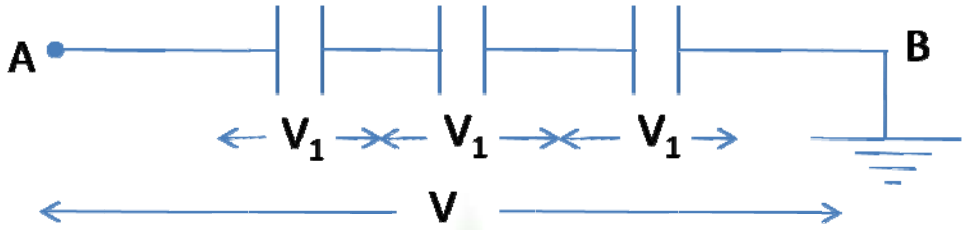
Capacitors in series:



Three capacitors are connected to end between the points A and B. The second plate of capacitor 1 is connected to the first plant of the capacitor 2 the second plate of the second is connected to the first plate of the third and so on.

V= Potential difference between the points A & B

C_1, C2 and C_3 = Capacitance of the first second and third capacitor respectively.

Let some charge say +Q flow in the first plate of 1 this charge +Q will induce a bound charge –Q on the inner surface and a free charge +Q on the outer surface of second plate. The induce free charge +Q flows through the conducting wire in the first plate of capacitor 2.

The same is repeated for the next capacitor and so on. Thus each of the capacitors stores some charge Q.

Let V_1, V_2, V_3 be the potential difference developed across the capacitors 1,2 and 3 respectively.

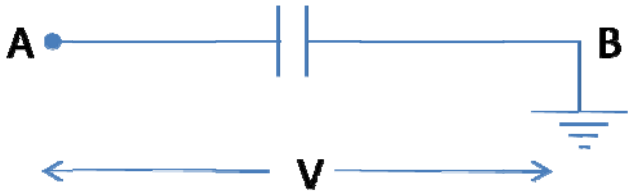
$$Q = C_1V_1 \text{ or } V_1 = \frac{Q}{C_1}, V_2 = \frac{Q}{C_2}, V_3 = \frac{Q}{C_3}$$

Total potential difference $V = V_1 + V_2 + V_3$

$$V = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$V = Q\left[\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right] \rightarrow (1)$$

Let single capacitor connected between the points A & B draws a charge +Q from the source of potential V. Then this single capacitor is equivalent to the three capacitors connected in series. Hence this single capacitor is said to be equivalent to the three capacitors connected in series. This single capacitor is said to be the equivalent capacitor and its capacitance is known as equivalent capacitance.



Let $C = \text{Equivalent capacitance}$

$\therefore Q = CV \text{ or } V = \frac{Q}{C} \rightarrow (2)$

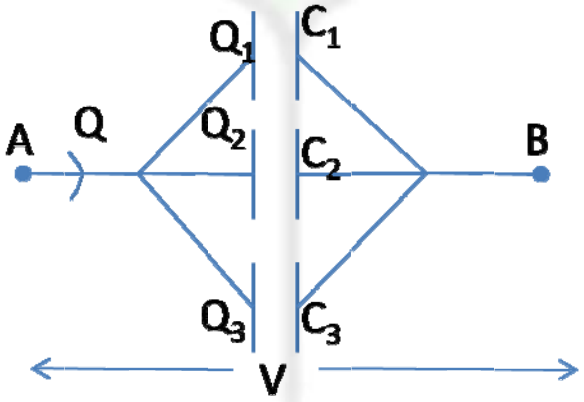
From equation (1) and (2)

$$\frac{Q}{C} = Q\left[\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right]$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

(2) Capacitors in Parallel:

First plate of all the three capacitors are connected to the same point A and the second plate are connected to the same point B.



V= Potential difference between the points A and B. Since no potential difference takes place across a conducting wire hence potential of the first plate of all the three capacitors are same as that of A and potential of second plate of all the three are same as that of B. I.e. Potential difference across each of the three capacitors is V.

Let Q_1, Q_2, Q_3 be the charge stored in capacitors 1, 2 & 3 respectively

$Q_1 = C_1V, Q_2 = C_2V, Q_3 = C_3V$

Let Q be the total charge drawn from the source of potential

$Q = Q_1 + Q_2 + Q_3$

$Q = C_1V + C_2V + C_3V$

$Q = V(C_1 + C_2 + C_3) \rightarrow (1)$

Let a single capacitor of capacitance C draws a total charge Q from the source of potential when connected between A & B hence C is equivalence capacitance.

$Q = CV \rightarrow (2)$

From equation (1) and (2): $CV = V(C_1 + C_2 + C_3)$

$C = C_1 + C_2 + C_3$

Specific Inductive Capacity: It is defined as the ratio of capacitance of a capacitor with the given dielectric medium to the capacitance of the same capacitor with air as dielectric medium.

$$S.I.C = \frac{\varepsilon A/d}{\varepsilon_0 A/d} = \frac{\varepsilon}{\varepsilon_0} = \varepsilon_r = \text{Dielectric constant or Relative Permittivity.}$$