

Ohm's Law

For many [conductors](#) of electricity, the [electric current](#) which will flow through them is directly proportional to the [voltage](#) applied to them. When a [microscopic view of Ohm's law](#) is taken, it is found to depend upon the fact that the drift velocity of charges through the material is proportional to the electric field in the conductor. The ratio of voltage to current is called the [resistance](#), and if the ratio is constant over a wide range of voltages, the material is said to be an "ohmic" material. If the material can be characterized by such a resistance, then the current can be predicted from the relationship:

Ohm's
Law

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

Electric current = Voltage / Resistance

Data can be entered into any of the boxes below. Specifying any two of the quantities determines the third. After you have entered values for two, click on the text representing the third in the active illustration above to calculate its value.

Amperes = volts / ohms

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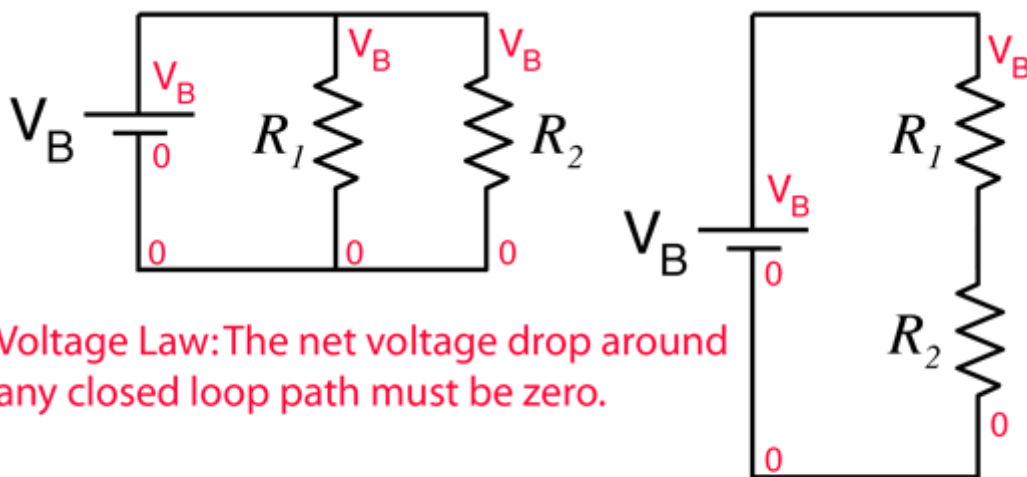
Voltage Law

The [voltage](#) changes around any closed loop must sum to zero. No matter what path you take through an [electric circuit](#), if you return to your starting point you must measure the same voltage, constraining the net change around the loop to be zero. Since voltage is electric potential energy per unit charge, the voltage law can be seen to be a consequence of [conservation of energy](#).

The voltage law has great practical utility in the analysis of electric circuits. It is used in conjunction with the [current law](#) in many circuit analysis tasks.

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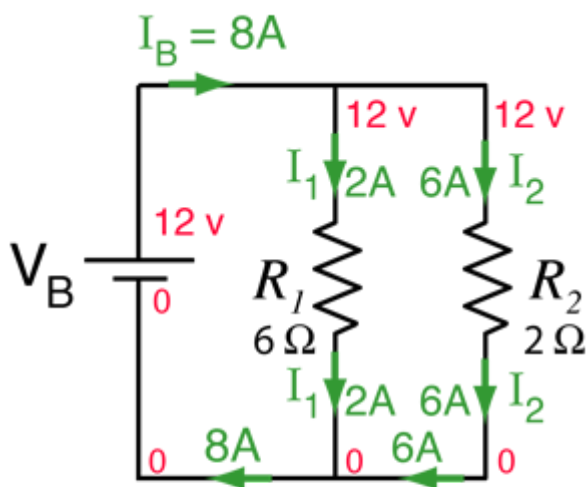
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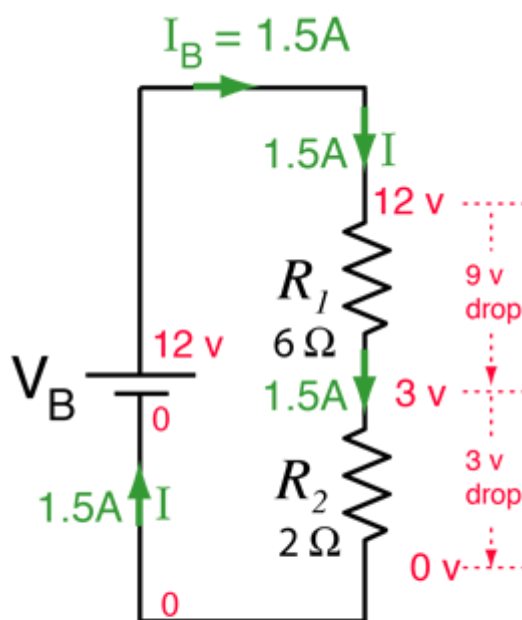
Voltage Law: The net voltage drop around any closed loop path must be zero.

For any path you follow around the circuit, the sum of the voltages rises (like batteries) must equal the sum of the voltage drops. Voltage represents energy per unit charge, and conservation of energy demands that energy is neither created nor destroyed.

The voltage law is one of the main tools for the analysis of electric circuits, along with [Ohm's Law](#), the [current law](#) and the [power relationship](#). Applying the voltage law to the above circuits along with Ohm's law and the rules for [combining resistors](#) gives the numbers shown below. The determining of the voltages and currents associated with a particular circuit along with the power allows you to completely describe the electrical state of a direct current circuit.



The voltages across elements in parallel are equal. This is one of the implications of the voltage law - since the change across either R_1 or R_2 must be equal to the battery voltage V_B , then they are equal to each other.



