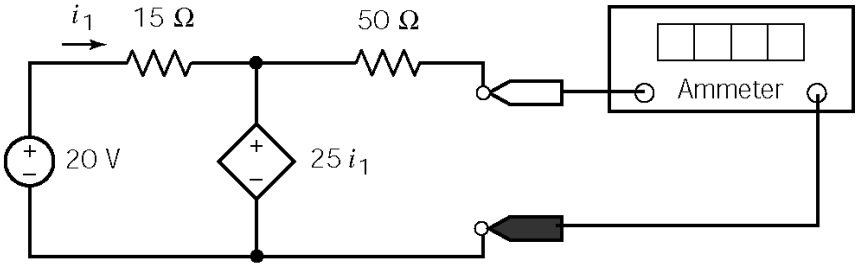
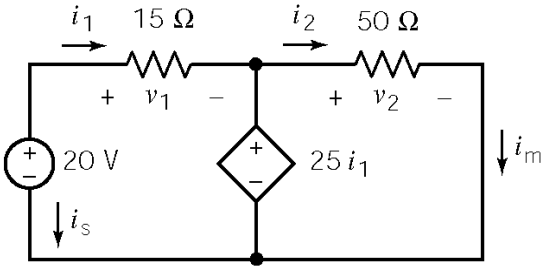
Four Examples

1. Determine the value of the current that is measured by the meter in this circuit.



Solution

We can label the circuit as shown.



The subscripts suggest a numbering of the circuit elements. Apply KVL to node the left mesh to get

$$15i_1 + 25i_1 - 20 = 0 \quad \Rightarrow \quad i_1 = \frac{20}{40} = 0.5 \text{ A}$$

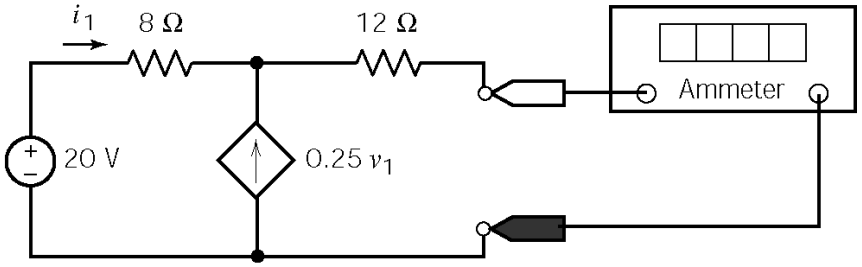
Apply KVL to node the left mesh to get

$$v_2 - 25i_1 = 0 \quad \Rightarrow \quad v_2 = 25i_1 = 25(0.5) = 12.5 \text{ V}$$

Apply KCL to get $i_m = i_2$. Finally, apply Ohm's law to the 50 Ω resistor to get

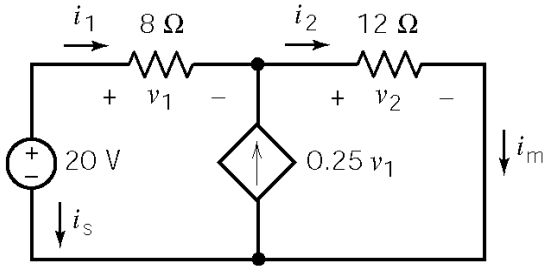
$$i_m = i_2 = \frac{v_2}{50} = \frac{12.5}{50} = 0.25 \text{ A}$$

2. Determine the value of the current that is measured by the meter in this circuit.



Solution

We can label the circuit as shown.



The subscripts suggest a numbering of the circuit elements. Ohm's law to the 8 Ω resistor to get

$$i_1 = \frac{v_1}{8}$$

Apply KCL at the top node of the CCCS to get

$$i_1 + 0.25v_1 = i_2 \quad \Rightarrow \quad i_2 = i_1 + 0.25v_1 = \frac{v_1}{8} + 0.25v_1 = 0.375v_1$$

Ohm's law to the 8 Ω resistor to get

$$v_2 = 12i_2 = 12\left(0.375v_1\right) = 4.5v_1$$

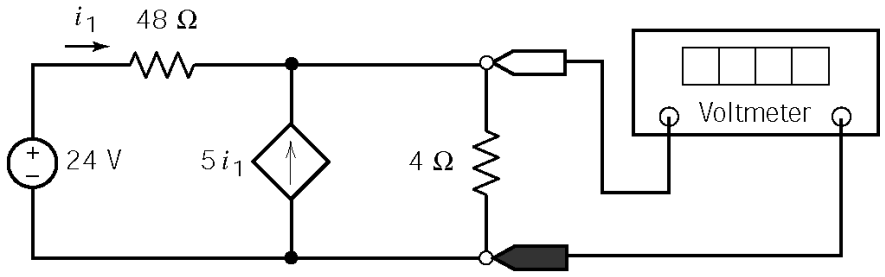
Apply KVL to the outside to get

$$v_1 + v_2 - 20 = 0 \quad \Rightarrow \quad v_1 + 4.5v_1 = 20 \quad \Rightarrow \quad v_1 = \frac{20}{5.5} = 3.636 \text{ V}$$

