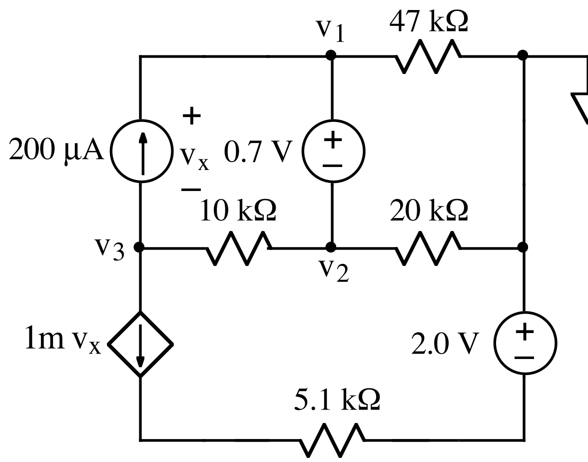
Ex:



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).

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

We add a v-drop eq'n:

$$v_2 + 0.7V = v_1$$

Then we finish with the current sum for node v_3:

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

↙ v_x in terms of node v's

↖ added to make units correct

Now we do the algebra: (1st & 3rd eq'ns 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 20kΩ to clear most fractions:

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

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

Use v-drop eq'n 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 eq'n by (−9) and sum eq'ns:

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

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

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

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

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

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

$$= \frac{-\frac{400V}{10} - \frac{7}{10}(29)V}{-9\cdot\frac{67}{47}} - 0.7V$$

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

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

$$= 4.7V - 0.7V$$

$$V_2 = 4.0\ V$$

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

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

$$4.7\left(\frac{20}{47}\right) + 4\cdot 3 + V_3(-2) = 4V$$

or $V_3 = 5V$