Q.1. The resistance of 0.02 N soln of an electrolyte is 200 Ω with cell constant 0.80 cm^{-1}

Cal. (i) Conductivity (ii) Equivalent Conductance.

Sol. given :- $R = 200\,\Omega$

$N = 2 \times 10^{-2}$

$G^* = 0.8\ cm^{-1}$

$= 8 \times 10^{-1}$

(i) $K = G \cdot G^*$

$K = \frac{1}{R} \cdot G^*$

$K = \frac{1}{200} \times 8 \times 10^{-1}$

$K = \frac{1}{25} \times 10^{-1}$

$K = \frac{100}{25} \times 10^{-1} \times 10^{-2} = 4 \times 10^{-3}\ \Omega^{-1} cm^{-1}$

(ii) $\lambda_{eq} = \frac{K \cdot 1000}{N} \Rightarrow \lambda_{eq} = \frac{4 \times 10^{-3} \times 1000}{2 \times 10^{-2}}$

$\lambda_{eq} = 200\ S\,cm^2 eq^{-1}$

Q.2 Resistance of 0.03M soln of $Al_2(SO_4)_3$ is 32 Ω. distance b/w two electrode is 1.8 cm & area of cross section of electrode 5.4 cm². Cal:

(i) Conductivity (ii) Eq. Conductance (iii) Molar Conductance

2×3

$Al^{+3} \Rightarrow V.f = 6$

Sol: given:-
$R = 32\ \Omega$
$m = 3 \times 10^{-2}$
$l = 1.8\ cm$
$A = 5.4\ cm^2$

(i) $K = G \cdot G^*$

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

$K = \frac{1}{32} \times \frac{1.8}{5.4}$ (5.4 ÷ 1.8 = 3)

$K = \frac{1}{96}\ \Omega^{-1} cm^{-1}$

(iii) $\lambda_m = \frac{K \cdot 1000}{M}$

$$\lambda_m = \frac{1}{96} \times \frac{1000}{3 \times 10^{-2}}$$

$$\lambda_m = \frac{1}{288} \times 10^{5}$$

$$\boxed{\lambda_m = \frac{10^{5}}{288}}$$

Relation b/w molar Conductance and equivalent Conductance

$$\lambda_{eq} = \frac{K \cdot 1000}{N}$$

$$N = M \cdot V.f.$$

$$\lambda_{eq} = \frac{K \cdot 1000}{M \cdot V.f}$$

$$\boxed{\lambda_{eq} = \frac{\lambda_m}{V.f.}}$$ **

(ii) v.f. = 6

$$\lambda_{eq} = \frac{10^5/288}{6}$$

$$\lambda_{eq} = \frac{10^5}{288 \times 6} \Rightarrow \boxed{\lambda_{eq} = \frac{10^5}{1728}}$$

Ques. The resistance & conductivity of 0.01 m soln of an electrolyte is $100\,\Omega$ & $1.29\ S\,m^{-1}$.

If same conductivity cell is filled with 0.02 M soln of same electrolyte, then resistance was found to be $520\,\Omega$. Molar conductance of 0.02 M soln will be.

∵ 1 m = 100 cm

(a) $1.24 \times 10^{-4}\ S\,m^2\,mol^{-1}$

(b) 12.4×10^{-4} — " —

(c) 124×10^{-4} — " —

(d) 1240×10^{-4} — " —

I^{st} Cell

given $R = 100\,\Omega$

$K = 1.29\ S/m$

$K = \frac{1.29}{100}\ S\,cm^{-1}$

$\frac{1}{R} \cdot G^* = \frac{1.29}{100}$

$\frac{1}{100} \times G^* = \frac{1.29}{100} \Rightarrow \boxed{G^* = 1.29}$

II^{nd} Cell

$R = 520\,\Omega$, $M = 2 \times 10^{-2}$

$K = \frac{1}{R} \cdot G^*$

$K = \frac{1}{520} \times 1.29\ S\,cm^{-1}$

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

$$\Lambda m = \frac{1}{520} \times \frac{1.29 \times 1000}{2 \times 10^{-2}}$$

$$\Lambda m = \frac{1.29}{104} \times 10^{4} \ S\, cm^{2}\, mol^{-1}$$

$$\Lambda m = \frac{129}{104 \times 100} \times 10^{4} \times (10^{-2})^{2}$$

$$\Lambda m = \frac{129}{104} \times 10^{-2} \Rightarrow \Lambda m = 1.24 \times 10^{-2}\ S\, m^{2}\, mol^{-1}$$

$$\boxed{\Lambda m = 124 \times 10^{-4}}$$

$1m = 100\,cm$

$1cm = \frac{1}{100}\,m$

$1cm = 10^{-2}\,m$

Measurement of molar conductance of Strong electrolyte at ∞ dilution.

