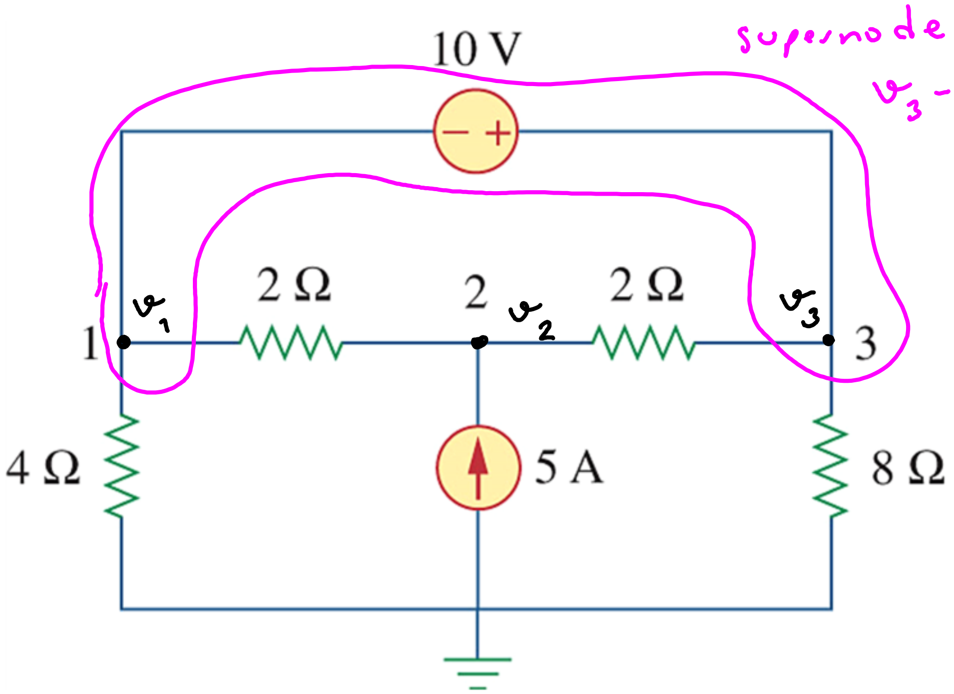
[Alexander and Sadiku, 2009, Q3.18]

Sunday, June 16, 2013 8:37 PM



supernode:

$v_3 - v_1 = 10$

KCL at supernode

$$\frac{v_1 - 0}{4} + \frac{v_1 - v_2}{2} + \frac{v_3 - v_2}{2} + \frac{v_3 - 0}{8} = 0$$

KCL at node 2

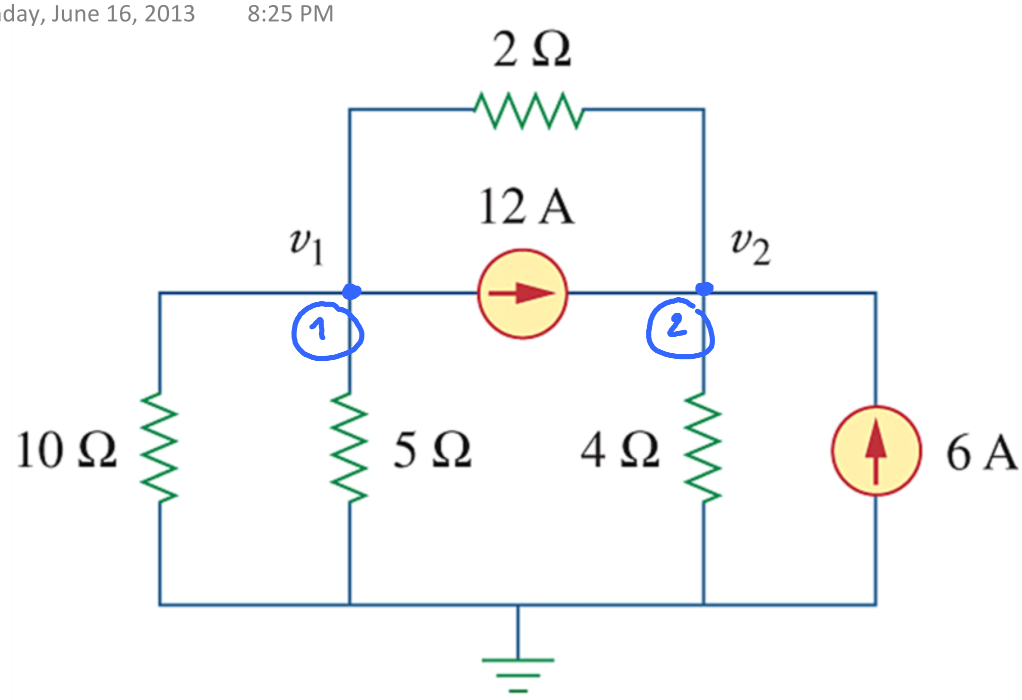
$$\frac{v_2 - v_1}{2} - 5 + \frac{v_2 - v_3}{2} = 0$$

