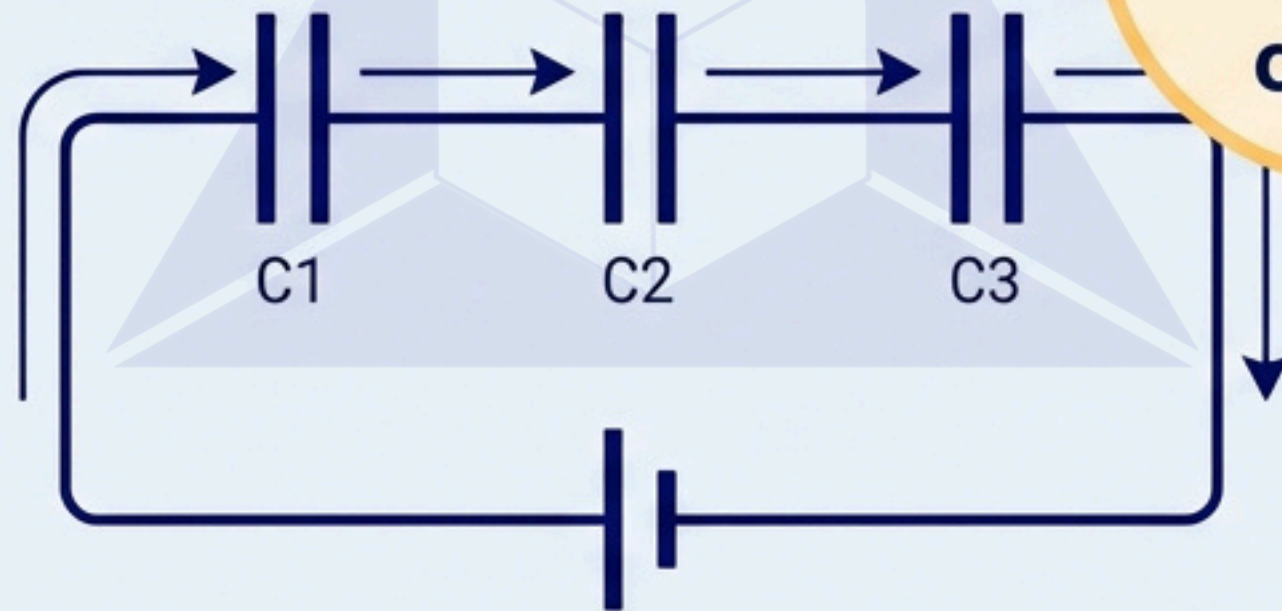


Section 2.14 – Combination of Capacitors

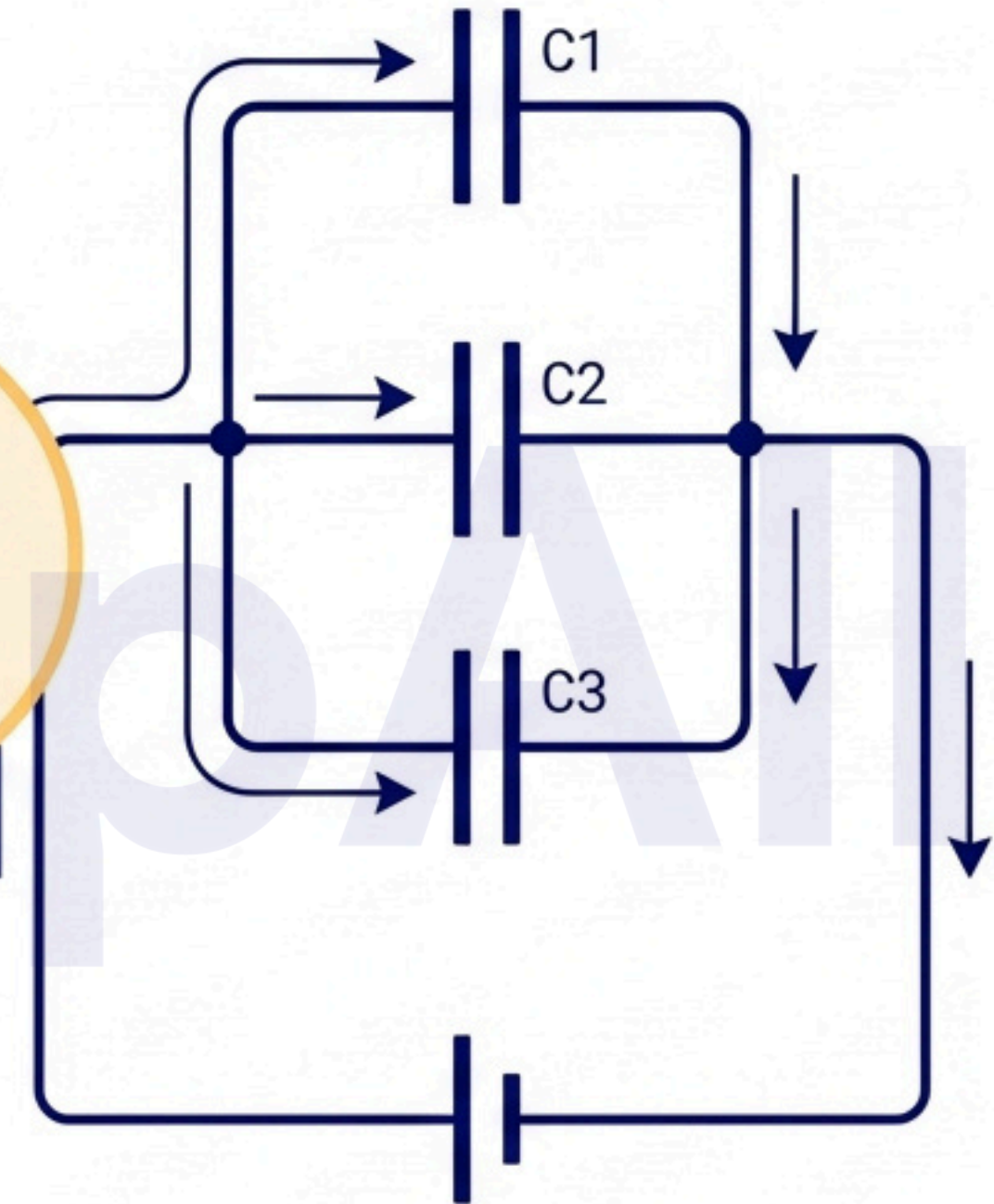
Series vs parallel capacitors — never mix them up

In real-world circuits and exam problems, you will rarely deal with just one capacitor. You need to combine them perfectly to find the exact effective capacitance.

Master the combinations to find effective capacitance (C)

