Engineering

Series Circuits Practice

April 13, 2020

9-12/ Engineering

Series Circuits Practice: [April 13, 2020]

Objective/Learning Targets:

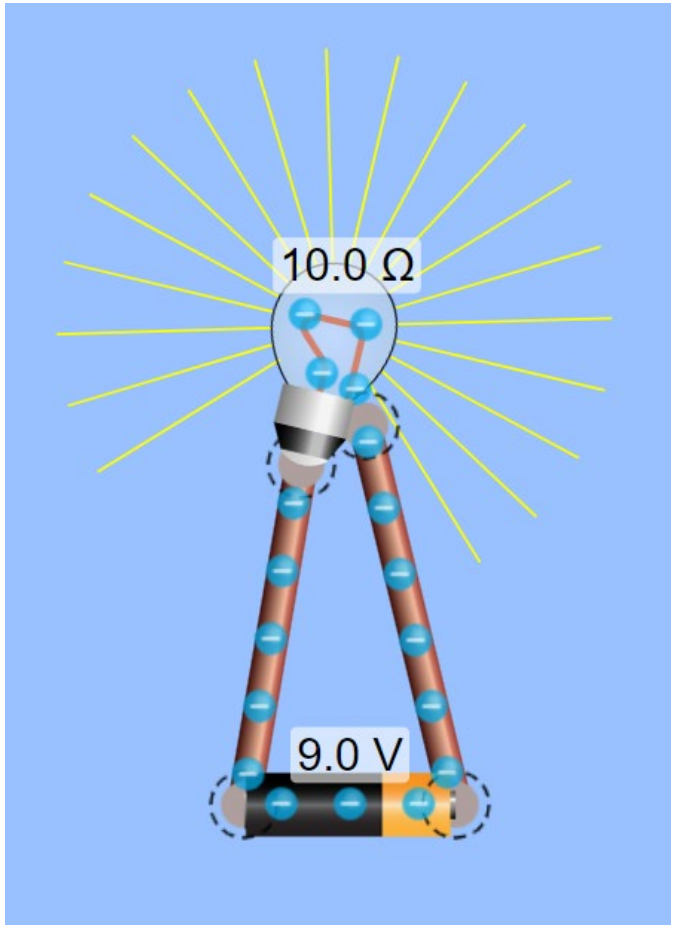
1. Discuss basic electricity relationships
2. Build circuits from schematic drawings
3. Understand the attributes of Ohm's law in series circuits
4. Calculate Ohm's law in series circuits
5. Introduction to resistor color coding

Ohm’s Law in Series Circuits

- Use lessons learned from April 9 and April 10 to support you in this lesson.
- Use the simulation tool to build your circuits and check your work or you can use online ohm’s law and circuit calculators to check your work. I recommend tools from Digikey.
- Use the supports that follow to help you with calculating ohm’s law in series circuits. Read carefully for what the question is asking for and follow the steps.
- If you need assistance email your engineering instructor.

Learning tools for today

- Use this link and press play to enter a free simulator.
- Select intro and build the simple series circuit included in this lesson. You will need to build circuits using a battery, light bulbs, and wires.
- Click the selection in the top right for labels and values.
- You will also be calculating Ohm's law to understand how attributes of the law apply in series circuits.



