MOLAR CONDUCTIVITY, λ

Definition:

This is the conductance of a volume of an electrolyte solution containing one mole of the electrolyte placed between two electrodes 1m or 1cm apart.

It is obtained as a ratio of electrolytic conductivity, *K,* of the solution to concentration, *C*;

$$molar\ conductivity\ at\ concentration, C, \qquad \lambda_c = \frac{\kappa}{C}$$

Consider, $\lambda_c = \kappa \text{ X } \frac{1}{C}, where\ \frac{1}{C} = dilution, v.$

$$Molar\ conductivity, \lambda_c = (Electrolytic\ conductivity \text{ X } dilution)$$

$$(\lambda_c = \kappa v)$$

Molar conductivity is measured in $\Omega^{-1}mol^{-1}cm^2$ or $\Omega^{-1}mol^{-1}m^2$

Note:

- Molar conductivity depends on the degree of dissociation of electrolyte but not on the concentration of electrolyte (number of ions present) like electrolytic conductivity.
- The degree of dissociation is defined as the fraction of each mole of an electrolyte that exists as ions.
- The degree of ionisation increases with dilution.

Factors which affect the magnitude of Molar Conductivity:

These include;

- Concentration
- Charge on the conducting ion
- Radius of conducting ion

Concentration:

Molar conductivity for both weak and strong electrolytes decreases with increase in concentration of the electrolyte.

For the weak electrolyte, the difference is because of decrease in the number of conducting ions since the degree of ionisation reduces.

For strong electrolytes, the decrease is because of increased ionic interference as the ions of opposite charge become closer to each other.

Charge on the conducting ion:

Increased ionic charge, the more strongly attracted is the ion, the greater the mobility and the greater the molar conductivity.

Consider the molar conductivities of the following ions;

Ion	$\boldsymbol{\lambda_c/\Omega^{-1}mol^{-1}cm^2}$
Na^+	50.1
Mg^{2+}	106
Cl^-	37.35
SO_4^{2-}	160.0

Radius of conducting ion:

The small the radius of the ion the greater the charge density and hence the increase in the shell of water molecules attracted, the lower the mobility and the lower the molar conductivity. For example;

Ion	$\boldsymbol{\lambda_c/\Omega^{-1}mol^{-1}cm^2}$
Li^+	38.69
Na^+	50.1
K^+	73.3

Variation of molar conductivity with concentration: