Conductance of electrolytic solution:

- **1 The conductivity of 0.20 M KCl at 298 kelvin is 0.025 Scm-1. Calculate its molar conductivity.**

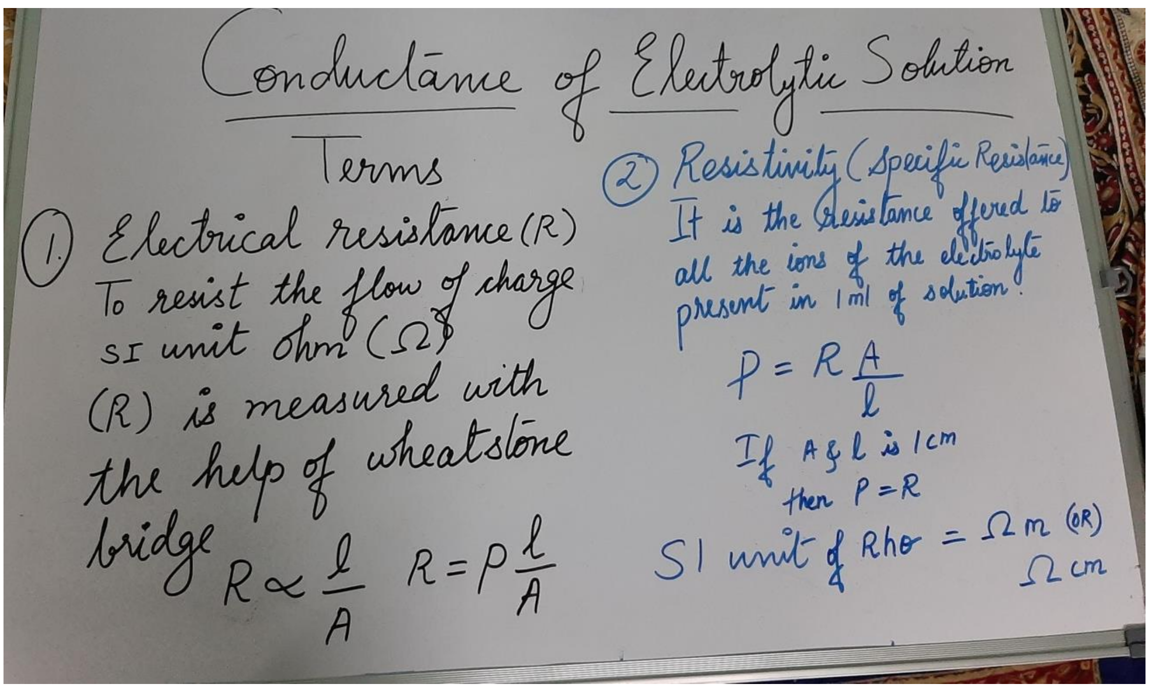
2 The electrical resistance of a column of 0.05 mole per litre NaCl solution of diameter 1 cm and length 50 cm is 5.55 × 10 -3 ohm .Calculate its resistivity,

conductivity and molar Molar

conductivity.

3 The resistance of 0.01 M KClsolution is 200 ohms calculate the specific conductivity and the molar conductivity if cell constant is equal to Unity.

4 When a certain electrolytic cell was filled with 0.1 M KCl,it has resistance of 85 ohm at 25 degree Celsius .When the same cell was filled with an aqueous solution of 0.052M unknown electrolyte ,the resistance was 96 Ohm calculate the molar conductance of the electrolyte at this concentration .(specific conductance of 0.1 M KCl = to 1.29 × 10-2/ohm/cm) .



Conductance of Electrolytic Solution

Terms

3. Conductance (G)

The inverse of resistance

$$G = \frac{1}{R} = \frac{1}{\Omega} = \Omega^{-1}$$

(OR)

Semens (S)

4. Conductivity (OR) Specific Conductance (K) Kappa

$$K = \frac{1}{Rho} \text{ or } \frac{1}{\rho} \text{ (OR) } \frac{1}{R \cdot \frac{A}{l}}$$

$$K = \frac{1}{R} \times \frac{l}{A}$$

$\frac{l}{A}$ = Cell constant (G^*)

SI unit = $S\,cm^{-1}$

Conductance of Electrolytic Solution

Terms

(5) Molar Conductivity

Λ_m → Conductance offered by all the ions in a given volume of electrolyte which contain 1 mole of electrolyte

$\Lambda_m = K \times$ Volume containing 1 mole of electrolyte

$$M = \frac{n}{volume}$$

n = 1 mole

$$\therefore M = \frac{1}{V}$$

$$V_{(in\ ml)} = \frac{1}{M}$$

$$V_{(in\ cm^3)} = \frac{1}{M} \times 1000$$

$$\therefore \Lambda_m = \frac{K \times 1000}{M}$$

SI unit = $\frac{S\,cm^{-1}}{mole/cm^3}$ (OR) $S\,cm^2/mole$

Conductance of Electrolytic Solution

Terms

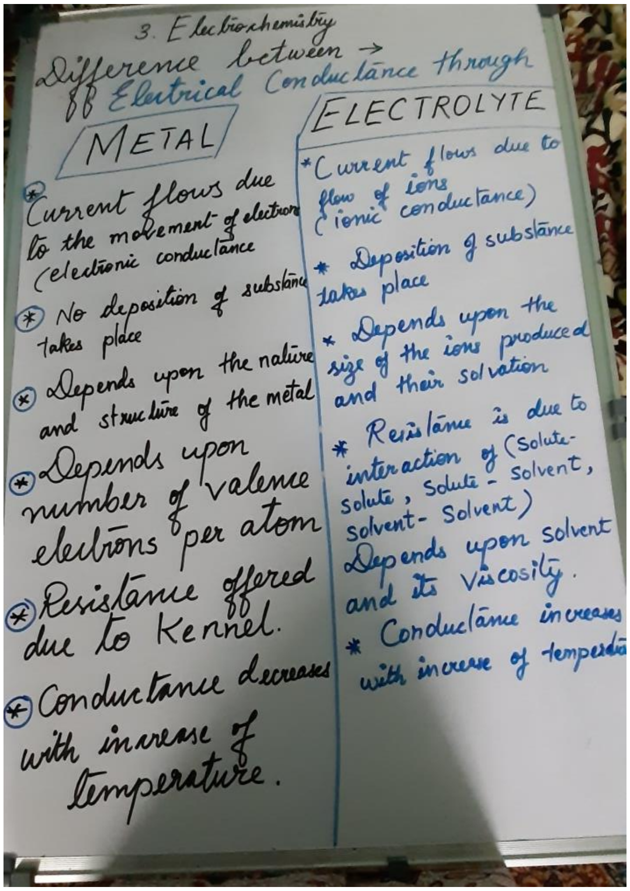
(6) Equivalent Conductivity

Conductance offered due to ions present in that volume of electrolyte

$$\Lambda_e = K \times V_{(cm^3)} \quad \frac{1}{N} \times 1000$$

$$\Lambda_e = \frac{K \times 1000}{N}$$

SI unit = $S\,cm^2\,eq^{-1}$



Variations of conductivity and molar conductivity with concentration or dilution

1. For conductance,: increase in dilution or increase in volume, conductance increases.

For weak electrolyte,:

increase in dilution the degree of dissociation increases the number of Ions increases hence conductance increases

For strong electrolyte, volume increases upon dilution but the degree of dissociation is 100% hence the number of Ions will not increase but the force of attraction between the ions decreases hence the ions will move apart which will increase the conductance.

2.Conductivity:

It is the conductance of all the ions present in 1 ml electrolytic solution.