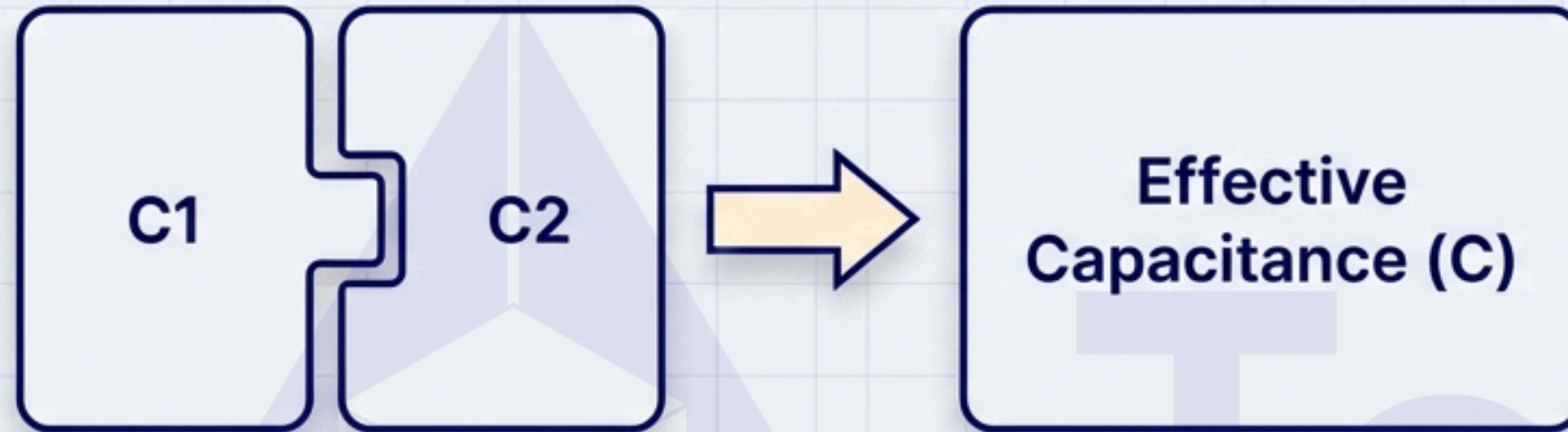


SERIES CONFIGURATION



PARALLEL CONFIGURATION

Why Do We Combine Capacitors?



The Problem:

We often have standard capacitors, but a circuit requires a very specific, non-standard capacitance value.

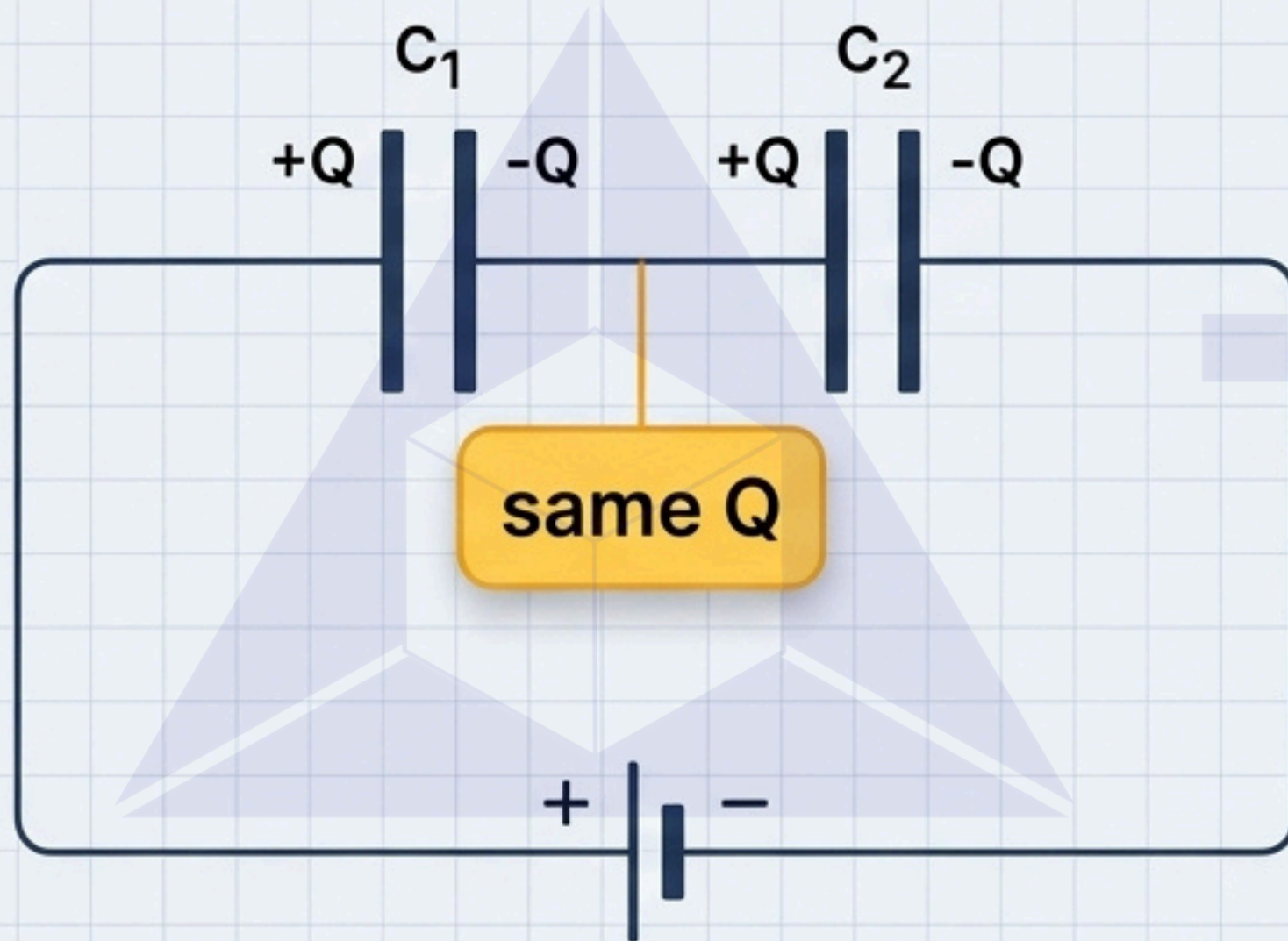
The Solution:

