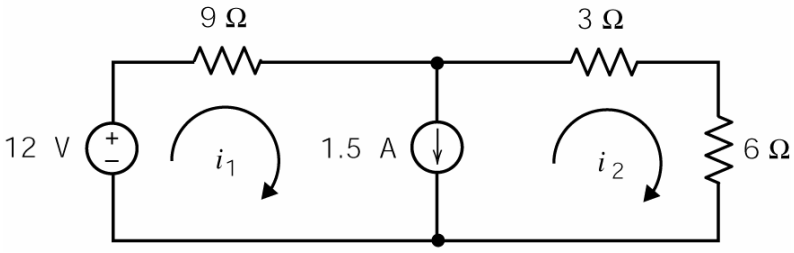
Example



Determine the values of the mesh currents, i_1 and i_2, for this circuit.

Solution

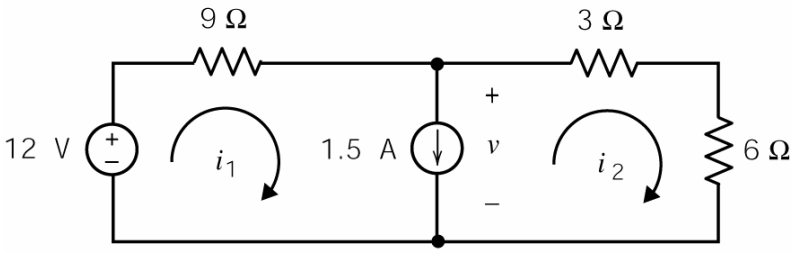
We can write one mesh equation by considering the current source. The current source current is related to the mesh currents at by

$$i_1 - i_2 = 1.5 \quad \Rightarrow \quad i_1 = i_2 + 1.5$$

In order to write the second mesh equation, we must decide what to do about the current source voltage. (Notice that there is no easy way to express the current source voltage in terms of the mesh currents.) In this example, illustrate two methods of writing the second mesh equation.

Method 1: Assign a name to the current source voltage. Apply KVL to both of the meshes. Eliminate the current source voltage from the KVL equations.

Here's the circuit after labeling the current source voltage.



The KVL equation for mesh 1 is

$$9i_1 + v - 12 = 0$$

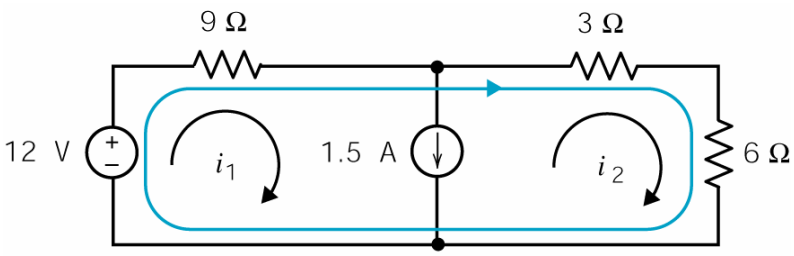
The KVL equation for mesh 2 is

$$3i_2 + 6i_2 - v = 0$$

Combining these two equations gives

$$9i_1 + \left(3i_2 + 6i_2\right) - 12 = 0 \quad \Rightarrow \quad 9i_1 + 9i_2 = 12$$

Method 2: Apply KVL to the supermesh corresponding to the current source. Shown below in blue, this supermesh is the perimeter of the two meshes that each contain the current source.



Apply KVL to the supermesh to get

$$9i_1 + 3i_2 + 6i_2 - 12 = 0 \quad \Rightarrow \quad 9i_1 + 9i_2 = 12$$

This is the same equation that was obtained using method 1. Applying KVL to the supermesh is a shortcut for doing three things:

1. labeling the current source voltage as *v*
2. applying KVL to both meshes that contain the current source
3. eliminating *v* from the KVL equations

In summary, the mesh equations are

$$i_1 = i_2 + 1.5$$

And

$$9i_1 + 9i_2 = 12$$

Solving the node equations gives

$$i_1 = 1.4167 \text{ A} \quad \text{and} \quad i_2 = -83.3 \text{ mA}$$