1. The cell constant of a given cell is $0.47\ cm^{-1}$. The resistance of a solution placed in this cell is measured to be $31.6\ ohm$. The conductivity of the solution in $S\ cm^{-1}$ is:

- A. 0.15
- B. 1.5
- C. 0.015 ✔
- D. 150

The conductivity (κ) is the product of reciprocal of resistance $(\frac{1}{R})$ and cell constant $(\frac{l}{a})$.

Hence,

$$\kappa = \frac{1}{R} \times \frac{l}{a}$$.

$$\kappa = \frac{1}{31.6\ ohm} \times 0.47\ cm^{-1} = 0.015\ S\ cm^{-1}$$

Option C is correct.

2. Specific conductance of $0.1\ M$ nitric acid is $6.3 \times 10^{-2}\ ohm^{-1}\ cm^{-1}$. The molar conductance of solution is

- ✔ **A.** $630\ ohm^{-1} cm^2\ mol^{-1}$
- ✖ **B.** $315\ ohm^{-1}\ cm^2\ mol^{-1}$
- ✖ **C.** $100\ ohm^{-1}\ cm^2\ mol^{-1}$
- ✖ **D.** $1201\ ohm^{-1}\ cm^2\ mol^{-1}$

$\text{Molar concentration, } (C) = 0.1\ M$
$\text{Conductivity, } \kappa = 6.3 \times 10^{-2}\ ohm^{-1}\ cm^{-1}$

$$\text{Molar conductance, } \Lambda_m = \frac{K}{C}$$

Also, we know
$1L = 1000\ cm^3$
$1L^{-1} = 10^{-3}\ cm^{-3}$
$\text{Molar concentration, } (C) = 0.1\ mol\ L^{-1}$
$\text{Molar concentration, } (C) = 0.1 \times 10^{-3}\ mol\ cm^{-3}$

$$\text{Molar conductance, } \Lambda_m = \frac{6.3 \times 10^{-2}}{0.1 \times 10^{-3}}$$

$$\text{Molar conductance, } \Lambda_m = 6.3 \times 10^2\ ohm^{-1}\ cm^2\ mol^{-1}$$

3. Resistance of a conductivity cell filled with a solution of an electrolyte of concentration $0.1\ M$ is $100\ ohm$. The conductivity of this solution is $1.29\ S\ m^{-1}$. Resistance of the same cell when filled with $0.2\ M$ of the same solution is $520\ ohm$. The molar conductivity of $0.2\ M$ solution of the electrolyte will be:

- ✔ **A.** $124 \times 10^{-5}\ S\,m^2\,mol^{-1}$
- ✖ **B.** $124 \times 10^{-4}\ S\,m^2\,mol^{-1}$
- ✖ **C.** $62 \times 10^{-4}\ S\,m^2\,mol^{-1}$
- ✖ **D.** $62 \times 10^{-5}\ S\,m^2\,mol^{-1}$

Cell constant is same for a particular cell. It is a constant.

We know,

Conductivity, $\kappa = \frac{1}{R} \times$ Cell constant

For $0.1\ M$ solution,

Resistance, $(R) = 100\ \Omega$

Conductivity, $\kappa = 1.29\ S\ m^{-1}$

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

$$1.29 = \frac{1}{100} \times \frac{l}{A}$$

Cell constant, $\frac{l}{A} = 129\ m^{-1}$

For $0.2\ M$ solution,

Resistance, $(R) = 520\ \Omega$

Conductivity, $\kappa = \frac{1}{R} \times$ Cell constant

Conductivity, $\kappa = \frac{1}{520} \times 129$

Conductivity, $\kappa = 0.248\ S\ m^{-1}$

$$\Lambda_m = \frac{\kappa}{C}$$

Also, we know

$1L = 10^{-3}\ m^3$

$1L^{-1} = 10^3\ m^{-3}$

Molar concentration, $(C) = 0.2 \times 10^3\ mol\ m^{-3}$

$$\Lambda_m = \frac{0.248}{0.2 \times 10^3}$$

$$\Lambda_m = 124 \times 10^{-5}\ S\ m^2\ mol^{-1}$$

4. The specific conductivity of $0.02\ M\ KCl$ solution at 25^oC is $2.768 \times 10^{-3}\ ohm^{-1}\ cm^{-1}$.
The resistance of this at 25^oC when measured with a particular cell was $250.2\ ohm$. The resistance of $0.01\ M\ CuSO_4$ solution at 25^oC measured with the same cell was $8331\ ohm$. Calculate the molar conductivity of the copper sulphate solution.

