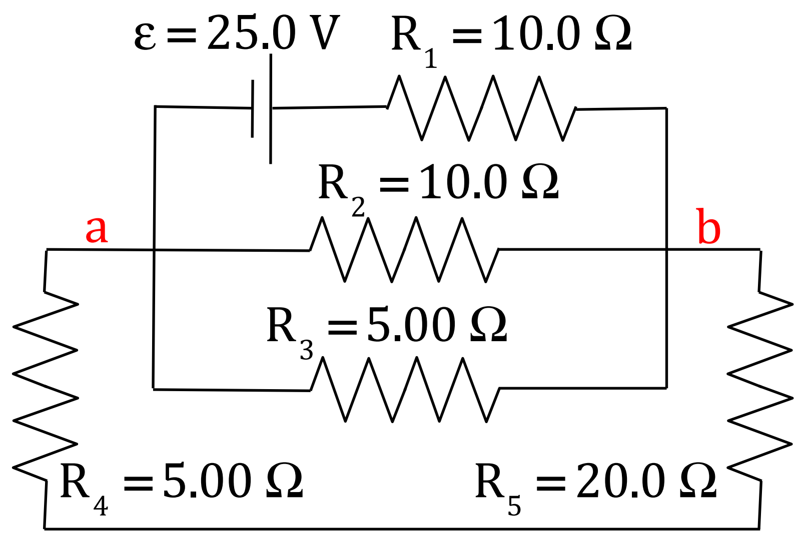
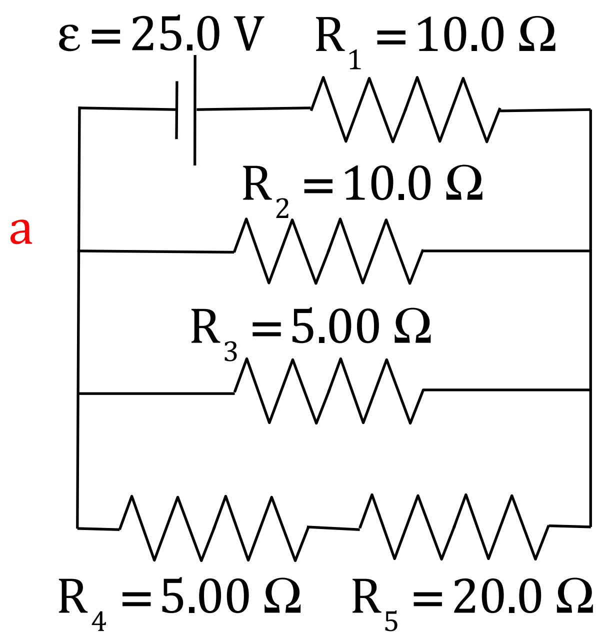
Problem 28.9

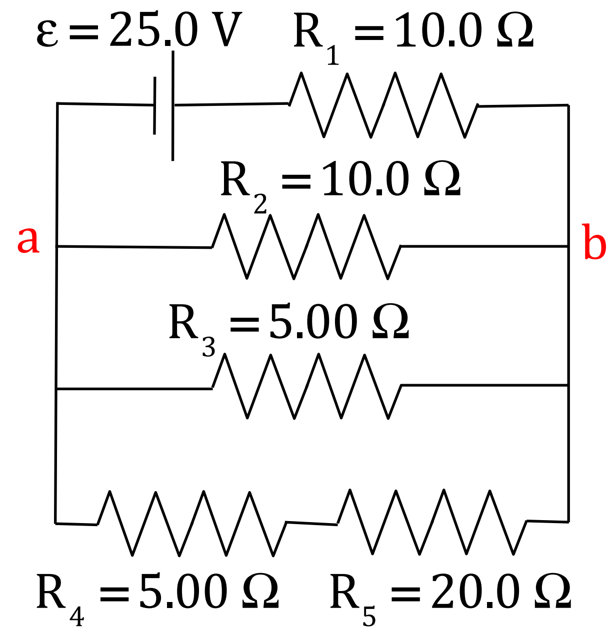
This is a seat-of-the-pants problem in the sense that the first thing to notice is that you can make it look a whole more hospitable by realizing the side resistors can be repositioned as shown below.





