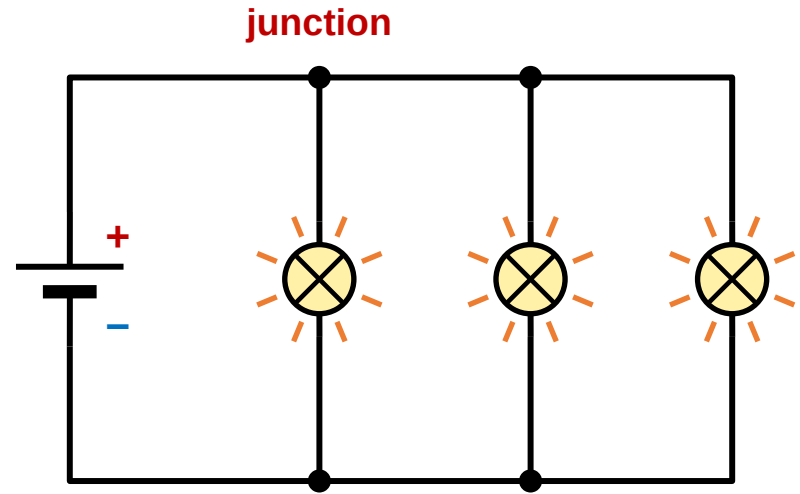


Essential Question

What happens when a circuit gives charges more than one path?

Multiple Branches

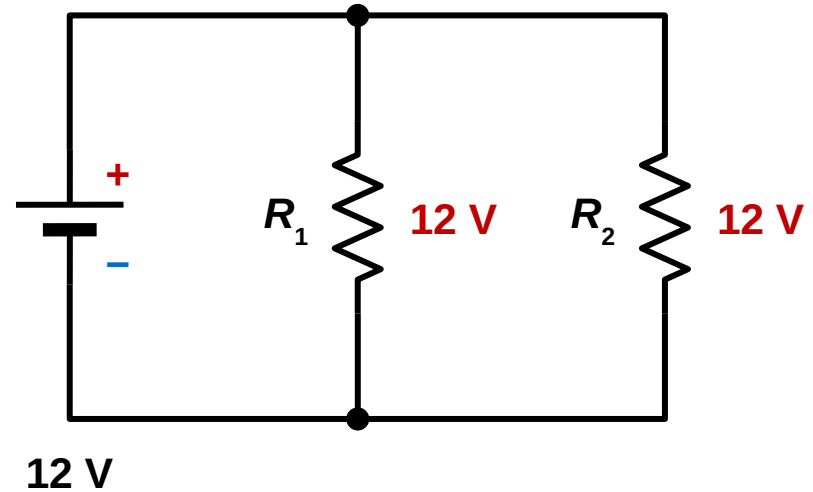
- Each part on its own branch
- Charge splits at a junction
- Paths rejoin at the bottom



three paths for the charge

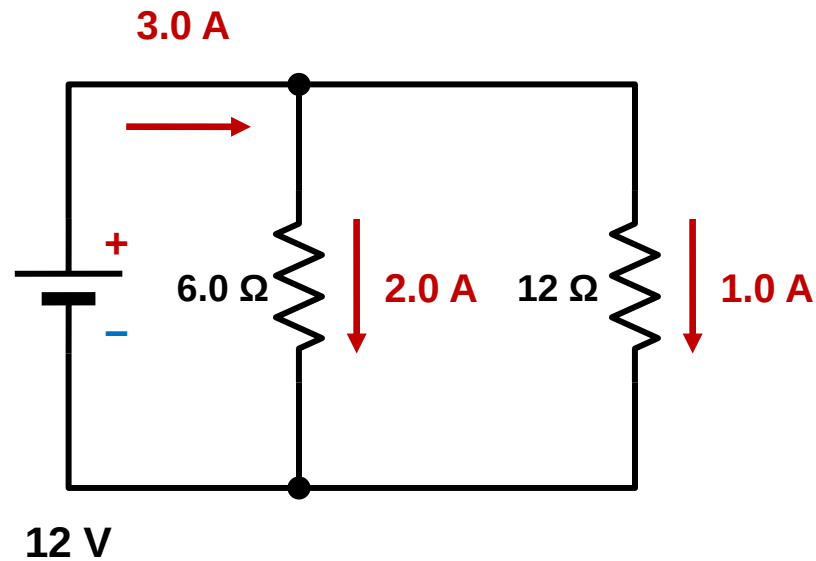
Same Voltage on Each Branch

- Each branch spans the battery
- Every branch gets the full voltage
- $V = V_1 = V_2$



Currents Add at Junctions

- Current splits at a junction
- Charge in = charge out
- $I = I_1 + I_2$



$$3.0\text{ A in} = 2.0\text{ A} + 1.0\text{ A out}$$

Total Resistance

- $1/R_T = 1/R_1 + 1/R_2 + \dots$
- Flip the answer to get R_T
- R_T is smaller than any branch

$$1/R_T = 1/R_1 + 1/R_2$$

6.0 Ω and 3.0 Ω in parallel:

