

# 11 Combining resistors and circuit rules – Part 2

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

## Recall

In Part A you used  $V = IR$  for a single resistor. Now handle circuits with **several**:

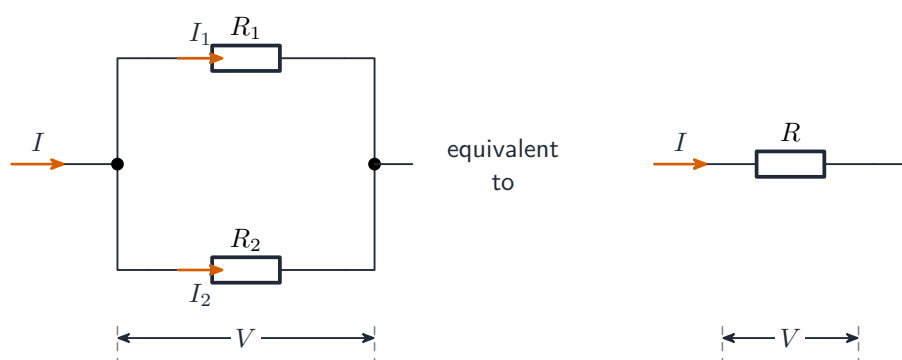
- Resistors in a line add up; resistors side by side share the current.
- Whatever current flows into a junction flows out again.

Each idea has a worked example before the Practice.

## New ideas

### ■ 1 Combining resistors

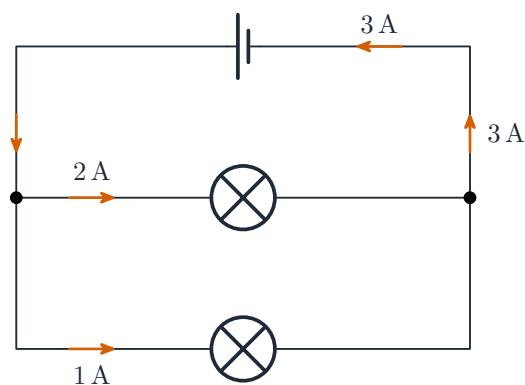
- **Series:**  $R_{\text{eq}} = R_1 + R_2 + \dots$  (they add).
- **Parallel:**  $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$  (the total is **less** than the smallest).



*Worked example.* A  $4.0\ \Omega$  and a  $12\ \Omega$  in parallel:  $\frac{1}{R_{\text{eq}}} = \frac{1}{4} + \frac{1}{12} = \frac{4}{12}$ , so  $R_{\text{eq}} = 3.0\ \Omega$ .

### ■ 2 The junction rule

The current flowing **into** a junction equals the current flowing **out** (charge is conserved).



at each junction:  $3\text{ A} = 2\text{ A} + 1\text{ A}$

### ■ 3 The loop rule

Going around any complete loop, the voltage gains (from the battery) and drops (across resistors) add up to **zero** (energy is conserved).

### ■ 4 Solving a circuit

*Worked example.* If  $5.0\text{ A}$  enters a junction and one branch carries  $2.0\text{ A}$ , the other carries  $5.0 - 2.0 = 3.0\text{ A}$ .

**Watch out:** putting resistors in **parallel** makes the total resistance **smaller** than the smallest one – because you have opened extra paths for the current. Series makes it larger.

## Practice

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Try these in order. The methods are all above.

**2.1** Find the equivalent resistance of a  $3.0\ \Omega$  and a  $5.0\ \Omega$  resistor in **series**. [2]

**2.2** Find the equivalent resistance of a  $6.0\ \Omega$  and a  $3.0\ \Omega$  resistor in **parallel**. [3]

**2.3** A current of  $4.0\ \text{A}$  enters a junction; one branch carries  $1.5\ \text{A}$ . Find the current in the other branch. [2]

**2.4** State the conservation idea behind the loop rule. [1]

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**2.5** State whether two resistors in parallel give a total larger or smaller than the smallest one. [1]

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