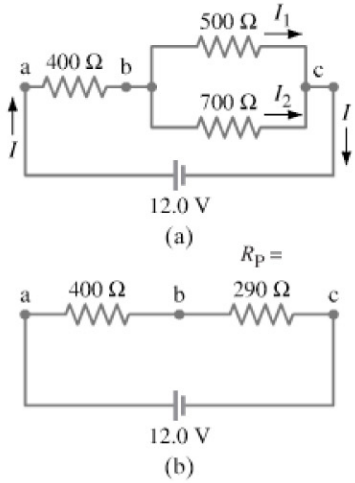


**FIGURE 19–8** (a) Circuit for Examples 19–4 and 19–5. (b) Equivalent circuit, showing the equivalent resistance of 290 Ω for the two parallel resistors in (a).

**EXAMPLE 19–4** **Circuit with series and parallel.** How much current is drawn from the battery shown in Fig. 19–8a?

**APPROACH** The current $I$ that flows out of the battery all passes through the 400-Ω resistor, but then it splits into $I_1$ and $I_2$ passing through the 500-Ω and 700-Ω resistors. The latter two resistors are in parallel with each other. We look for simplicity, something that we already know how to treat. So let's start by finding the equivalent resistance, $R_P$, of the parallel resistors, 500 Ω and 700 Ω. Then we can consider this $R_P$ to be in series with the 400-Ω resistor.

**SOLUTION** The equivalent resistance, $R_P$, of the 500-Ω and 700-Ω resistors in parallel is given by

$$\frac{1}{R_P} = \frac{1}{500\ \Omega} + \frac{1}{700\ \Omega} = 0.0020\ \Omega^{-1} + 0.0014\ \Omega^{-1} = 0.0034\ \Omega^{-1}.$$

**CAUTION**
*Remember to take the reciprocal*

This is $1/R_P$, so we take the reciprocal to find $R_P$. It is a common mistake to forget to take this reciprocal. Notice that the units of reciprocal ohms, $\Omega^{-1}$, are a reminder. Thus

$$R_P = \frac{1}{0.0034\ \Omega^{-1}} = 290\ \Omega.$$

This 290 Ω is the equivalent resistance of the two parallel resistors, and is in series with the 400-Ω resistor as shown in the equivalent circuit of Fig. 19–8b. To find the total equivalent resistance $R_{eq}$, we add the 400-Ω and 290-Ω resistances together, since they are in series, and find

$$R_{eq} = 400\ \Omega + 290\ \Omega = 690\ \Omega.$$

The total current flowing from the battery is then

$$I = \frac{V}{R_{eq}} = \frac{12.0\ \text{V}}{690\ \Omega} = 0.0174\ \text{A} \approx 17\ \text{mA}.$$

**NOTE** This $I$ is also the current flowing through the 400-Ω resistor, but not through the 500-Ω and 700-Ω resistors (both currents are less—see the next Example).

**NOTE** Complex resistor circuits can often be analyzed in this way, considering the circuit as a combination of series and parallel resistances.