

Name: _____

Skill Sheet 20.2

Network Circuits

Network circuits are combinations of series and parallel circuits. Therefore, solving problems that involve networks circuits require using one or two formulas. In this skill sheet, you will practice solving these kinds of problems.

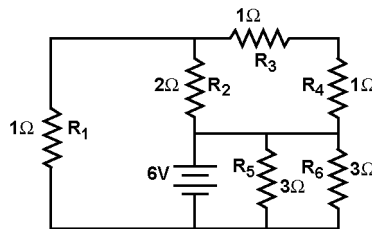
1. The formulas for solving network circuit problems

When solving resistor network circuits we have to remember the following formulas:

1. Ohm's law: $V = IR$
2. Combining resistors: R_{total} equals total resistance for the circuit:
 - a. In series: $R_{\text{total}} = R_1 + R_2 + \dots$
 - b. In parallel: $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
3. Kirchhoff's voltage law: The sum of voltages around a loop is zero.
4. Kirchhoff's current law: The sum of currents into a node equals the sum of currents out of the node.

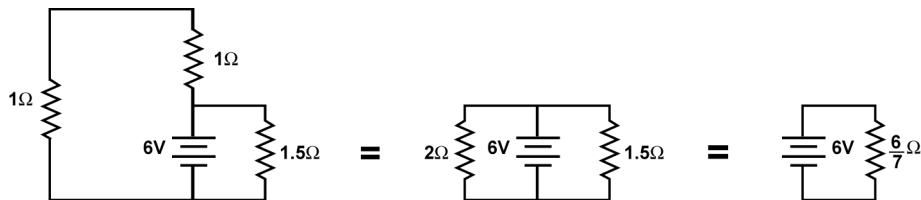
Example problem:

For the following circuit, calculate the total resistance and the total current drawn from the 6-volt battery.



First notice that resistors R_5 and R_6 are in parallel and that they combine to give a resulting resistance of 1.5 ohms.

Next, notice that resistors R_3 and R_4 are in series resulting in a resistance of 2 ohms. The resulting 2 ohms resistance is connected in parallel with another 2-ohm resistor. Thus the combined resistance of R_3 , R_4 , and R_2 is 1 ohm. Now the circuit looks like:



We see now that the 1-ohm resistors are connected in series. Therefore, they represent a 2-ohm resistor connected in parallel with the 1.5-ohm resistor.

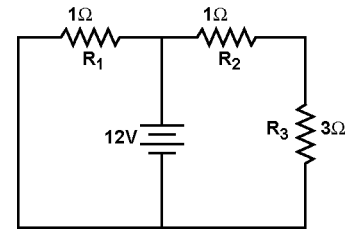
The 2-ohm resistor in parallel with the 1.5 ohm gives a total resistance of $\frac{6}{7}$ or 0.86 ohms.

The total current drawn from the battery can be now found by applying Ohm's law:

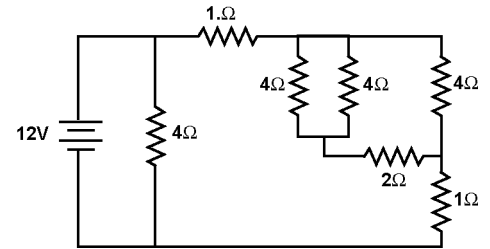
$$I = \frac{V}{R} = \frac{6 \text{ volts}}{6/7\Omega} = 7 \text{ A}$$

2. Problems

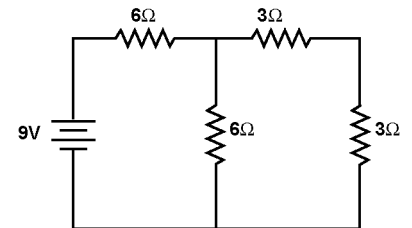
1. A 12-volt battery is connected to the resistor network shown on the schematic. Calculate the current through each resistor in the network.



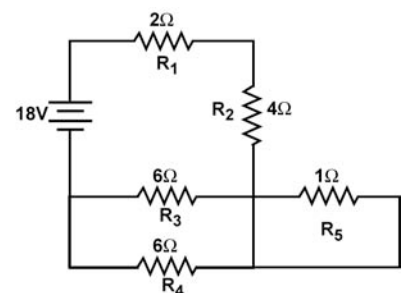
2. Combine resistances and calculate the total resistance.



3. Calculate the total current drawn from the 9-volt battery.

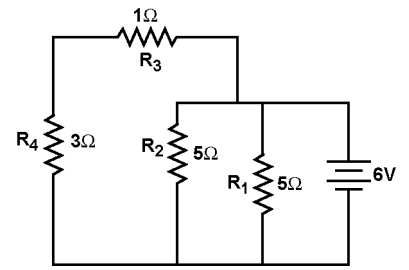


4. For the circuit at right, trace the path of the current through the circuit and then answer the following questions:

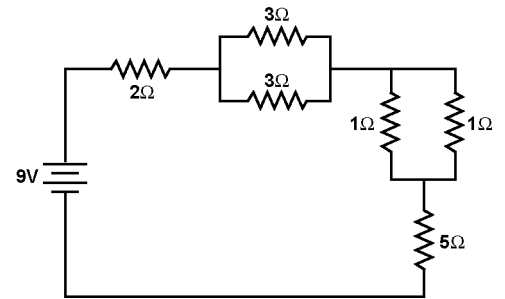


- a. Does current flow through R5? Why or why not?
- b. Given your answer to (a), what is the total resistance for the circuit?
- c. Given your answer to (a), what is the total current leaving the battery?
- d. What is the current through resistor R₃?
- e. What is the voltage across R₅? Explain your answer.

5. Find the total current drawn from the 6-volt battery. What is the voltage across resistor R_4 ?



6. What is the voltage across the 5-ohm resistor?



7. Calculate the voltage across points A and B (V_{AB}) when the resistor R_4 is $10\ \Omega$. HINT: Find the voltage at A (V_A) and the voltage at B (V_B) and subtract.