Relationships of Electrical Properties

Ohm's Law

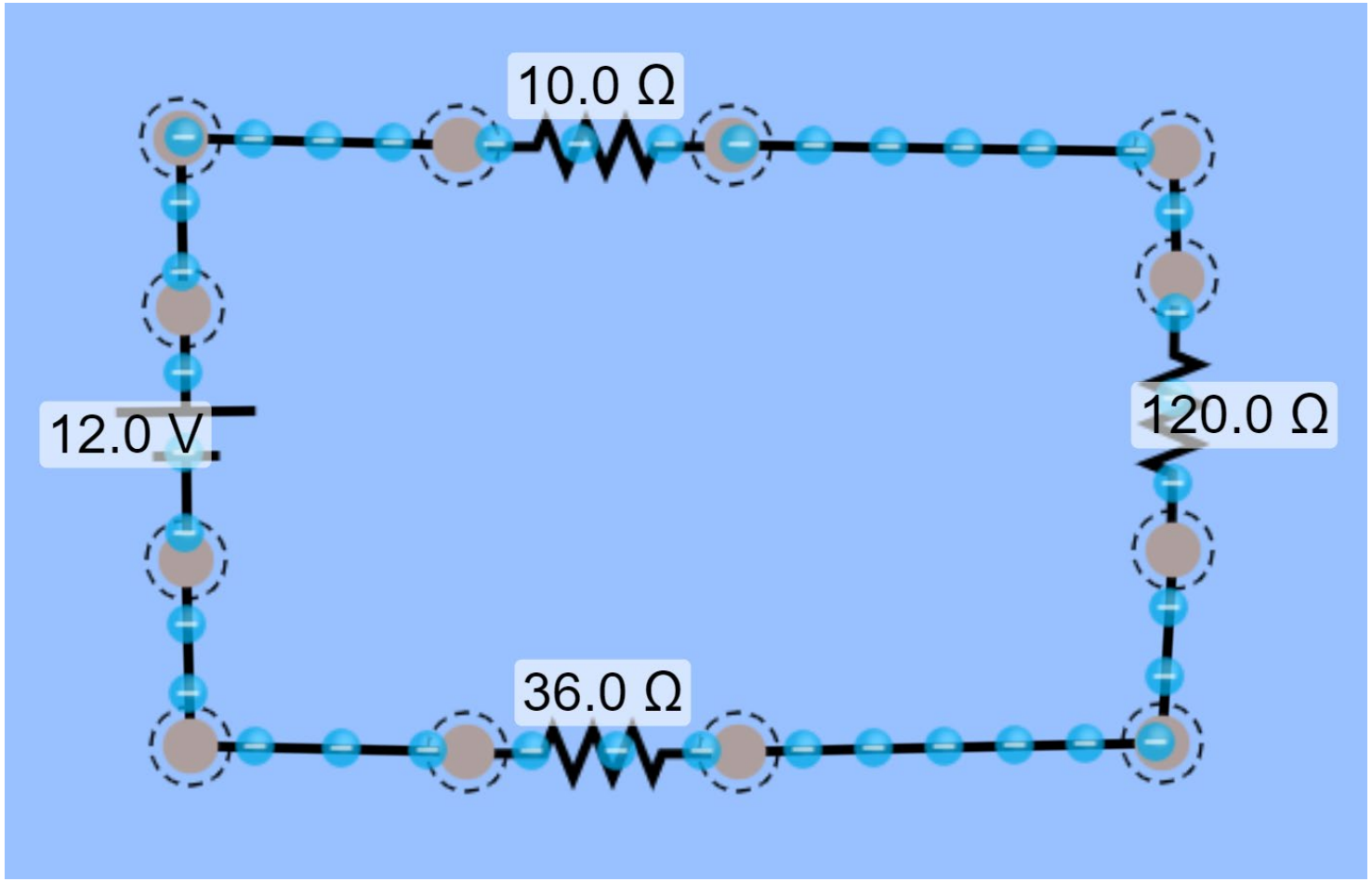
- Ohm's Law is the mathematical relationship between current, voltage, and resistance.

