Ch2:- Resistance and ohm's law.

1. ohm's law:-

* Resistance:-

→ The SI unit of resistance (R) is the (Ω) ohm.

$$V \propto I$$

$$V = RI \qquad \therefore I = \frac{V}{R}$$

ohm:- Is the electric resistance of a conductor is if an applied voltage of 1V causes a current of 1A to flow

→ The inverse of resistance is called **conductance (G)**

$$G = \frac{1}{R}$$

→ The SI unit of conductance (S), (℧)

$$\therefore I = \frac{V}{R} = GV$$

2. Resistivity:-

→ directly proportional to the length of the conductor

$$R \propto l$$

→ inversely proportional to the cross-sectional area

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

$$\therefore R \propto \frac{l}{A}$$

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

R → Ω, ρ → Ω.m, l → m, A → m²

EX:- A 100W light bulb draws 0,833 A at 120 V, what is its resistance?

$I = 0,833$ $V = 120V$ $\therefore R = \frac{V}{I} = 144\ \Omega$

EX:- A 60W light bulb has a 240 Ω resistance with 120 V applied, what is the current?

$I = \frac{V}{R} = \frac{120}{240} = 0,5\ A$

Conductors:- Such as Metals, Alloys.

→ A good conductor has a resistivity close to $10^{-8}\ \Omega \cdot m$

→ Silver: The best conductor

→ Copper, Aluminum is a common conductor

Insulators:- Such as Glass, Plastic etc.

→ Materials with resistivity greater than $10^{12}\ \Omega \cdot m$ are called Insulator

*Semiconductor:- Such as Si, G

→ $10^{-6} > semi > 10^{-4}$

$\therefore G = \frac{1}{R}$ $\rho = \frac{1}{\sigma}$ → (Sigma) conductivity

$\therefore G = \frac{\sigma A}{\ell}$

→ SI unit of conductivity (σ) is the (S/m)

3. Temperature Effects:-

→ The resistances of most good conducting materials increase almost linearly with Temperature over the range of normal operating Temp.

مقاومة معظم الموصلات ~ تزيد مع زيادة درجة الحرارة

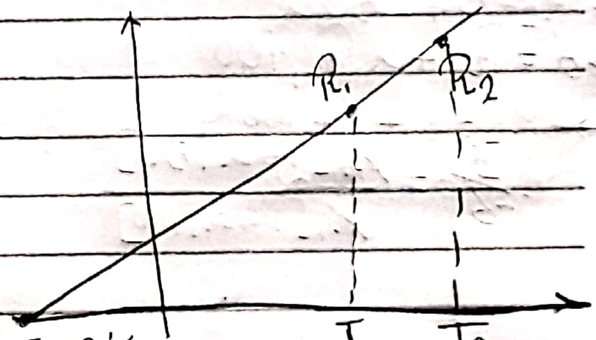
$R \propto T$ ~ في الموصلات

→ However, some materials, and common semi in particular have resistances that decrease with Temp increases.

بعض المواد وأشباه الموصلات ~ تنخفض مقاومتها مع زيادة درجة الحرارة

~ أشباه الموصلات

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



$R_1 \propto (T_1 - T_0)$

$R_2 \propto (T_2 - T_0)$

$$\frac{R_2}{R_1} = \frac{T_2 - T_0}{T_1 - T_0} \quad \therefore R_2 = \frac{(T_2 - T_0) R_1}{(T_1 - T_0)}$$

لو في الرسم البياني.

$$R_2 = R_1 [1 + \alpha_1 (T_2 - T_1)]$$

← لو دون الرسم البياني.

*كل ما اختلف درجة الحرارة اختلف R, α

$[R_1, \alpha_1, T_1]$

→ The unit of α is per degree celsius with symbol $(°C^{-1})$

Ex(3):- The resistance is 5Ω at 50°C and 6Ω at 100 °C, Then what will be the resistance of the wire at 0 °C?
T_1

$T_1 = 50\,^\circ C \longrightarrow R_1 = 5\,\Omega$

$T_2 = 100\,^\circ C \longrightarrow R_2 = 6\,\Omega \leftarrow$

$\rightarrow R_2 = R_1[1 + \alpha[T_2 - T_1]]$ ($T_1 = 0$)

$\checkmark [T=0] \Leftarrow T_1$

$R_2 = R_1[1 + \alpha_1[T_2 - T_1]]$

$\rightarrow R_2 = R_1[1 + \alpha[T_2 - T_1]]$

$T_1 = 0$

① $\rightarrow 5 = R_1 + \alpha_1 R_1 50$

② $\rightarrow 6 = R_1 + \alpha_1 R_1 100$

$$\frac{5}{6} = \frac{R_1[1+\alpha_1 50]}{R_1[1+\alpha_1 100]}$$

$$\frac{5}{6} = \frac{1+50\alpha_1}{1+100\alpha_1}$$

$\therefore \alpha_1 = 5 \times 10^{-3}$

$\therefore R_2 = 4\,\Omega$ ✱✱

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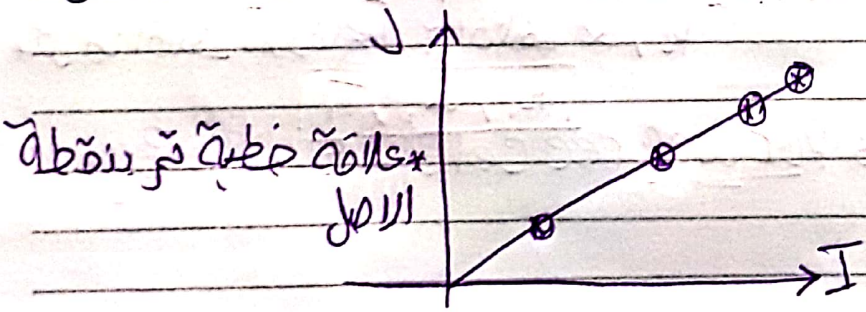
4. Resistors:-

→ is a circuit component that is used because of its resistance.

هو مكون دائرة يستخدم بسبب مقاومته.



Resistor Power Adsorptions:-

* The power absorbed by a linear resistor interms of resistance

$$V = I * R \qquad P = V * I$$

$$\boxed{P = \frac{V^2}{R} = I^2 R}$$

5. Open and Short circuits:-

Ex:- A 12 V battery has an internal resistance of 0,1 Ω what is the battery delivers 30 A?

الدارة

$V = 12\,V,\ R = 0,1\,\Omega \Rightarrow I = 30\,A$

$V_1 = R * I = 0,1 * 30 = 3\,V$

$V_T = 12 - 3 = 9\,V$ *