13. Find the current in the 12-Ω resistor in Figure P18.13.

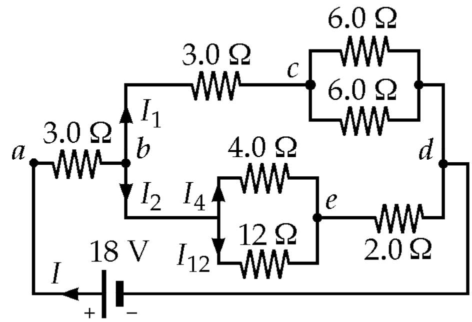

Figure P18.13 (modified)
Figure 1

Solution This circuit can be reduced to its simplest equivalent form by successive applications of the rules for combining resistors in series and parallel as shown in the figures at the right.

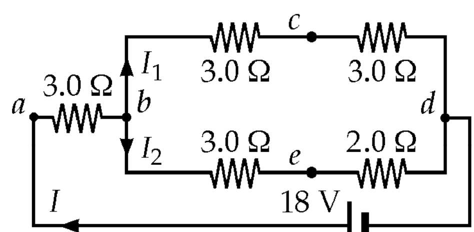

Figure 2

The strategy is to start with the simplest of these equivalent circuits and work back to the original circuit, gathering more information at each step of the way.

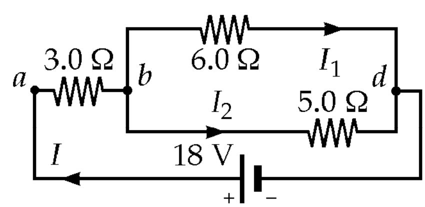

Figure 3

From Figure 5, the total resistance of the circuit is seen to be $R_{ad} = 63/11\ \Omega$. Therefore, the total current supplied by the battery must be

$$I = \frac{\Delta V_{ad}}{R_{ad}} = \frac{18\text{ V}}{63/11\ \Omega} = 3.14\text{ A}$$

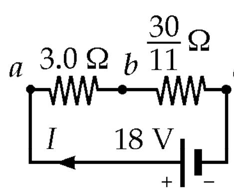

Figure 4

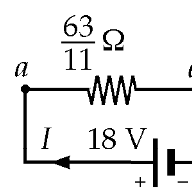

Figure 5

The potential difference between points b and d can now be found from Figure 4 as

$$\Delta V_{bd} = IR_{bd} = (3.14\text{ A})(30/11\ \Omega) = 8.57\text{ V}$$

From Fig. 3,

$$I_2 = \frac{\Delta V_{bd}}{5.0\ \Omega} = \frac{8.57\text{ V}}{5.0\ \Omega} = 1.71\text{ A}$$

Going back to Figure 2, the potential difference between points b and e is seen to be

$$\Delta V_{be} = I_2 R_{be} = (1.71\text{ A})(3.0\ \Omega) = 5.14\text{ V}$$

With this knowledge, the current in the 12-Ω resistor can be found from Figure 1 as:

$$I_{12} = \frac{\Delta V_{be}}{12\ \Omega} = \frac{5.14\text{ V}}{12\ \Omega} = 0.43\text{ A}$$

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