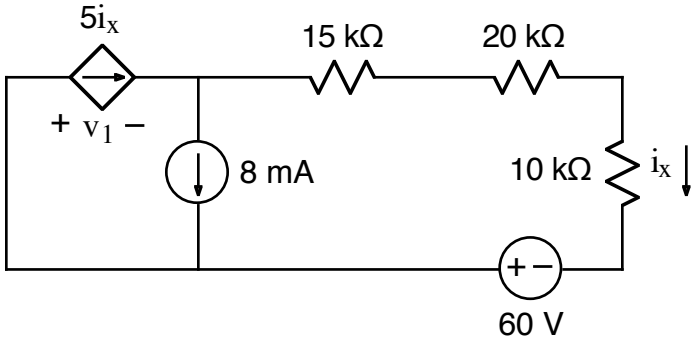
HOMEWORK #3 prob 5 solution

Ex:



Find i_x, v_1, and the power dissipated by the dependent source.

Soln: First, we observe that i_x flows thru all 3 resistors since they are in series.

Rather than defining voltages for every resistor, we may use Ohm's law directly to define the voltages as $v = iR$. Note that the + and − signs of the voltage measurements must obey the passive sign convention: the current arrow must point toward the − sign of the v-drop measurement.

Turning to v-loop eqns, we discover that all loops pass thru current sources, meaning we should avoid writing those v-loop eqns.

Note: even though the dependent current source is labeled with a v-drop, we should avoid using v_1 in a v-loop. Instead, we can solve the circuit first and then find v_1.

We now write a current-sum eq'n for the top-center node:

$$-5i_x + 8\,mA + i_x = 0\,A$$

or $$4i_x = 8\,mA$$

or $$i_x = 2\,mA$$

Now we use a v-loop around the outside of the circuit to find v_1:

$$-v_1 - i_x\,15\,k\Omega - i_x\,20\,k\Omega - i_x\,10\,k\Omega + 60V = 0V$$

or $$v_1 = -i_x(15\,k\Omega + 20\,k\Omega + 10\,k\Omega) + 60V$$

$$= -2mA \cdot 45\,k\Omega + 60V$$

$$= -90V + 60V$$

$$v_1 = -30V$$

The power for the dependent source is

$$p = i \cdot v = 5i_x v_1 = 5(2mA)(-30V)$$

$$p = -300\,mW$$