Series circuits: current and voltage sharing

Student activity • investigation and reasoning

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The question

How do two series resistors share a source voltage?

Compare one resistor with two in series, then measure current and voltage at different positions.

Equipment

- Current-limited 0–3 V source, switch, ammeter, voltmeter and leads
- Two 100 Ω resistors and one 220 Ω resistor, each ≥0.5 W

Keep the source at or below 3.0 V and current limit at 0.05 A. Disconnect before moving meters or changing resistors. Never put the ammeter across the source. Use only the specified low-voltage components.

Course coverage: Shared Physics / Double Award: 2.7–2.9, 2.13, 2.19. Series circuits.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. Build a staff-checked 3.0 V maximum circuit containing a 100 Ω resistor rated at least 0.5 W, a switch and series ammeter. Record actual source voltage and current.

2. Disconnect and add a second 100 Ω resistor in series. Reconnect after checking and record source voltage, current and voltage across each resistor.

3. Disconnect before moving the ammeter to another point in the same series loop. Compare the steady current readings.

4. Replace the second resistor with 220 Ω, still rated at least 0.5 W. Repeat the voltage and current measurements without changing the chosen source setting.

5. Compare the sum of the resistor voltages with the measured source voltage. Calculate total resistance by addition and predict current using actual source voltage.

6. Explain why opening one point stops current through both components, and why series wiring is unsuitable for independently switched domestic lamps.

Cleanup

- Switch off, disconnect and return components.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Ideal practice example: 3.0 V across 100 Ω + 200 Ω gives 0.010 A, with 1.0 V and 2.0 V across the resistors. Actual experiment values use 100 Ω and 220 Ω; do not substitute the practice numbers for measurements.

Configuration	Source V / V	Current / A	$V_1 + V_2$ / V
One 100 Ω			—
100 Ω + 100 Ω			
Moved ammeter			
100 Ω + 220 Ω			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. How do series resistances combine?

2. How does steady current compare around the loop?

3. How do component voltages compare with source voltage?

4. Which of two unequal resistors has greater voltage at the same current?

5. What happens when the loop is opened?

6. Find total resistance in the practice example.