By arranging them differently, we create an effective capacitance (C).

Key Takeaways

- ✓ Combine to modify total charge storage.
- ✓ Combine to manage potential difference limits.
- ✓ The arrangement determines the final C.

Capacitors in Series: The Logic



Charge Conservation

Capacitors connected end-to-end. By charge conservation, isolated inner plates have a net charge of zero. The charge ($+Q$, $-Q$) is identical on every capacitor.

Potential Drop

Total potential drop across the system is the sum of the individual potential drops.

$$V = V_1 + V_2$$



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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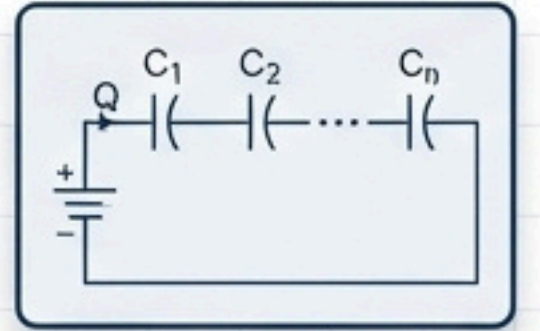
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The Series Combination Formula



Step 1: $V = V_1 + V_2 + \dots + V_n$

Step 2: We know $V_1 = Q/C_1$, $V_2 = Q/C_2$

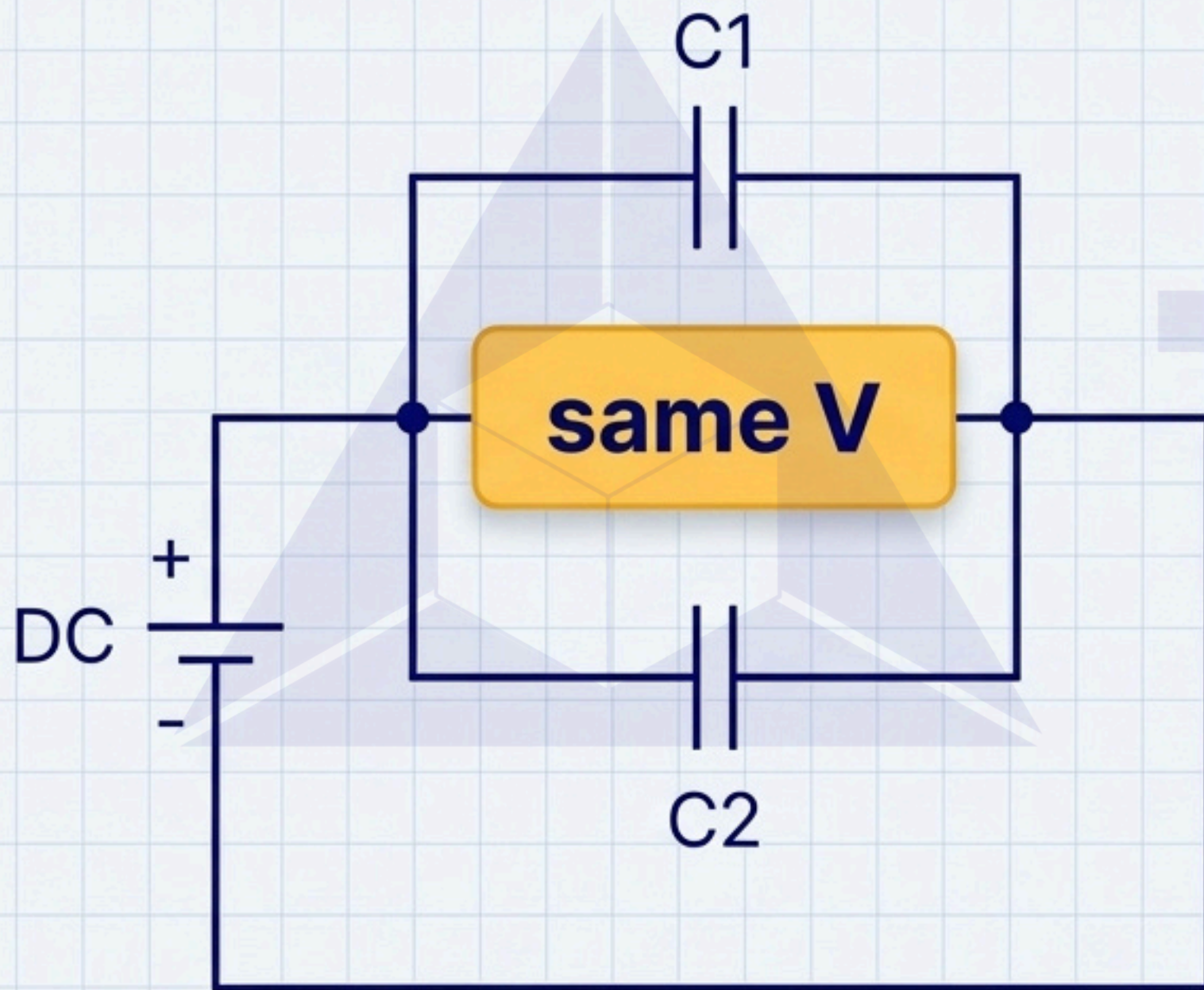
Step 3: Substitute to get $V = Q(1/C_1 + 1/C_2 + \dots + 1/C_n)$

Equation (2.60)

For n capacitors in series:

$$1/C = 1/C_1 + 1/C_2 + \dots + 1/C_n$$

