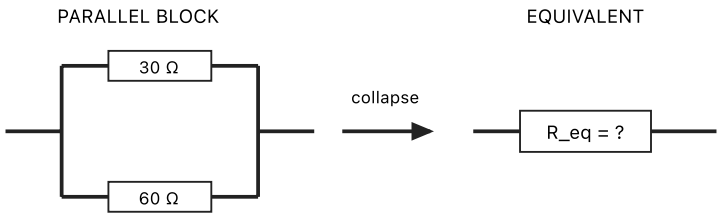
CIRCUITS DAY 7: SERIES & PARALLEL EQUIVALENT RESISTANCE

CED 11.5 · Skill 2.B · FRQ: MR

PREDICT

Two identical resistors R are connected in parallel. Circle one for the equivalent resistance: **2R / R / R/2 / R/4**. Be ready to defend your choice.

TWO PATHS COLLAPSE TO ONE EQUIVALENT



parallel equivalent resistance is less than the smallest branch resistance

USE NODES, NOT DRAWING SHAPE

Elements are in **series** when the same current must pass through them. Elements are in **parallel** when both ends connect to the same two nodes, so they share a voltage.

NOTES / REASONING

EQUIVALENT RESISTANCE

Series

$$R_{eq} = R_1 + R_2 + \cdots$$

One path; the same current passes each element.

Parallel

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Multiple paths; the equivalent is less than the smallest branch resistance.

WE DO Find R_{eq} for $30\ \Omega$ and $60\ \Omega$ in parallel.

YOU DO Find R_{eq} for $30\ \Omega$ and $60\ \Omega$ in series.

WALK BACK FOR CURRENT AND VOLTAGE

A $30\ \Omega$ and $60\ \Omega$ pair is connected to $18\ \text{V}$.

SERIES Find total current and the voltage across each resistor.

PARALLEL Find total current and the current through each branch.

Series check: resistor voltages add to the source voltage. Parallel check: branch currents add to total current.

PRACTICE

1. Find R_{eq} for 20 Ω and 50 Ω in series.

2. Find R_{eq} for two 80 Ω resistors in parallel.

3. Find R_{eq} for 24 Ω and 48 Ω in parallel.

4. A 12 V source is connected across two 24 Ω parallel branches. Find total current.

5. Explain why adding a finite-resistance parallel branch cannot increase R_{eq}.