**31.10. Model:** The batteries and the connecting wires are ideal.

**Visualize:** Please refer to Figure Ex31.10.

**Solve:** (a) Choose the current $I$ to be in the clockwise direction. If $I$ ends up being a positive number, then the current really does flow in this direction. If $I$ is negative, the current really flows counterclockwise. There are no junctions, so $I$ is the same for all elements in the circuit. With the 9 V battery being labeled 1 and the 6 V battery being labeled 2. Kirchhoff’s loop law is

$$
\sum \Delta V = \Delta V_{bat,1} + \Delta V_R + \Delta V_{bat,2} = +\mathcal{E}_1 - IR - \mathcal{E}_2 = 0
$$

$$
\Rightarrow I = \frac{\mathcal{E}_1 - \mathcal{E}_2}{R} = \frac{9 \text{ V} - 6 \text{ V}}{30 \Omega} = 0.100 \text{ A}
$$

Note the signs: Potential is gained in battery 1, but potential is lost both in the resistor and in battery 2. Because $I$ is positive, we can say that $I = 0.100 \text{ A}$ flows from left to right through the resistor.

(b) The graph shows 9 V gained in battery 1, $\Delta V_R = -IR = 3 \text{ V}$ lost in the resistor, and another 6 V lost in battery 2. The final potential is the same as the initial potential, as required.