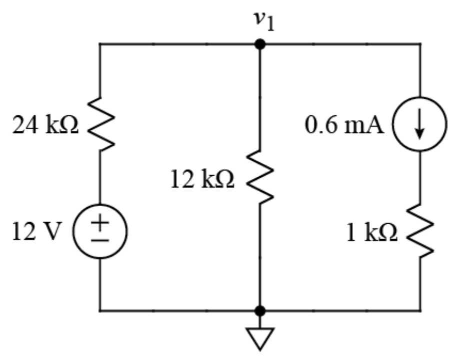
HOMEWORK #4 prob 5 solution

Ex:



For the circuit shown, use the node-voltage method to find v_1.

SOL'N: With the one node, the currents in the left, center, and right branches flowing out of the node sum to zero.

$$\frac{v_1 - 12\,\text{V}}{24\,\text{k}\Omega} + \frac{v_1}{12\,\text{k}\Omega} + 0.6\,\text{mA} = 0\,\text{A}$$

Note that the current source in the right branch determines the current regardless of the series resistance. In general, a resistor in series with a current source may be ignored. The only effect of the resistance is that it causes the current source to change its voltage drop by an amount that is equal to the value of the current source times the resistance.

To solve the equation, we collect the terms multiplying v_1.

$$v_1\left(\frac{1}{24\,\text{k}\Omega} + \frac{1}{12\,\text{k}\Omega}\right) = \frac{12\,\text{V}}{24\,\text{k}\Omega} - 0.6\,\text{mA} = \text{-}0.1\,\text{mA}$$

or

$$v_1 = -\frac{0.1\,\text{mA}}{\dfrac{1}{24\,\text{k}\Omega} + \dfrac{1}{12\,\text{k}\Omega}} = -\frac{0.1\,\text{mA}}{\dfrac{1}{24\,\text{k}\Omega} + \dfrac{1}{12\,\text{k}\Omega}} \cdot \frac{24\,\text{k}\Omega}{24\,\text{k}\Omega}$$

or

$$v_1 = -\frac{0.1\,\text{mA}(24\,\text{k}\Omega)}{3} = -0.8\,\text{V}$$