

Current and circuits

International Baccalaureate · IB Diploma · Physics · HL

Scope and prerequisites

This handout covers selected HL 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.

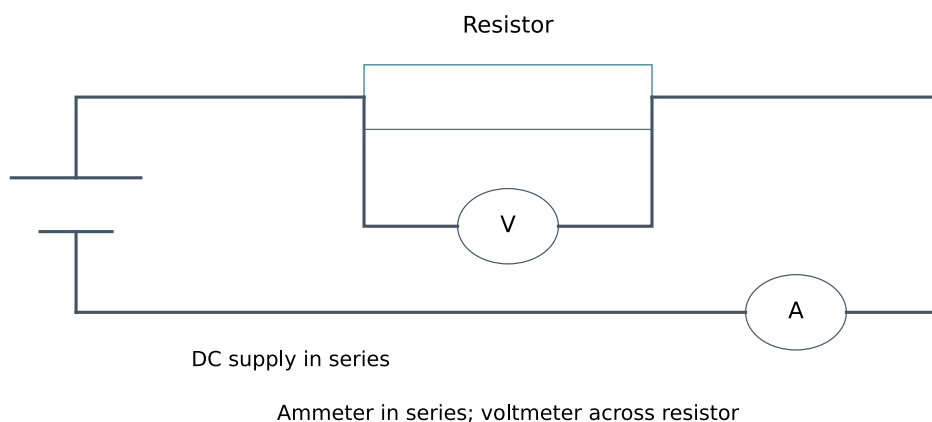
Current, potential difference and resistance

■ 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.
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■ 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.



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

■ 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 = $6.0 \times 0.30 = 1.8$ 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 36 ohms

- A component has 9 V across it and carries 0.25 A.
- Find the resistance and the power. A lamp does not use up current.

■ **Write from a power of 2.25 watts**

- A component has 9 V across it and carries 0.25 A.
- $P = VI = 2.25 \text{ W}$, checked by I^2R with $R = 36 \text{ ohm}$: $0.0625 \times 36 = 2.25 \text{ W}$ – two routes, one answer.

■ **Write from a series-parallel split**

- Two 12-ohm resistors: in series 24 ohm, in parallel 6 ohm.
- Series carries one current through both; parallel splits it – the SAME pair, four times different in resistance.