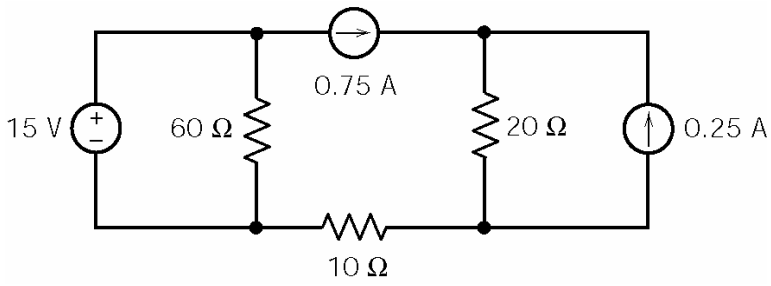
Problem

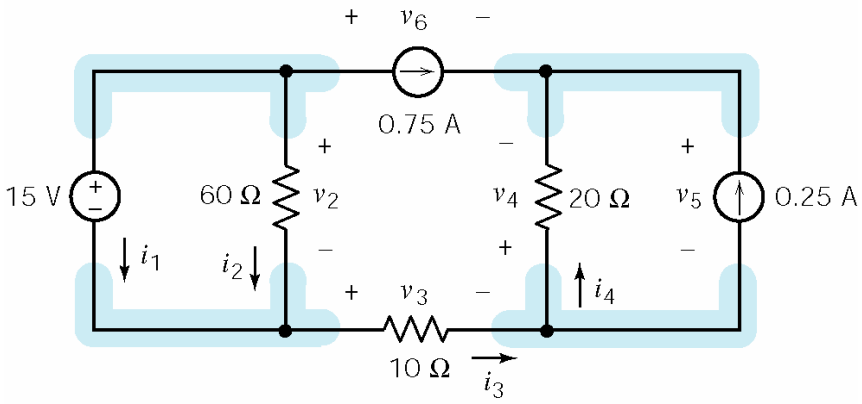
Determine the voltage and current of each of the circuit elements in this circuit.



Hint: You'll need to specify reference directions for the element voltages and currents. There is more than on way to do that, and your answers will depend on the reference directions that you choose.

Solution

We can label the circuit as follows:



The subscripts suggest a numbering of the circuit elements. Apply KCL at node *b* to get

$$i_4 + 0.25 + 0.75 = 0 \quad \Rightarrow \quad i_4 = -1.0 \text{ A}$$

Next, apply KCL at node *d* to get

$$i_3 = i_4 + 0.25 = -1.0 + 0.25 = -0.75 \text{ A}$$

Next, apply KVL to the loop consisting of the voltage source and the 60 Ω resistor to get

$$v_2 - 15 = 0 \quad \Rightarrow \quad v_2 = 15 \text{ V}$$

Apply Ohm's law to each of the resistors to get

$$i_2 = \frac{v_2}{60} = \frac{15}{60} = 0.25 \text{ A},$$

$$v_3 = 10\, i_3 = 10\left(-0.75\right) = -7.5 \text{ V}$$

and

$$v_4 = 20\, i_4 = 20\left(-1\right) = -20 \text{ V}$$

Next, apply KCL at node *c* to get

$$i_1 + i_2 = i_3 = 0 \quad \Rightarrow \quad i_1 = i_3 - i_2 = -0.75 - 0.25 = -1.0 \text{ A}$$

Next, apply KVL to the loop consisting of the 0.75 A current source and three resistors to get

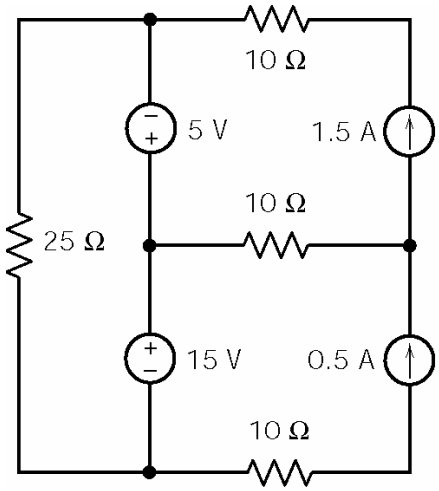
$$v_6 - v_4 - v_3 - v_2 = 0 \quad \Rightarrow \quad v_6 = v_4 + v_3 + v_2 = -20 + (-7.5) + 15 = -12.5 \text{ V}$$

