Resistance

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

Resistance
- Proportional to length
- Inversely proportional to area
- Unit is Ohm (Ω)

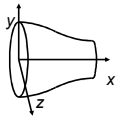
Applications: Jumper cables and holiday lights.

Resistance

Resistance depends on the material (resistivity) and the geometry of the device.

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

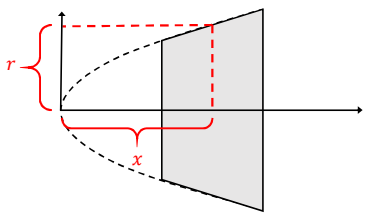
Integrate if the cross-section is not uniform.



$$R = \int_0^L \rho \frac{dx}{A}$$

(*A* is a function of *x*.)

Example: The radius of a conductor is given by $r = \frac{1}{4}x^2$ between $x = 2\text{mm}$ and $x = 4\text{mm}$. Determine the resistance of the conductor for a current flowing in the x-direction.



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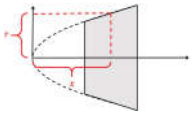

$$R = \rho\frac{L}{A} \rightarrow R = \int \rho\frac{dx}{A}$$

$$R = \int_{x_0}^{x_f} \rho\frac{dx}{\pi r^2}$$

$$R = \int_{x_0}^{x_f} \rho\frac{dx}{\pi\left(\frac{1}{4}x^2\right)^2} = \int_{x_0}^{x_f} \rho\frac{16dx}{\pi x^4}$$

$$R = -\frac{16\rho}{3\pi}\left(\frac{1}{x_f^3} - \frac{1}{x_0^3}\right)$$

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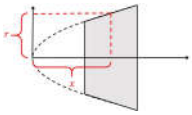

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Be careful to enter limits in meters.

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