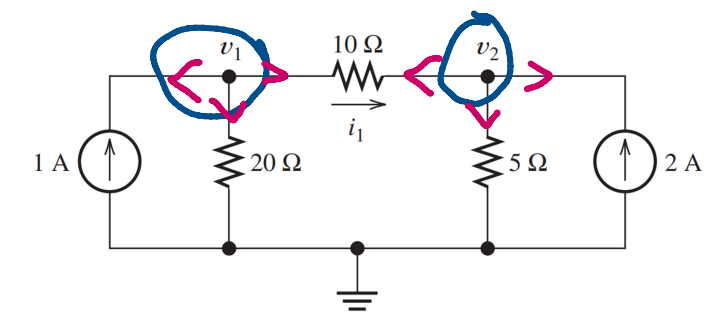


Node-Voltage Analysis - Ex 1

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- Write equations and solve for the node voltages shown in Figure. Then, find the value of i_1 .

Node-Voltage Analysis at Node 1

$$(v_1 - v_2)/10 + (v_1 - 0)/20 - 1 = 0$$

Node 2:

$$(v_2 - v_1)/10 + (v_2 - 0)/5 - 2 = 0$$

$$(0.15) v_1 + (-0.1) v_2 = 1$$

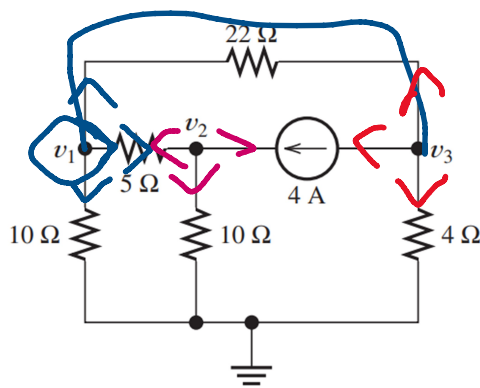
$$(-0.1) v_1 + (0.3) v_2 = 2$$

$$V_1 = 7.6 \text{ V}$$

$$V_2 = 12.5 \text{ V}$$

Example 2

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- Solve for the node voltages shown in Figure.
- What are the new values of the node voltages after the direction of the current source is reversed?
- How are the values related?

$V_1, v_2, \text{ \& } v_3$

Node 1:

$$(v_1 - v_2)/5 + (v_1 - v_3)/22 + (v_1 - 0)/10 = 0$$

Node 2:

$$(v_2 - v_1)/5 + (v_2 - 0)/10 - 4 = 0$$

$$\begin{aligned} (1/5 + 1/22 + 1/10) v_1 + (-1/5) v_2 + (-1/22) v_3 &= 0 \\ (-1/5) v_1 + (1/5 + 1/10) v_2 + (0) v_3 &= 4 \\ (-1/22) v_1 + (0) v_2 + (1/22 + 1/4) v_3 &= -4 \end{aligned}$$

Node 3:

$$(v_3 - v_1)/22 + (v_3 - 0)/4 + 4 = 0$$

$$\begin{aligned} V_1 &= X \\ V_2 &= Y \\ V_3 &= Z \end{aligned}$$

Node 1:

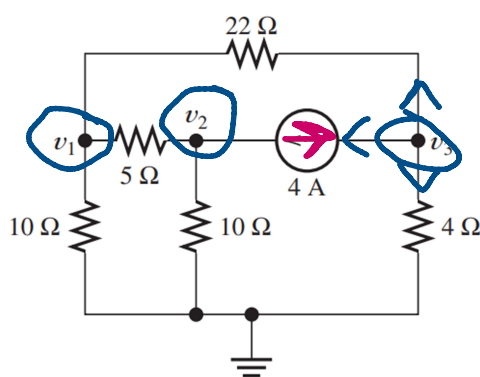
$$(v_1 - v_3)/22 + (v_1 - 0)/10 + (v_1 - v_2)/5 = 0$$