- If you know two of the three quantities, you can solve for the third quantity.

V=IR	I=V/R	R=V/I

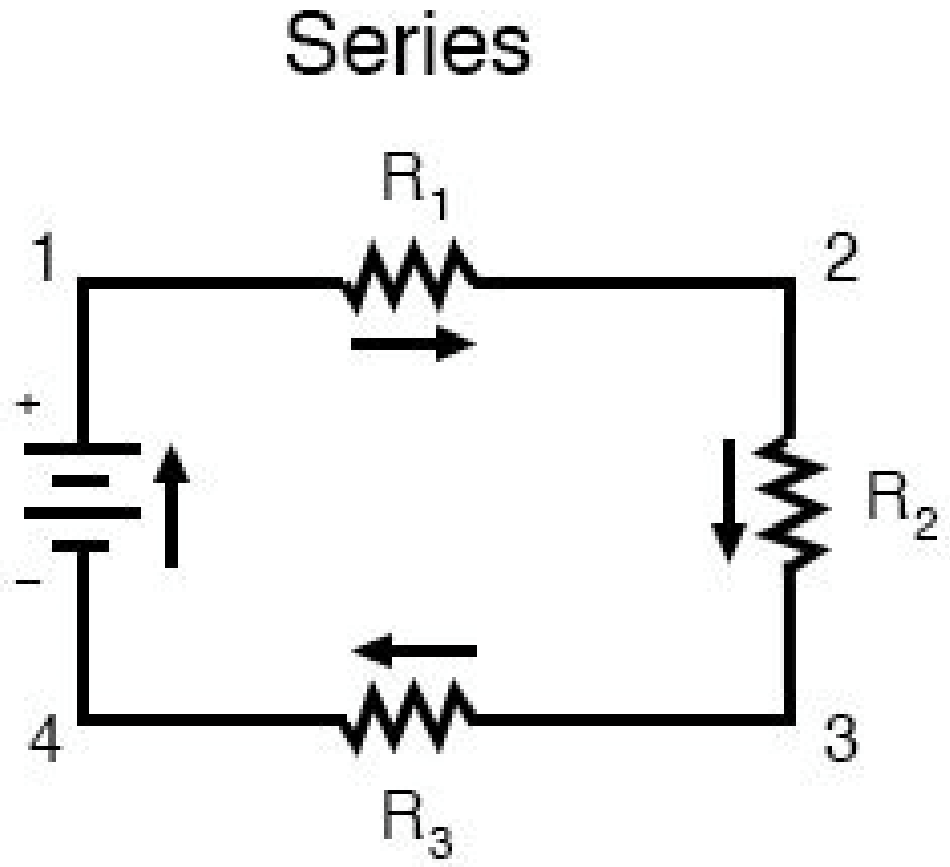
Concept	Measurement	Symbol	Formula
Voltage	Volts	V	V
Current	Amperes	A	I
Resistance	Ohms	Ω	R