- ✗ **A.** $2.42\ ohm^{-1}\ cm^2\ mol^{-1}$
- ✗ **B.** $14.24\ ohm^{-1}\ cm^2\ mol^{-1}$
- ✗ **C.** $6.02\ ohm^{-1}\ cm^2\ mol^{-1}$
- ✓ **D.** $8.31\ ohm^{-1}\ cm^2\ mol^{-1}$

Cell constant is same for a particular cell. It is a constant.
For $0.02\ M\ KCl$ solution,

$\text{Resistance, } (R) = 250.2\ \Omega$

$\text{Cell constant, } \frac{l}{A} = \text{Conductivity of KCl} \times \text{ Resistance of KCl}$

$= 2.768 \times 10^{-3} \times 250.2$

For $0.01\ M\ CuSO_4$ solution

$$\text{Conductivity, } \kappa = \frac{\text{Cell constant}}{\text{Resistance}}$$

$$\kappa = 2.768 \times 10^{-3} \times 250.2 \times \frac{1}{8331}$$

$$\text{Molar conductance, } \Lambda_m = \text{Conductivity} \times \frac{1000}{C}$$

$$\Lambda_m = \frac{2.768 \times 10^{-3} \times 250.2}{8331} \times \frac{1000}{1/100} = 8.312\ ohm^{-1}\ cm^2\ mol^{-1}$$

5. Calculate the equivalent conductivity of $1\ \mathrm{M}\ H_2SO_4$ solution if its specific conductivity is $26 \times 10^{-2}\ \mathrm{ohm}^{-1}\mathrm{cm}^{-1}$.

$(\text{Atomic weight of sulphur } = 32\ \mathrm{g/mol})$

A. $\Lambda_{eq} = 2.6 \times 10^2\ \mathrm{ohm}^{-1}\mathrm{cm}^2\mathrm{equiv}^{-1}$

B. $\Lambda_{eq} = 1.3 \times 10^2\ \mathrm{ohm}^{-1}\mathrm{cm}^2\mathrm{equiv}^{-1}$ ✔

C. $\Lambda_{eq} = 13 \times 10^{-5}\ \mathrm{ohm}^{-1}\mathrm{cm}^2\mathrm{equiv}^{-1}$

D. $\Lambda_{eq} = 26 \times 10^{-5}\ \mathrm{ohm}^{-1}\mathrm{cm}^2\mathrm{equiv}^{-1}$

Relation betweem molarity and normality:
$\text{Normality } = n \times \text{Molarity}$
n is n-factor

As H_2SO_4 is a diprotic acid
so, $n = 2$

Thus,
$N = nM = 2 \times 1\,M = 2\,N$

$\text{Specific conductivity, } \kappa = 26 \times 10^{-2}\ \mathrm{ohm}^{-1}\ \mathrm{cm}^{-1}$

$1\ \mathrm{L} = 1000\ \mathrm{cm}^3$
$1\ \mathrm{L}^{-1} = 10^{-3}\ \mathrm{cm}^{-3}$
$\text{Concentration, } (C) = 2\ \text{g equiv L}^{-1}$
$\text{Concentration, } (C) = 2 \times 10^{-3}\ \text{g equiv cm}^{-3}$

If κ is expressed in $\mathrm{S\ cm}^{-1}$ and C in g equiv cm^{-3}

$$\Rightarrow \Lambda_{eq} = \frac{\kappa \times 1000}{\mathrm{N}}$$

$$\Rightarrow \Lambda_{eq} = \frac{1000 \times 26 \times 10^{-2}}{2}$$

$$\Rightarrow \Lambda_{eq} = 1.3 \times 10^2\ \mathrm{ohm}^{-1}\mathrm{cm}^2\mathrm{equiv}^{-1}$$