ELECTROPHORUS AND CAPACITORS

The electrophorus is a device for transferring and storing charges. It produces electric charges by electrostatic induction.

It consists simply of a circular metal disc or plate P fitted with an insulating handle H and another flat disc made of an insulating material such as ebonite or polythene tile.

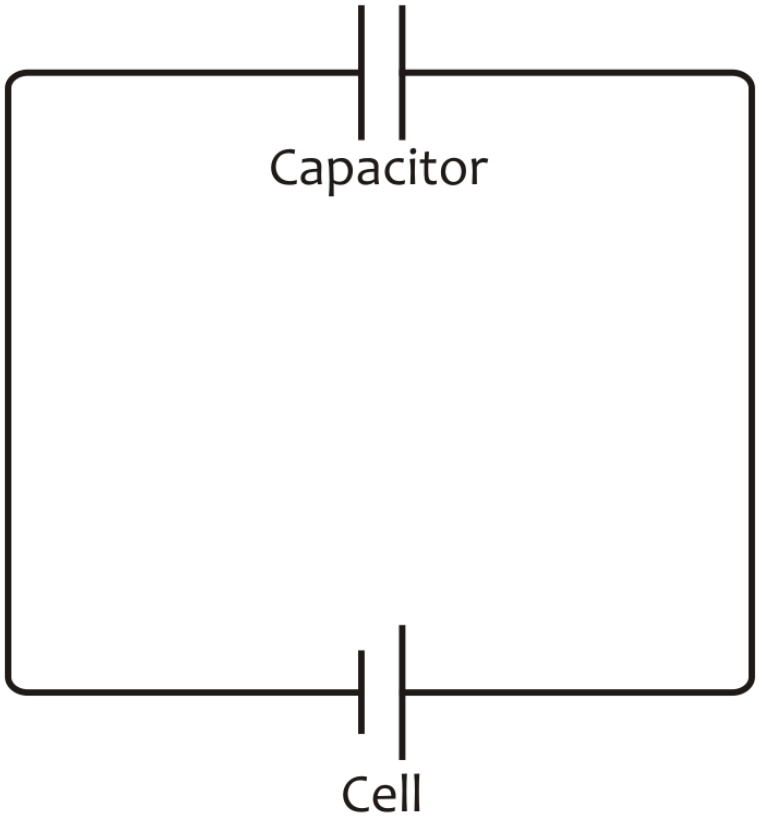
The ebonite or polythene disc is given a negative charge. The metal disc is then placed over the ebonite disc. There are only a few contact points between the two discs, hence no charges flow between them. Positive and negative charges are given to the metal disc by electrostatic induction. The metal disc is now touched with the finger, the negative charges flow away through the body to the earth, and the metal disc is left with only the positive charges. These charges are then stored in the disc when the handle is lifted from the ebonite. The amount of charge stored can be built up by repeating the above process. Apart

from the electrophorus, capacitors are used to store charges.

Capacitors and Capacitance

A capacitor is a device for storing electric charges or for storing electricity. It consists essentially of two conductors (metal plates) carrying opposite charges. The metal plates are separated by a small distance, d, by an insulator.