1 Solve for all unknown values



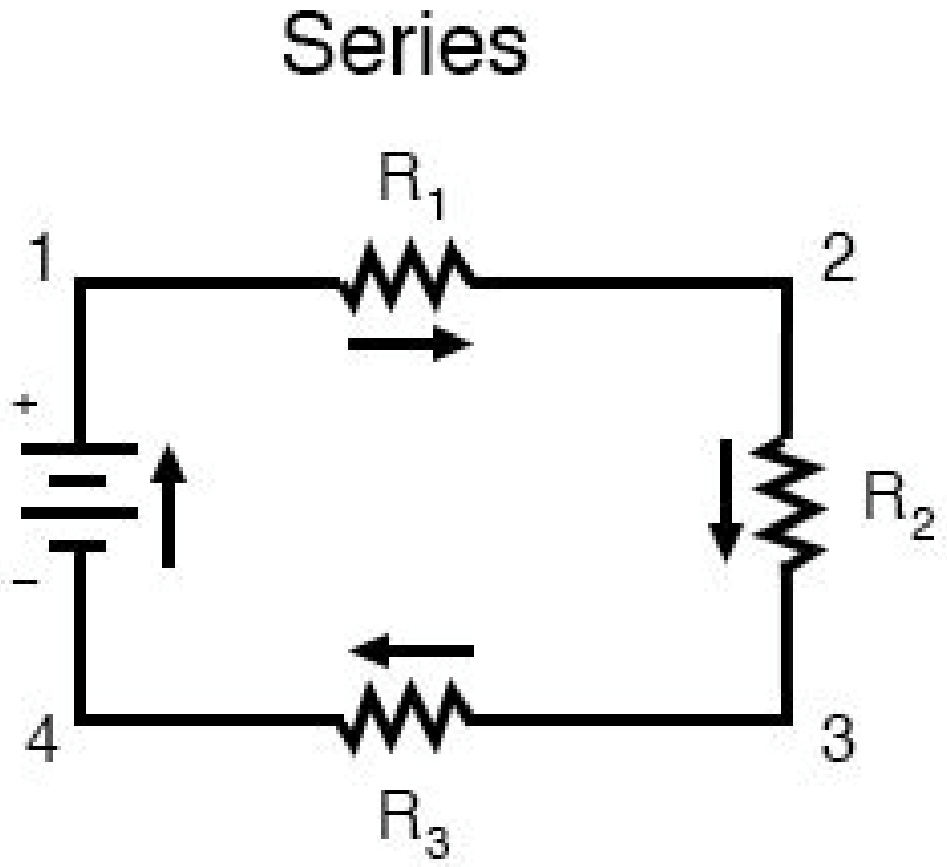
2 Solve for all unknown values

- VT=18V
- R1=30Ω
- R2=100Ω
- R3=70Ω



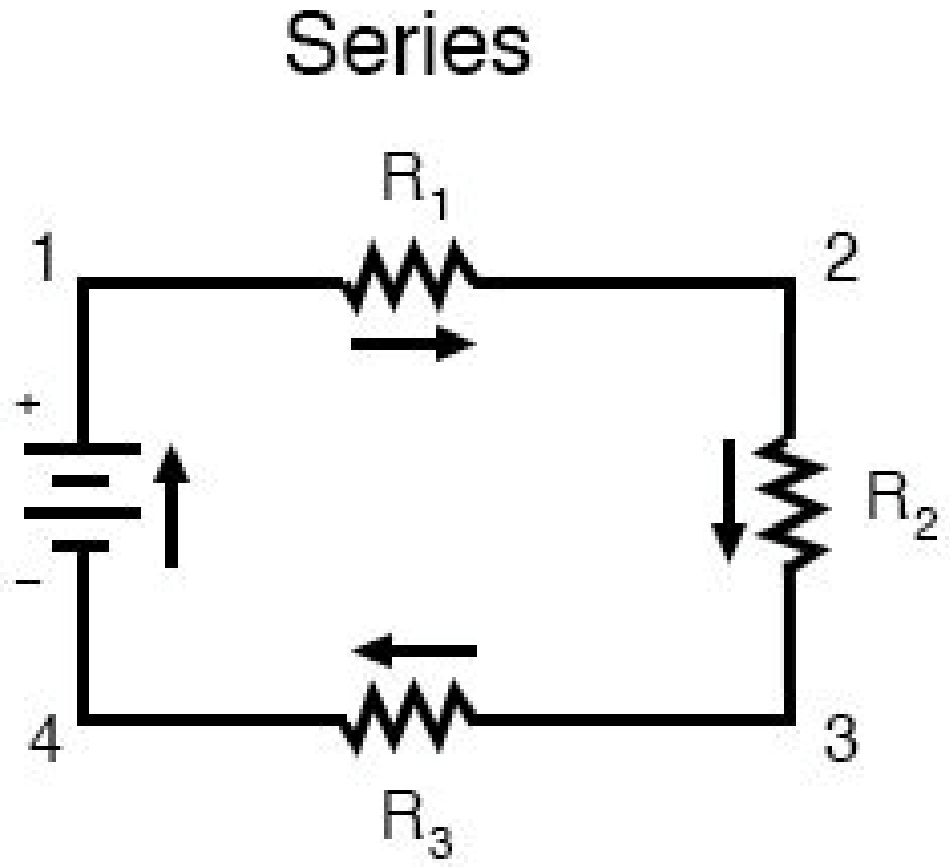
3 Solve for all unknown values

- Use the circuit to as a model for your actual circuit.
- Sketch a simple series circuit with 4 resistors using the following known values.
- VT=120V
- R1=20Ω
- R2=120Ω
- R3=40Ω
- R4=80Ω



