conductance of electrolytic solution:

Conductors allow electricity to flow through them.
Insulators do not allow current to flow through them.

Conductors are two types:
① Those which allow electricity to flow with decomposition called electronic conductors eg. metals, graphite etc. due to flow of e^-.

② Those which undergo decomposition when current is passed through them. eg. electrolytic conductors or electrolytes. They conduct due to flow of ions. Thus called ionic conductance.

They are further classified into two types:-

① Strong electrolytes. HCl, HNO_3 → acid
KOH, $NaOH$ → bases.
② Weak electrolytes — HCN, H_2CO_3, H_3PO_4 acid
NH_4OH, $Ca(OH)_2$, $Al(OH)_3$ – bases

Substances like sugar, urea do not conduct electricity called non electrolyte

Factors affecting electrolytic conductance

i) Nature of electrolyte – Strong →
weak →

ii) Size of ion and their solvation – Greater the size of ion or greater the solvation of ions, less the conductance.

iii) Nature of solvent & viscosity

iv) Concentration of solution → High conc. low cond.

v) Temp. → ↑se c̄ Temp.

Factors affecting metallic conductance:

① Nature ~~and etc~~ structure of metal.

② Number of valence e⁻ per atom

③ Temp. → ↓se with ↑se temp.

metallic	electrolytic
① definition	
② flow of e^-	② flow of ions.
③ decreases with ↑se T	③ ↑se $\bar{c}$ Temp.
④	

Electrical resistance and conductance:

Ohm's law:

$$V \propto I$$
$$V = IR$$
$$R = \frac{V}{I}$$ → called resistance

Denoted by Ω

$$I \propto 1/R$$

The reciprocal of the electrical resistance is called the conductance. It is denoted by G.

Thus $G = 1/R$

Unit is Ω^{-1} or mho or Siemens (S)

Specific conductance: (conductivity)

$$R \propto l$$

$$R \propto \frac{1}{a}$$

$$R = \rho \frac{l}{a}$$

$\rho \rightarrow$ called resistivity

Depends on material of conductor.

If $l = 1$, $a = 1\ cm^2$, $R = \rho$.

Thus resistivity is defined as resistance of conductor whose length is 1 cm and area of cross section is $1\ cm^2$, i.e. it is resistance of $1\ cm^3$ of the conductor or it is resistance of $1\ cm^3$ of conductor.

$$K = G \times \frac{l}{a}$$

Conductivity of a solution is defined as the conductance of a solution of 1 cm length and having 1 sq. cm as the area of cross section.

Equivalent Conductivity:

Equivalent conductivity of a solution at the dilution V is defined as the conductance of all the ions produced from one gram

[redacted]

equivalent of electrolyte dissolved in V cm^3 of the solution when the distance between the electrode is one cm and the area of electrode is so large that whole of the solution is contained between them. It is represented by Λ

$$\text{Eq. conductivity} = K_v \times V$$

specific conductivity

$$= K_c \times \frac{1000}{C_{eq}} = K_c \times \frac{1000}{\text{normality}}$$

Unit is $S\,m^2\,eq^{-1}$

<u>molar conductivity</u>: conductance of a solution at a dilution V is conductance of all ions produced from one mole of the electrolyte dissolved in V cm^3 of the solution when the electrodes are one cm apart and area of electrode is so large that the whole of the solution is contained between them. It is denoted by Λ_m.

$$\Lambda_m = K_v \times V$$

$$= K_c \times \frac{1000}{C}$$

$$= K_c \times \frac{1000}{\text{molarity}}$$

[redacted]

Its units $S\ m^2\ mol^{-1}$

Variation of conductance, specific conductance, equivalent conductivity and molar conductivity with dilution.

For weak as well as strong electrolyte conductance, equivalent conductivity and molar conductivity increases with dilution whereas specific conductivity ↓ses with dilution.

The conductance of a solution is due to the of ions. Thus on ↑ing dilution number of ions increase hence conductance ↑se.

Specific conductivity ↓ses with dilution because the number of current-carrying particles i.e. ions produced per centimetre cube of the solution becomes less on dilution.

