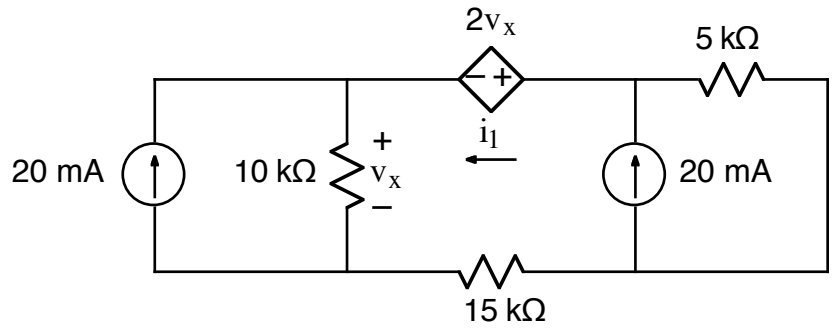
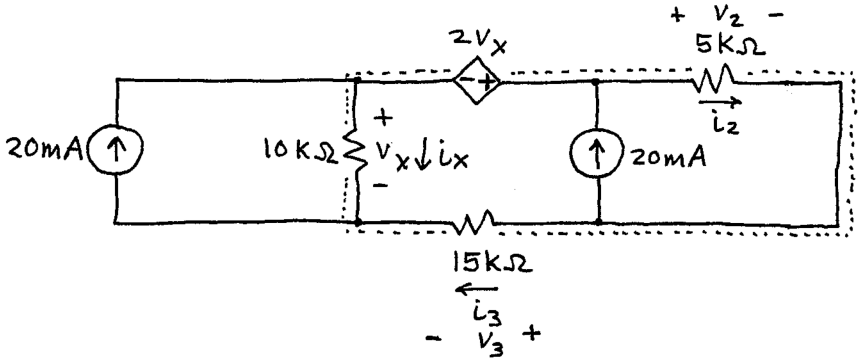
EX:



Find v_x, i_1, and the power dissipated by the dependent source.

sol'n: We find i_1, the current for the dependent v-src after we solve the circuit.

First, label i's and v's for R's:



Second, write v-loop eq'ns for loops not containg current src's. There is only one such loop, indicated by the dotted line:

$$+v_x + 2v_x - v_2 - v_3 = 0V$$

Third, write current-sum eq'ns for nodes (unless nodes are connected only by v src's). We don't use the nodes on top since they are connected by only the $2v_x$ source.

For the node on the bottom, left of center, we have

$$+20mA - i_x - i_3 = 0A \quad (1)$$

For the node on the bottom, right of center, we have

$$i_3 + 20mA - i_2 = 0A \quad (2)$$

Fourth, we look components in series carrying the same current. Here, we lack any such components.

Fifth, we write Ohm's Law eq'ns for all the R's:

$$v_x = i_x \cdot 10k\Omega$$

$$v_2 = i_2 \cdot 5k\Omega$$

$$v_3 = i_3 \cdot 15k\Omega$$

Now substitute Ohm's Law for v's in v-loop eq'n:

$$i_x \cdot 10k\Omega + 2\,i_x \cdot 10k\Omega - i_2 \cdot 5k\Omega - i_3 \cdot 15k\Omega = 0V \quad (3)$$

Solve one the three eq'ns (1-3) for a current:

$$i_3 = i_2 - 20mA$$

Substitute this in eq'ns (1) and (2):

$$20\,mA - i_x - (i_2 - 20\,mA) = 0A$$

$$i_x(10k\Omega + 20k\Omega) - i_2(5k\Omega) - (i_2 - 20mA)\,15k\Omega = 0V$$

Solving the first of these eq'ns for i_2 gives

$$i_2 = 40\,mA - i_x$$

Using this in the second of the two eq'ns gives:

$$i_x(30k\Omega) - (40\,mA - i_x)(5k\Omega + 15k\Omega) = -20mA \cdot 15k\Omega$$

or $$i_x(30k\Omega + 20k\Omega) = 40mA(20k\Omega) - 20mA \cdot 15k\Omega$$

or $$i_x(50k\Omega) = 500\,V$$

or $$i_x = \frac{500V}{50k\Omega} = 10\,mA$$

Now we can find i_1 from a current sum at the node on top to the left of center:

$$-20\,mA + i_x - i_1 = 0\,mA$$

or $$i_1 = -20\,mA + i_x = -20\,mA + 10\,mA = -10mA$$

The power dissipated by the dependent source is

$$p = i_1 \cdot 2v_x = -10mA \cdot 2 \cdot \underbrace{10mA \cdot 10k\Omega}_{v_x \text{ from ohms law}}$$

or $$p = -2\,W$$