$\Longrightarrow$ Mathcad

$$\boxed{\begin{array}{l} v_1 = 10 \text{ V} \\ v_2 = v_3 = 20 \text{ V} \end{array}}$$

[Alexander and Sadiku, 2009, Q3.2]

Sunday, June 16, 2013 8:25 PM



KCL at 1

$$\frac{v_1 - 0}{10} + \frac{v_1 - 0}{5} + \frac{v_1 - v_2}{2} + 12 = 0$$

KCL at 2

$$-12 + \frac{v_2 - v_1}{2} + \frac{v_2}{4} - 6 = 0$$

Mathcad

$$\Rightarrow \begin{cases} v_1 = 0 \\ v_2 = 24\,V \end{cases}$$

[Alexander and Sadiku, 2009, Q3.6]

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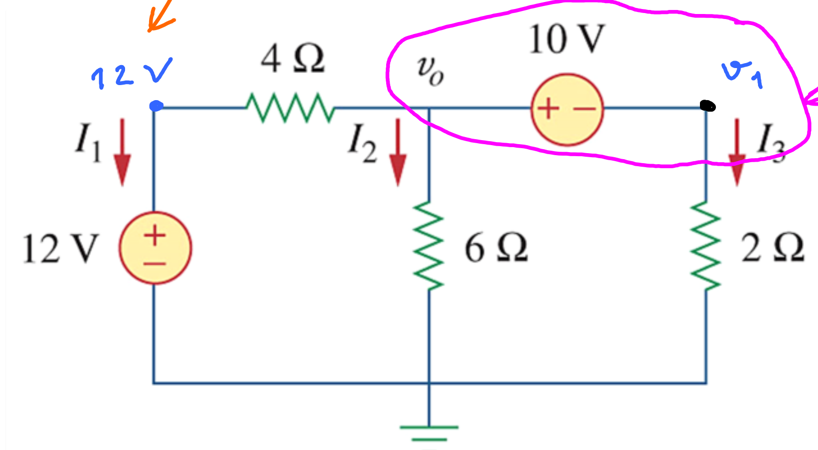
we get the voltage at this non-reference node immediately because a voltage source is between this node and the ground.



supernode

$v_o - v_1 = 10$

KCL at supernode :

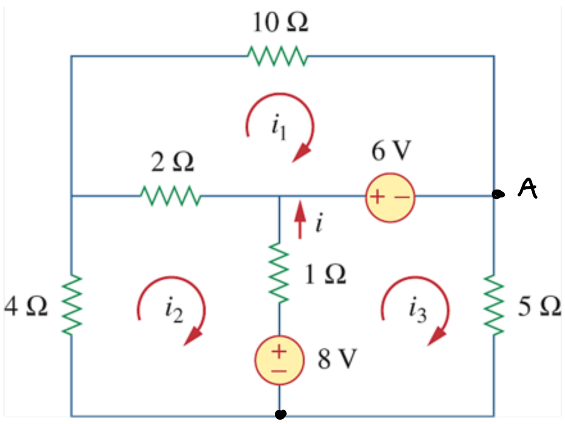
$$\frac{v_o - 12}{4} + \frac{v_o - 0}{6} + \frac{v_1}{2} = 0$$

Mathcad

$$\begin{cases} v_o \approx 8.727\ V \\ v_1 \approx -1.273\ V \end{cases}$$

[Alexander and Sadiku, 2009, Q3.41]

Monday, June 24, 2013 10:05 AM



For mesh 1 : We apply KVL starting from node A:

$$+6 - 2\times(i_1 - i_2) - 10\, i_1 = 0$$

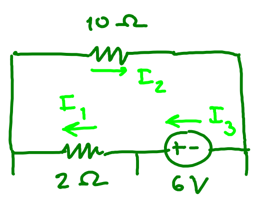
Moving from − to + terminal of a 6V voltage source means I gain 6 V.

Moving pass the resistor means we lose IR volts

The current here must be $i_1 - i_2$ because both i_1 and i_2 passes this 2Ω resister.

If you feel uncomfortable with the above method for getting the equation, let's take a look at the following derivation:

In loop 1, we have



We first need to find the currents passing through these elements : I_1, I_2, I_3

It turns out that I will apply KVL later and hence I don't really care about I_3.

So, we will focus only on I_1 and I_2.

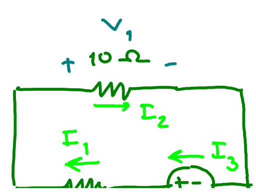
Notice how the mesh currents are defined.

