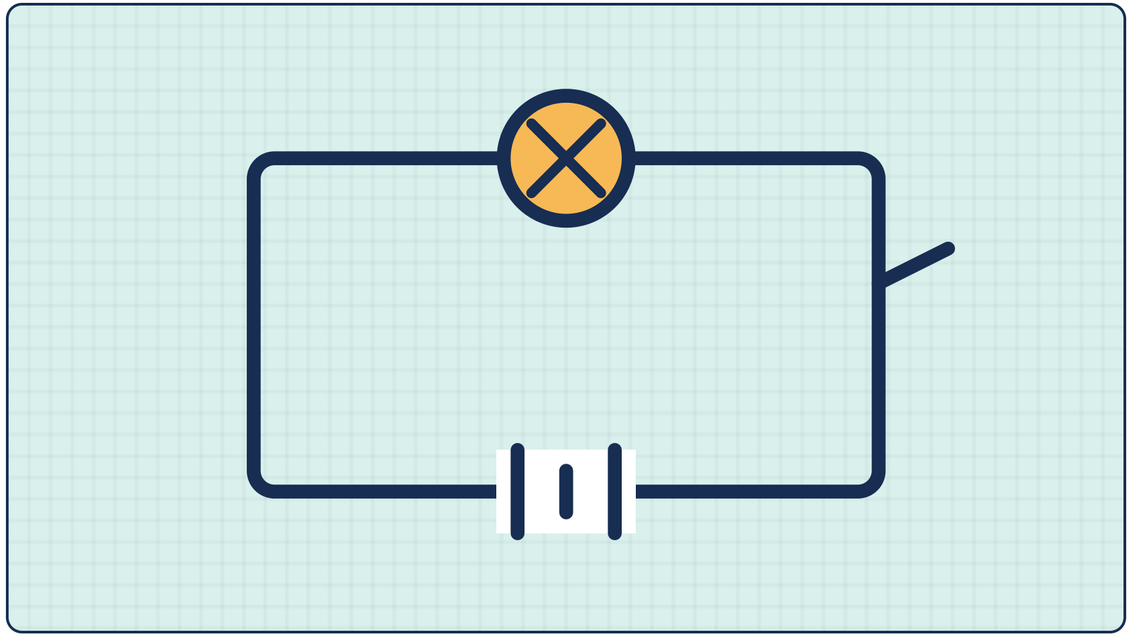
Physics · Current, voltage, resistance, and series vs parallel

Electric Circuits



Goals

By the end of this lesson you can

- Explain why a circuit must be a complete loop
- Describe current, potential difference and resistance
- Calculate with V = IR
- Compare series and parallel circuits
- Explain how homes are wired

A circuit is a complete loop

- Charge flows only around a complete, unbroken loop
- The cell or battery pushes the charge round
- Opening a switch breaks the loop and the current stops
- Conventional current flows from + to – outside the cell
- Electrons actually drift the other way, from – to +

Current and potential difference

Current (I)

- The rate of flow of charge
- Unit: ampere (A); 1 A = 1 coulomb per second
- Measured with an ammeter
- Ammeter goes in series, in the loop

Potential difference (V)

- Energy transferred per unit of charge
- Also called voltage; unit: volt (V)
- Measured with a voltmeter
- Voltmeter goes in parallel, across a component

Resistance and Ohm's law

- Resistance opposes the current in a component
- Unit: ohm (Ω); 1 Ω = 1 volt per ampere
- $V = I \times R$
- For a fixed resistance, more voltage means more current
- Copper wires have low resistance; lamp filaments have high resistance

Worked example

Worked example: a torch lamp

- A lamp is connected to a 3.0 V battery
- The ammeter reads 0.25 A
- $R = V \div I$
- $R = 3.0 \div 0.25$
- $R = 12\ \Omega$

Series circuits: one path

- All components sit in one loop
- The current is the same at every point
- Supply voltage is shared between components
- Total resistance = $R_1 + R_2 + \ldots$
- If one lamp breaks, the whole circuit stops

Parallel circuits: several paths

- Each component has its own branch to the supply
- Each branch gets the full supply voltage
- Branch currents add up to the total current
- Adding a branch lowers the total resistance
- Each branch can be switched on or off separately

Series vs parallel at a glance

Series

- One path for the current
- Same current everywhere
- Voltage shared between components
- More lamps: each lamp dimmer
- One break stops everything

Parallel

- Two or more paths
- Current splits, then rejoins
- Same voltage across each branch
- More lamps: each stays bright
- One break stops only that branch