Apply KCL to get $i_m = i_2$. Finally, apply Ohm's law to the 12 Ω resistor to get

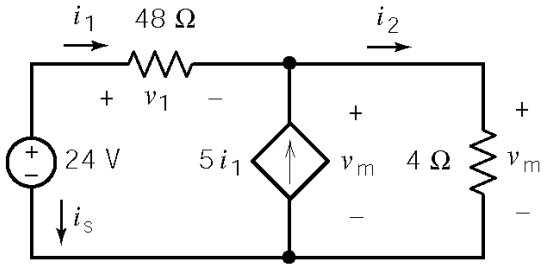
$$i_m = i_2 = \frac{v_2}{12} = \frac{4.5v_1}{12} = \frac{4.5\left(3.636\right)}{12} = 1.634 \text{ A}$$

3. Determine the value of the voltage that is measured by the meter in this circuit



Solution

We can label the circuit as shown.



The subscripts suggest a numbering of the circuit elements. Ohm's law to the 48 Ω resistor to get

$$v_1 = 48 i_1$$

Apply KCL at the top node of the CCCS to get

$$i_1 + 5i_1 = i_2 \quad \Rightarrow \quad i_2 = 6i_1$$

Ohm's law to the 4 Ω resistor to get

$$v_m = 4i_2 = 4\left(6i_1\right) = 24 i_1$$

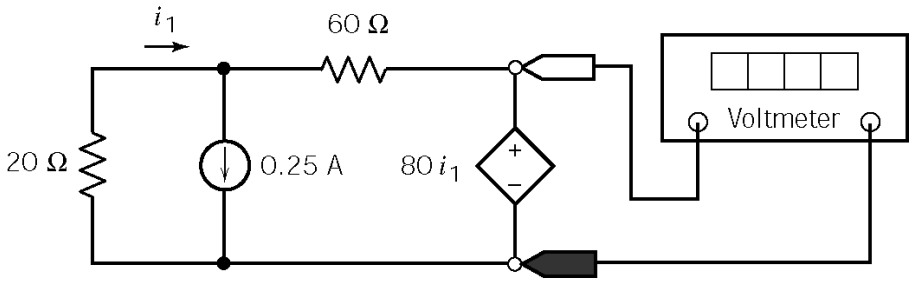
Apply KVL to the outside loop to get

$$v_1 + v_m - 24 = 0 \quad \Rightarrow \quad 48 i_1 + 24 i_1 = 24 \quad \Rightarrow \quad i_1 = \frac{24}{72} = \frac{1}{3} \text{ A}$$

Finally,

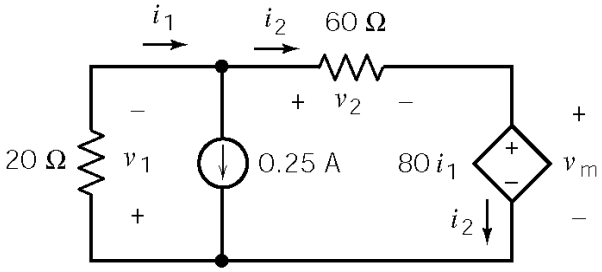
$$v_m = 24 i_1 = 24\left(\frac{1}{3}\right) = 8 \text{ V}$$

4. Determine the value of the voltage that is measured by the meter in this circuit.



Solution

We can label the circuit as shown.



The subscripts suggest a numbering of the circuit elements. Apply KCL at the top node of the current source to get

$$i_1 = i_2 + 0.25$$

Ohm's law to the resistors to get

$$v_1 = 20\,i_1 \quad \text{and} \quad v_2 = 60\,i_2 = 60\left(i_1 - 0.25\right) = 60\,i_1 - 15$$

Apply KVL to the outside to get

$$v_2 + 80\,i_1 + v_1 = 0 \quad \Rightarrow \quad \left(60\,i_1 - 15\right) + 80\,i_1 + 20\,i_1 = 0 \quad \Rightarrow \quad i_1 = \frac{15}{160} = 0.09375 \text{ A}$$

Finally,

$$v_m = 80\,i_1 = 80\left(0.09375\right) = 7.5 \text{ V}$$