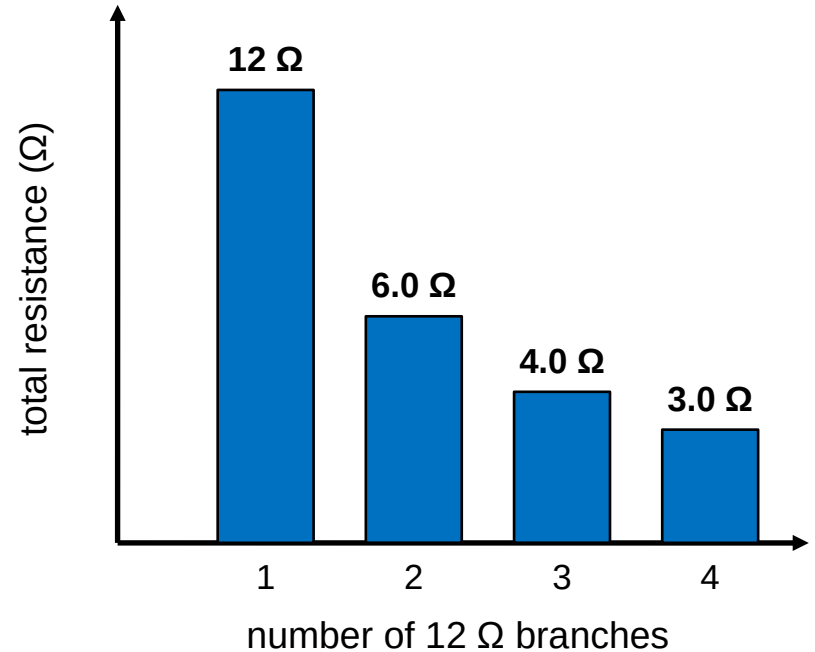
$$1/R_T = 1/6.0 + 1/3.0 = 3/6.0$$

$$R_T = 6.0/3 = 2.0 \Omega$$

2.0 Ω is less than 3.0 Ω

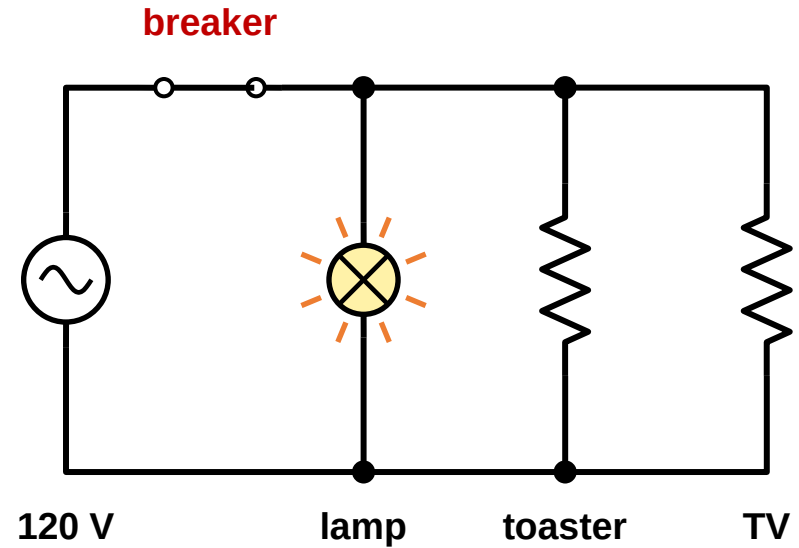
More Branches, Less Resistance

- Each branch is a new path
- Like more checkout lanes
- Total current goes up



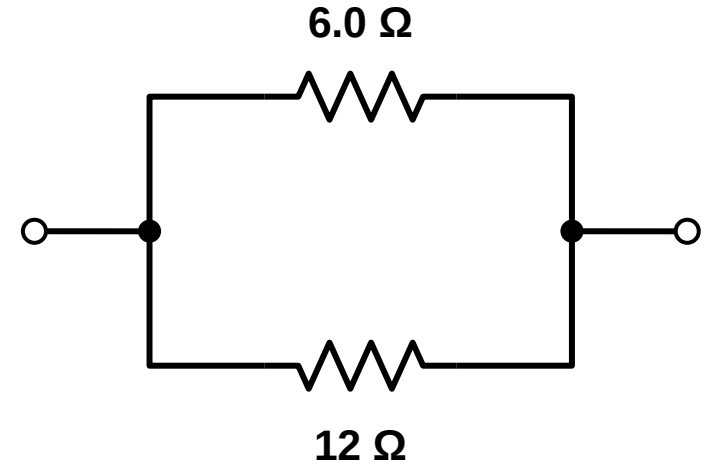
Household Wiring

- Outlets are wired in parallel
- Every device gets 120 V
- Each device works on its own
- Too much current trips the breaker