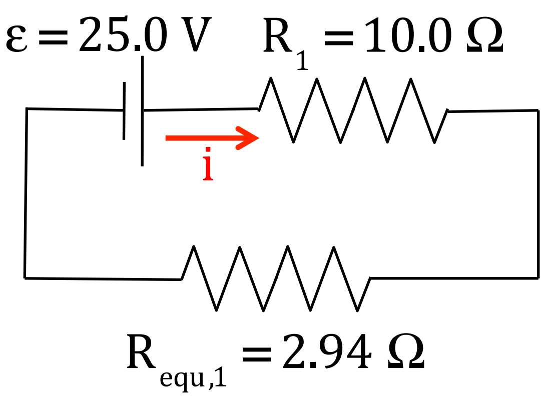
In other words, what you have is a battery and resistor in series across a three-branch parallel circuit with one branch made up of a series combination.

Determining the equivalent resistance of the three bottom parallel branches yields:



$$\frac{1}{R_{eq,1}} = \frac{1}{(10.0\ \Omega)} + \frac{1}{(5.0\ \Omega)} + \frac{1}{(25.0\ \Omega)}$$
$$= .34$$
$$\Rightarrow \quad R_{eq,1} = 2.94\ \Omega$$

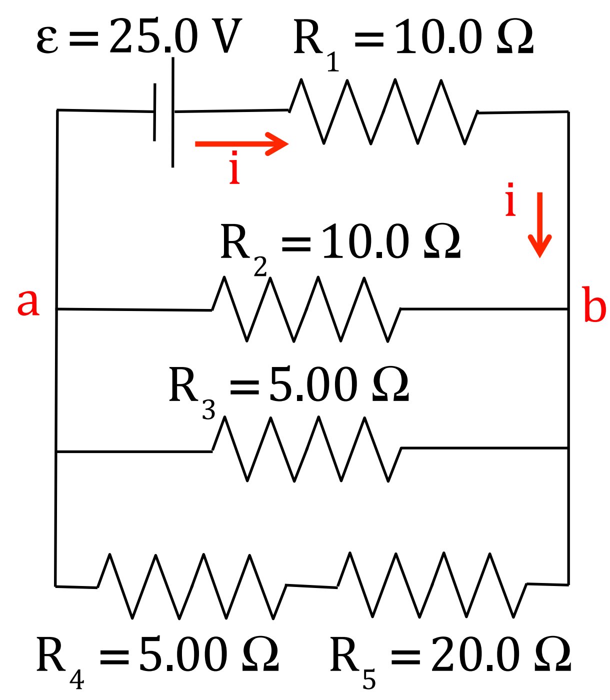
This leaves us with:



. . . so that the current drawn from the battery is:

$$\varepsilon - R_1 i - R_{eq,1} i = 0$$
$$\Rightarrow \quad 25.0 = (10.0\ \Omega)i + (2.94\ \Omega)i$$
$$\Rightarrow \quad i = 1.93\ \mathrm{A}$$

Knowing the current drawn from the battery allows us to determine the voltage drop across *a-b*, which is:



$$
\begin{aligned}
V_{ab} &= \varepsilon - iR_1 \\
&= (25.0\ \text{V}) - (1.93\ \text{A})(10.0\ \Omega) \\
&= 5.70\ \text{V}
\end{aligned}
$$

(This happens to be the answer to *Part b.)*

The voltage across *a-b* is the same as the voltage across R_2 and the voltage across R_3 and the voltage across the R_4 and R_5 combination. That means we can write:

$$
\begin{aligned}
V_{ab} &= iR_{4+5} \\
\Rightarrow\quad (5.70\ \text{V}) &= i(20.0\ \Omega + 5.00\ \Omega) \\
\Rightarrow\quad i &= .228\ \text{A} \qquad \text{(or 228 mA)}
\end{aligned}
$$

This is the current through the $20.0\ \Omega$ resistor.