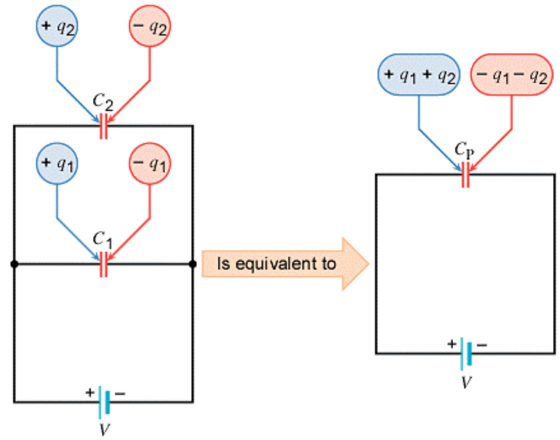
Capacitors in Series and Parallel



In a parallel combination of capacitances C_1 and C_2 , the voltage V across each capacitor is the same, but the charges q_1 and q_2 on each capacitor are different.

Even though two capacitors are connected in parallel across it, the seat of emf "sees" a single equivalent capacitance C_P:

$$C_P = \frac{q_1 + q_2}{V} \quad \text{or}$$

$$C_P = \frac{q_1}{V} + \frac{q_2}{V} \quad \text{or}$$

$$\boxed{C_P = C_1 + C_2}$$

Example

A 3.0 µF and a 5.0 µF capacitor are connected in parallel across a 12 V battery.

a. Find the charge on each capacitor.

b. Find the equivalent capacitance.

In a series combination of capacitances C_1 and C_2 , the same amount of charge q is on the plates of each capacitor, but the voltages V_1 and V_2 across each capacitor are different.

Even though two capacitors are connected in series with it, the seat of emf "sees" a single equivalent capacitance C_P, which may be determined as follows.

$$V = V_1 + V_2$$

$$\frac{q}{C_S} = \frac{q}{C_1} + \frac{q}{C_2}; \quad \boxed{\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}}$$

An example follows on the next page.
Example

A 3.0 μF and a 5.0 μF capacitor are connected in series with a 12 V battery.

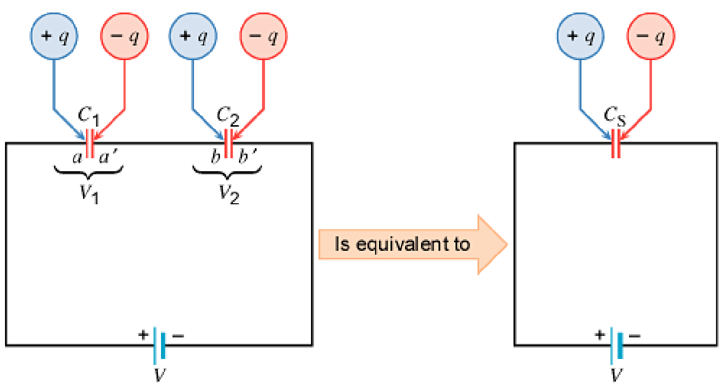
a. Find the equivalent capacitance.

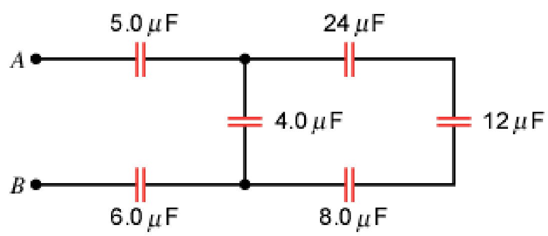
b. Find the charge on each capacitor.

c. Find the potential drop (or voltage) across each capacitor.

Capacitance Networks

It is possible to use the formulas for capacitors connected in series and parallel to find the equivalent capacitance of more elaborate capacitance networks.





Determine the equivalent capacitance between *A* and *B* for the group of capacitors in the drawing.

87. ***REASONING*** Our approach to this problem is to deal with the arrangement in parts. We will combine separately those parts that involve a series connection and those that involve a parallel connection.