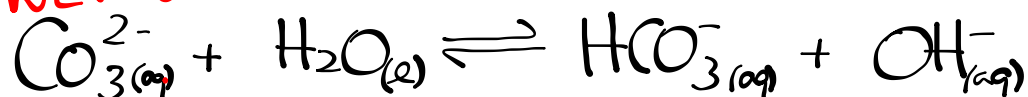


Calculate the pH of a 0.221 mol/L solution of $\text{CO}_3^{2-}(\text{aq})$ at equilibrium.

WEAK BASE



0.221 mol/L

$$K_b = \frac{[\text{HCO}_3^{-}(\text{aq})][\text{OH}^{-}(\text{aq})]}{[\text{CO}_3^{2-}(\text{aq})]}, \quad [\text{HCO}_3^{-}(\text{aq})] = [\text{OH}^{-}(\text{aq})]$$

$$K_b = \frac{[\text{OH}^{-}(\text{aq})]^2}{[\text{CO}_3^{2-}(\text{aq})]}$$

$$2.1 \times 10^{-4} = \frac{[\text{OH}^{-}(\text{aq})]^2}{[0.221]}$$

$$[\text{OH}^{-}(\text{aq})] = \sqrt{(2.1 \times 10^{-4})(0.221)}$$

$$[\text{OH}^{-}(\text{aq})] = 6.86 \times 10^{-3} \text{ M}$$

$$\text{pOH} = -\log[\text{OH}^{-}(\text{aq})]$$

$$\text{pOH} = -\log[6.86 \times 10^{-3}]$$

$$\text{pOH} = 2.164$$

$$K_a K_b = K_w$$

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{4.7 \times 10^{-11}}$$

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

$$\text{pH} + \text{pOH} = 14.000$$

$$\text{pH} = 14.000 - 2.164$$

$$\boxed{\text{pH} = 11.836}$$

Worksheet