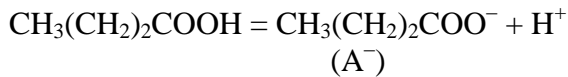


Problem 10-05 Limiting molar conductivity, transference number

The value of limiting molar conductivity of butyric acid at the temperature of 25 °C is $3.823 \cdot 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$ and the limiting molar conductivity of H^+ is $0.03497 \text{ S m}^2 \text{ mol}^{-1}$. If you can assume that the mean activity coefficient equals to one, determine the limiting molar conductivity of anion $\text{CH}_3(\text{CH}_2)_2\text{COO}^-$ and the transference number of both ions at infinite dilution.

$$[\lambda^\infty(\text{C}_3\text{H}_7\text{COO}^-) = 0.00326 \text{ S m}^2 \text{ mol}^{-1}, t_{\text{H}^+} = 0.9147, t_{\text{A}^-} = 0.0853]$$

Solution:



$$\lambda^\infty = \nu_{\text{K}} \cdot \lambda_{\text{K}}^\infty + \nu_{\text{A}} \cdot \lambda_{\text{A}}^\infty = \lambda^\infty(\text{A}^-) + \lambda^\infty(\text{H}^+)$$

$$\nu_{\text{A}^-} = 1, \quad \nu_{\text{H}^+} = 1$$

$$\lambda^\infty(\text{H}^+) = 0.03497 \text{ S m}^2 \text{ mol}^{-1}, \quad \lambda^\infty = 3.823 \cdot 10^{-2} \text{ S m}^2 \text{ mol}^{-1}$$

$$\lambda^\infty(\text{A}^-) = \lambda^\infty(\text{AH}) - \lambda^\infty(\text{H}^+) = 0.03823 - 0.03497 = 0.00326 \text{ S m}^2 \text{ mol}^{-1}$$

$$t_i^\infty = \nu_i \cdot \frac{\lambda_i^\infty}{\lambda^\infty}$$

$$t_{\text{A}^-}^\infty = \frac{\lambda_{\text{A}^-}^\infty}{\lambda^\infty} = \frac{0.00326}{0.03823} = 0.08527$$

$$t_{\text{H}^+}^\infty = 1 - t_{\text{A}^-}^\infty = 1 - 0.08527 = 0.91473$$