

**Problem 10-06 Absolute velocity of ions, molar conductivity, transference numbers**

Molar conductivity of  $\text{NH}_4\text{Cl}$  solution with concentration  $0.01 \text{ mol dm}^{-3}$  at the temperature of  $25^\circ\text{C}$  is  $0.0129 \text{ S m}^2 \text{ mol}^{-1}$ . The transference number of the cation in this solution is  $0.4907$ . What is the absolute velocity of the chloride ion in the conductivity cell where the distance of the electrodes is  $5.5 \text{ cm}$  and the voltage between the electrodes is  $7 \text{ V}$

$$[u_A = 8.67 \cdot 10^{-6} \text{ m s}^{-1}]$$

**Solution:**

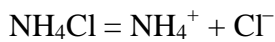
$$c = 0.01 \text{ mol dm}^{-3}$$

$$\lambda_{\text{NH}_4\text{Cl}} = 0.0129 \text{ S m}^2 \text{ mol}^{-1}$$

$$t_C = 0.4907 \Rightarrow t_A = 1 - t_C = 1 - 0.4907 = 0.5093$$

$$U = 7 \text{ V}$$

$$\ell = 5.5 \text{ cm} = 0.055 \text{ m}$$



$$z_A = 1, \quad \nu_A = 1$$

$$\left. \begin{array}{l} t_A = \nu_A \cdot \frac{\lambda_A}{\lambda} \\ \lambda_A = u_A \cdot z_A \cdot F \end{array} \right\} \quad u_A = \frac{\lambda_A}{z_A \cdot F} = \frac{t_A \cdot \lambda}{\nu_A \cdot z_A \cdot F} = \frac{0.5093 \cdot 0.0129}{1 \cdot 1 \cdot 96485.3} = 6.8093 \cdot 10^{-8} \text{ s m}^2 \text{ V}^{-1}$$
$$\left[ \frac{\text{S m}^2 \text{ mol}^{-1}}{\text{C mol}^{-1}} = \frac{\text{s m}^2}{\text{V}} \right] \quad \left[ \begin{array}{l} I = Q/\tau = U/R \\ [\text{C} \cdot \text{s}^{-1} = \text{V} \cdot \text{S}] \end{array} \right]$$

$$u_A = \frac{v_A}{E}, \quad E = \frac{U}{\ell} \Rightarrow v_A = u_A \cdot E = u_A \cdot \frac{U}{\ell} = 6.8093 \cdot 10^{-8} \cdot \frac{7}{0.055} = 8.67 \cdot 10^{-6} \text{ m s}^{-1}$$