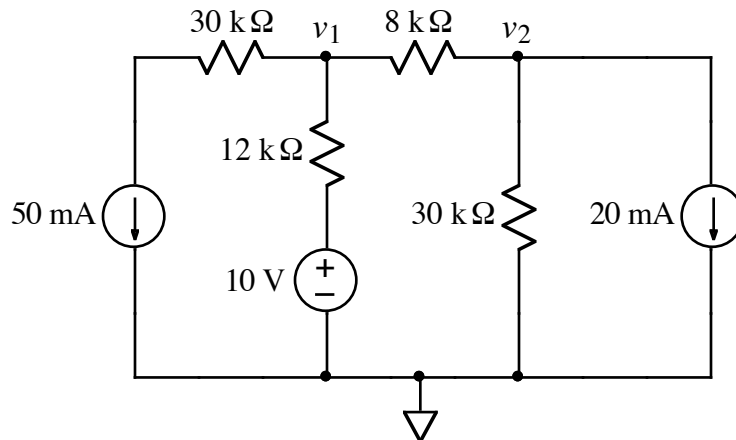


Ex:



Use the node-voltage method to find v_1 and v_2 .

SOL'N: We sum the currents out of the v_1 node and then the v_2 node.

$$v_1 \text{ node: } 50 \text{ mA} + \frac{v_1 - 10 \text{ V}}{12 \text{ k}\Omega} + \frac{v_1 - v_2}{8 \text{ k}\Omega} = 0 \text{ A}$$

$$v_2 \text{ node: } \frac{v_2 - v_1}{8 \text{ k}\Omega} + \frac{v_2}{30 \text{ k}\Omega} + 20 \text{ mA} = 0 \text{ A}$$

For each equation, one approach to the algebra is to group terms multiplying v_1 and v_2 and move constant terms to the right side.

$$v_1 \left(\frac{1}{12 \text{ k}\Omega} + \frac{1}{8 \text{ k}\Omega} \right) - v_2 \frac{1}{8 \text{ k}\Omega} = \frac{10 \text{ V}}{12 \text{ k}\Omega} - 50 \text{ mA}$$

$$-v_1 \frac{1}{8 \text{ k}\Omega} + v_2 \left(\frac{1}{8 \text{ k}\Omega} + \frac{1}{30 \text{ k}\Omega} \right) = -20 \text{ mA}$$

The next ^{step} is to multiply by common denominators.

$$24k\Omega \left[v_1 \left(\frac{1}{12k\Omega} + \frac{1}{8k\Omega} \right) - v_2 \frac{1}{8k\Omega} \right] = 24k\Omega \left(\frac{10V - 50mA}{12k\Omega} \right)$$

$$\text{or } v_1(2+3) - v_2(3) = 20V - 1200V$$

Now for the second equation:

$$120k\Omega \left[(-v_1) \frac{1}{8k\Omega} + v_2 \left(\frac{1}{8k\Omega} + \frac{1}{30k\Omega} \right) \right] = 120k\Omega (-20mA)$$

or

$$-v_1(15) + v_2(15+4) = -2400V$$

Summary of our two eq's:

$$v_1(5) - v_2(3) = -1180V$$

$$-v_1(15) + v_2(19) = -2400V$$

One way to solve these equations is to multiply the first eq'n by 3 and add the result to the second eq'n, cancelling the v_1 term:

$$\begin{array}{r} 3v_1(5) - 3v_2(3) = 3(-1180V) \\ + \quad -v_1(15) + v_2(19) = -2400V \\ \hline v_2(10) = -5940V \end{array}$$

or

$$v_2 = \frac{-5940V}{10} = -594V$$

Using an eq'n above, we find v_1 :

$$v_1 = \frac{-1180V + (-594V)(3)}{5} = -592.4V$$