Where,

Λ_c = Equivalent Conductance of 'C' concentration

Λ_∞ = Equivalent Conductance of ∞ dilution.

This is approximately true for weak electrolytes but not in strong electrolytes.

*. Kohlrausch's law :-

A/c to Kohlrausch' —

'The dissociation of any electrolyte is complete at ∞ (infinite) dilution and there is no inter-ionic effect at this dilution.

So, He concluded that —

Both cation's and anions contributed independently towards equivalent conductance. Hence, He stated his law as —

Equivalent Conductance of an electrolyte at infinite dilution (∞) is composed of two factors — one contributed by cation and the other contributed by an anion. i.e.

$$\Lambda_\infty = \nu^+ \lambda^+ + \nu^- \lambda^-$$

Where, λ^+, λ^- are the ionic conductance of cation & anion.

ν^+, ν^- are their valencies.

Application of Kohlrausch's law:-

(1) Determination of molar Conductivity of Weak electrolyte at infinite dilution. (Λ_∞).

It is determined with the help of molar Conductivity of strong electrolyte.

for eg -

Given,

Λ_∞ C_2H_5COONa = 85.1 $ohm^{-1}\ cm^2\ eq^{-1}$.

Λ_∞ HCl = 426.3 " " "

Λ_∞ $NaCl$ = 126.1 " "

Λ_∞ C_2H_5COOH = ?

$\Lambda_\infty C_2H_5COONa = \lambda_{C_2H_5COO^-} + \lambda_{Na^+} = 85.1\ ohm^{-1}\ cm^2\ eq^{-1}$ — (1)

$\Lambda_\infty HCl = \lambda_{H^+} + \lambda_{Cl^-} = 426.3$ " " " — (2)

$\Lambda_\infty NaCl = \lambda_{Na^+} + \lambda_{Cl^-} = 126.1$ " " — (3)

$\Lambda_\infty C_2H_5COOH = \lambda_{C_2H_5COO^-} + \lambda_{H^+} = ?$

On adding eqs — (1) & (2) and then substrating eqs — (3)

We get —

$$\lambda_{C_2H_5COO^-} + \cancel{\lambda_{Na^+}} + \lambda_{H^+} + \cancel{\lambda_{Cl^-}} - \cancel{\lambda_{Na^+}} - \cancel{\lambda_{Cl^-}} = 85.1 + 426.3 - 126.1$$

$$\lambda_{C_2H_5COO^-} + \lambda_{H^+} = 385.3\ ohm^{-1}\ cm^2\ eq^{-1}.$$

$\therefore$ $\Lambda_\infty C_2H_5COOH = 385.3\ ohm^{-1}\ cm^2\ eq^{-1}$.

(2) Determination of degree of dissociation (α) for weak electrolyte.

It is determined from the formula:-

$$\alpha = \frac{\Lambda_c}{\Lambda_\infty}$$

Λ_c = molar conductivity of the electrolyte at any concentration.

Λ_∞ = molar conductivity of the electrolyte at infinite dilution.

α = degree of dissociation of weak electrolyte.

(3) Determination of dissociation constant (K_c) of weak electrolytes —

We know that as equilibrium constant —

$$K_c = \frac{c\alpha^2}{1-\alpha}$$

for weak acid $K_a = \frac{c\alpha^2}{1-\alpha}$

for weak base $K_b = \frac{c\alpha^2}{1-\alpha}$

This formula is not applicable to strong electrolytes such as $NaCl$, $NaOH$, $AgNO_3$, $CuSO_4$, HNO_3 etc. because, strong electrolytes are almost 100% dissociated in aq. sol^n.

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