17 December 2020 05:17

Question

Calculate Λ_m° for $CaCl_2$ and $MgSO_4$ from the given data

Ion	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}
λ ($Scm^2 mol^{-1}$)	119	106	76.3	160.0

Answer

By kohlrausch law:

$$\Lambda_m^\circ (CaCl_2) = \lambda^\circ_{Ca^{2+}} + 2\lambda^\circ_{Cl^-}$$

$$= 119 + 2 \times 76.3$$

$$= 271.6 \ Scm^2 mol^{-1}$$

$$\Lambda_m^\circ (MgSO_4) = \lambda^\circ_{Mg^{2+}} + \lambda^\circ_{SO_4^{2-}}$$

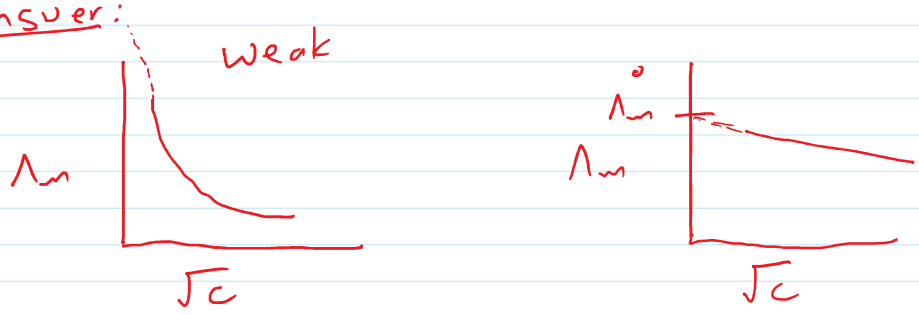
$$= 106 + 160$$

$$= 266 \ Scm^2 mol^{-1}$$

Question

Λ_m° for NaCl, HCl and NaAc are 126.4, 425.9 and 91.0 $Scm^2 mol^{-1}$ respectively. Calculate Λ_m° for HAc.

Answer:



By kohlrausch law:

$$\Lambda_m^\circ(HAc) = \lambda_{H^+}^\circ + \lambda_{Ac^-}^\circ$$

$$= \left(\lambda_{H^+}^\circ + \lambda_{Cl^-}^\circ\right) + \left(\lambda_{Ac^-}^\circ + \lambda_{Na^+}^\circ\right) - \lambda_{Cl^-}^\circ - \lambda_{Na^+}^\circ$$

$$= \Lambda_m^\circ(HCl) + \Lambda_m^\circ(NaAc) - \Lambda_m^\circ(NaCl)$$

$$= 425.9 + 91.0 - 126.4$$

$$= 390.5 \ S cm^2 mol^{-1}$$

Question

Suggest a way to determine Λ_m° value of water.

Answer:

By kohlrausch law:

$$\Lambda_m^\circ(H_2O) = \lambda_{H^+}^\circ + \lambda_{OH^-}^\circ$$

$$= \left(\lambda_{H^+}^\circ + \lambda_{Cl^-}^\circ\right) + \left(\lambda_{OH^-}^\circ + \lambda_{Na^+}^\circ\right) - \left(\lambda_{Na^+}^\circ + \lambda_{Cl^-}^\circ\right)$$

$$= \Lambda_m^\circ(HCl) + \Lambda_m^\circ(NaOH) - \Lambda_m^\circ(NaCl)$$

HCl, NaOH, NaCl are strong electrolytes, hence their molar conductivity at infinite dilution can be experimentally determined. By knowing these values, $\Lambda_m^\circ(H_2O)$ can be calculated

Question

The molar conductivity of $0.025 \ mol L^{-1}$ methanoic acid is $46.1 \ S cm^2 mol^{-1}$. Calculate its degree of dissociation and dissociation constant. Given $\lambda^\circ(H^+) = 349.6 \ S cm^2 mol^{-1}$ and $\lambda^\circ(HCOO^-) = 54.6 \ S cm^2 mol^{-1}$.

Answer:

By kohlrausch law:

$$\Lambda_m^\circ (HCOOH) = \lambda^\circ_{H^+} + \lambda^\circ_{HCOO^-}$$

$$= 349.6 + 54.6$$

$$= 404.2 \ S cm^2 mol^{-1}$$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{46.1}{404.2} = 0.114$$

$$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.025 \times (0.114)^2}{(1-0.114)} = 3.67 \times 10^{-4} \frac{mol}{L}$$