CIRCUITS DAY 13: EQUIVALENT CAPACITANCE: SERIES & PARALLEL

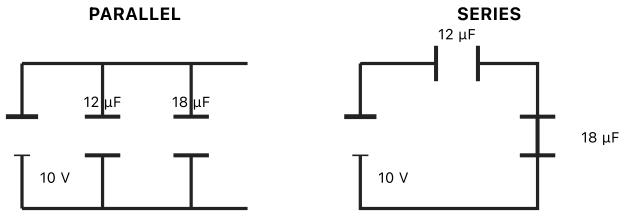
CED 11.8 · Skill 2.C · FRQ: QQT

PREDICT BEFORE OBSERVING

Two identical capacitors are connected side-by-side across one battery, then end-to-end across the same battery. Which arrangement has the larger equivalent capacitance: **parallel / series / equal**?

Observation source: projected capacitor-network simulation or the paired printed schematic below.

SAME CAPACITORS, TWO ARRANGEMENTS



WHAT EQUIVALENT CAPACITANCE MEANS

$$C_{eq} = Q_{total}/V_{battery}$$

The equivalent capacitor stores the same total charge at the same battery potential difference.

NOTES / REASONING

PARALLEL CAPACITORS

Each branch spans the same two nodes, so $V_1 = V_2 = V$. Stored charge adds.

$$Q_{total} = C_1V + C_2V = (C_1 + C_2)V$$

$$C_{eq} = C_1 + C_2$$

WE DO Connect 12 µF and 18 µF in parallel across 10 V. Find C_{eq}, each charge, and total charge.

SERIES CAPACITORS

The middle conductor remains neutral overall, so the capacitors carry equal-magnitude charge. Their potential differences add.

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

WE DO Connect the same 12 µF and 18 µF capacitors in series across 10 V. Find C_{eq}, common charge, and each voltage.

Check: a series equivalent capacitance must be smaller than the smallest capacitor.

TRANSLATE: SCHEMATIC ↔ LEDGER ↔ EQUIVALENT

arrangement	C_eq (μF)	V_1 (V)	V_2 (V)	Q_1 (μC)	Q_2 (μC)
parallel					
series					

1. Complete the ledger for both 10 V arrangements.

2. Explain why adding a parallel capacitor increases C_{eq}.

3. Two 20 μF capacitors are in series. Find C_{eq}.

4. State one numerical check for each arrangement.