Current–voltage graphs: cool wire and fixed resistor

Student activity • investigation and reasoning

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The question

What graph supports the claim that a component has constant resistance?

Measure a fixed resistor and a mounted resistance wire at low currents, including reversed polarity, while controlling temperature.

Equipment

- Current-limited low-voltage source, switch, two meters and leads
- 100 Ω resistor ≥0.5 W; staff-mounted 10–20 Ω resistance wire

Staff prepare and secure the wire; pupils do not cut it. Limit current to 0.05 A, resistor voltage to 3.0 V and wire voltage to 1.0 V. Disconnect before reversing polarity. Do not touch the wire during a run; stop if it heats noticeably.

Course coverage: Shared Physics / Double Award: 2.9, 2.13. Ohmic current–voltage characteristics.

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. Staff check a series ammeter circuit with a voltmeter across a 100 Ω resistor rated at least 0.5 W. Use a low-voltage source with a 0.05 A current limit.

2. Measure two positive voltage/current pairs below 3.0 V and a zero-source reading. Disconnect before reversing the source polarity and record two negative pairs, using signed meter readings.

3. Disconnect and substitute a staff-mounted 10–20 Ω resistance wire on a heat-resistant board. Reduce the voltage ceiling to 1.0 V and retain the 0.05 A current limit.

4. Repeat two positive, zero and two negative settings for the wire. Take brief readings, open the switch between them and allow cooling if needed. Record actual V and I even when the current limit restricts the source.

5. Plot I vertically against V horizontally for each component. Look for an approximately straight line through the origin over the tested range.

6. Calculate resistance from a nonzero V/I pair and compare it with the inverse gradient when axes use amperes and volts. Explain why heating could change the result.

Cleanup

- Switch off and disconnect sources; allow wire boards to cool before collection.

Record your evidence

Blank spaces are for your own work

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Reference and task data

For an I-against-V graph, gradient is I/V, so resistance is its inverse for a straight line through the origin. The experiment tests a restricted low-current range. Wire length and diameter must be chosen by staff to provide 10–20 Ω; do not assume an arbitrary short wire is safe at 3 V.

Setting	Resistor V / V	Resistor I / A	Wire V / V	Wire I / A
Negative high				
Negative low				
Zero				
Positive low				
Positive high				

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Which quantity is on the vertical axis?

2. What shape supports constant resistance?

3. Is the I–V gradient itself resistance?

4. Why reverse both signs?

5. Why restrict wire current?

6. Can V/I be found at the origin?