CIRCUITS DAY 3: SERIES & PARALLEL

WARMUP Opposite Day

Capacitors: parallel ADDED C, series added 1/C. Resistors flip it. Before any formulas — why should MORE parallel paths mean LESS resistance? (Think doors out of a crowded room.)

COMBINING RESISTORS

Series (same I, voltages add): **$R_{eq} = R_1 + R_2 + \ldots$** — a longer pipe.

Parallel (same V, currents add): **$1/R_{eq} = 1/R_1 + 1/R_2 + \ldots$** — more doors. Two-resistor shortcut: product/sum. Always BELOW the smallest member.

The routine: collapse inside-out, Ohm the whole thing, then walk back out branch by branch.

WE DO Exercise 1: The Full Routine

A 24 V battery drives a 6.0 Ω resistor in series with a (3.0 Ω ∥ 6.0 Ω) pair. **(a)** $R_\parallel$ = ________. **(b)** R_total = ________, I_battery = ________. **(c)** V across the pair = ________. **(d)** Current in the 3.0 Ω branch = ________.

DIVIDERS AND CHECKS

WE DO **Exercise 2: Voltage Divider**

A 4.0 Ω and an 8.0 Ω resistor in series across 24 V. Same current everywhere — so the volts split in proportion to R: V_4 = _________, V_8 = _________ (check the sum).

YOU DO **Exercise 3: Current Divider**

A 12 V battery across a 4.0 Ω ∥ 12 Ω pair. Find the current in each branch and show the junction rule holds at the split.

CALC **Exercise 4: Derive the Parallel Rule**

Same V across both; currents add: $I = V/R_1 + V/R_2$. Divide by V to finish $1/R\_eq = 1/R_1 + 1/R_2$. Then verify the "always smaller" claim: show $R\_eq < R_1$ no matter what $R_2 > 0$ is.

PAPER PRACTICE

PRACTICE PROBLEMS

P1 **Series**

3.0 Ω, 5.0 Ω, and 4.0 Ω in series: R_eq?

P2 **Parallel**

6.0 Ω and 12 Ω in parallel: R_eq?

P3 **Mixed Network**

A 5.0 Ω resistor in series with (10 Ω ∥ 10 Ω), across 20 V. Find R_eq and the battery current.

P4 **Power Split**

For P3's circuit, find the power dissipated in the series 5.0 Ω resistor and in EACH 10 Ω branch. Check that the three powers sum to the battery's output P = IV.