Monday, January 07, 2013
11:59 AM

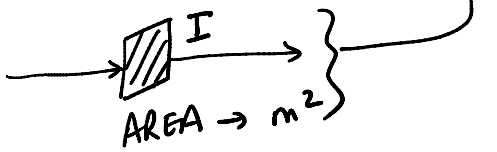
LECTURE 1 → REVIEW ELECTRICAL CONCEPTS

CURRENT → I i

UNIT → A

CURRENT DENSITY → J

UNIT → A/m^2



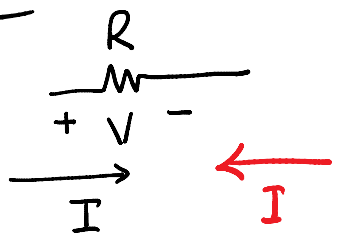
VOLTAGE → V ϑ

UNIT → VOLT

POLARITY + −

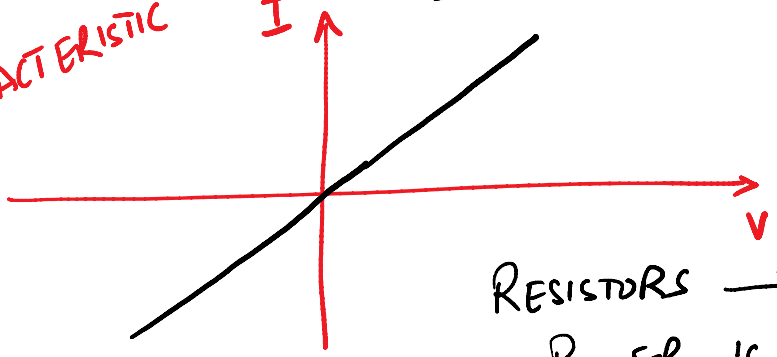
OHM's LAW

$V = IR$



$V = -IR$

IV CHARACTERISTIC



RESISTORS → PASSIVE CONVENTION

POWER IS ABSORBED → +

CURRENT

DEF. $\longrightarrow$ 1 A $\longrightarrow$ $1\ C/s = \frac{dq}{dt}$

VOLTAGE

1 V $\longrightarrow$ WORK / CHARGE OF 1 JOULE / 1 COLOUMB

FOR MOVING A POSITIVE CHARGE BETWEEN TWO POINTS

E $\longrightarrow$ ELECTRIC FIELD $\longrightarrow$ UNITS $\rightarrow$ V/m

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RESISTIVITY ρ Ωm Ωcm

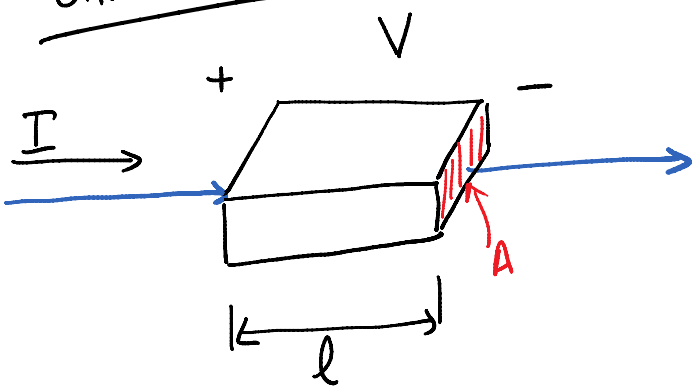
CONDUCTIVITY $\sigma = \frac{1}{\rho}$ $(\Omega m)^{-1}$

$$\rho = \frac{1}{\sigma}$$

LENGTH → GIVEN IN m → CONVERT Cm

ρ → Ωcm

OHM's LAW



$$R = \frac{\rho \ell}{A} = \frac{\ell}{A\sigma}$$

FIELD's CONCEPT

$$E = \rho J \qquad E = \frac{V}{\ell}$$

$$J = \frac{I}{A}$$

$$\Rightarrow \frac{V}{\ell} = \rho \frac{I}{A} \Rightarrow \frac{V}{I} = \frac{\rho \ell}{A}$$

$$\boxed{R = \frac{\rho \ell}{A}}$$

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CLASSIFY SOLIDS BASED ON RESISTIVITY / CONDUCTIVITY

1) INSULATORS → $\rho \uparrow \sigma \downarrow$

2) CONDUCTORS → $\rho \downarrow \sigma \uparrow$

PORCELAIN → $\rho = 10^{12} - 10^{14}\ \Omega cm$

Cu → $\rho = 1.725 \times 10^{-6}\ \Omega cm$

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

ρ → IS TEMPERATURE DEPENDENT

$$\rho(T) = \rho_{20}\left[1 + \alpha_{20}(T - 20)\right]$$

$\rho(T)$: TO FIND ?

ρ_{20}: GIVEN

α_{20}: GIVEN

$(T - 20)$: GIVEN

α_{20} → TEMPERATURE COEFFICIENT OF RESISTIVITY (TEMPERATURE DEPENDENT) SPECIFIED!

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AWG #12 $\quad \ell = 10\,\text{cm}$

d (DIAMETER) $= 2.053\,\text{mm}$

AREA 'A' $= \frac{\pi}{4}(0.2053)^2\ \text{cm}^2$

Cu $\quad \rho = 1.725 \times 10^{-6}\ \Omega\text{cm}$

$$R = \frac{\rho \ell}{A} = \frac{(10)(1.725 \times 10^{-6})}{(\pi/4)(0.2053)^2}$$

$$= 5.21 \times 10^{-4}\ \Omega$$

Cu

$\alpha_{20} = 3.9 \times 10^{-3}\ C^{-1}$

$\rho_{20} = 1.7 \times 10^{-6}\ \Omega cm$

} AT 20°C

$\rho(T) = \rho_{20}\left[1 + \alpha_{20}(T-20)\right]$

$T = 350K$

$T(K) = 273 + T(°C)$

$T(°C) = 350 - 273 = 77°C$

$\rho(350K) = 1.7 \times 10^{-6}\left[1 + (3.9 \times 10^{-3})(77-20)\right]$

$= 2.07791 \times 10^{-6}\ \Omega cm$

AS $T \uparrow$ $\rho \uparrow$ $\sigma \downarrow$