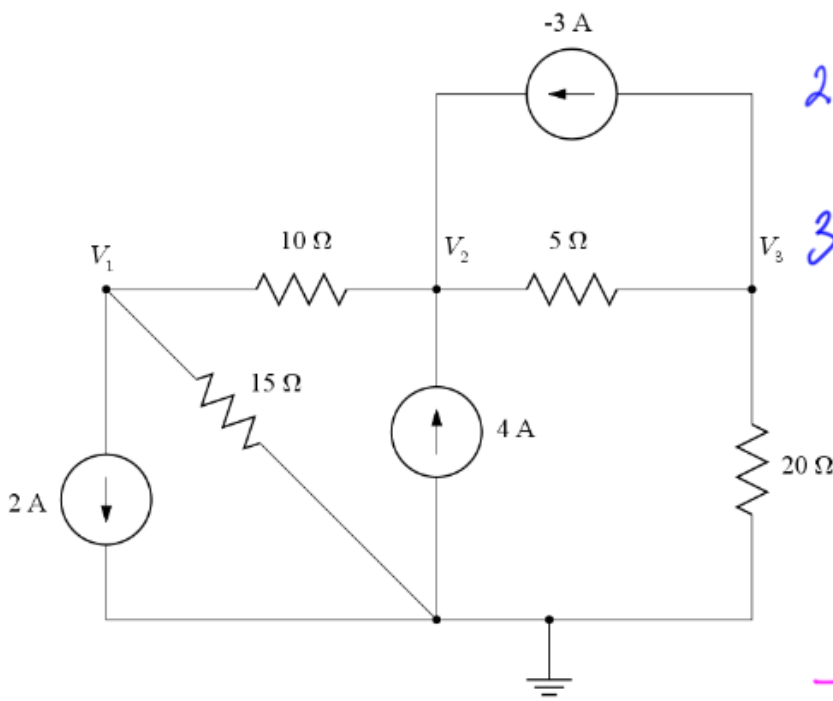


Find the three indicated node voltages using the node voltage method.



$$1: 2 + \frac{V_1}{15} + \frac{V_1 - V_2}{10} = 0$$

$$2: \frac{V_2 - V_1}{10} + (-4) + \frac{V_2 - V_3}{5} + (-(-3)) = 0$$

$$3: \frac{V_3 - V_2}{5} + \frac{V_3}{20} + (-3) = 0$$

Re-write in matrix form:

$$1: V_1 \left(\frac{1}{15} + \frac{1}{10} \right) + V_2 \left(-\frac{1}{10} \right) + V_3 (0) = -2$$

$$2: V_1 \left(-\frac{1}{10} \right) + V_2 \left(\frac{1}{10} + \frac{1}{5} \right) + V_3 \left(-\frac{1}{5} \right) = 1$$

$$3: V_1 (0) + V_2 \left(-\frac{1}{5} \right) + V_3 \left(\frac{1}{5} + \frac{1}{20} \right) = 3$$

Solve:

$$V_1 = 4.48 \text{ V}$$

$$V_2 = 27.5 \text{ V}$$

$$V_3 = 34.0 \text{ V}$$

$$\left[\begin{array}{ccc} 0.167 & -0.100 & 0 \\ -0.100 & 0.300 & -0.200 \\ 0 & -0.200 & 0.250 \end{array} \right] \cdot \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} -2 \\ 1 \\ 3 \end{bmatrix}$$