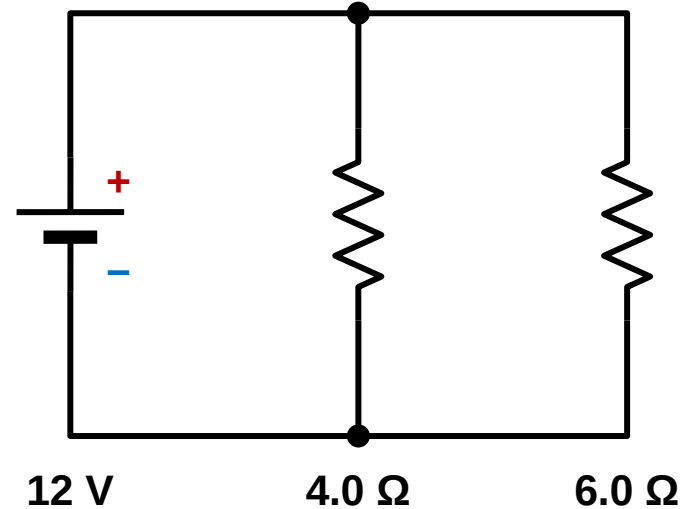
Example: Total Resistance

A $6.0\ \Omega$ resistor and a $12\ \Omega$ resistor are connected in parallel. What is their total resistance?



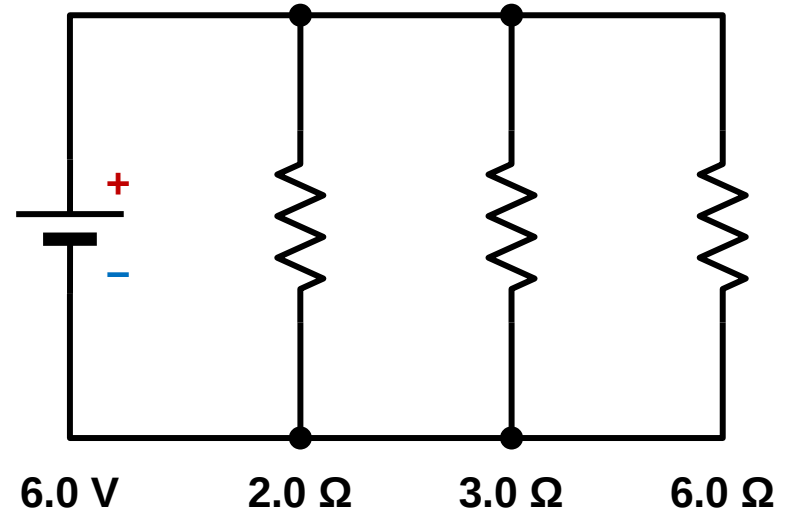
Example: Branch Currents

A 12 V battery is connected to a $4.0\ \Omega$ resistor and a $6.0\ \Omega$ resistor in parallel. Find the current in each branch and the total current.



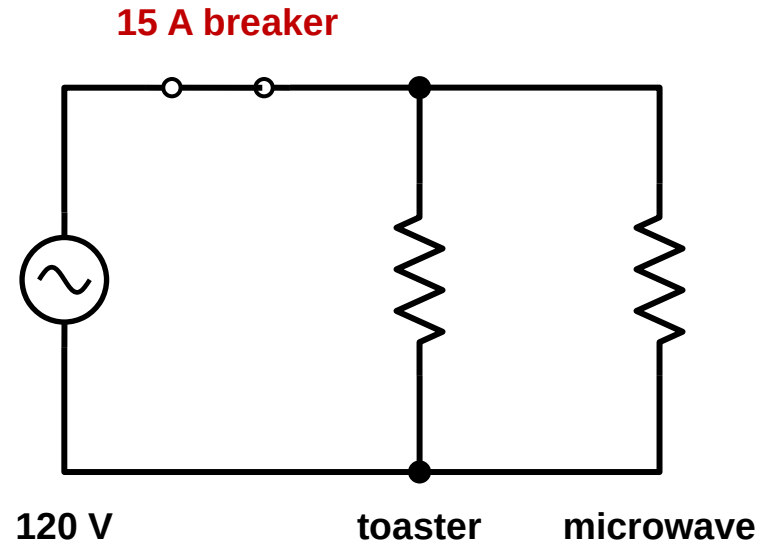
Example: Three Branches

A 6.0 V battery is connected to three resistors in parallel: 2.0 Ω , 3.0 Ω , and 6.0 Ω . Find the total resistance and the total current.



Example: Kitchen Circuit

A 120 V kitchen circuit has a 15 A breaker. A $16\ \Omega$ toaster and a $15\ \Omega$ microwave are plugged in at the same time. Will the breaker trip?



Big Ideas

- Every branch gets the full voltage
- Currents add: $I = I_1 + I_2 + \dots$
- $1/R_T = 1/R_1 + 1/R_2 + \dots$
- More branches, less R_T , more I