Electricity

Charge and current

Electric charge is measured in coulombs. An electric current is a rate of flow of charge, measured in amperes. A current of one ampere transfers one coulomb of charge each second. A complete conducting circuit is needed for a steady current. An open switch breaks the path and stops the steady current in a simple battery circuit.

In metal wires, mobile electrons carry charge. Conventional current is defined in the direction that positive charge would move, opposite to electron drift in a metal. A battery supplies energy to charges; it does not supply a fixed current regardless of the circuit. Current depends on the potential difference and the resistance of the complete path. An ammeter measures current and is connected in series with the component.

Electricity

Voltage and resistance

Potential difference is energy transferred per unit charge and is measured in volts. A potential difference of one volt transfers one joule for each coulomb. A voltmeter measures potential difference and is connected in parallel across a component. Resistance describes how strongly a component opposes current and is measured in ohms.

For an ohmic conductor at constant temperature, current is proportional to potential difference. The relationship can be written as voltage equals current multiplied by resistance. A four-ohm resistor carrying two amperes has a potential difference of eight volts. Heating a metal wire usually increases its resistance, so constant temperature matters when applying this simple proportional relationship. Not every electrical component is ohmic.

Electricity

Series, parallel and power

Components connected in series form a single path. The current is the same through each series component, and the total resistance is the sum of the individual resistances. In parallel branches, each branch has the same potential difference across it. Current divides between the branches, and the total current equals the sum of the branch currents.

Electrical power is the rate of energy transfer and is measured in watts. Power equals voltage multiplied by current. A device using twelve volts and two amperes transfers energy at twenty-four watts. Energy transferred equals power multiplied by time when power is constant. A twenty-four-watt device running for ten seconds transfers two hundred and forty joules. These ideal circuit relationships do not replace electrical safety guidance.