We see that I_2 is the same as i_1.

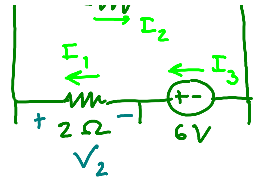
However, for I_1 we hae two mesh currents i_1 and i_2 going in opposite directions. So, $I_1 = i_1 - i_2$.

Next, we define the voltages V_1 and V_2 :

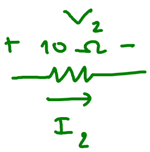
(We need the voltages because we are going to apply KVL.)



(We need the voltages because we are going to apply KVL.)

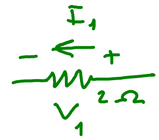


Now, by Ohm's law, we have



$$V_2 = I_2 \times 10 = i_1 \times 10 \text{ V}$$

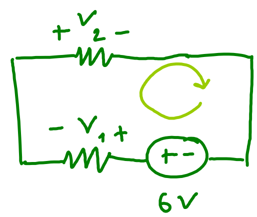
and



$$V_1 = I_1 \times 2 = (i_1 - i_2) \times 2 \text{ V}$$

Note that we don't have any extra minus sign in my Ohm's law because we defined the polarities of our voltages in such a way that, when considered with the directions of the branch currents, they conform with the passive sign convention.

Return to mesh 1. We now have



So, by KVL, we have

$$6 - V_1 - V_2 = 0.$$

Plugging in the Ohm's-law expressions for V_1 and V_2, we then have

$$+6 - (i_1 - i_2) \times 2 - i_1 \times 10 = 0$$

which is the same equation that we got earlier.

Once you apply this technique for many times, you should be able to "read" the equation directly from a loop without thinking much.

For mesh 2, starting from the bottom, we have $-4 \times i_2 - 2 \times (i_2 - i_1) - 1 \times (i_2 - i_3) - 8 = 0$

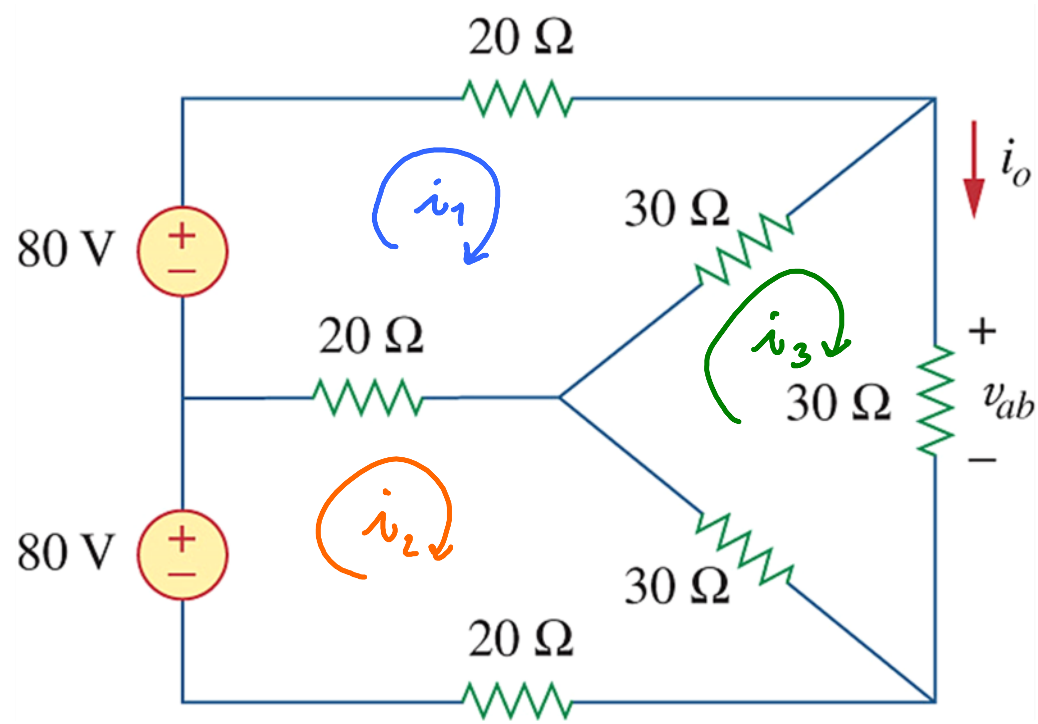
For mesh 3, starting from node A, we have $-5 i_3 + 8 - (i_3 - i_2) \times 1 - 6 = 0$

Calculator $\Rightarrow i_1 = \frac{77}{234}$, $i_2 = -\frac{40}{39}$, $i_3 = \frac{19}{117}$

