PHYSICS
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Unit 5G
Series Circuits
Series Circuits Lab

Name:

Date:

As county 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 was to take office, city hall caught fire and burned to the ground. Some call it an accident; others suspect arson. As you arrive on scene, the local fire chief briefs you with the details.

You learn that the fire began late at night, and based on the burn pattern seems to have started in a basement kitchen area used for special events. Taking a look in the kitchen, you notice the remaining wall supports are badly burned, with one beam that touches a nearly-melted wire being especially charred. Building maintenance informs you that the wire is part of a circuit to power countertop appliances in the kitchen, and had a fuse to make sure the current would never exceed 2A. The circuit is wall-powered (120 V), and inspecting what remains of the wire closely, you notice several places where the wire appears to be broken open and rejoined with solder. You can find no fuses in the circuit. A coffeemaker is all that seems to be connected to the circuit, with a slow cooker also on the counter but not plugged-in.

With mounting pressure for answers about what caused the fire, you carefully extract the wire circuit, and hurry back to your lab with the wire, the coffeemaker and slow-cooker. Through testing the circuit and appliances you hope to get an answer about the fire's origin….

Materials:

- One resistor labeled 'Coffee maker'
- One resistor labeled 'Slow cooker'
- 5 ft copper wire (3 pieces)
- Alligator clips or other electrical connectors
- Multimeter

Procedure:

a. Using the multimeter, measure each of the circuit component materials (coffee maker resistor, slow cooker resistor, each piece of 5 ft. copper wire) and record their values in this table:

Circuit Element	Resistance (Ohms)
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 real circuit, these elements were not separate from one another, but joined in a row. Using the alligator clips or other connectors, link together and measure the resistance of the following element combinations:

Circuit	Resistance (Ohms)
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 answers, what 'rule' for the total resistance in a series circuit can you deduce? In other words, what trend do you observe, and how can that trend be written in words or as an equation?

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

Circuit	Current (Amperes)
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 real circuit in city hall, are any of these circuits unsafe, meaning they would burn out the circuit fuse? If so, which one(s)?

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Questions to consider:

3. Based on your measurements and on your inspection of the wire, write a brief report to the fire chief that explains your findings. If possible, give a decision for whether the fire was intentional or not, and why. If not possible, explain the factors that prevent a clear decision.

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