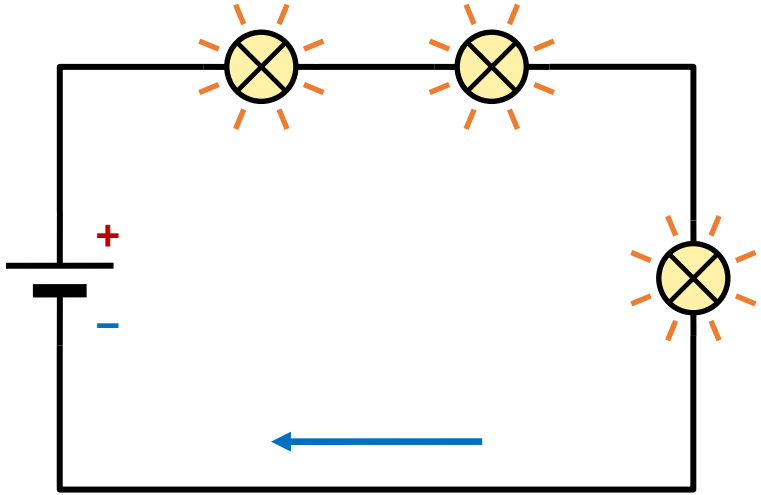
Essential Question

What happens when parts of a circuit share one path?

Series Circuits

One Path

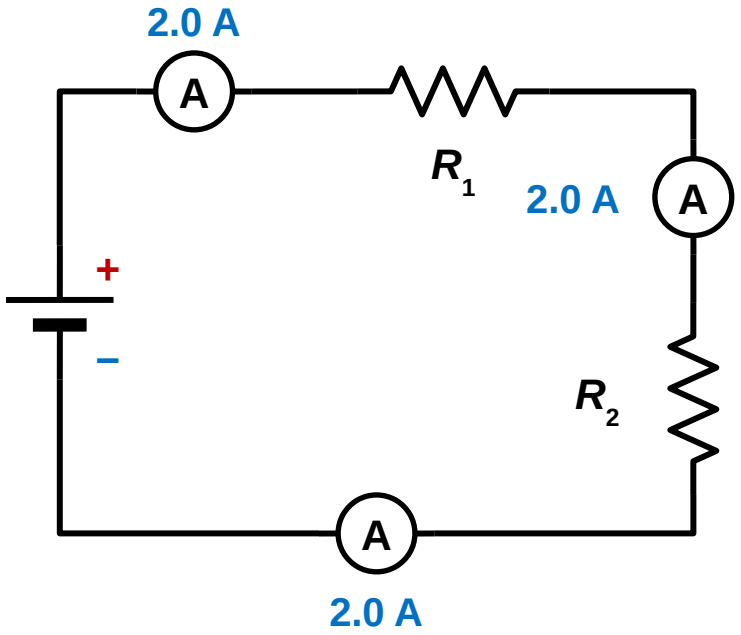
- Parts connected end to end
- Charge has only one path
- It flows through every part