Therefore, $i = i_3 - i_2 = \frac{139}{117} \approx 1.19$ A

[Alexander and Sadiku, 2009, Q3.43]

Monday, June 24, 2013 10:09 AM



Mesh 1 : $80 - i_1 \times 20 - 30 \times (i_1 - i_3) - 20(i_1 - i_2) = 0$

Mesh 2 : $80 - (i_2 - i_1) \times 20 - (i_2 - i_3) \times 30 - 20 i_2 = 0$

Mesh 3 : $-30(i_3 - i_2) - 30(i_3 - i_1) - 30 i_3 = 0$

$$\Rightarrow i_3 = \frac{16}{9} \qquad \left(i_1 = i_2 = \frac{8}{3} \right)$$

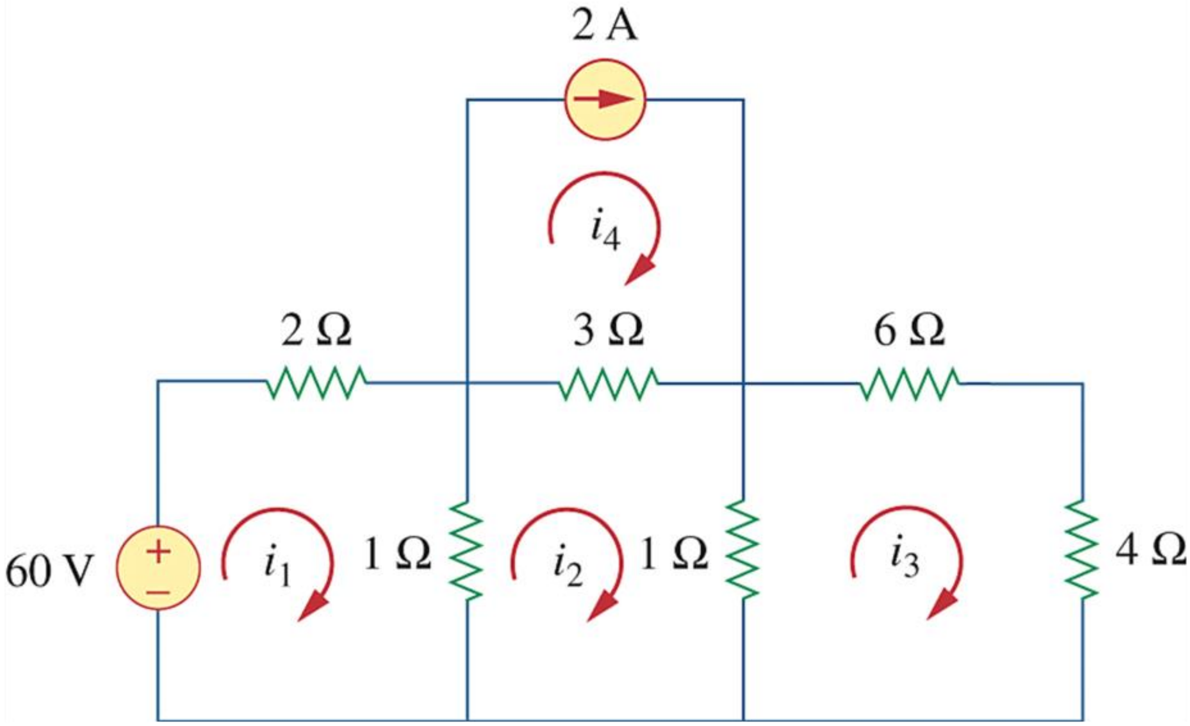
Note that $i_o = i_3$.

So, $i_o = \frac{16}{9}$ A ≈ 1.78 A

$$v_{ab} = i_o \times 30 = \frac{16}{\cancel{9}_{\,3}} \times \cancel{30} = \frac{160}{3} \text{ V} \approx 53.33 \text{ V}$$

[Alexander and Sadiku, 2009, Q3.46]

Monday, June 24, 2013 10:11 AM



In this problem, because i_4 is the only current that passes through 2A current source. We automatically get

$$i_4 = 2A.$$

Mesh 1: $+60 - 2i_1 - (i_1 - i_2) = 0$

Mesh 2: $-(i_2 - i_1) - 3(i_2 - \underset{2}{\underset{\uparrow}{i_4}}) - (i_2 - i_3) = 0$

Mesh 3: $-(i_3 - i_2) - 6i_3 - 4i_3 = 0$

$$\Rightarrow i_1 = \frac{3306}{151}, \quad i_2 = \frac{858}{151}, \quad i_3 = \frac{78}{151}$$

$$i_1 \approx 21.89\ A, \quad i_2 \approx 5.68\ A, \quad i_3 \approx 0.52\ A$$