The Power Equation

Electric power is the rate at which energy is converted from electrical energy to some other form such as heat or mechanical energy. When charge moves through a resistor it loses potential energy. That energy is converted to heat. Power dissipated (as heat) by a component in a DC circuit is given by the product of the voltage across the component and the current through the component:

$$
\begin{aligned}
Watts = Volts \times Amps \quad & \text{in other words,} \\
P = V \times I \quad & \text{and since,} \\
V = I \times R \quad & \text{by substitution,} \\
P = I^2 \times R \quad & \text{and also,} \\
P = \frac{V^2}{R} &
\end{aligned}
$$

For example, in the circuit below, how much power is dissipated in the 1.5 Ω resistor?

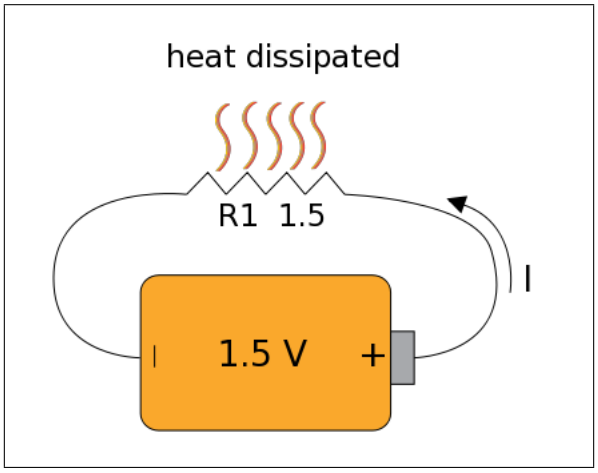

Figure 1: The battery is generating power, resistor dissipates it

Solving for current first:

$$
\begin{aligned}
I &= \frac{V}{R} \\
&= \frac{1.5}{1.5} \\
&= 1 \text{ Amp}
\end{aligned}
$$

now, compute power using the power equation,

$$
\begin{aligned}
P &= 1.5 \times 1 \\
&= 1.5 \text{ Watts}
\end{aligned}
$$

alternatively, since

$$\begin{aligned} P &= I^2 \times R \quad \text{then} \\ P &= 1 \times 1 \times 1.5 \\ &= 1.5 \text{ Watts} \end{aligned}$$

In each case the power is dissipated as heat in the resistor. Resistors can only dissipate power. They convert electrical energy to heat. Since the resistor dissipated 1.5 watts of power, the battery must have supplied 1.5 Watts of power. We can also say that the battery dissipated -1.5 Watts.