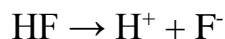


Answer to the Question 63493

How many moles of HF ($K_a = 6.8 \times 10^{-4}$) must be added to water to form 0.250 L of solution with a pH of 3.20?



$$K_a = \frac{[\text{H}^+] \cdot [\text{F}^-]}{[\text{HF}]}$$

$$K_a = \frac{\alpha^2 \cdot C_m}{(1 - \alpha)}$$

$$[\text{H}^+] = \alpha \cdot C_m$$

$$K_a = \frac{\alpha \cdot [\text{H}^+]}{(1 - \alpha)}$$

$$C_m = \frac{n(\text{HF})}{V} = \frac{n(\text{HF})}{0.25} = 4 \cdot n(\text{HF})$$

$$\text{pH} = -\lg[\text{H}^+]$$

$$[\text{H}^+] = 10^{-\text{pH}} = 10^{-3.2} = 6.31 \cdot 10^{-4}$$

$$K_a = \frac{\alpha \cdot [\text{H}^+]}{(1 - \alpha)} = \frac{\alpha \cdot 6.31 \cdot 10^{-4}}{(1 - \alpha)} = 6.8 \times 10^{-4}$$

$$\alpha \cdot 6.31 \cdot 10^{-4} = 6.8 \times 10^{-4}(1 - \alpha)$$

$$\alpha = 0.5187$$

$$[\text{H}^+] = \alpha \cdot C_m = 4 \cdot n(\text{HF}) \cdot \alpha = 6.31 \cdot 10^{-4}$$

$$n(\text{HF}) = \frac{6.31 \cdot 10^{-4}}{4 \cdot \alpha} = 3 \cdot 10^{-4} \text{ mol}$$