Capacitors in Parallel: The Logic



Shared Nodes

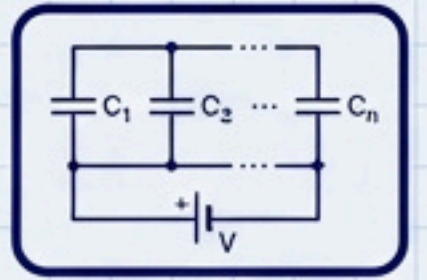
Capacitors connected across the exact same two points. Because they share connecting nodes, the potential difference (V) is identical across every capacitor.

Charge Distribution

The total charge is the sum of the individual charges drawn by each branch.

$$Q = Q1 + Q2$$

The Parallel Combination Formula



Step 1: $Q = Q_1 + Q_2 + \dots + Q_n$

Step 2: We know $Q_1 = C_1V$, $Q_2 = C_2V$

Step 3: Substitute to get $Q = V(C_1 + C_2 + \dots + C_n)$

Equation (2.67) in Inter

For n capacitors in parallel:

$$C = C_1 + C_2 + \dots + C_n$$

Master the Matrix: Series vs. Parallel

Property	Series	Parallel
Constant Variable	Same Q	Same V
Total Voltage	$V = V1 + V2$	Same as individual
Total Charge	Same as individual	$Q = Q1 + Q2$
Effective C Formula	Reciprocal sum Eq (2.60)	Direct sum Eq (2.67)



**Exam Trap: Do not confuse with resistors! For capacitors:
Parallel = Direct Sum (Higher C). Series = Reciprocal Sum (Lower C).**



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