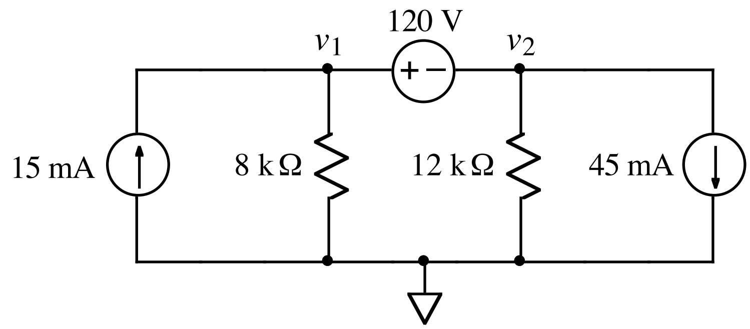
HOMEWORK #6 solution

EX:



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

SOL'N: We have only a voltage source between the nodes labeled v_1 and v_2. Thus, we have a supernode. We draw a bubble around these two nodes, (with the 120 V source inside), and we set the sum of currents flowing out of the bubble equal to zero:

$$-15 \text{ mA} + \frac{v_1}{8 \text{ k}\Omega} + \frac{v_2}{12 \text{ k}\Omega} + 45 \text{ mA} = 0 \text{ A}$$

We obtain a second equation for the supernode from the voltage relationship between the nodes.

$$v_1 - v_2 = 120 \text{ V}$$

NOTE: The node next to the plus sign of the 120 V source, v_1, is added in this equation and the node next to the minus sign of the 120 V source, v_2, is subtracted in this equation.

We solve these two equations in two unknowns. Here, we eliminate v_2 first.

$$v_2 = v_1 - 120 \text{ V}$$

Substituting into the first equation gives one equation with one unknown.

$$-15 \text{ mA} + \frac{v_1}{8 \text{ k}\Omega} + \frac{v_1 - 120 \text{ V}}{12 \text{ k}\Omega} + 45 \text{ mA} = 0 \text{ A}$$

We collect terms multiplying v_1 and put constant terms on the right side.

$$v_1\left(\frac{1}{8 \text{ k}\Omega} + \frac{1}{12 \text{ k}\Omega}\right) = 15 \text{ mA} - 45 \text{ mA} + \frac{120 \text{ V}}{12 \text{ k}\Omega}$$

or

$$v_1\left(\frac{1}{8\ \text{k}\Omega}+\frac{1}{12\ \text{k}\Omega}\right)=-20\ \text{mA}$$

or

$$24\ \text{k}\Omega\cdot v_1\left(\frac{1}{8\ \text{k}\Omega}+\frac{1}{12\ \text{k}\Omega}\right)=-20\ \text{mA}\cdot 24\ \text{k}\Omega$$

or

$$v_1(3+2)=-480\ \text{V}$$

or

$$v_1=\frac{-480\ \text{V}}{5}=-96\ \text{V}$$

Using the second of the original equations, we find v_2.

$$v_2=v_1-120\ \text{V}=-96\ \text{V}-120\ \text{V}=-216\ \text{V}$$