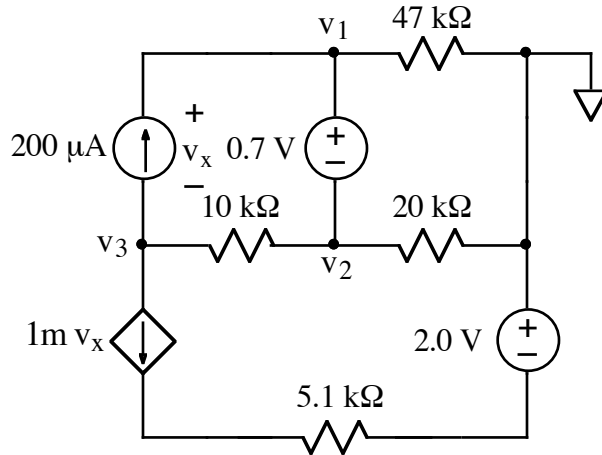


Ex:



Use the node-voltage method to find v_1 , v_2 , and v_3 .

sol'n: We have v_1, v_2 supernode since v -src without resistor is between nodes. Thus, we sum all currents out of bubble, (arrows):

$$-200 \mu A + \frac{v_1 - 0V}{47k\Omega} + \frac{v_2 - v_3}{10k\Omega} + \frac{v_2 - 0V}{20k\Omega} = 0A$$

We add a v -drop eq'n:

$$v_2 + 0.7V = v_1$$

Then we finish with the current sum for node v_3 :

$$200 \mu A + \frac{v_3 - v_2}{10k\Omega} + \frac{1m \cdot (v_1 - v_3)}{\Omega} = 0A$$

$\leftarrow v_x$ in terms of node v 's
 \leftarrow added to make units correct

Now we do the algebra: (1st & 3rd eqns first)

$$v_1 \cdot \frac{1}{47k\Omega} + v_2 \left(\frac{1}{10k\Omega} + \frac{1}{20k\Omega} \right) + v_3 \left(\frac{-1}{10k\Omega} \right) = 200\mu A$$

$$v_1 \cdot 1m + v_2 \frac{-1}{10k\Omega} + v_3 \left(\frac{1}{10k\Omega} - 1m \right) = -200\mu A$$

Multiply both sides by $20k\Omega$ to clear most fractions:

$$v_1 \frac{20k\Omega}{47k\Omega} + v_2 \cdot 3 + v_3 (-2) = 4V$$

$$v_1 \cdot 20 + v_2 (-2) + v_3 \underbrace{(2 - 20)}_{-18} = -4V$$

Use v-drop eqn to substitute for v_1 :

$$(v_2 + 0.7V) \frac{20}{47} + v_2 (3) + v_3 (-2) = 4V$$

$$(v_2 + 0.7) 20 + v_2 (-2) + v_3 (-18) = -4V$$

Now multiply 1st eqn by (-9) and sum eqns:

$$+ \quad (-9) (v_2 + 0.7V) \frac{20}{47} + (-9) v_2 (3) + (-9) v_3 (-2) = (-9) 4V$$

$$\Rightarrow \quad (v_2 + 0.7) \left[(-9) \frac{20}{47} + 20 \right] + v_2 (-29) = -40V$$

$$\Rightarrow \quad v_2 \left((-9) \frac{20}{47} + 20 - 29 \right) = -40V - 0.7 \left[(-9) \frac{20}{47} + 20 \right] V$$

$$\text{or } v_2 (-9) \left(\frac{20}{47} + 1 \right) = -40V - 0.7 \left[(-9) \left[\frac{20}{47} + 1 \right] + 29 \right] V$$

$$\text{or } v_2 (-9) \left[\frac{20}{47} + 1 \right] = -40V - 0.7(29)V - 0.7 \left[\frac{20}{47} + 1 \right] V$$

$$\text{or } v_2 = \frac{-40V - 0.7(29)V - 0.7V}{-9 \left(\frac{20}{47} + 1 \right)}$$

$$= \frac{-\frac{400V}{10} - \frac{20.3V}{10} - 0.7V}{-9 \cdot \frac{67}{47}}$$

$$= \frac{-\frac{603}{(-9)10} \cdot \frac{47}{67} V - 0.7V}{}$$

$$= \frac{-9}{-9} \cdot \frac{47}{10} V - 0.7V$$

$$= 4.7V - 0.7V$$

$$v_2 = 4.0V$$

$$v_1 = v_2 + 0.7V = 4.7V$$

$$v_1 \left(\frac{20}{47} \right) + v_2 (+3) + v_3 (-2) = 4V$$

$$4.7 \left(\frac{20}{47} \right) + 4 \cdot 3 + v_3 (-2) = 4V$$

$$\text{or } v_3 = 5V$$