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**:

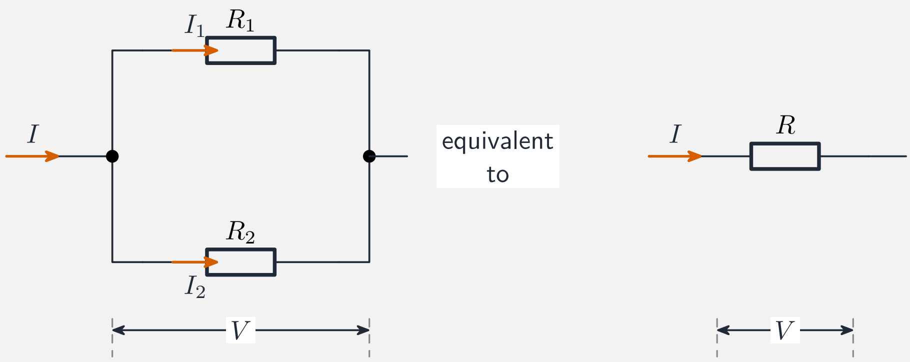
- Resistors in a line add up; resistors side by side share the current.
- Whatever current flows into a junction flows out again.

Each idea has a worked example before the Practice.

New ideas

■ 1 Combining resistors

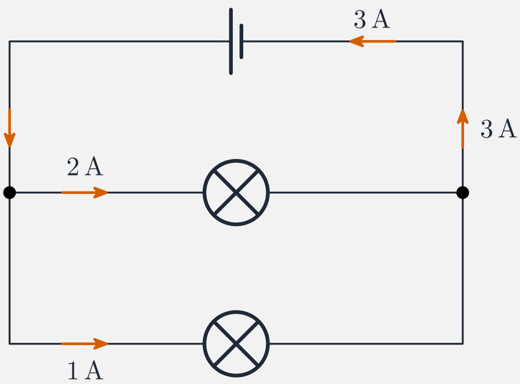
- **Series:** $R_{eq} = R_1 + R_2 + \cdots$ (they add).
- **Parallel:** $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \cdots$ (the total is **less** than the smallest).



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

■ 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 A enters a junction and one branch carries 2.0 A, the other carries $5.0 - 2.0 = 3.0$ 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

Try these in order. The methods are all above.

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

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

2.3 A current of 4.0 A enters a junction; one branch carries 1.5 A. Find the current in the other branch. [2]

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

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