Node 2:

$$(v_2 - v_1)/5 + (v_2 - 0)/10 + 4 = 0$$

Node 3:

$$(v_3 - v_1)/22 + (v_3 - 0)/4 - 4 = 0$$



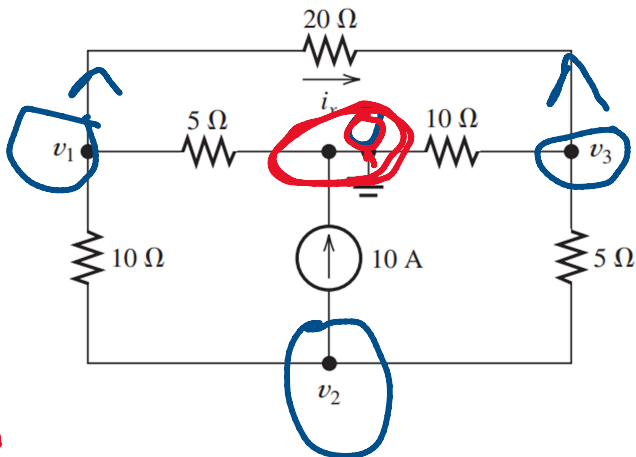
$$\begin{aligned} (1/5 + 1/22 + 1/10) v_1 + (-1/5) v_2 + (-1/22) v_3 &= 0 \\ (-1/5) v_1 + (1/5 + 1/10) v_2 + (0) v_3 &= -4 \\ (-1/22) v_1 + (0) v_2 + (1/22 + 1/4) v_3 &= 4 \end{aligned}$$

$$\begin{aligned} V_1 &= -X \\ V_2 &= -Y \\ V_3 &= -Z \end{aligned}$$

Example 3

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- Find Node Voltages and then find i_x



Node 1:

$$(v_1 - v_3)/20 + (v_1 - v_2)/10 + (v_1 - 0)/5 = 0$$

Node 2:

$$(v_2 - v_1)/10 + (v_2 - v_3)/5 + 10 = 0$$

Node 3:

$$(v_3 - v_2)/5 + (v_3 - v_1)/20 + (v_3 - 0)/10 = 0$$

$$i_x = (v_1 - v_3)/20$$

\Rightarrow

$V_1 =$

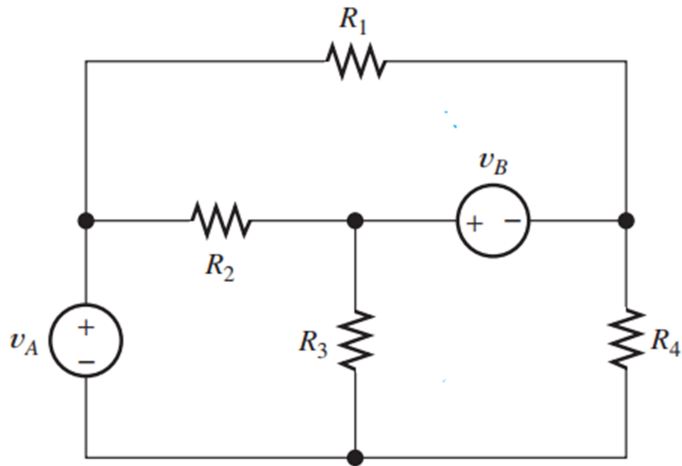
$V_2 =$

$V_3 =$

Choosing the Mesh Currents

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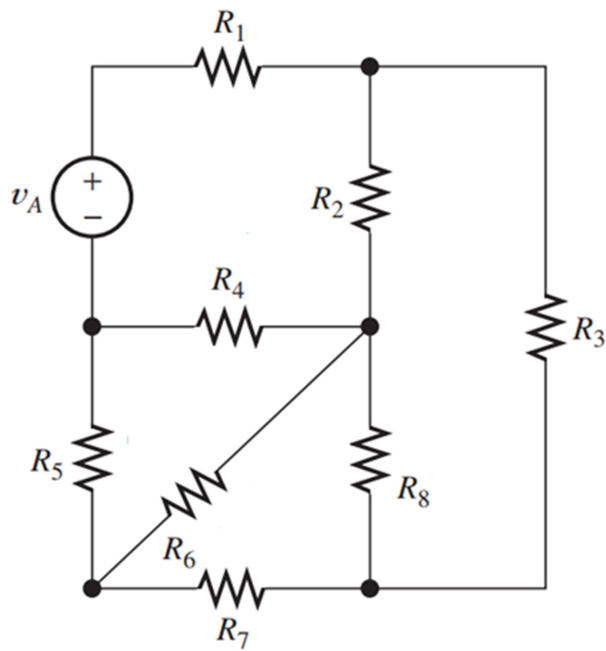