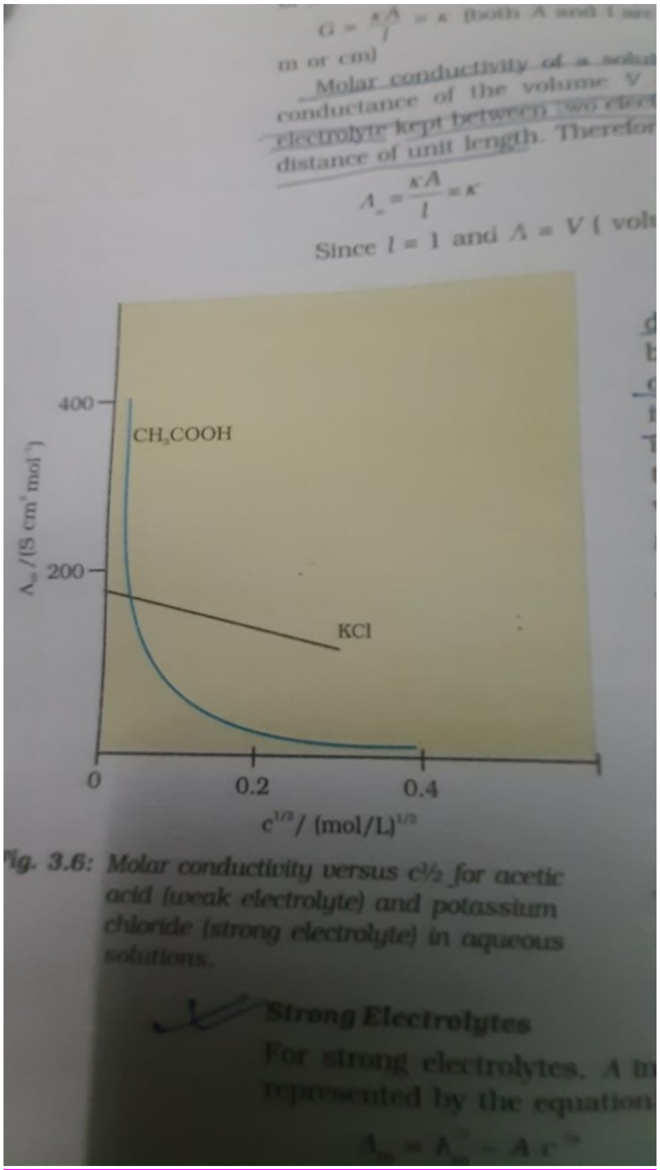
On increasing dilution, the volume of the electrolyte increases but the density of ions in 1 ml of the solution decreases or the number of ions in 1ml of the solution decreases when concentration decreases .

3.Molar Conductivity : conductance ofall the sensor that volume which contains one mole of electrolytic solution.

When dilution increases, volume increases but volume is inversely proportional to molarity therefore volume increases ,molarity increases and molar conductivity increases.

Molar conductivity versus concentration for acetic acid (weak electrolyte)and potassium chloride

Strong electrolyte) in aqueous solution.



$G = \frac{\kappa A}{l} = \kappa$ (both A and l are

m or cm)

Molar conductivity of a solu… conductance of the volume V … electrolyte kept between two elec… distance of unit length. Therefor…

$\Lambda_m = \frac{\kappa A}{l} = \kappa$

Since $l = 1$ and $A = V$ (vol…

Fig. 3.6: Molar conductivity versus $c^{1/2}$ for acetic acid (weak electrolyte) and potassium chloride (strong electrolyte) in aqueous solutions.

Strong Electrolytes

For strong electrolytes, Λ in… represented by the equation

$\Lambda_m = \Lambda_m^0 - A c^{1/2}$

When you move towards the left concentration decreases as the dilution increases the volume also increases therefore for the strong electrolyte the variation of the graph is very small we get a straight line which Intercept at Lambda M infinity.
When the concentration approaches zero the molar conductivity is known as limiting molar conductivity at infinite dilution.
For the weak electrolyte we cannot use Debye Huckel Onsager equation
Because the slope is not a straight line but it is a curved line.
Solve this concepts we have Kohlrausch law of independent Migration of Ions. This law is applicable for both strong and weak electrolytes with an equation.