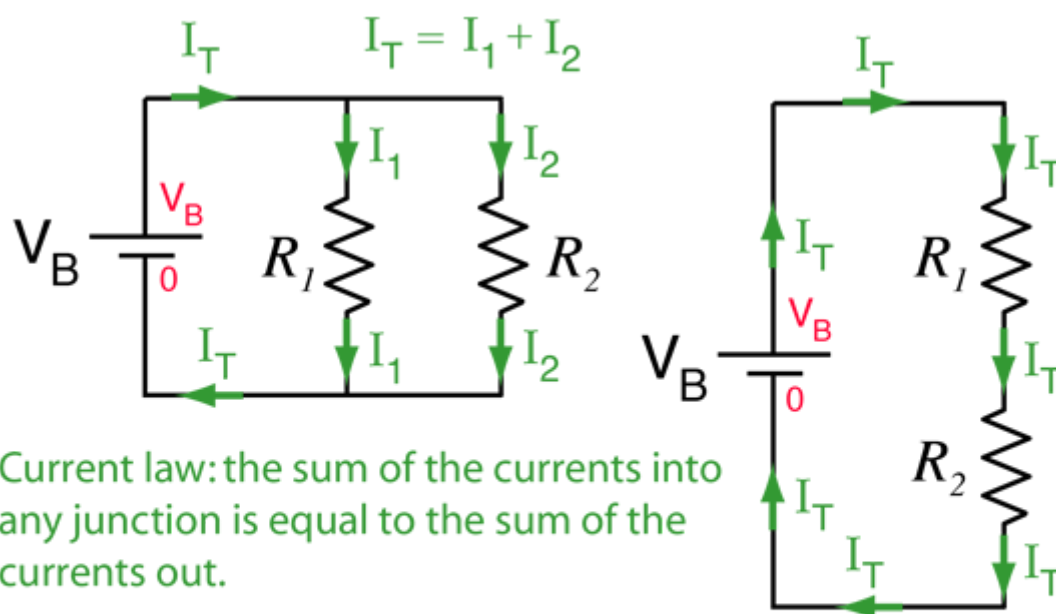
For a series combination, the sum of the voltage drops across R_1 and R_2 must sum to equal V_B .

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Current Law

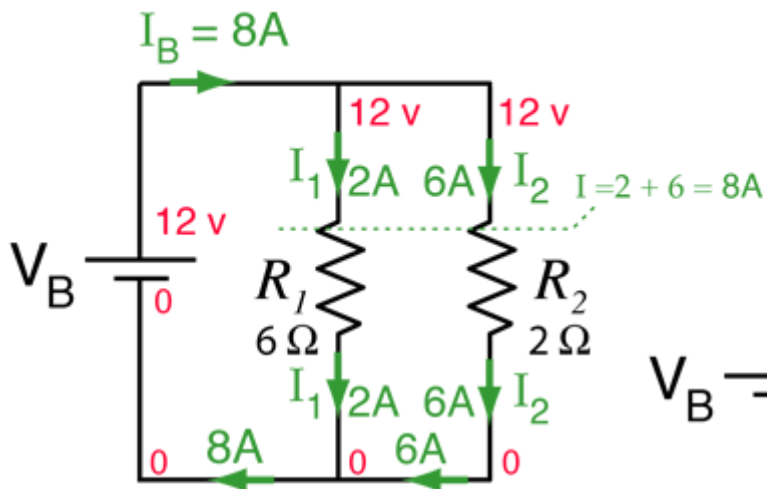
The [electric current](#) in amperes that flows into any junction in an [electric circuit](#) is equal to the current which flows out. This can be seen to be just a statement of conservation of [charge](#). Since you do not lose any charge during the flow process around the circuit, the total current in any cross-section of the circuit is the same. Along with the [voltage law](#), this law is a powerful tool for the analysis of electric circuits.



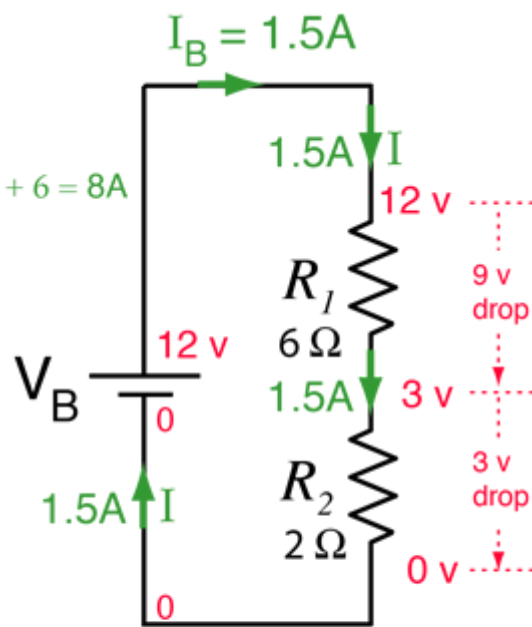
For any branch of the circuit, the current out of the branch must be equal to the current into the branch. This is required by the conservation of electric charge. Any cross-section of the circuit must carry the total current. For a series circuit, the current is the same at any point in the circuit.

The current law is one of the main tools for the analysis of electric circuits, along with [Ohm's Law](#), the [voltage law](#) and the [power relationship](#). Applying the current law to the above circuits along with Ohm's law and the rules for [combining resistors](#) gives the numbers shown below. The determining of the voltages and currents associated with a particular circuit along with the power allows you to completely describe the electrical state of a direct current circuit.

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The sum of the currents out of any branch in the circuit must equal to the current into the junction. Any cross-section containing all the conductors must have the same total current.



For a series combination, the current is the same at any point in the circuit. It is like water flowing through a single pipe.

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