Branch Currents

Choosing the Mesh Currents

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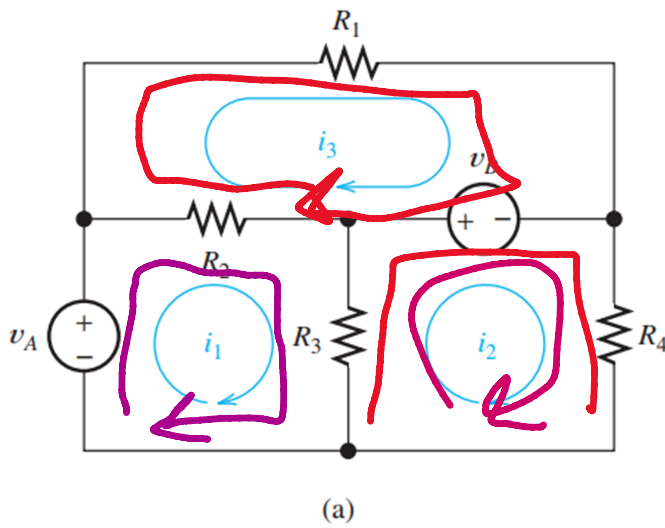


Branch Currents

Mesh-Current Equations using KVL

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Loop 1:

$$-v_a + (i_1 - i_3)R_2 + (i_1 - i_2)R_3 = 0$$

Loop 2:

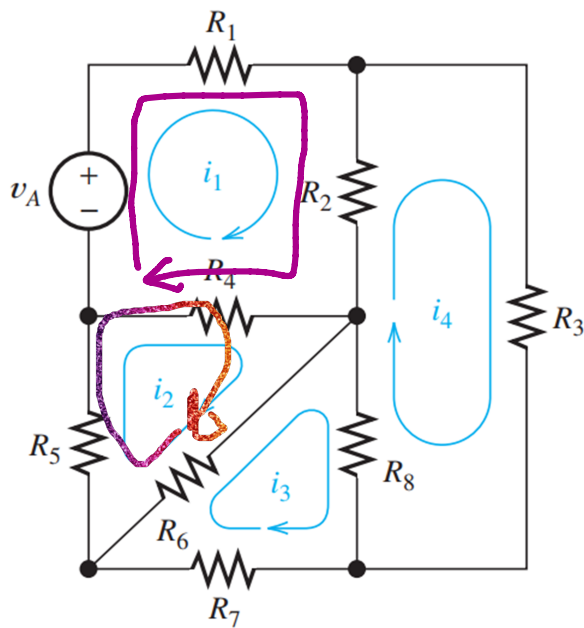
$$(i_2 - i_1)R_3 + v_b + i_2 R_4 = 0$$

Loop 3:

$$(i_3 - i_1)R_2 + i_3 R_1 - v_b = 0$$

Mesh-Current Equations using KVL

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Loop 1:

$$-v_A + i_1 R_1 + (i_1 - i_4) R_2 + (i_1 - i_2) R_4 = 0$$

Loop 2:

$$(i_2 - i_1) R_4 + (i_2 - i_3) R_6 + i_2 R_5 = 0$$

Loop 3:

$$(i_3 - i_2) R_6 + (i_3 - i_4) R_8 + i_3 R_7 = 0$$

Loop 4:

$$(i_4 - i_1) R_2 + i_4 R_3 + (i_4 - i_3) R_8 = 0$$