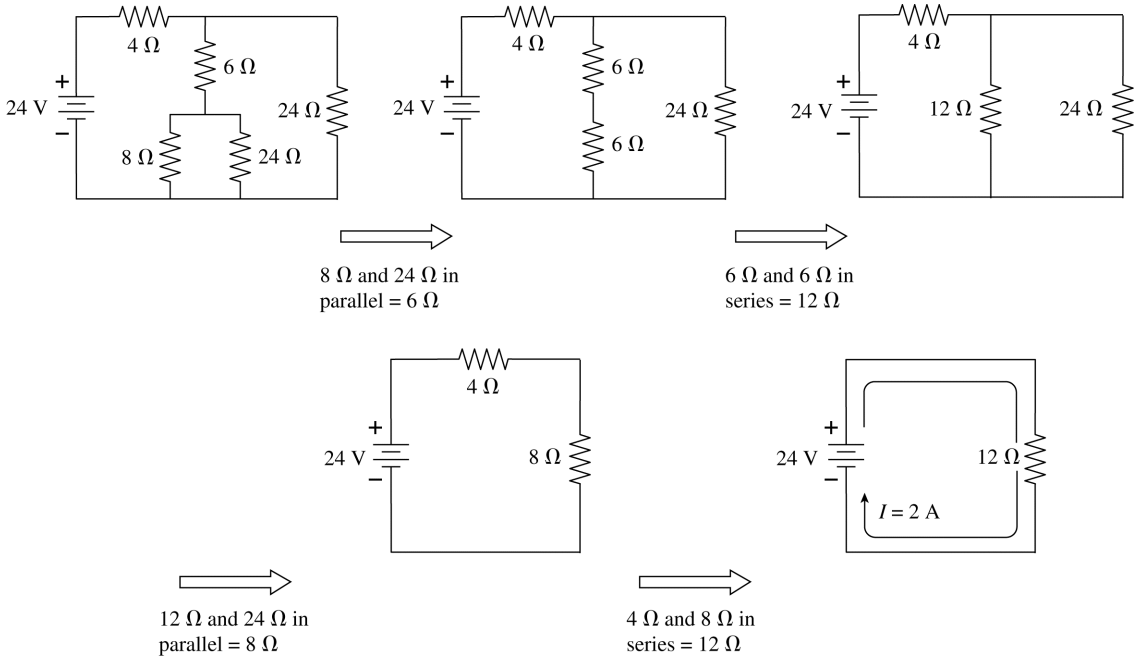
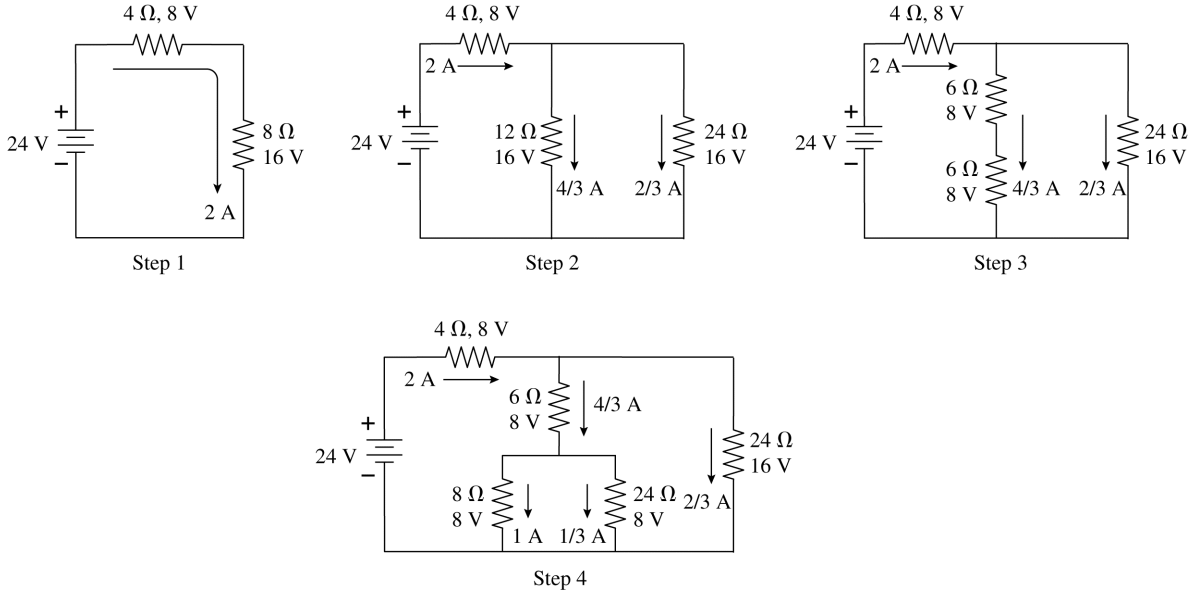
31.69. **Model:** The battery and the connecting wires are ideal.

Visualize:



The figure shows how to simplify the circuit in Figure P31.69 using the laws of series and parallel resistances. We will reverse the procedure and "build up" the circuit using the loop law and junction law to find the current and potential difference of each resistor.

Solve: Having found R_{eq} = 12 Ω, the current from the battery is I = (24 V)/(12 Ω) = 2.0 A. As we rebuild the circuit, we note that series resistors *must* have the same current I and that parallel resistors *must* have the same potential difference ΔV.



In Step 1 of the above figure, the 12 Ω resistor is returned to 4 Ω and 8 Ω resistors in series. Both resistors must have the same 2.0 A as the 12 Ω resistor. We use Ohm's law to find $\Delta V_4 = 8$ V and $\Delta V_8 = 16$ V. As a check, 8 V + 16 V = 24 V, which was ΔV of the 12 Ω resistor. In Step 2, the 8 Ω resistor is returned to the 12 Ω and 24 Ω resistors in parallel. Both resistors must have the same $\Delta V = 16$ V as the 8 Ω resistor. From Ohm's law, $I_{12} = (16\text{ V})/(12\ \Omega) = \frac{4}{3}$ A and $I_{24} = \frac{2}{3}$ A. As a check, $I_{12} + I_{24} = 2.0$ A, which was the current I of the 8 Ω resistor. In Step 3, the 12 Ω resistor is returned to the two 6 Ω resistors in series. Both resistors must have the same $\frac{4}{3}$ A as the 12 Ω resistor. We use Ohm's law to find $\Delta V_6 = 8$ V and $\Delta V_6 = 8$ V. As a check, 8 V + 8 V = 16 V, which was ΔV of the 12 Ω resistor. Finally, in Step 4, the 6 Ω resistor is returned to the 8 Ω and 24 Ω resistors in parallel. Both resistors must have the same $\Delta V = 8$ V as the 6 Ω resistor. From Ohm's law, $I_8 = (8\text{ V})/(8\ \Omega) = 1$ A and $I_{24} = \frac{1}{3}$ A. As a check, $I_8 + I_{24} = \frac{4}{3}$ A, which was the current I of the 6 Ω resistor.

Resistor	Potential difference (V)	Current (A)
4 Ω	8	2
6 Ω	8	$\frac{4}{3}$
8 Ω	8	1
Bottom 24 Ω	8	$\frac{1}{3}$
Right 24 Ω	16	$\frac{2}{3}$