Resistance from voltage and current

Student activity • investigation and reasoning

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The question

Can repeated voltage and current measurements identify a resistor's resistance?

Use a low-voltage circuit to calculate resistance and check whether it remains approximately constant.

Equipment

- Current-limited low-voltage source, switch, ammeter, voltmeter and leads
- 100 Ω and 220 Ω resistors, each at least 0.5 W

Keep the source at or below 3.0 V with a 0.05 A current limit. Disconnect before changing resistors or meter connections. Never connect an ammeter across the source. Stop if components warm unexpectedly.

Course coverage: Shared Physics / Double Award: 2.10, 2.13. V = IR.

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. With the source disconnected, connect a 100 Ω resistor rated at least 0.5 W, switch and ammeter in series. Connect the voltmeter across the resistor and ask staff to check the circuit.

2. Use a 0–3 V source limited to 0.05 A. Record actual V and I at three increasing settings near 1, 2 and 3 V, opening the switch between readings.

3. Calculate R = V/I for each pair, converting milliamperes to amperes. Compare the results with the resistor's marked value and tolerance.

4. Disconnect and substitute a 220 Ω resistor rated at least 0.5 W. Repeat the three settings and calculations.

5. Explain differences using meter resolution, component tolerance and temperature. Do not divide by a zero current reading or treat an over-range display as zero.

6. Use the practice pair 2.4 V and 0.020 A to calculate resistance, then solve V = IR for a 150 Ω resistor carrying 0.010 A.

Cleanup

- Switch off and disconnect all sources; return resistors and meters.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Practice pairs are invented. Resistance at an operating point is V/I. Approximate constancy across measurements is evidence of ohmic behaviour over the tested range, not a guarantee at all temperatures or voltages.

Resistor / setting	V / V	I / A	R / Ω
100 Ω / 1 V			
100 Ω / 2 V			
100 Ω / 3 V			
220 Ω / 1 V			
220 Ω / 2 V			
220 Ω / 3 V			

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Rearrange V = IR for R.

2. Find R for 2.4 V and 0.020 A.

3. Find V for 150 Ω and 0.010 A.

4. Why convert mA?

5. Why avoid a zero-current division?

6. Why might resistance change during a test?