

**Kirchhoff's Rules**

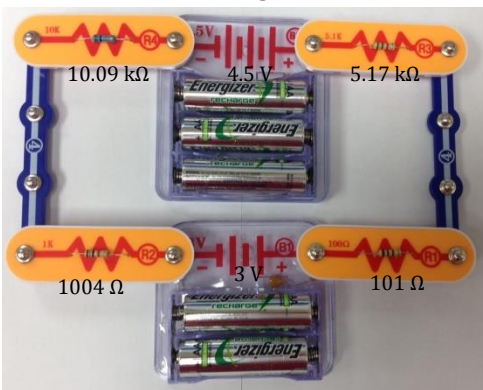
**Junction Rule**  
 Total \_\_\_\_\_ a junction must \_\_\_\_\_ the total current \_\_\_\_\_ of a junction

**Loop Rule**  
 For a \_\_\_\_\_-circuit loop, the \_\_\_\_\_ of all the potential \_\_\_\_\_ - total of all potential \_\_\_\_\_ = 0  
 (or the total voltage of a loop is zero)

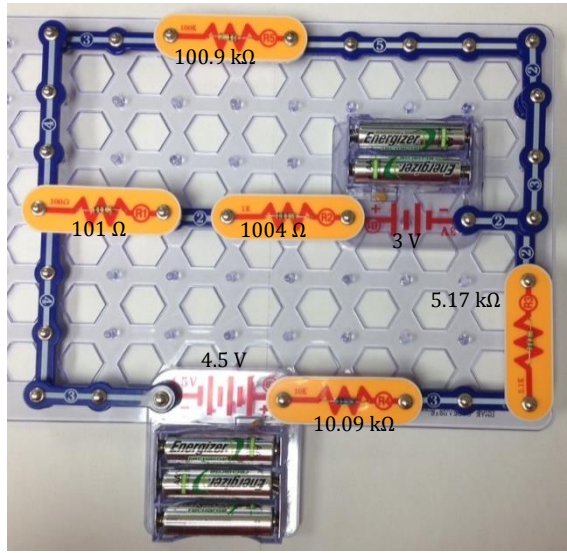
**Reasoning Strategy**

1. Draw the \_\_\_\_\_ in each branch of the circuit (flows out of positive terminal of battery). Choose any \_\_\_\_\_ . If you are wrong you will get a \_\_\_\_\_ current.
2. Mark each \_\_\_\_\_ with a \_\_\_\_\_ and \_\_\_\_\_ signs at opposite ends to show \_\_\_\_\_ drop. (Current flows from + to - through a resistor)
3. If the current \_\_\_\_\_ the element at +, voltage \_\_\_\_\_
4. If the current \_\_\_\_\_ the element at -, voltage \_\_\_\_\_
5. Apply \_\_\_\_\_ rule and \_\_\_\_\_ rule to get as many independent \_\_\_\_\_ as there are \_\_\_\_\_.
6. Solve the \_\_\_\_\_ of equations.

Find the current through the circuit



Find the currents through each element.



**Homework**

1. Can all of the currents going into the junction in Figure 1 be positive? Explain.
2. Apply the junction rule to junction b in Figure 2. Is any new information gained by applying the junction rule at e? (In the figure, each emf is represented by script E.)
3. Apply the loop rule to loop afedcba in Figure 2.
4. Apply the loop rule to loop abcdefgha in Figure 3. (OpenStax 21.31)  $-I_2R_2 + E_1 - I_2r_1 + I_3R_3 + I_3r_2 - E_2 = 0$
5. Apply the loop rule to loop aedcba in Figure 3. (OpenStax 21.32)  $I_1R_1 + I_2r_1 - E_1 + I_2R_2 = 0$
6. Apply the junction rule at point a in Figure 4. (OpenStax 21.35)  $I_3 = I_1 + I_2$
7. Apply the loop rule to loop abcdefghija in Figure 4. (OpenStax 21.36)  $-I_1R_1 + E_1 - I_1r_1 - I_1R_5 - I_3r_4 - E_4 - I_3r_3 + E_3 - I_3R_3 = 0$
8. Solve the circuit in Figure 3. Use the loop abcdefgha for one of your equations. (OpenStax 21.38)  $I_1 = 4.75 \text{ A}, I_2 = -3.5 \text{ A}, I_3 = 8.25 \text{ A}$

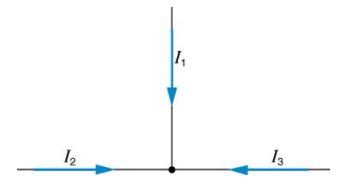


Figure 1

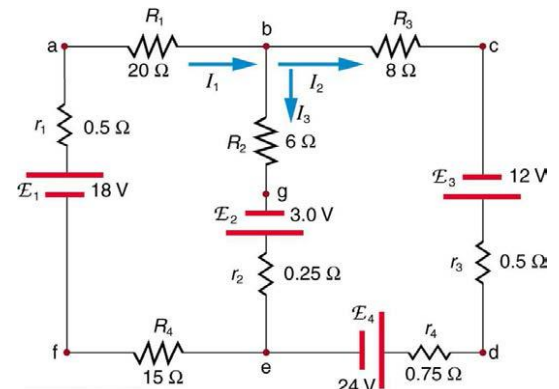


Figure 2

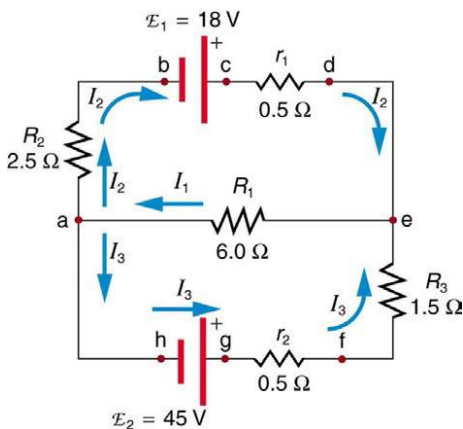


Figure 3

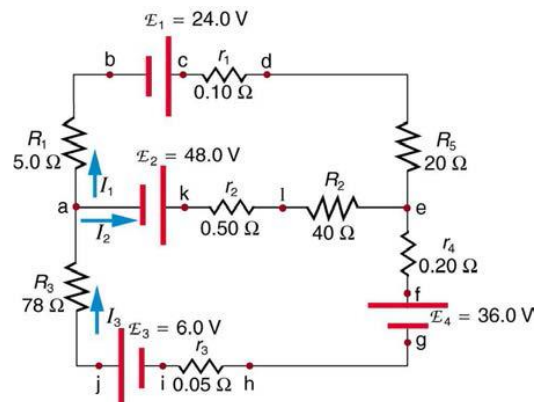


Figure 4