CAPACITORS DAY 5: SERIES & PARALLEL

WARMUP Why the Same Q?

Two capacitors in series: the wire between them is an ISLAND — no charge can enter or leave it. If the left plate of the island pair holds –Q, what must the right plate hold, and why does that force both capacitors to carry identical Q?

COMBINING CAPACITORS

Parallel (same ΔV, charges add): **$C_{eq} = C_1 + C_2 + \ldots$** — side-by-side plates are one BIGGER plate.

Series (same Q, voltages add): **$1/C_{eq} = 1/C_1 + 1/C_2 + \ldots$** — stacked gaps are one WIDER gap. Two-cap shortcut: $C_{eq} = C_1C_2/(C_1+C_2)$.

Opposite of resistors-to-come. Series ALWAYS gives less than the smallest member.

WE DO Exercise 1: Both Ways

$C_1 = 2.0\ \mu F$ and $C_2 = 3.0\ \mu F$. **(a)** In parallel: C_{eq} = _____ μF. **(b)** In series: $C_{eq} = (2\cdot3)/(2+3)$ = _____ μF.

DIVIDING THE VOLTS, DIVIDING THE CHARGE

WE DO Exercise 2: Series Division

The series pair (C_{eq} = 1.2 μF) goes across 10 V. **(a)** $Q = C_{eq} \cdot V$ = _____ μC — on EACH capacitor. **(b)** $V_1 = Q/C_1$ = _____ V, $V_2 = Q/C_2$ = _____ V. **(c)** Check: they sum to _____.

YOU DO Exercise 3: Mixed Network

Two 2.0 μF capacitors in series, and that pair in parallel with a 3.0 μF capacitor. Find C_{eq} of the whole network.

CALC Exercise 4: Derive the Series Rule

Same Q on both; voltages add: $V = Q/C_1 + Q/C_2$. Divide by Q and finish the derivation of $1/C_{eq}$. Then explain geometrically: for two IDENTICAL plate capacitors stacked, what single capacitor is the stack equivalent to?

PAPER PRACTICE

PRACTICE PROBLEMS

P1 Parallel

2.0 μF, 3.0 μF, and 6.0 μF in parallel: C_eq?

P2 Series

Three 6.0 μF capacitors in series: C_eq?

P3 Network + Charge

A 6.0 μF in series with a 3.0 μF; that pair in parallel with a 4.0 μF; the network across 12 V. Find C_eq, then the total charge drawn from the battery.

P4 Series vs Parallel Energy

Two 4.0 μF capacitors across 12 V — once in series, once in parallel. Compute the total stored energy each way, and the ratio parallel/series.