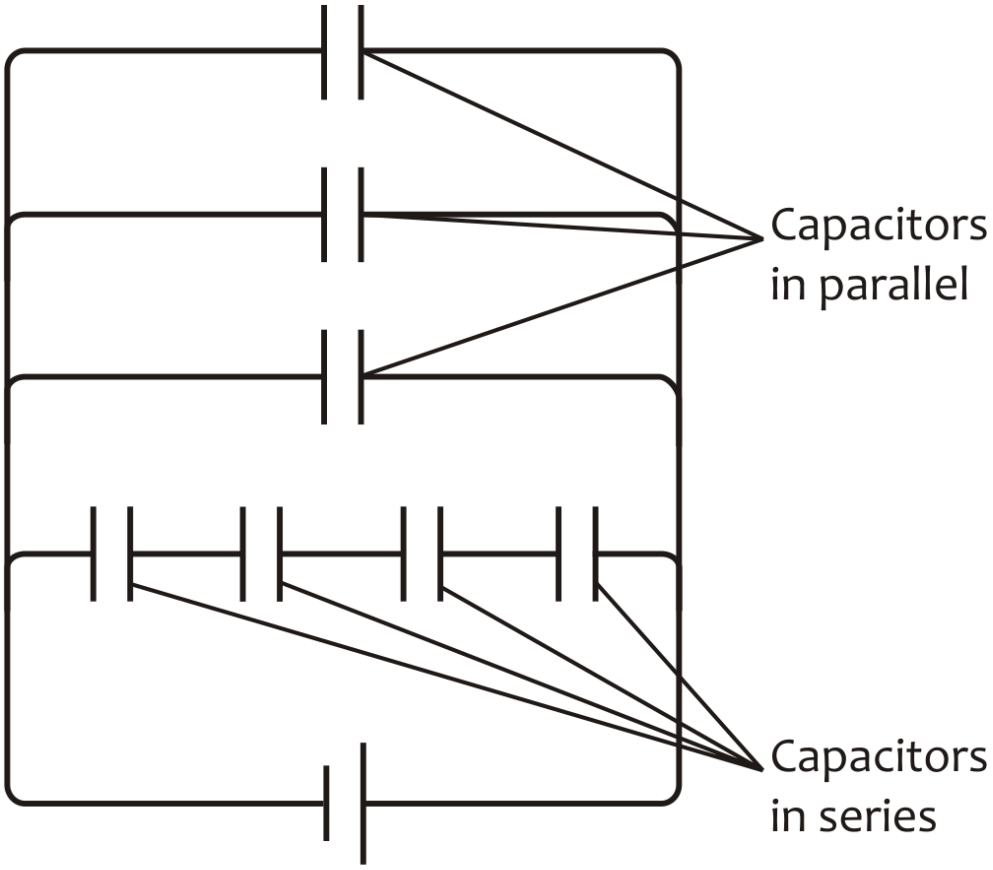
The insulating material placed between the plates of a capacitor is called a dielectric substance. The capacitance increases with the area between the plates, decreases with increasing distance, and increases with di-electric constant.



Capacitance (C) is the quantity that describes the amount of charge (q) a capacitor can store from the voltage passing through it. Thus, it is defined as the ratio of charge Q on either plates of conductors to the potential difference V between them. The unit for measuring capacitance is Farad (Coulomb per volt).

Arrangement of Capacitors

Capacitors can be arranged in series or parallel. The diagram below shows how they arranged:



For capacitors in parallel, the equivalent capacitance C is given as:

$$C = C_1 + C_2 + C_3$$

For capacitors in series, the equivalent capacitance C is given as

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

Note that the resultant or equivalent capacitance of any number of capacitors connected in parallel is the sum of their individual capacitances. The reciprocal of the equivalent capacitance of any number of capacitors connected in series is the sum of the reciprocals of the individual capacitances.

Energy Stored in a Capacitor

A capacitor is charged so that it can store electrical energy. While the capacitor is being charged, its charge builds up from an initial value of zero to a final value q and the potential difference between the plates builds up from zero to a final value V.

During the charging of the capacitor, the average value of the potential difference is given by

$$\frac{0+V}{2} = \frac{1}{2}.V$$

The work done is charging the capacitor through an average potential difference of $\frac{1}{2}V$.

$$W = VQ; \qquad V = \frac{1}{2}V; \qquad Q = q$$

$$W = \frac{1}{2} \times V \times q$$

$$C = \frac{q}{V} \quad or \quad V = \frac{q}{C} \quad or \quad q = CV$$

Thus, $W = ½ . \frac{q}{C} . q = \frac{1}{2} . \frac{q^2}{C}$ or

$$= \frac{1}{2}V.CV = \frac{1}{2}CV^2$$

$$\Rightarrow \quad W = \frac{1}{2}Vq \quad or \frac{1}{2}CV^2 \quad or \quad \frac{1}{2}.\frac{q^2}{C}$$

W is in Joules, C is in Farads, V is in volts, and q is in Coulombs.

Click to Ask Question(s)



Igwuruta, Igwuruta-Ali, Omagwa, Isiokpo, Elele, Omudioga, Egbeda, Ubimini, Ikiri, Omoku.

