

Chap 15 Team Problem

Calculate the concentrations of all the species in 0.100M Na_2CO_3

Na_2CO_3 is a strong electrolyte (Alkali metal ionic)



$$[\text{Na}^+] = 0.200\text{M}$$

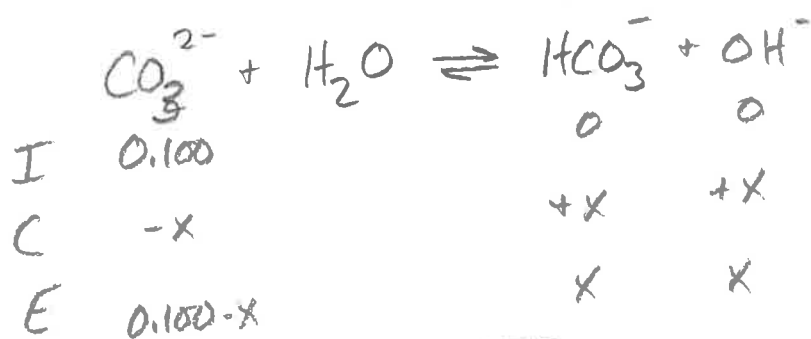
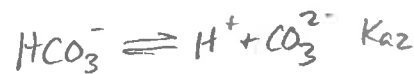
$$[\text{CO}_3^{2-}] = 0.100\text{M}$$

↳ conjugate base of a weak acid

Knowns

$$\text{H}_2\text{CO}_3 \quad K_{a1} = 4.2 \times 10^{-7}$$

$$K_{a2} = 4.8 \times 10^{-11}$$



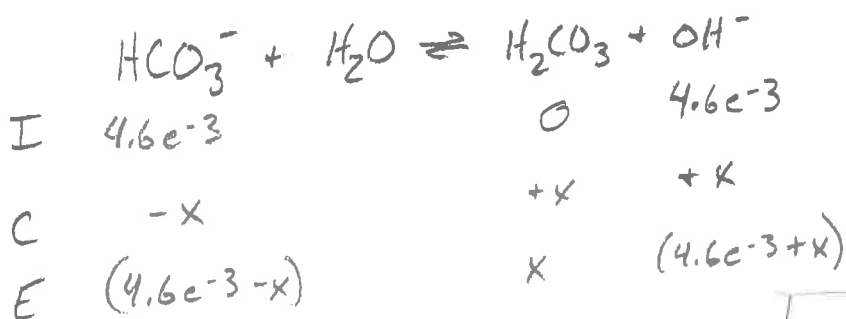
$$K_b = \frac{[x][x]}{[0.100]} = 2.1 \times 10^{-4}$$

$$K_w = K_{a2} K_b \leftarrow \text{for } \text{CO}_3^{2-}$$

$$1 \times 10^{-14} = (4.8 \times 10^{-11}) K_b$$

$$2.1 \times 10^{-4} = K_b$$

$$x = [\text{OH}^-] = [\text{HCO}_3^-] = 4.6 \times 10^{-3}\text{M}$$



$$K_b = \frac{[x][4.6 \times 10^{-3}]}{[4.6 \times 10^{-3}]} = 2.4 \times 10^{-8}$$

$$[x] = [\text{H}_2\text{CO}_3] = 2.4 \times 10^{-8}$$

$$K_w = K_{a1} K_b \leftarrow \text{for } \text{HCO}_3^-$$

$$1 \times 10^{-14} = (4.2 \times 10^{-7}) K_b$$

$$2.4 \times 10^{-8} = K_b$$

$$[\text{H}^+][\text{OH}^-] = K_w = 1 \times 10^{-14} = [\text{H}^+][4.6 \times 10^{-3}]$$

$$[\text{H}^+] = 2.2 \times 10^{-12}$$

Because all water solutions have both $[\text{H}^+] \neq [\text{OH}^-]$