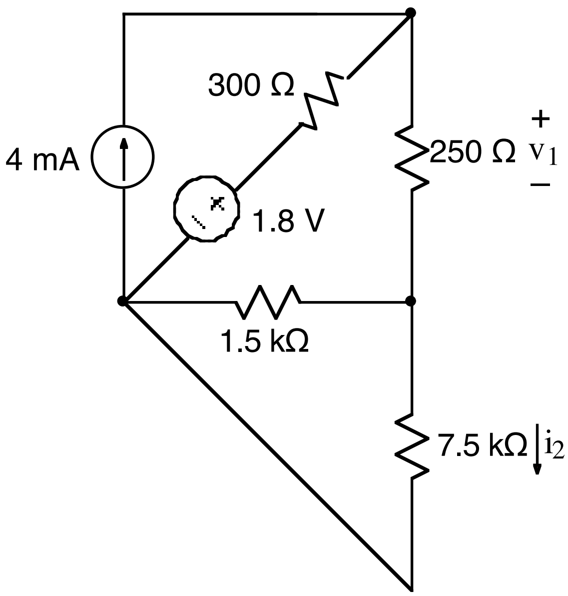
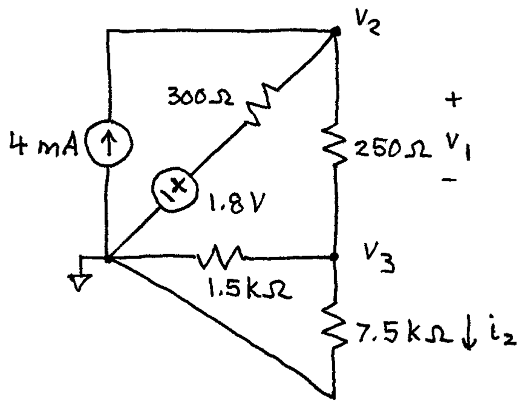
EX:



Use the node-voltage method to calculate v_1 and i_2.

SOL'N: We first assign a reference node. The node on the left is convenient since it is connected to the − of the 1.8V supply.

We assign node voltages v_2 and v_3 on the right side of the circuit, (since v_1 is already used).



We check for dependent sources and super nodes, but neither is present in this circuit.

Now we write current summation eq'ns for each node.

$$v_2 \text{ node: } -4\text{ mA} + \frac{v_2 - 1.8\text{V}}{300\,\Omega} + \frac{v_2 - v_3}{250\,\Omega} = 0\text{A}$$

$$v_3 \text{ node: } \frac{v_3 - v_2}{250\,\Omega} + \frac{v_3 - 0\text{V}}{1.5\text{k}\Omega} + \frac{v_3 - 0\text{V}}{7.5\text{k}\Omega} = 0\text{A}$$

We solve these eq'ns for v_2 and v_3. Grouping terms multiplying v_2 and v_3 and putting constant terms on the right side of the eq'n keeps things organized.

$$v_2\left(\frac{1}{300\,\Omega} + \frac{1}{250\,\Omega}\right) + v_3\left(\frac{-1}{250\,\Omega}\right) = 4\text{mA} + \frac{1.8\text{V}}{300\,\Omega}$$

$$v_2\left(\frac{-1}{250\,\Omega}\right) + v_3\left(\frac{1}{250\,\Omega} + \frac{1}{1.5\text{k}\Omega} + \frac{1}{7.5\text{k}\Omega}\right) = 0\text{A}$$

Multiplying both sides by $7.5\text{k}\Omega$ clears the denominators.

$$v_2(25 + 30) + v_3(-30) = 30\text{V} + 1.8\text{V}(25)$$

$$v_2(-30) + v_3(30 + 5 + 1) = 0\text{V}$$

The 2nd eq'n is easier to solve. (We may solve for either v_2 or v_3.)

$$v_2 = v_3 \frac{36}{30} = v_3 \cdot \frac{6}{5}$$

Substituting into the 1st eq'n, we have

$$v_3 \cdot \frac{6}{5}(55) + v_3(-30) = 30V + 45V = 75V$$

or $v_3 \cdot (66 - 30) = 75V$

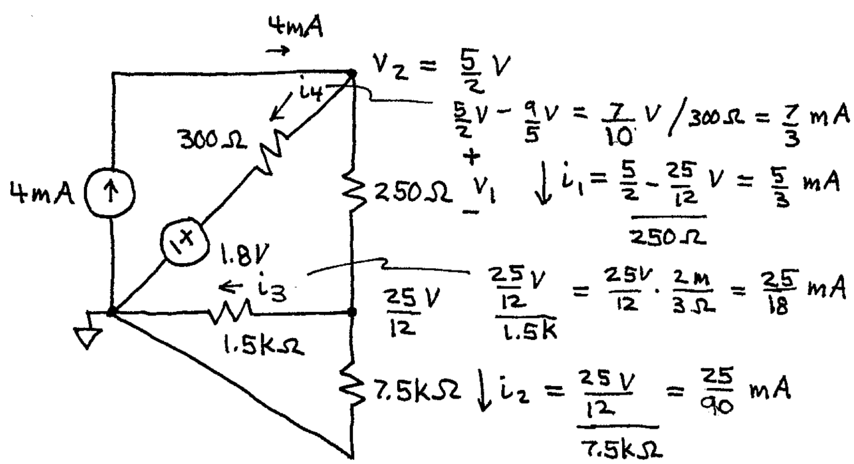
or $v_3 \cdot 36 = 75\ V$

or $v_3 = \frac{75}{36}\ V = \frac{25}{12}\ V$

Using or earlier eq'n for v_2, we have

$$v_2 = v_3 \cdot \frac{6}{5} = \frac{25}{12} V \cdot \frac{6}{5} = \frac{5}{2}\ V$$

Before going further we perform a consistency check on the currents to verify that they sum to zero at each node:



Check: $-4\text{mA} + \frac{7}{3}\text{mA} + \frac{5}{3}\text{mA} = 0\ \text{mA}$ ✓

$-\frac{5}{3}\text{mA} + \frac{25}{18}\text{mA} + \frac{25}{90}\text{mA} = 0\ \text{mA}$ ✓

For v_1 we have $v_1 = v_2 - v_3 = \frac{5}{2} - \frac{25}{12}$ V

or $v_1 = \frac{30}{12} - \frac{25}{12}$ V $= \frac{5}{12}$ V

For i_2 we have $i_2 = \frac{v_3}{7.5\text{k}\Omega} = \frac{25/12}{7.5}$ mA

$i_2 = \frac{25}{12} \cdot \frac{10}{75} = \frac{5}{18}$ mA

(Note: v_1 and i_2 we actually found earlier in the consistency check.)