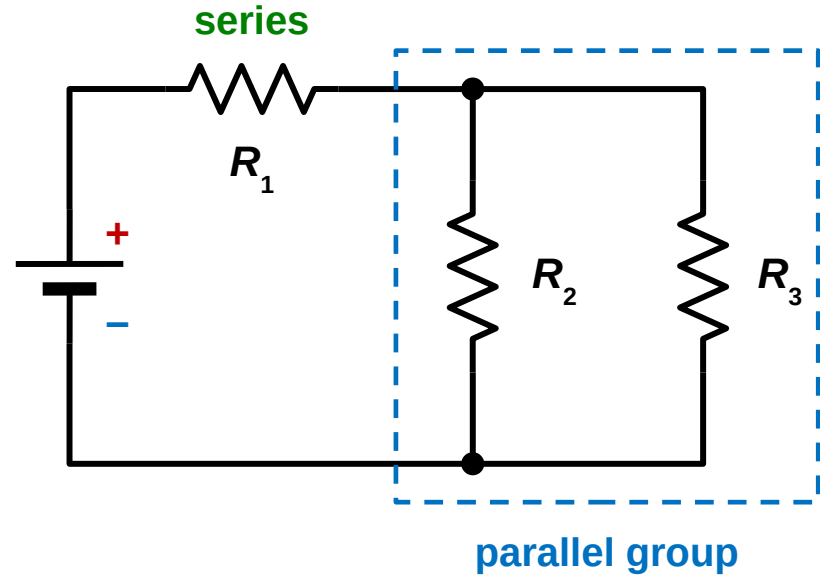


Essential Question

How do we solve a circuit that has series and parallel parts?

