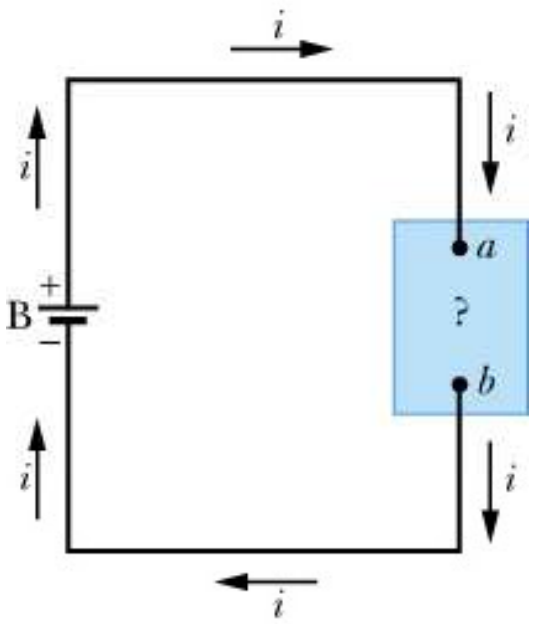
$P = iV$

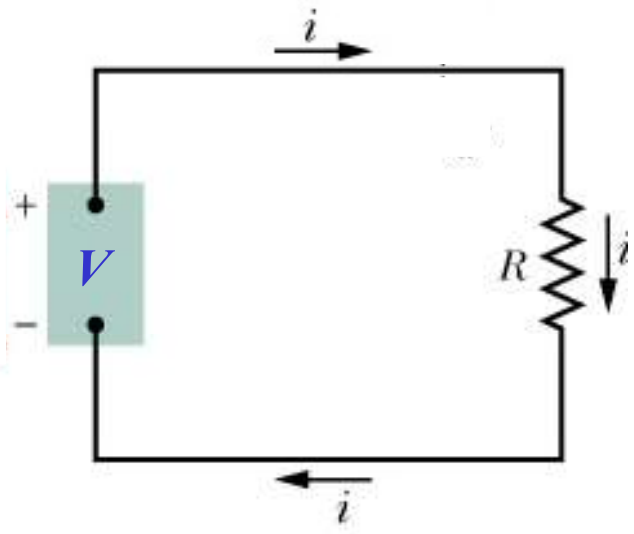


Power in Electric Circuits

Consider the circuit shown in the figure. A battery of voltage V is connected across the terminals a and b of a device. This can be a resistor, a motor, etc. The battery maintains a potential difference V between the terminals a and b and thus a current i flows in the circuit as shown in the figure. During the time interval dt a charge $dq = idt$ moves between the terminals. We note that $V_a > V_b$.

The potential energy of the charge decreases by an amount $dU = Vdq = Vidt$.
Using energy conservation we conclude that the lost energy has been transferred by the battery to the device and has been converted into some other form of energy.
The rate at which energy is transferred to the device is known as "**power**" and it is equal to $P = \frac{dU}{dt} = \frac{Vidt}{dt} = Vi.$

SI unit for P : $\mathrm{V} \cdot \mathrm{A}$ It is known as the "watt" (symbol W).



$$P = i^2 R$$

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

If the device connected to the battery is a resistor R then the energy transferred by the battery is converted as **heat** that appears on R. If we combine the equation $P = iV$ with Ohm's law $i = \frac{V}{R}$, we get the following two equivalent expressions for the rate at which heat is dissipated on R:

$P = i^2 R$ and $P = \frac{V^2}{R}$