PHYSICS IN MOTION
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Unit 5G
Series Circuits
Series Circuits Lab

Name:

Date:

As fire inspector in your small town, you see some interesting things, but this might top them all. Following a contentious mayoral election, and just three days before the newly elected mayor is to take office, city hall catches fire and nearly burns to the ground. Some call it an accident; others suspect arson. As you arrive on the scene, the local fire chief briefs you on the details.

You learn that the fire began late at night and seems to have started in the special events kitchen based on the burn pattern. Taking a closer look around the kitchen, you notice the remaining wall supports are badly burned. One beam that touches a partially melted wire is especially charred. Building maintenance informs you the wire is part of a circuit that powers countertop appliances in the kitchen, and the circuit was wired with a fuse to make sure the current would never exceed 2 A. The circuit is wall-powered (120 V), and you notice several places on the damaged wire where it appears to have been broken open and rejoined with solder. You can find no fuses in the circuit. There is a slow cooker on the counter that is unplugged, but the only appliance connected to the circuit is a coffee maker.

With mounting pressure for answers about what caused the fire, you carefully extract the circuit and hurry back to your lab with the wire, the coffee maker, and the slow cooker. By testing the circuit and the appliances, you hope to find the truth about the fire's origin.

Materials:

- resistor labeled "coffee maker"
- resistor labeled "slow cooker"
- 5 ft copper wire (in 3 pieces)
- alligator clips or other electrical connectors
- multimeter

Procedure:

a. Using the multimeter, measure the resistance of each of the circuit elements (coffee maker resistor, slow cooker resistor, each piece of the copper wire), and record these values in the table below:

Circuit Element	Resistance (Ω)
Coffee Maker Resistor	
Slow Cooker Resistor	
Wire Segment #1	
Wire Segment #2	
Wire Segment #3	

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Questions to consider:

b. In the actual circuit, these elements were not separate from one another but were rather connected in a row. Using the alligator clips, link them together and measure the resistance of the following element combinations:

Circuit	Resistance (Ω)
CM Resistor + 2 Wire Segments	
SC Resistor + 3 Wire Segments	
CM Resistor + SC Resistor + 1 Wire Segment	
CM Resistor + SC Resistor + 3 Wire Segments	

1. Based on your results, what "rule" applies for the total resistance in a series circuit? In other words, what trend do you observe? Explain that trend in words and as an equation below.

c. Assuming a voltage of 120 V, use Ohm's law to solve for the current in each of the above circuits. Enter the calculated values in the table below:

Circuit	Current (A)
CM Resistor + 2 Wire Segments	
SC Resistor + 3 Wire Segments	
CM Resistor + SC Resistor + 1 Wire Segment	
CM Resistor + SC Resistor + 3 Wire Segments	

2. Based on the current limits of the actual circuit in city hall, are any of these experimental circuits unsafe, meaning they would burn out the fuse? If so, which one(s)?

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3. **Based on your measurements and on your inspection of the scene, write a brief report to the fire chief that explains your findings. If possible, discuss whether you believe the fire was set intentionally and why you came to that conclusion. If not possible, explain the factors that prevent you from making a clear decision.**