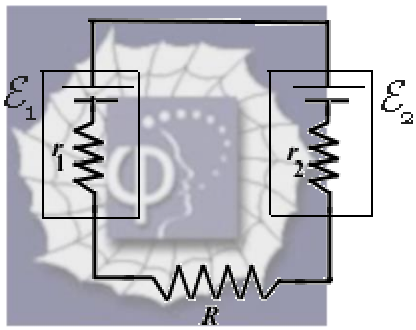
403.

<u>Problem 33.7 (RHK)</u>

For the circuit shown in the figure, we have to find (a) the value of R so that the current in the circuit is 50 mA. We may take $E_1 = 2.0\text{ V}$, $E_2 = 3.0\text{ V}$, *and* $r_1 = r_2 = 3.0\ \Omega$. (b) *We have to find the rate at which internal energy appears in R.*



<u>Solution:</u>

In the circuit shown in the figure

$E_1 = 2.0\text{ V}$,

$E_2 = 3.0\text{ V}$,

and

$r_1 = r_2 = 3.0\ \Omega$.

As

$E_2 > E_1$, the direction of the current in the circuit will be counter-clockwise. Let the current in the circuit be *i* A. We go round the circuit in the counter-clockwise direction and write the algebraic equation for the potential changes. We have

$$-2.0\text{ V} - ir_1 - iR - ir_2 + 3.0\text{ V} = 0.$$

As $r_1 = r_2 = 3.0\ \Omega,$ we have

$$(6 + R)i\ \Omega\ \text{A} = 1\text{ V}.$$

We want current, *i*, in the circuit to be 50 mA.

Therefore, the value of *R* should be

$$R = \left(\frac{1}{50\times10^{-3}} - 6\right)\Omega = 14\ \Omega.$$

(b)

Rate at which internal energy appears in *R* will be the Joule heat, and is given by the equation

$$P = i^2R = \left(50\times10^{-3}\right)^2 \times 14\text{ W} = 35\text{ mW}.$$