Current and circuits

International Baccalaureate · IB Diploma · Physics · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

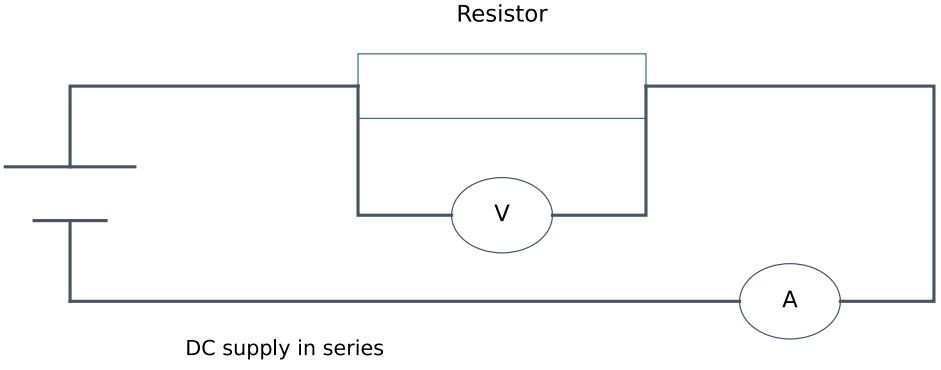
Current , potential difference and resistance

What would explain this observation?

- A lamp becomes dimmer when another is added in series. **Current** and energy transfer depend on the whole circuit, not only one lamp.

Build the model

- Current is charge passing per time.
- **Potential difference** is energy transferred per charge.
- Resistance is potential difference divided by current for a stated operating point.
- current: Rate of flow of charge.
- potential difference: Energy transferred per unit charge.



Ammeter in series; voltmeter across resistor

An ammeter goes in series to measure current; a voltmeter goes in parallel across the component

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Choose evidence that can test it

- Current is the same through components in series.
- Potential differences add around the series path.
- In parallel, branches share the same potential difference, while branch currents sum at a junction.

In the lab: Place an ammeter in series and a voltmeter in parallel. For an I-V investigation, change voltage in steps, reverse polarity when appropriate and limit current to reduce heating.

Work from known quantities

- Known: a resistor has 6.0 V across it and carries 0.30 A.
- Use R = V/I.
- R = 6.0/0.30 = 20 ohms.
- Power = VI.
- Power = 6.0×0.30 = 1.8 W.
- These quantities describe the same operating point.

Your turn: A component has 12 V across it and carries 0.40 A. Find resistance.

Check the conclusion and its limits

- Current is not used up by a lamp.
- A filament heats up, so its resistance need not remain constant as voltage changes.

Not true: A lamp uses up electric current as charge passes through it. Current is a flow of charge, and charge is conserved: the same current enters and leaves a lamp. The lamp transfers energy from the charges to heat and light; it does not consume the charges.

Key:

- Current is charge passing per time.
- Current is the same through components in series.
- Watch for: current is not used up by a lamp.

Write from a resistance of 24 ohms

- A component has 12 V across it and carries 0.50 A.
- Find the resistance and the power. A lamp does not use up current.

Write from a power of 6.0 watts

- A component has 12 V across it and carries 0.50 A.
- P = VI = 6.0 W, checked by P = I squared R = 0.25 × 24 = 6.0 W – two routes, one answer.

Write from a series total of 15 ohms

- A 6-ohm and a 9-ohm resistor connect in series, then in parallel.
- Series: 15 ohm (one current); parallel: 54 ÷ 15 = 3.6 ohm – series adds resistances, parallel adds conductances.