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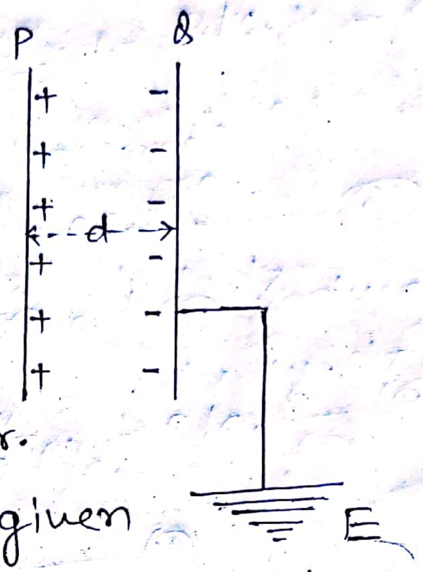
B.Sc (Part-II) Hons

Capacity of a parallel plate capacitor



Two metalic parallel plates of any shape but same size and seprated by a small distance constitute parallel plate capacitor.

If the charge q is given to to the plate P, It will induce a charge -q to the upper surface of the earthed plate Q.

Let A be the area of each plate. If the sepration d is assumed to be very small compared with the plate may be neglected. Thus electric lines of force starting from plate P and ending at the Q plate are parallel to each other and perpendicular to the plates.

we Know that the Intensity at a point between the parallel plate is σ/ϵ_0, where σ is the surface density of charge.

Thus the potential of plate p is given by

$$V = -\int_Q^P E \cdot dr = \int_0^d \frac{\sigma}{\epsilon_0} dr = \frac{\sigma}{\epsilon_0}\int_0^d dr$$

$$= \frac{\sigma d}{\epsilon_0}$$

Here the distance is measured from the lower plate Q in upward direction, and E and dr are opposite to each other.

$\therefore$ capacity $C = \frac{q}{V}$

$$C = \frac{\sigma A}{\sigma d/\epsilon_0}$$

$$\boxed{C = \frac{\epsilon_0 A}{d}} \text{ farad}$$

Instead of two plates, if there are n similar plates at equal distances from each other and the alternat plates are connected togther, the capacitance of the arrangement is given by

$$C = (n-1)\epsilon_0 A/d$$