Phy "Resistors" Summary

Wednesday, January 11, 2023 8:41 AM

→ A resistor is an electric element that converts (transforms) electric energy into heat (thermal) energy.
→ The resistance of a resistor measures the opposition to the flow of electric charges.
→ S.I unit of resistance is ohms (Ω).
→ The resistance is measured by an ohm-meter.
→ The poles of the resistor are identical.
→ It doesn't matter how you connect the resistor to the circuit, in other words, polarity is not important.

1. Ohm's law of a resistor:

$$U_{AB} = R \times I_{AB}$$

Where:

- ✓ U_{AB}: Voltagein volts (V)
- ✓ R: Resistance in ohms (Ω)
- ✓ I_{AB}: current in amperes (A)

- 1 kilo-watt (Kw) $\xrightarrow{x10^2}$ watt (w)
- 1 Mega-watt (Mw) $\xrightarrow{x\ 10^6}$ watt (w)
- 1 milli-watt (mw) $\xrightarrow{x\ 10^{-3}}$ watt (w)

REMARK!!!

→ $U_{AB} = U_A - U_B$
⇒ From A→ B: along direction of current.

→ $U_{BA} = U_B - U_A$
⇒ From B→ A: popposite to th direction of current.

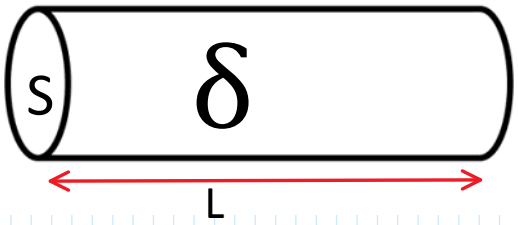
→ As R increases (↑), I decreases(↓).
→ If $R_1 > R_2$
$\Rightarrow I_1 < I_2$
→ If $R_2 > R_1$
$\Rightarrow I_2 < I_1$

2. Characteristics curve of a resistor:

Straight line passing through the origin.

$$\begin{cases} U = R \times I \\ Y = a \times x \end{cases} \rightarrow \boxed{R = a = \frac{Y_A - Y_B}{X_A - X_B}}$$: A and B are 2 points on the curve.

3. The resistance of very long conducting wire:



$$R = \frac{\delta \times L}{S}$$

Where:

- ✓ δ: *length of the wire* (m)
- ✓ S: cross-sectional area (m^2)
- ✓ R: resistance of the very long conducting wire (Ω)

REMARK!!!

→ The resistivity of metal increases with temperature.

→ Electric energy transferred in to a resistor is totally converted into heat.

4. Grouping of resistors:

Equivalent Resistance:

Used to replace grouping of resistors between 2 terminals.

→ **Resistors connected in series:**

$R_{equivilant} = R_1 + R_2 + R_3 \ldots .$ ★ $R_{equivilant}$ is greater than the greatest resistor.

→ **Resistors grouped in parallel:**

1st method:

$$\frac{1}{R_{equivilant}} = \frac{1}{R_1} + \frac{1}{R_2}$$

★ $R_{equivilant}$ is smaller than the smallest resistor

2nd method:

$$R_{equivilant} = \frac{R_1 \times R_2}{R_1 + R_2}$$

Only valid if you have 2 resistors in parallel

5. Power and Energy:

→ Energy: ability to do work.

→ Electric power: rate of transfer of electric energy.

→ P = U x T

Where:

- ✓ P: power in watts
- ✓ U: Voltage in volts
- ✓ I: current in amperes

→ P=U x I

= (R x I) x I

= R x I^2

Or

→ P = U x I

= U x $\frac{U}{R}$

= $\frac{U^2}{R}$

- ★ 1 kilo-watt (Kw) $\xrightarrow{x10^2}$ watt (w)
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→ E = P x t

Where:

- ✓ E: energy in joules(J)
- ✓ P: power in watts(W)
- ✓ t: time in seconds(sec)

REMARK!!!

→ E(J) = P(w) x t(sec)

→ E(Kw-hr) = P(w) x t(hr)

→ E(w-hr) = P(w) x t(hr)

→ $P_{dry\ cell} = P_1 + P_2 + P_3 \ldots.$

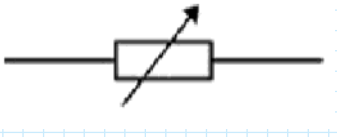
6. Joule's Effect:

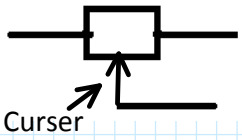
When electricity flows through an electrical device, part of it is converted into heat.

REMARK!!!

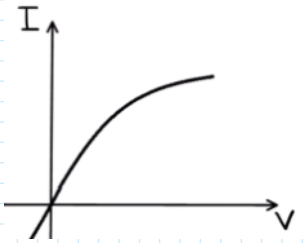
→ (P_{max}, V_{max}) or (P_{max}, I_{max}): limits of functioning of a resistor.

→ Rheostat: resistor with variable resistance that allows the variation in current and the voltage in the circuit.





→ The I-V characteristic curve for a lamp is not a straight line due to the variation of the resistance of the lamp with temperature.


I
V