Finally, apply KVL to the loop consisting of the 0.25 A current source and the 20 Ω resistor to get

$$v_5 + v_4 = 0 \quad \Rightarrow \quad v_5 = -v_4 = -\left(-20\right) = 20 \text{ V}$$

Problem

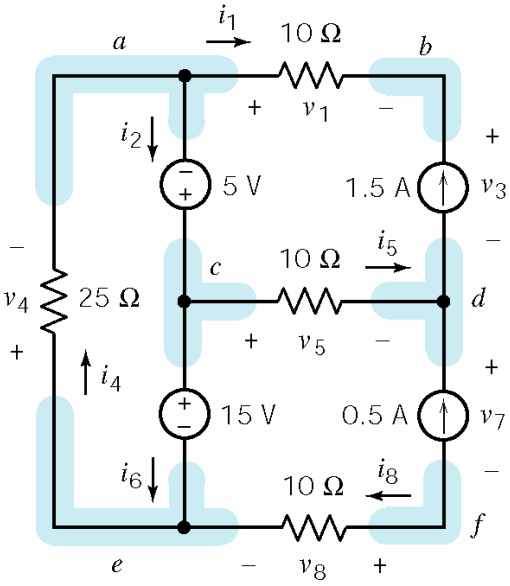
Determine the voltage and current of each of the circuit elements in this circuit.



Hint: You'll need to specify reference directions for the element voltages and currents. There is more than on way to do that, and your answers will depend on the reference directions that you choose.

Solution

We can label the circuit as follows:



The subscripts suggest a numbering of the circuit elements. Apply KCL at node *b* to get

$$i_1 + 1.5 = 0 \quad \Rightarrow \quad i_1 = -1.5 \text{ A}$$

Apply KCL at node *d* to get

$$i_5 + 0.5 = 1.5 \quad \Rightarrow \quad i_5 = 1.0 \text{ A}$$

Apply KCL at node *f* to get

$$i_8 + 0.5 = 0 \quad \Rightarrow \quad i_8 = -0.5 \text{ A}$$

Apply Ohm's law to each of the 10 Ω resistors to get

$$v_1 = 10\, i_1 = 10(-1.5) = -15 \text{ V}, \quad v_5 = 10\, i_5 = 10(1) = 10 \text{ V} \quad \text{and} \quad v_8 = 10\, i_8 = 10(-0.5) = -5 \text{ V}$$

Apply KVL to the loop consisting of the voltage sources and the 25 Ω resistor to get

$$-5+15+v_4=0 \quad \Rightarrow \quad v_4=-10 \text{ V}$$

Apply Ohm's law to the 25 Ω resistor to get

$$i_4=\frac{v_4}{25}=\frac{-10}{25}=-0.4 \text{ A}$$

Apply KCL at node *a* to get

$$i_1+i_2=i_4 \quad \Rightarrow \quad i_2=i_4-i_1=-0.4-(-1.5)=1.1 \text{ A}$$

Apply KCL at node *e* to get

$$i_6+i_8=i_4 \quad \Rightarrow i_6=i_4-i_8=-0.4-(-0.5)=0.1 \text{ A}$$

Apply KVL to the loop consisting of the 1.5 A current source, the 5 V voltage source and two 10 Ω resistors to get

$$v_1+v_3-v_5+5=0 \quad \Rightarrow \quad v_3=-5+v_5-v_1=-5+10-\left(-15\right)=20 \text{ V}$$

Finally, apply KVL to the loop consisting of the 0.5 A current source, the 15 V voltage source and two 10 Ω resistors to get

$$v_7+v_8-15+v_5=0 \quad \Rightarrow \quad v_7=15-\left(v_5+v_8\right)=15-\left(10+\left(-5\right)\right)=10 \text{ V}$$