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**:

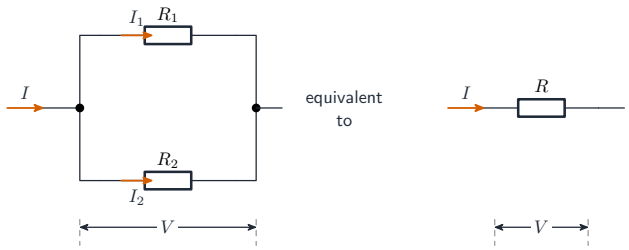
- Resistors in a line add up; resistors side by side share the current.
- Whatever current flows into a junction flows out again.

Each idea has a worked example before the Practice.

New ideas

1 Combining resistors

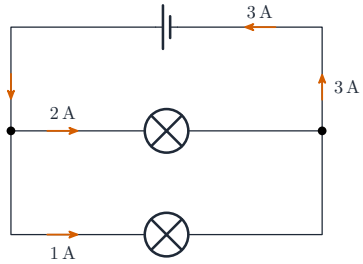
- **Series:** $R_{\text{eq}} = R_1 + R_2 + \cdots$ (they add).
- **Parallel:** $\dfrac{1}{R_{\text{eq}}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \cdots$ (the total is **less** than the smallest).



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