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EE 178: Physics II

Electricity & Magnetism

Chapter 6: Current, Resistance and Ohm's Law

A current (I) of electricity exists in a region when a net electric charge is transported from one point to another in that region. Suppose the charge is moving through a wire. If a charge q is transported through a given cross section of the wire in a time t, then the current through the wire is:

$$\mathrm{I} = \frac{q}{C}$$

q (Coulomb), t (seconds)

SI unit of I is : Ampere=C/s

Flow of the electrons to the right ≡ a current to the left

The resistance R: of a wire or other object is a measure of the potential difference (V) that must be impressed across the object to cause a current of one ampere through it:

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

The unit of resistance is the **Ohm**, for which the symbol Ω (Greek omega) is used:
1Ω = 1 V/A

Ohm's Law: originally contained two parts. Its first part was simply the defining equation for resistance: $V = R\,I$.

We often refer to this equation as being Ohm's Law. However, Ohm's Law also stated that R is a constant independent of V and I. This latter part of the law is only approximately correct.

The relation $V = R\,I$ can be applied to any resistor, where V is the potential difference between the two ends of the resistor, I is the current through the resistor and R is the resistance of the resistor under those conditions.

Resistivity: The resistance R of a wire of length L and cross sectional area A is:

$$R = \rho\,\frac{L}{A}$$

Where ρ is a constant called the **resistivity**. The resistivity is a characteristic of the material from which the wire is made. For L in m, A in m^2, and R in Ω, the unit of ρ is Ω.m

Resistors in series: $R_{eq} = R_1 + R_2 + R_3 + \cdots$

Resistors in parallel:

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$