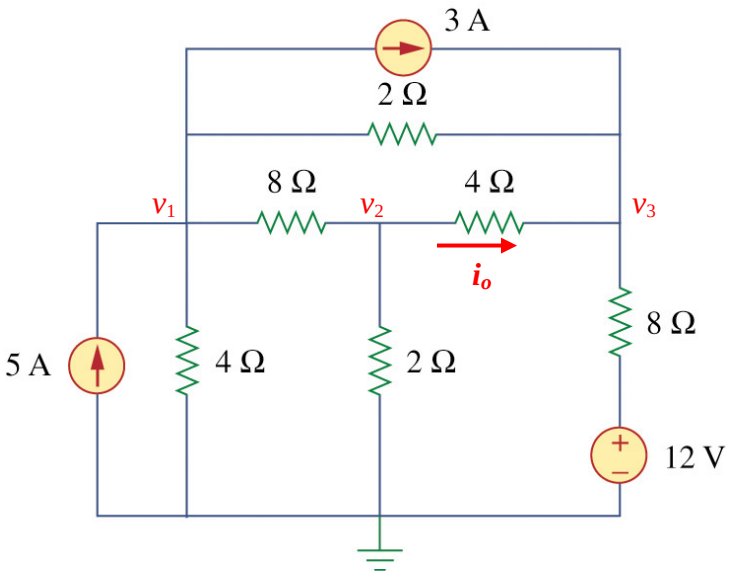
Node-Voltage Method Comparison with 2 Different Ground Locations

In the following circuit, the unknown current (i_o) will be found using the node-voltage method with the ground (**V = 0**) placed at two different locations. This comparison will show that while the choice of ground will affect the individual node voltages, the final analysis of the circuit will be the same.

Ground Location I



Node-Voltage Equations

v_1: $$-5+\frac{v_1}{4}+\frac{v_1-v_2}{8}+\frac{v_1-v_3}{2}+3=0$$

v_2: $$\frac{v_2-v_1}{8}+\frac{v_2}{2}+\frac{v_2-v_3}{4}=0$$

v_3: $$-3+\frac{v_3-v_1}{2}+\frac{v_3-v_2}{4}+\frac{v_3-12}{8}=0$$

Solution

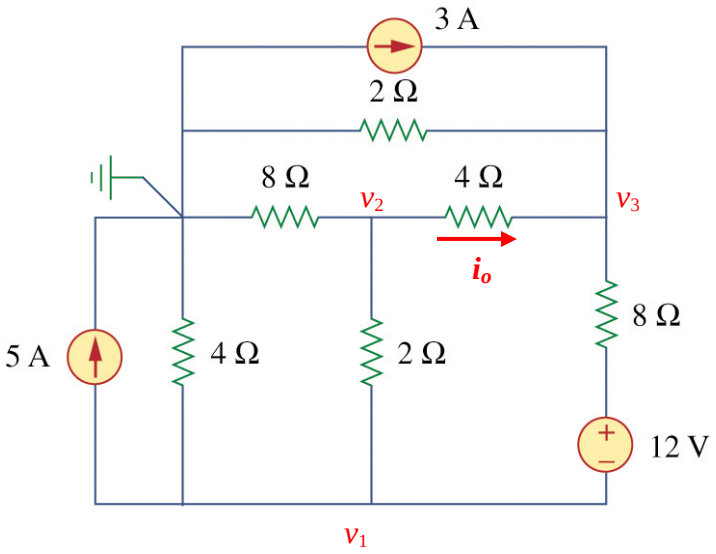
v_1 = 10 V

v_2 = 4.933 V

v_3 = 12.267 V

➔ $$i_o=\frac{v_2-v_3}{4}=\frac{4.933-12.267}{4}=-1.834\text{ A}$$

***Ground Location* II**



Node-Voltage Equations

v_1: $$5+\frac{v_1}{4}+\frac{v_1-v_2}{2}+\frac{v_1+12-v_3}{8}=0$$

v_2: $$\frac{v_2}{8}+\frac{v_2-v_1}{2}+\frac{v_2-v_3}{4}=0$$

v_3: $$-3+\frac{v_3}{2}+\frac{v_3-v_2}{4}+\frac{v_3-12-v_1}{8}=0$$

Solution

v_1 = – 10 V

v_2 = – 5.067 V ➔ $$i_o=\frac{v_2-v_3}{4}=\frac{-5.067-2.267}{4}=-1.834\ \text{A}$$

v_3 = 2.267 V