$$\frac{\cdot}{\circ}$$

$$\Lambda m = \frac{K \cdot 1000}{M}$$

$$M = \frac{n_{solute}}{V_{(L)}}$$

$$\left\{ \infty = \frac{1}{0} \right\}$$

$$V \rightarrow \infty$$

$$C \rightarrow 0$$

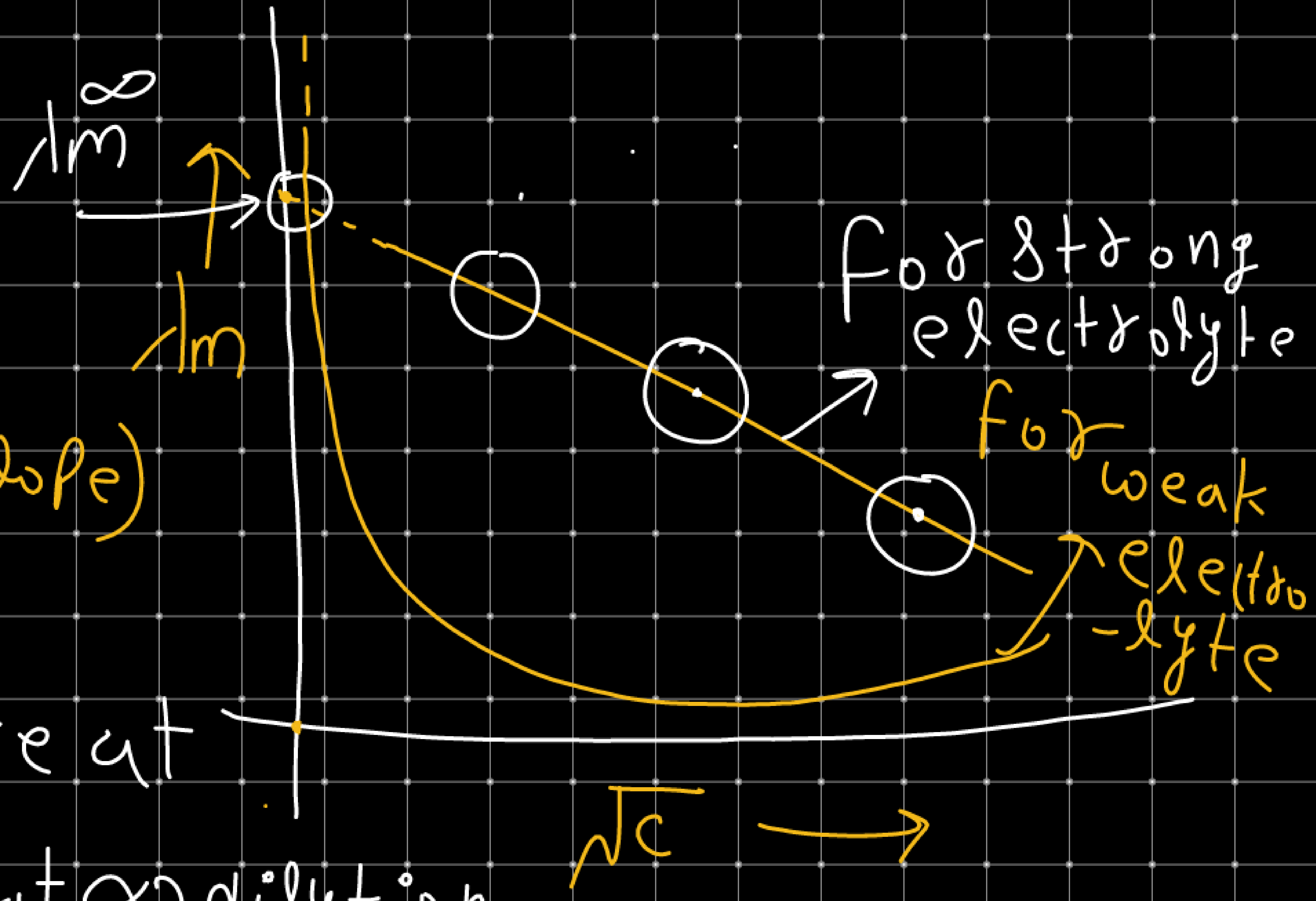
(1) De-bye huckle Onsager equation

$$\Lambda_m = \Lambda_m^{\infty} - b\sqrt{C}$$

$$y = c + mx$$

$m = -b$ (-Ve slope)

intercept $\Rightarrow c = \Lambda_m^{\infty}$



$\Lambda_m \Rightarrow$ molar Conductance at C - conc.

$\Lambda_m^{\infty} \Rightarrow$ molar Conductance at ∞ dilution

$b \Rightarrow$ debye huckle Constant

$C \Rightarrow$ Conc.

Value of b depends on -

(1) Nature of electrolyte

$NaCl$ [1 : 1 ration of Charge on cation & anion]

$CaCl_2$ [2 : 1]

Na_2O [1 : 2]

(2) Nature of Solvent

(3) Temp.