 or 3 significant figures) to use this MOST of the time.