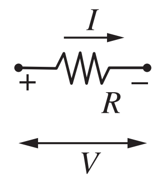
Ohm's Law

Ohm's law applies to a single resistive element

$$V = IR$$

where V is the voltage in volt, I is the current in amp, and R is the resistance in ohm.

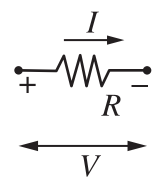


Power Dissipated in a Resistor

The following formulas apply to a single resistive element

$$P = VI = I^2R = \frac{V^2}{R}$$

P is the power in watt. Note that if you know one of these relationships, say $P = VI$, you can obtain the rest by substituting Ohm's law for V or I on the right hand side.



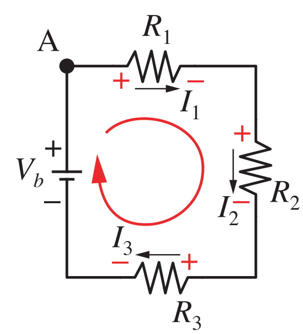
Kirchoff's Voltage Law

Apply to a loop, starting and ending at the same node. The sign of voltage is positive if the current flows in the direction of the loop.

$$\sum \Delta V = 0$$

For the circuit to the right

$$V_1 + V_2 + V_3 - V_b = 0$$



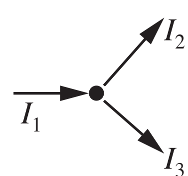
Kirchoff's Current Law

Apply to a node. The sign of current is positive if the current flows into a node.

$$\sum I = 0$$

For the circuit to the right

$$I_1 - I_2 - I_3 = 0$$



Applications

Applying the basic formulas on the preceding page produces other useful results.

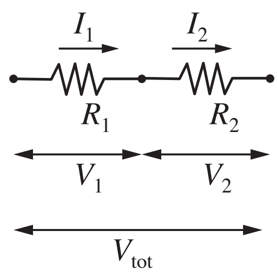
Resistors in Series

Applying Kirchoff's voltage and current laws to the two resistors in series, we obtain

$$V_{\mathrm{tot}} = V_1 + V_2 \quad \text{and} \quad I_1 = I_2$$

Substituting Ohm's law into the voltage sum formula and eliminating the common current we get

$$R_{\mathrm{eq}} = R_1 + R_2$$



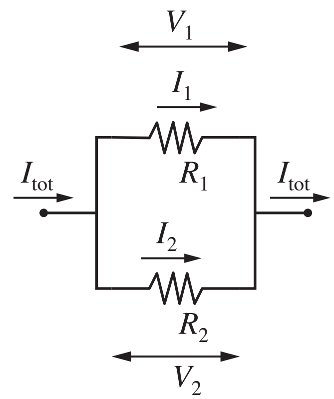
Resistors in Parallel

Applying Kirchoff's voltage and current laws to the two resistors in parallel, we obtain

$$V_1 = V_2 \quad \text{and} \quad I_{\mathrm{tot}} = I_1 + I_2$$

Substituting Ohm's law into the current sum formula and eliminating the common voltage we get

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



Voltage Divider

Applying Kirchoff's voltage law and Ohm's law to the two resistors in series, we obtain

$$V_{\mathrm{tot}} = V_1 + V_2 = I_1 R_1 + I_2 R_2$$

Kirchoff's current law requires $I_1 = I_2$ so

$$V_{\mathrm{tot}} = I_2(R_1 + R_2) \Longrightarrow I_2 = V_{\mathrm{tot}} \frac{1}{R_1 + R_2}$$

Using $V_2 = I_2 R_2 \Longrightarrow I_2 = V_2/R_2$ gives

$$\frac{V_2}{R_2} = V_{\mathrm{tot}} \frac{1}{R_1 + R_2}$$

or

$$V_2 = V_{\mathrm{tot}} \frac{R_2}{R_1 + R_2}$$