15-3 Resistance to Flow of Charge

The resistance of a wire varies directly with the length of the wire and inversely with the cross-sectional area of the wire:

$$\left.\begin{array}{l} R \propto L \\ R \propto \frac{1}{A} \end{array}\right\} \quad R \propto \frac{L}{A}$$

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

Where R is the resistance (Ω)
ρ is resistivity of the wire ($\Omega \cdot m$)
L is the length of the wire (m)
A is the cross-sectional area (m^2)
($A = \pi r^2$)

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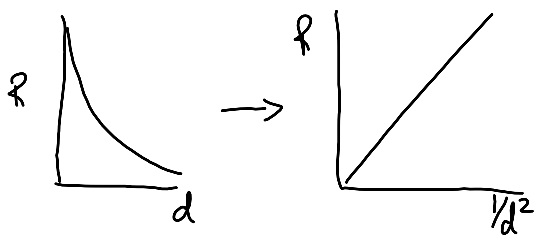
$L = 15 m$
copper $\rho = 1.7 \times 10^{-8} \Omega \cdot m$
$d = 0.050 cm \rightarrow m \rightarrow$ find A!

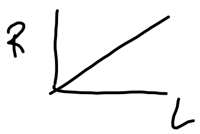
$A = \pi r^2$
$A = \pi (0.025 \times 10^{-2} m)^2$
$A = 1.96 \times 10^{-7} m^2$
↑ use the unrounded value

$R = \rho \frac{L}{A}$
$R = \frac{(1.7 \times 10^{-8} \Omega \cdot m)(15 m)}{1.96 \times 10^{-7} m^2}$
$R = 1.3 \Omega$

Recall "Analyzing Experimental Data"



$R \propto \frac{1}{d^2}$



$R \propto L$

$$\left.\right\} \quad R \propto \frac{L}{d^2}$$

$$R = k \frac{L}{d^2}$$

$A = \pi \left(\frac{d}{2}\right)^2$
$A = \frac{\pi d^2}{4}$

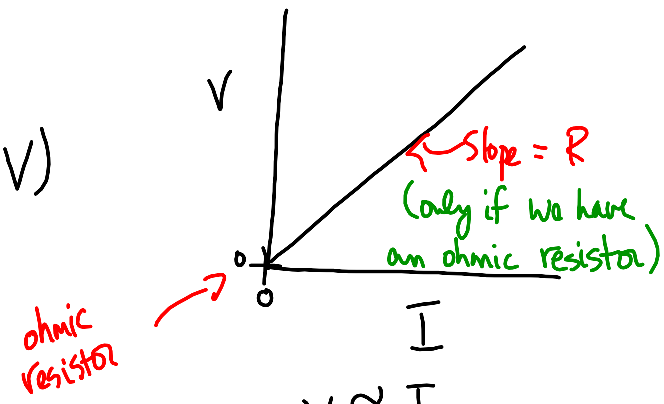
compare to
$R = \rho \frac{L}{A}$

$R = \frac{4 \rho L}{\pi d^2}$ → k

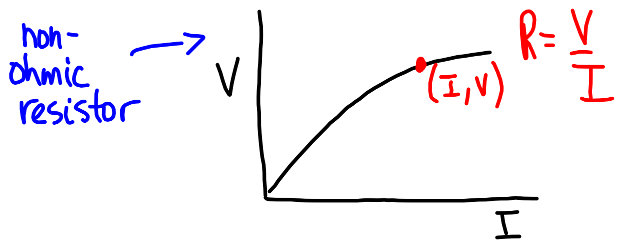
Ohm's Law

$$V = IR$$

where V is the potential difference (V)
I is the current (A)
R is the resistance (Ω)



$$V \propto I$$



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$V = 9.0\,V$

$I = 0.45\,A$

$R = ?$

$$V = IR$$

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

$$R = \frac{9.0\,V}{0.45\,A}$$

$$R = 20\,\Omega$$

$$R = 2.0 \times 10^{1}\,\Omega$$