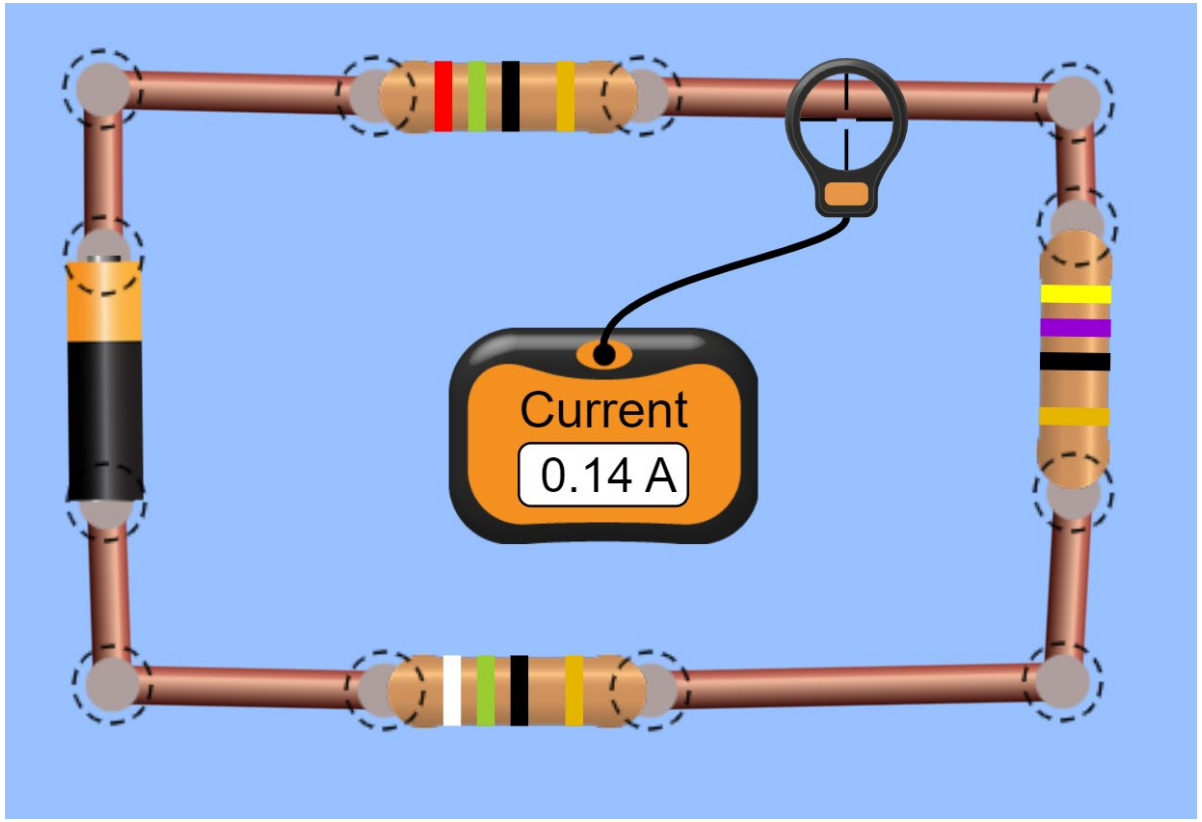
4 Solve for all unknown values

- IT=.25 A
- R1=16Ω
- R2=32Ω
- R3=49Ω



5 Solve for all unknown values

- For this circuit you will need to determine the resistance of the resistors by resistor color code. Use this simulator to determine the resistance.
- Do you see a pattern to the color code (Chart Here)?
- What are the resistance values?
- Watch this to learn more about resistor color codes. You only need to watch to the 3:10 minute mark.
- For our purposes we will only use 4 band resistors.



EXAMPLE PROBLEM ON RESISTORS IN SERIES

Question

The current flowing in a circuit containing four resistors connected in series is **I = 1.0 A**. The potential drops across the first, second and third resistors are, respectively: **V = 5 V**, **V = 8 V** and **V = 7 V**.
The equivalent resistance of the circuit is **R = 30 Ω**.

Find the total voltage supplied by the battery, and also current, voltage drop, and resistance of each resistor in the circuit.

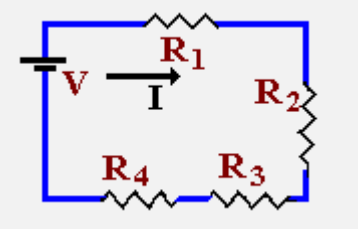


Figure 1 ***Example Problem: Resistors in series***

Hints

1. How are resistors related when connected in series?
2. What is true about potential drops of resistors when connected in series?
3. You will need to use Ohm's Law.

Solution

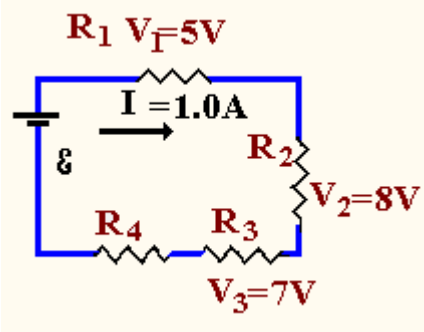


Figure 2 *Example Problem, with given data*

First, let's label the diagram with the information given in the question.

There are several ways of solving this problem (see alternate solutions), but this tutorial will only go through one of these ways.

Because the resistors are connected in series, then the same current flows through each one. Using the Ohm's Law, we can find the resistances of the first, second and third resistors.

$$R_1 = \frac{V_1}{I}, R_2 = \frac{V_2}{I}, R_3 = \frac{V_3}{I}$$

$$R_1 = \frac{5.0}{1.0} = 5.0 \ \Omega \quad R_2 = \frac{8.0}{1.0} = 8.0 \ \Omega \quad R_3 = \frac{7.0}{1.0} = 7.0 \ \Omega$$

Now, using the equivalent resistance, we can find the resistance in the fourth resistor. This is a series circuit, so the equivalent resistance is the sum of the individual resistances.

$$R_{equivalent} = R_1 + R_2 + R_3 + R_4$$

$$R_4 = R_{equivalent} - (R_1 + R_2 + R_3)$$

$$R_4 = 30 - (5.0 + 8.0 + 7.0) = 10 \ \Omega$$

The current flowing through the fourth resistor is also I=1.0A. Using Ohm's Law again, we find the voltage across this resistor.

$$V_4 = I \cdot R_4$$

$$V_4 = (1.0) \cdot (10) = 10 \ V$$

The total voltage supplied by the battery must equal to the total voltage drop across the circuit (this is known as Kirchhoff's Voltage Law). So, we must sum up the voltage drops across the resistors.

$$V = V_1 + V_2 + V_3 + V_4$$

$$V = 5.0 + 8.0 + 7.0 + 10 = 30 \ V$$