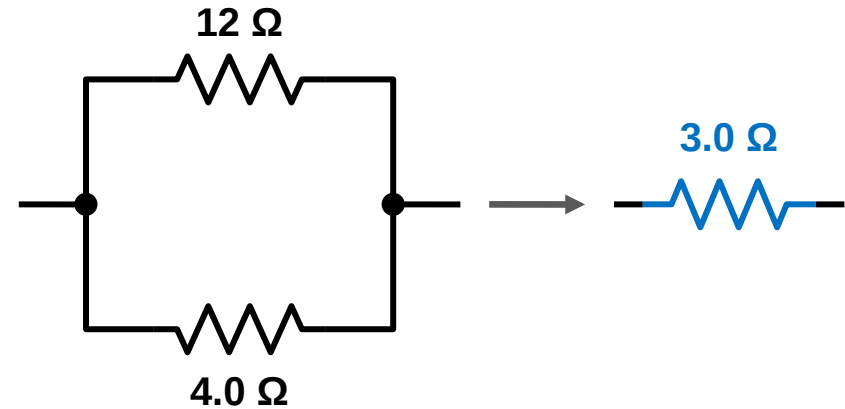
Series and Parallel Together

- Some parts in series
- Some parts in parallel
- Find the groups first



Step 1: Simplify Parallel Groups

- Find each parallel group
- Replace it with one resistor
- Use the $1/R$ rule

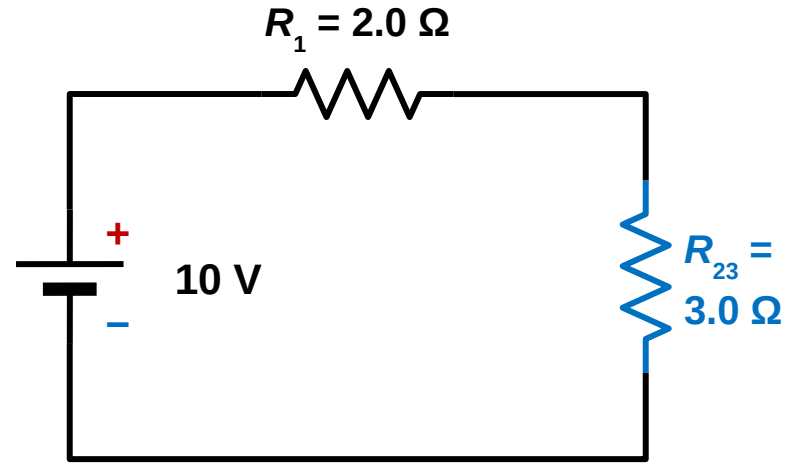


$$1/R_{23} = 1/12 + 1/4.0 = 4/12$$

$$R_{23} = 12/4 = 3.0\ \Omega$$

Step 2: Add the Series Parts

- Now it's a simple loop
- $R_T = R_1 + R_{23}$
- Then $I = V/R_T$

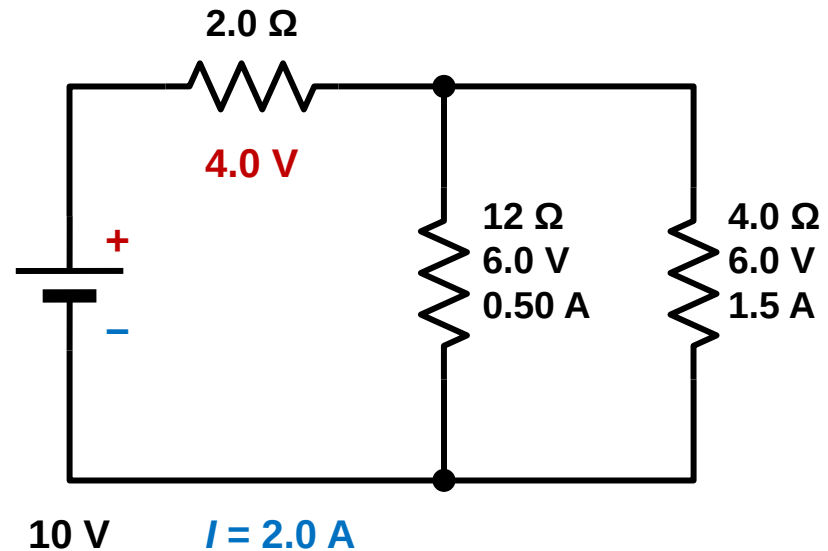


$$R_T = 2.0 \Omega + 3.0 \Omega = 5.0 \Omega$$

$$I = 10 \text{ V} \div 5.0 \Omega = 2.0 \text{ A}$$

Step 3: Work Backward

- Series part: use the total I
- Parallel group shares one V
- Use $V = IR$ for each part



Check with the Rules

- Junction rule: in = out
- Loop rule: drops = battery
- Both must check out

Junction rule (charge)

$$0.50 \text{ A} + 1.5 \text{ A} = 2.0 \text{ A} \checkmark$$

Loop rule (energy)

$$4.0 \text{ V} + 6.0 \text{ V} = 10 \text{ V} \checkmark$$

both rules check out

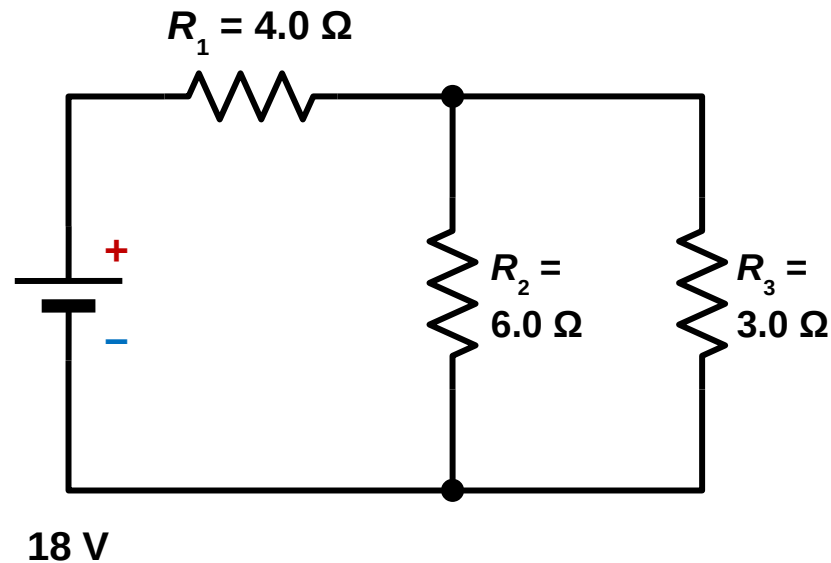
A Solving Table

- Track R , I , V for each part
- Fill in what you know
- Use $V = IR$ on each row

	$R (\Omega)$	$I (A)$	$V (V)$
R_1	2.0	2.0	4.0
R_2	12	0.50	6.0
R_3	4.0	1.5	6.0
total	5.0	2.0	10