Worked example

Worked example: two 6 Ω resistors, 6 V battery

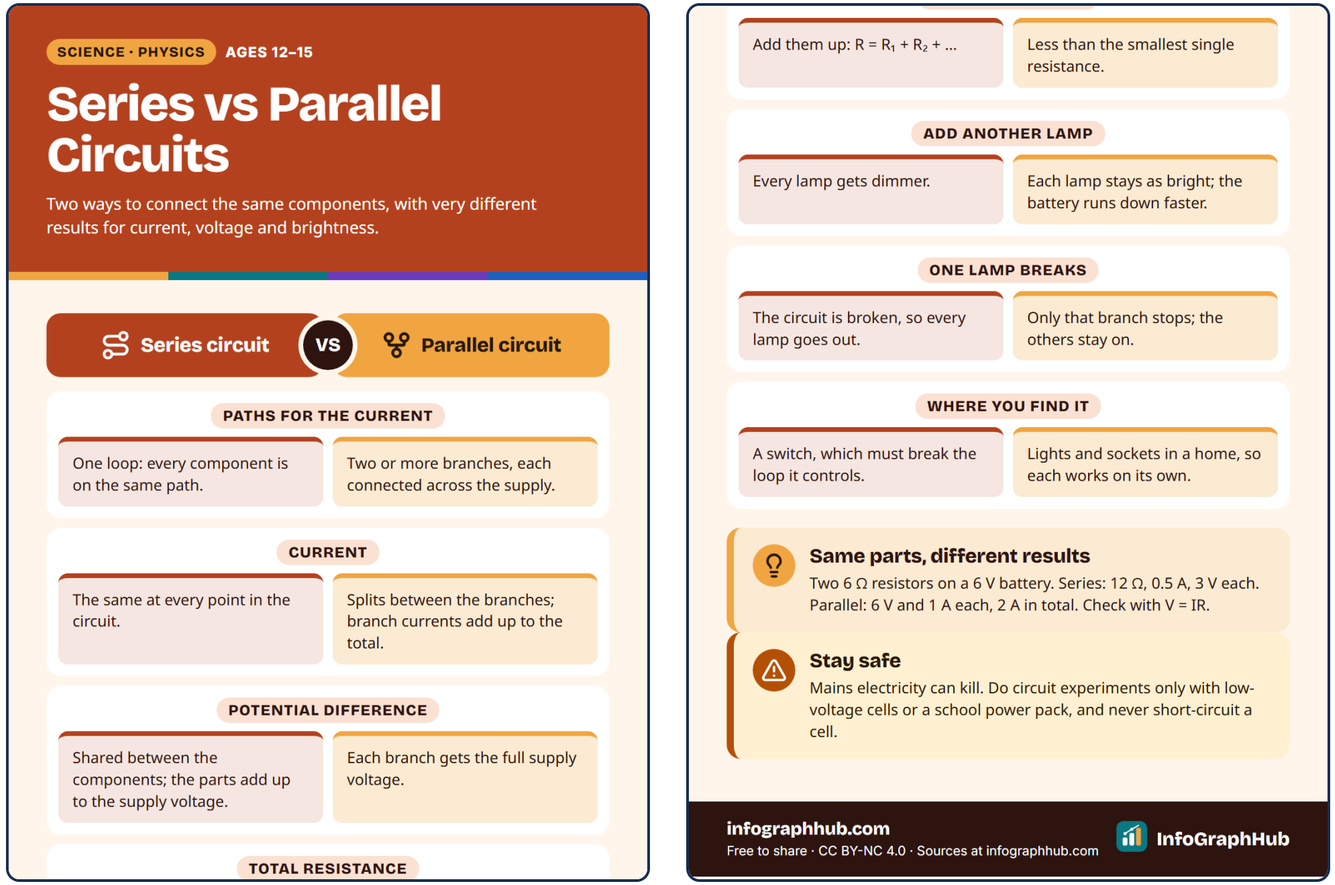
- Series: total R = 6 + 6 = 12 Ω
- Series: I = 6 ÷ 12 = 0.5 A; each resistor gets 3 V
- Parallel: each resistor gets the full 6 V
- Parallel: each branch I = 6 ÷ 6 = 1 A
- Parallel: total current = 1 + 1 = 2 A

Why homes are wired in parallel

- Every appliance gets the full mains voltage
- Each light or socket can be switched on its own
- One appliance failing does not switch off the rest
- Mains electricity can kill: never experiment with it
- Fuses and circuit breakers cut off dangerous currents

Series and parallel on one page

Series: one path, current the same everywhere, voltage shared. Parallel: several paths, voltage the same across each branch, currents add up.



Poster: Series vs Parallel Circuits: Key Differences

Quick check

Two identical lamps are in series with a 6 V battery. What is the potential difference across each lamp?

A. 6 V

B. 12 V

C. 3 V

D. 0 V

Summary

Key takeaways

1. Current flows only in a complete circuit and is not used up
2. Current in amperes, potential difference in volts, resistance in ohms
3. V = IR links all three
4. Series: same current, shared voltage
5. Parallel: same voltage, currents add up