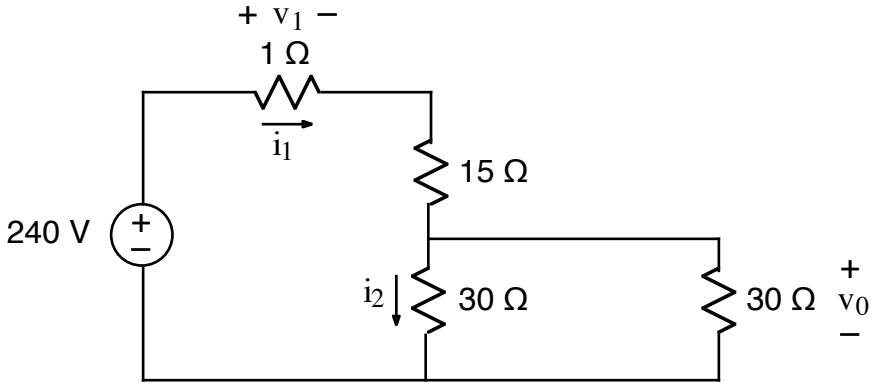
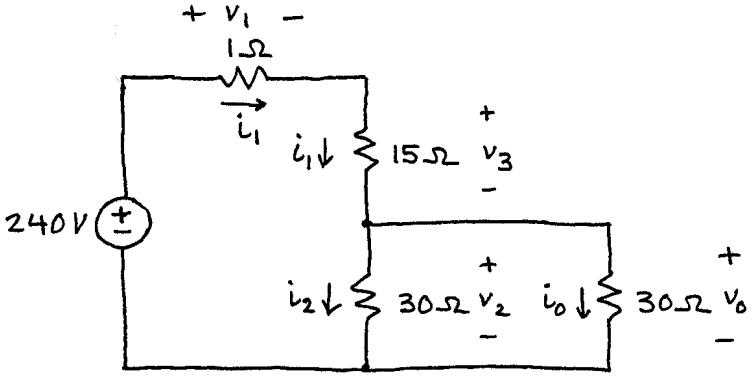
Ex:



Calculate i_1, i_2, and v_0.

soln: First, we label R's.



Second, we write v-loop eq'ns. We write eq'ns for both inner loops.

$$+240V - v_1 - v_3 - v_2 = 0V$$

$$+v_2 - v_o = 0V$$

Third, we write current-sum eq'ns for all but one node. For the node between R's on the right side we have

$$-i_1 + i_2 + i_o = 0A$$

Fourth, we equate currents for components in series. We have already done this, however, by using i_1 for both the 1Ω and 15Ω R's.

Fifth, we write Ohm's law eq'ns for every R:

$$v_1 = i_1 \cdot 1\Omega$$

$$v_3 = i_1 \cdot 15\Omega$$

$$v_2 = i_2 \cdot 30\Omega$$

$$v_o = i_o \cdot 30\Omega$$

Now we use the Ohm's law eq'ns to substitute for v's:

$$+240V - i_1 \cdot 1\Omega - i_1 \cdot 15\Omega - i_2 \cdot 30\Omega = 0\,V$$

$$+ i_2 \cdot 30\Omega - i_o \cdot 30\Omega = 0V$$

Our current sum eq'n is unchanged:

$$-i_1 + i_2 + i_o = 0A$$

From the 2nd of the above 3 eq'ns we have

$$i_o = i_2$$

Using this in the 3rd eq'n gives

$$i_1 = 2 i_2$$

Using this in the 1st eqn gives

$$+240\,V - 2 i_2 \left(1\Omega + 15\Omega\right) - i_2 \cdot 30\Omega = 0V$$

or $$i_2 \left(2 \cdot 16\Omega + 30\Omega\right) = 240V$$

or $$i_2 = \frac{240V}{62\Omega} = \frac{120}{31}\,A \approx 3.87A$$

$$i_1 = 2 i_2 = \frac{240}{31}\,A \approx 7.74\,A$$

$$v_o = i_o \cdot 30\Omega = i_2 \cdot 30\Omega = \frac{120}{31}(30)\,V$$

or $$v_o = \frac{3600}{31}\,V \approx 116\,V$$