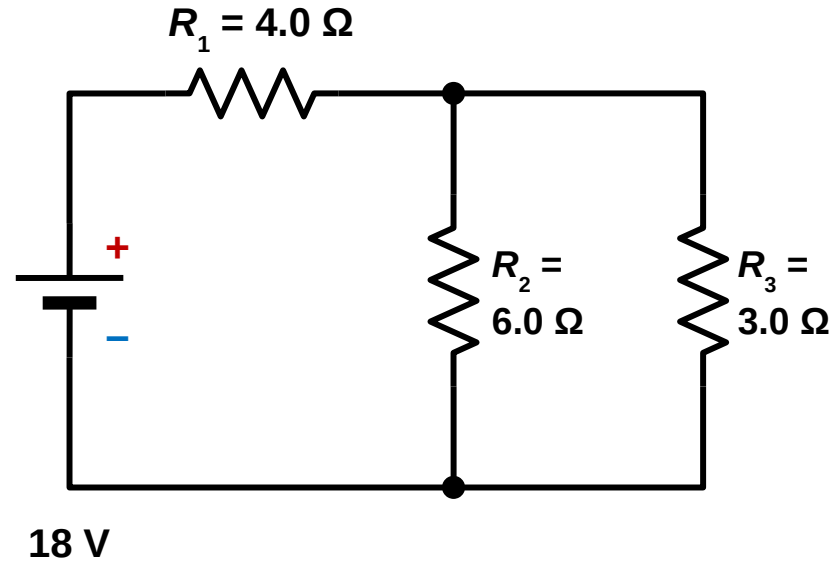
Example: Total Resistance

An 18 V battery is connected to $R_1 = 4.0\ \Omega$ in series with a parallel pair, $R_2 = 6.0\ \Omega$ and $R_3 = 3.0\ \Omega$. Find the total resistance.



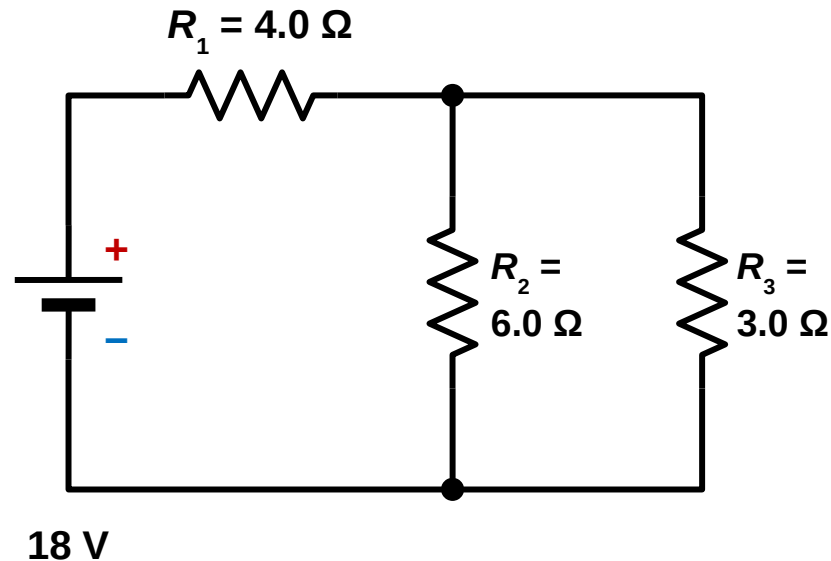
Example: Current and Voltages

For the same circuit, find the total current, the voltage across R_1 , and the voltage across the parallel pair.



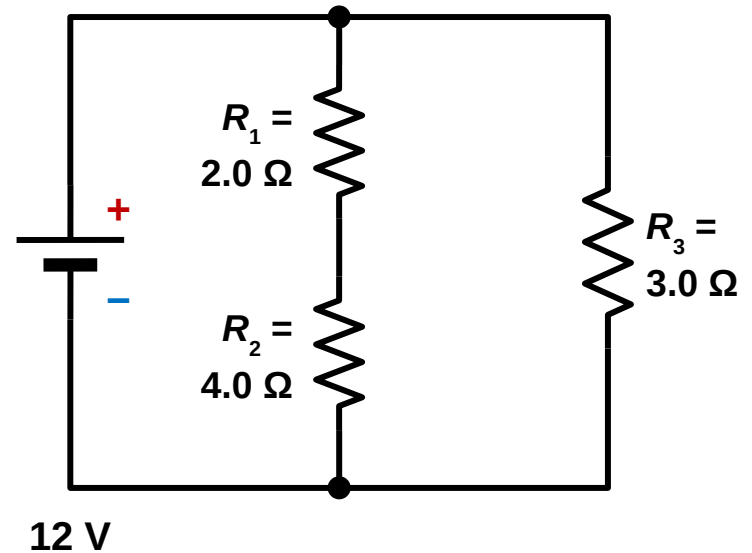
Example: Branch Currents

For the same circuit (6.0 V across the parallel pair), find the current through R_2 and through R_3 .



Example: Series Inside a Branch

A 12 V battery is connected to two branches in parallel. One branch has $R_1 = 2.0\ \Omega$ and $R_2 = 4.0\ \Omega$ in series. The other has $R_3 = 3.0\ \Omega$. Find R_T and the total current.



Big Ideas

- Simplify groups, starting with the innermost
- Add the series parts to get R_T
- $I = V/R_T$, then work backward
- Check: junction rule and loop rule