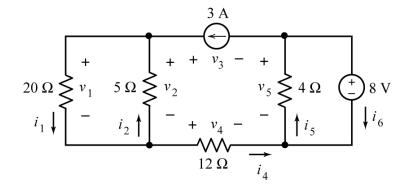
Exercise 1:

This circuit consists of 6 elements connected together at 4 nodes:



Write 6 element equations, one for each element.

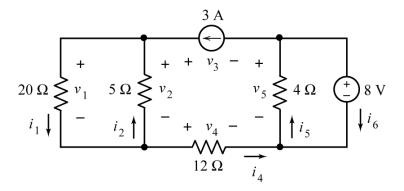
Write 4 KCL equations, one at each of the 4 nodes.

Write 4 KVL equations, one for each mesh and one for the outside loop.

Describe the following: $v_1 i_1$, $v_2 i_2$, $v_3 i_3$ and $v_6 i_6$.

Solution 1:

This circuit consists of 6 elements connected together at 4 nodes:



Write 6 element equations, one for each element.

$$v_1 = 20i_1$$
, $v_2 = -5i_2$, $i_3 = 3$ A, $v_4 = 12i_4$, $v_5 = -4i_5$, $v_6 = 8$ V

Write 4 KCL equations, one at each of the 4 nodes.

$$i_2 + i_3 = i_1$$
, $i_5 = i_3 + i_6$, $i_4 + i_6 = i_5$, $i_1 = i_2 + i_4$

Write 4 KVL equations, one for each mesh and one for the outside loop.

$$v_2 - v_1 = 0$$
, $v_3 + v_5 - v_4 - v_2 = 0$, $v_6 - v_5 = 0$ $v_3 + v_6 - v_4 - v_1 = 0$

Describe the following: $v_1 i_1$, $v_2 i_2$, $v_3 i_3$ and $v_6 i_6$.

 $v_1 i_1$ is the power received by the 20 Ω resistor,

 $v_2 i_2$ is the power supplied by the 5 Ω resistor,

 $v_3 i_3$ is the power supplied by the current source,

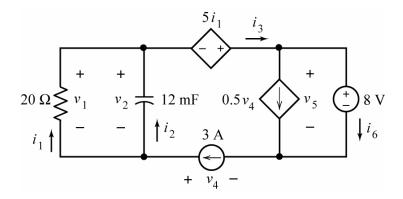
 $v_6 i_6$ is the power received by the voltage source

Remark:

There are 12 unknowns in this exercise, $v_1, v_2, v_3, v_4, v_5, v_6, i_1, i_2, i_3, i_4, i_5$, and i_6 , the element voltages and currents of 6 elements. We've written 6 element equations and 8 Kirchhoff's law equations for a total of 14 equations in 12 unknowns. That's a lot of equations, too many equations.

Exercise 2:

This circuit consists of 6 elements connected together at 4 nodes:



Write 6 element equations, one for each element.

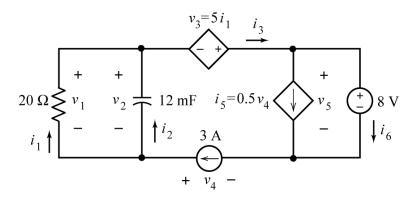
Write 4 KCL equations, one at each of the 4 nodes.

Write 4 KVL equations, one for each mesh and one for the outside loop.

Describe the following: $v_1 i_1$, $v_3 i_3$, $v_5 i_5$ and $v_6 i_6$.

Solution 2:

It's helpful to add the names of the controlled voltage of the VCCS and the controlled current of the CCVS to the labels of these elements.



Write 6 element equations, one for each element.

$$v_1 = -20i_1$$
, $i_2 = -0.012 \frac{dv_2}{dt}$, $v_3 = 5i_1$, $i_4 = 3 \,\text{A}$, $i_5 = 0.5 \,v_4$, $v_6 = 8 \,\text{V}$

Write 4 KCL equations, one at each of the 4 nodes.

$$i_1 + i_2 = i_3$$
, $i_3 = i_5 + i_6$, $i_5 + i_6 = i_4$, $i_4 = i_1 + i_2$

Write 4 KVL equations, one for each mesh and one for the outside loop.

$$v_2 - v_1 = 0$$
, $-v_3 + v_5 - v_4 - v_2 = 0$, $v_6 - v_5 = 0$ $-v_3 + v_6 - v_4 - v_1 = 0$

Describe the following: $v_1 i_1$, $v_3 i_3$, $v_5 i_5$ and $v_6 i_6$.

 $v_1 i_1$ is the power supplied by the 20 Ω resistor,

 $v_3 i_3$ is the power supplied by the CCVS,

 $v_5 i_5$ is the power received by the VCCS,

 $v_6 i_6$ is the power received by the (independent) voltage source