31.34. Model: Grounding does not affect a circuit's behavior.

Visualize: Please refer to Figure Ex31.34.

Solve: Because the earth has $V_{earth} = 0$ V, point d has a potential of zero. In going from point d to point a, the potential increases by 9 V. Thus, point a is at a potential of 9 V. Let us calculate the current I in the circuit before calculating the potentials at points b and c. Applying Kirchhoff's loop rule, starting clockwise from point d,

$$\sum_i (\Delta V)_i = \Delta V_{9\text{ V bat}} + \Delta V_{2\ \Omega} + \Delta V_{3\text{ V bat}} + \Delta V_{4\ \Omega} = 0$$

$$\Rightarrow +9\text{ V} - I(2\ \Omega) - 3\text{ V} - I(4\ \Omega) = 0 \Rightarrow I = \frac{6\text{ V}}{6\Omega} = 1\text{ A}$$

There is a drop in potential from point a to point b by an amount $IR = (1\text{ A})(2\ \Omega) = 2$ V. Thus, the potential at point b is 9 V − 2 V = 7 V. The potential decreases from 7 V at point b to 7 V − 3 V = 4 V at point c. There is a further decrease in potential across the 4 Ω resistor of $IR = (1\text{ A})(4\ \Omega) = 4$ V. That is, the potential of 4 V at c becomes 0 V at point d, as it must. In summary, the potentials at a, b, c, and d are 9 V, 7 V, 4 V, and 0 V.