Alkalinity: 2 examples

Case 1: Na^+, Cl^-, one weak acid

$HA \leftrightarrow H^+ + A^-$; K_A, $pK_A = 6$ $\quad K_w = 10^{-13.2177}$

$pH = 8.2$, $[Na^+] = 0.6\ mol/kg$

$A_T = [HA] + [A^-] = 2300\ mmol/kg$ $\quad K_A = \frac{[A^-][H^+]}{[HA]}$

$[OH^-] = K_w / [H^+] = 9.6\ \mu mol/kg$

$$A_T = \frac{[A^-][H^+]}{K_A} + [A^-]$$

$$A_T = [A^-] \cdot \left(\frac{[H^+]}{K_A} + 1\right), \quad [A^-] = \frac{A_T}{\left(1 + \frac{[H^+]}{K_A}\right)} = 2286 \frac{\mu mol}{kg}$$

Solution will be charge balanced by weak acid and water.

$[Cl^-] = [Na^+] + [H^+] - [A^-] - [OH^-] = 0.5977\ mol/kg$

$[Na^+] - [Cl^-] = 0.033\ mol$ = Total Alkalinity

Titration of HCl adds Cl until alkalinity is 0. pH = 4.3

Case 2: fix $[Na^+]$ and $[Cl^-]$

$TA = [Na^+] - [Cl^-] = [A^-] + [OH^-] - [H^+] = 0$

if you plug in and solve for $[H^+]$ you get pH of 4.3