one loop, one path

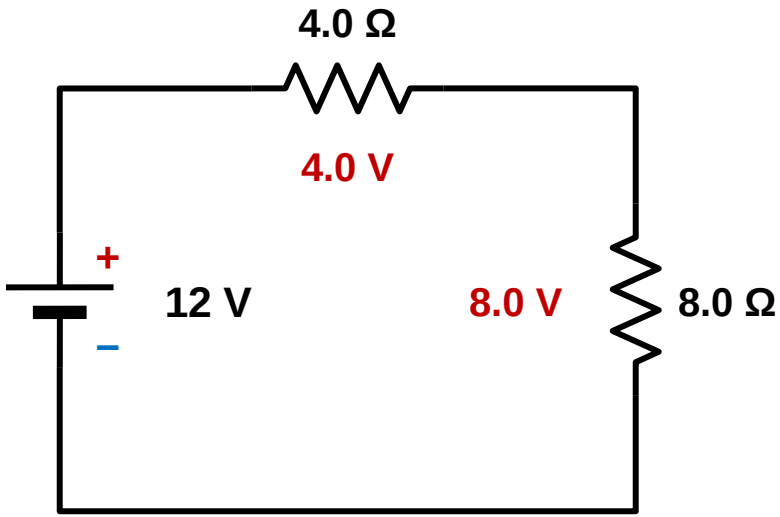
Same Current Everywhere

- Same current at every point
- Charge is not used up
- $I = I_1 = I_2$



Voltages Add Up

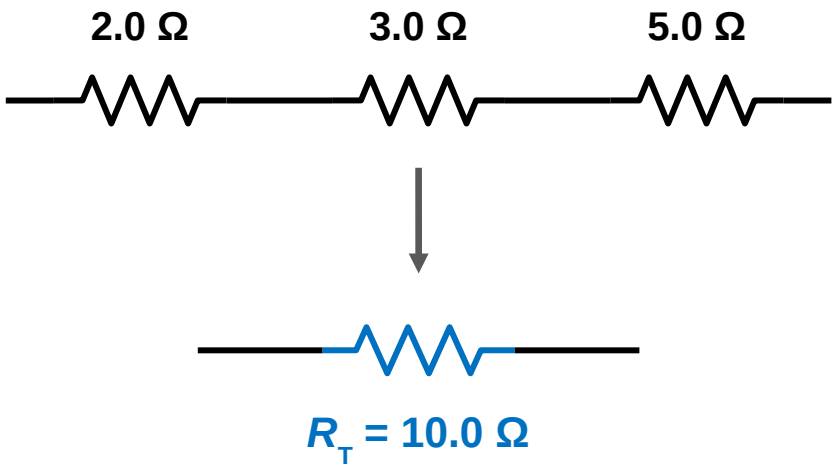
- Each part uses some voltage
- Drops add to the battery voltage
- $V = V_1 + V_2 + \ldots$



4.0 V + 8.0 V = 12 V

Total Resistance

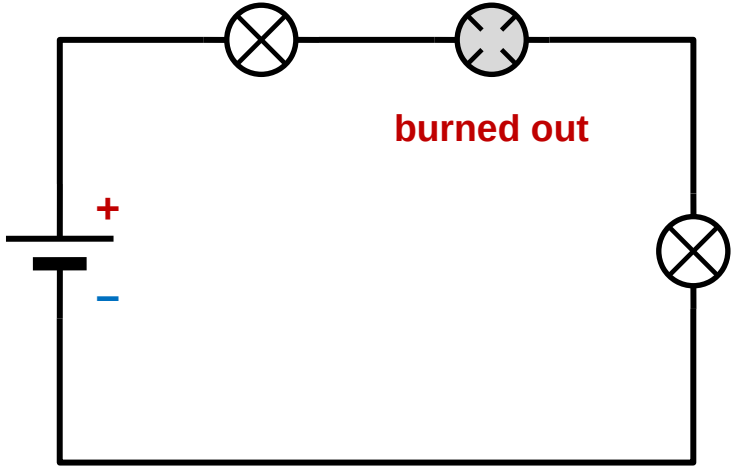
- Resistances in series add
- $R_T = R_1 + R_2 + ...$
- More resistors, less current



2.0 Ω + 3.0 Ω + 5.0 Ω = 10.0 Ω

One Bulb Out, All Out

- A break anywhere opens the loop
- Current stops everywhere
- Every bulb goes dark



one bulb out, all out

Solving Series Circuits

- Work from the whole to the parts
- Same *I* through every part
- Check: drops add to *V*

