

Units in Electricity



Resistance --

$$R = \rho \times L / A$$

Resistance = Resistivity x Length / Cross-sectional area

$$\text{ohms} = \text{ohm}\cdot\text{meters} \times \text{meters} / \text{meters}^2$$

$$\Omega = \Omega\cdot\text{m} \times \text{m} / \text{m}^2 = \text{V}\cdot\text{m} / \text{A} \times \text{m} / \text{m}^2$$

$$\text{Joule}\cdot\text{Second}/\text{Coulomb}^2 = [\text{Joule}\cdot\text{Second}/\text{Coulomb}^2]\cdot\text{m} \times \text{meters} / \text{meters}^2$$

$$= \text{Volt}\cdot\text{meter} / \text{Ampere} \times \text{meters} / \text{meters}^2$$

$$\text{J}\cdot\text{s} / \text{C}^2 = [\text{J}\cdot\text{s}\cdot\text{m} / \text{C}^2]\cdot\text{m} \times \text{m} / \text{m}^2 = [\text{J}/\text{C}]\cdot\text{m}[\text{C}/\text{s}] \times \text{m} / \text{m}^2$$



Ohm's Law --

$$\mathbf{V = I \times R}$$

Voltage change across a resistor in a circuit = Current x Resistance

$$\text{volts} = \text{amperes} \times \text{ohms}$$

$$V = A \times \Omega$$

$$\text{Joules/Coulomb} = \text{Coulomb/second} \times \text{Joule}\cdot\text{Second/Coulomb}^2$$

$$J / C = C / s \times J\cdot s / C^2$$

Note: $J\cdot s / C^2$ should be viewed as $[J / C] / [C / s] = \text{volts} / \text{amperes}$

Charge on a capacitor --

$$\mathbf{Q = C \times V}$$

Charge = Capacitance x Voltage

$$\text{coulombs} = \text{coulombs/volt} \times \text{volts}$$

$$C = C/V \times V$$

$$\text{coulombs} = \text{coulomb} / (\text{joules/coulomb}) \times (\text{joules/coulomb})$$

$$C = C / (J/C) \times (J/C)$$

Electric Power --

$$\mathbf{P_{Elec} = I V = I^2 R = V^2 / R}$$

Power = Current x Voltage = Current² x Resistance = Voltage² / Resistance

$$\text{Watts} = \text{amperes} \times \text{volts} = \text{amperes}^2 \times \text{ohms} = \text{voltage}^2 / \text{ohms}$$

$$W = A \times V = A^2 \times \Omega = V^2 / \Omega$$

joules/second = coulombs/second x joules/coulomb

$$= \text{coulombs}^2/\text{second}^2 \times \text{joule}\cdot\text{second/coulomb}^2$$

$$= [\text{joules}^2/\text{coulomb}^2] / [\text{joule}\cdot\text{second/coulomb}^2]$$

$$J/s = C/s \times J/C = (C/s)^2 \times J\cdot s / C^2 = (J/C)^2 / [J\cdot s / C^2]$$