89. (a) The six resistors to the left of $\mathcal{E}_1 = 16$ V battery can be reduced to a single resistor $R = 8.0\ \Omega$, through which the current must be $i_R = \mathcal{E}_1/R = 2.0$ A. Now, by the loop rule, the current through the 3.0 Ω and 1.0 Ω resistors at the upper right corner is

$$i' = \frac{16.0\,\text{V} - 8.0\,\text{V}}{3.0\ \Omega + 1.0\ \Omega} = 2.0\ \text{A}$$

in a direction that is "backward" relative to the $\mathcal{E}_2 = 8.0$ V battery. Thus, by the junction rule,

$$i_1 = i_R + i' = 4.0\ \text{A}$$

and is upward (that is, in the "forward" direction relative to $\mathcal{E}_1$).

(b) The current i_2 derives from a succession of symmetric splittings of i_R (reversing the procedure of reducing those six resistors to find R in part (a)). We find

$$i_2 = \frac{1}{2}\left(\frac{1}{2}\, i_R\right) = 0.50\ \text{A}$$

and is clearly downward.

(c) Using our conclusions from part (a) in Eq. 28-14, we obtain $P = i_1\mathcal{E}_1 = (4)(16) = 64$ W supplied.

(d) Using results calculated in part (a) in Eq. 28-14, we obtain $P = i'\mathcal{E}_2 = (2)(8) = 16$ W absorbed.