The ↑se of equivalent and molar conductivity on dilution is due to fact that these are product of specific conductivity & volume of the solution containing 1 g equivalent of electrolyte

Variation of molar conductivity with dilution:

$$\Lambda_m^c = \Lambda_m^\circ - A\sqrt{c}$$

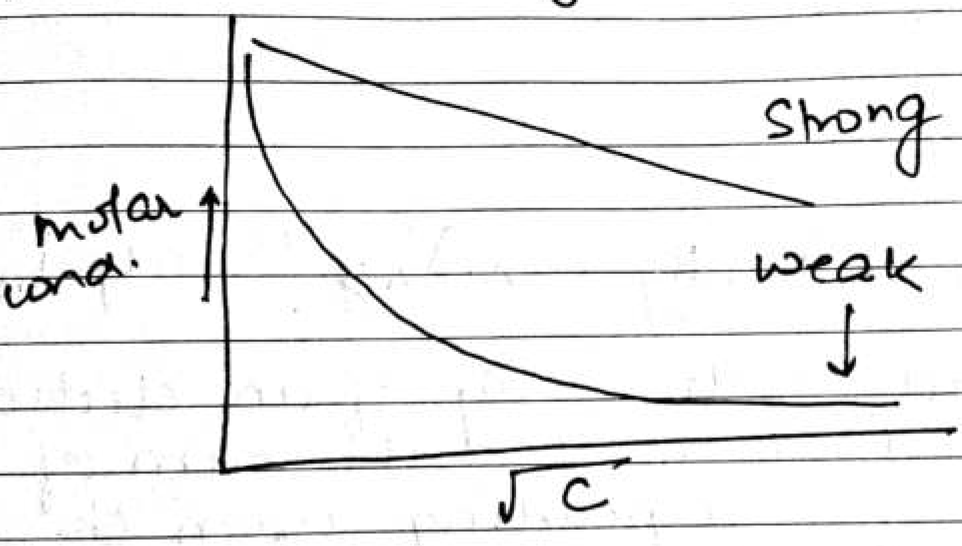
1) Conductance behaviour of strong electrolytes

A → constant depending on electrolytes

Λ_m° → limiting molar conductance (molar conductance at infinite dilution)

c → concentration.

(Debye-Huckel Onsager eqn)



Greater inter-ionic attraction at higher concentration which retards the motion & hence conductance falls with ↑sing concentration.

With ↑se in dilution the attraction ↓ses and ions move freely & at infinite dilution it becomes Λ_m° or Λ_m^∞

Conductance behaviour of weak electrolyte

Kohlrausch law

The molar conductivity of an electrolyte at infinite dilution is the sum of the ionic conductivities of the cation and anion each multiplied with the number of ions present in one formula unit of the electrolyte.

Mathematically.

$$\Lambda^{\circ}_{m} \text{ for } A_m B_y = x\lambda^{\circ}_{A^{y+}} + y\lambda^{\circ}_{B^{x-}}$$

The equivalent conductivity of an electrolyte at indefinite dilution is the sum of two value one depending upon the cation and the other upon the ~~other~~ ~~upon~~ anion.

$$\Lambda^{\circ}_{eq} = \lambda^{\circ}_{c} + \lambda^{\circ}_{a}$$

Monday

Application of Kohlrausch's law:

(1) Calculation of molar conductivity of weak electrolytes at infinite dilution.

(2) Calcaution of degree of dissociation.
Acc. to Arrhenius theory of electrolytic dissociation, the Inc in molar conductivity at infinite dilution is due to the increase complete dissociation

Degree of dissociation $\alpha = \frac{\Lambda_m^c}{\Lambda_m^\circ}$

(3) Calculation of dissociation constant of weak electrolyte.

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

Q1: If molar conductivities of NaCl, HCl and CH_3COONa at infinite dilution are 126.4, 426.1, 91.0 Ω^{-1} cm^2 mol^{-1} what will that be of acetic acid.

✓ Due to some technical issues the notes are sent via scanned means today

Hope you will manage Today. Thanks and regards. Ankita Ojha