1. $R_T = R_1 + R_2$

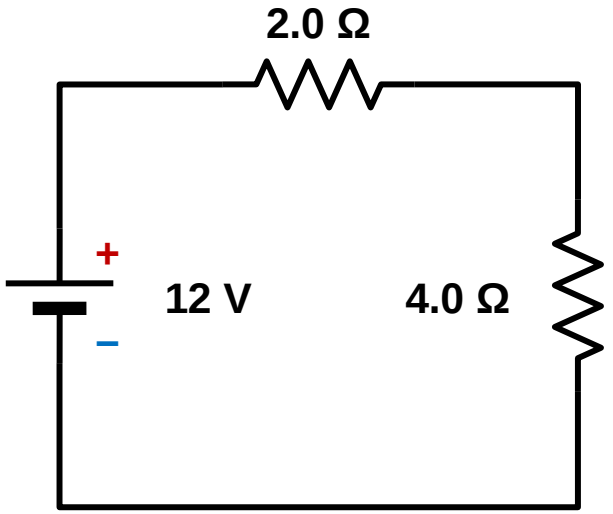
2. $I = V / R_T$

3. $V_1 = IR_1$, $V_2 = IR_2$

4. check: $V_1 + V_2 = V$

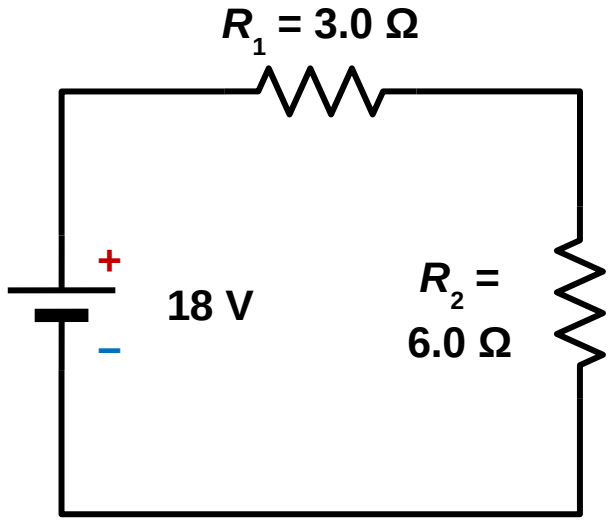
Example: Total Resistance and Current

A 12 V battery is connected in series with a 2.0 Ω resistor and a 4.0 Ω resistor. Find the total resistance and the current.



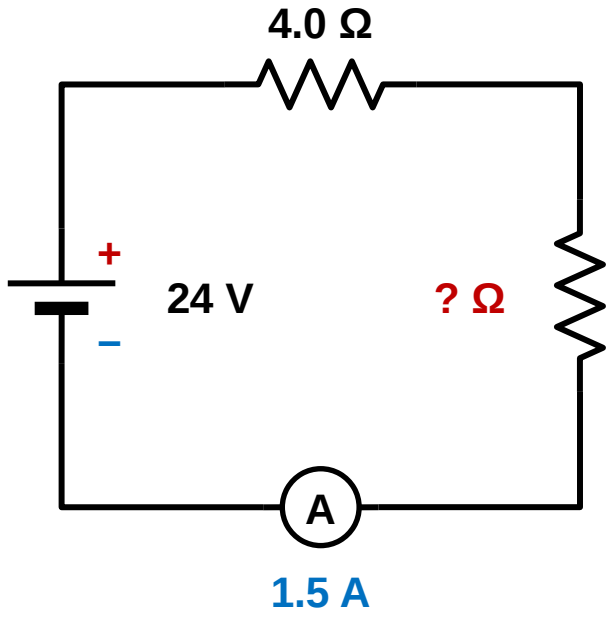
Example: Voltage Drops

An 18 V battery is in series with R_1 = 3.0 Ω and R_2 = 6.0 Ω. Find the voltage across each resistor.



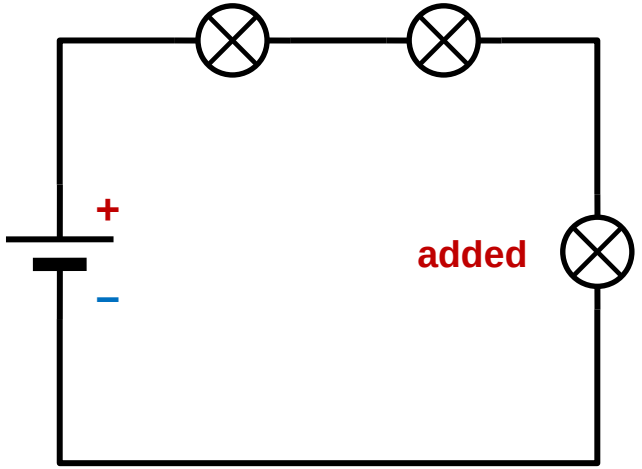
Example: Missing Resistor

A 24 V battery pushes 1.5 A through two resistors in series. One resistor is 4.0 Ω. What is the other?



Example: Adding a Bulb

Two identical 4.0 Ω bulbs are in series with a 12 V battery. A third identical bulb is added in series. Find the current before and after. What happens to the brightness?



Series Circuits

Big Ideas

- One path: same current everywhere
- Voltage drops add to the battery voltage
- $R_T = R_1 + R_2 + ...$
- One bulb out, all out