Electric flux (ϕ)

"It is a measure of the number of lines of force passing through some surface held in the electric field"

$$\phi = \oint \vec{E} \cdot d\vec{A}$$

E = Electric field intensity

$d\vec{A}$ = Area vector

$d\vec{A} = |d\vec{A}|\hat{n}$

$\hat{n}$ = Unit vector

Unit: NM^2C^{-1} or Vm

Dimensional formula

$$= \frac{[MLT^{-2}]}{[AT]}[L^2] = [ML^3T^{-3}A^{-1}]$$

GAUSS' THEOREM

"The electric flux through any closed surface is equal to $\frac{1}{\epsilon_0}$ times the 'net' charge q enclosed by the surface.

$$\phi = \oint \vec{E} \cdot d\vec{A} = \frac{q}{\epsilon_0}$$

ϵ_0 = permittivity of free space.

Important points

* It is valid for closed surface.
* It does not depend upon the position of charge inside the surface.
* The net electric flux through a closed surface due to the charge outside the surface is zero.
* The charge q is the sum of all the charges located anywhere inside the closed surface.

Gaussian Surface Properties

* It is an arbitrary closed surface in three dimensional space
* It should be a closed surface.
* The surface must pass through the point where electric field is to be calculated.
* The field should be normal to the surface at each point and should be constant in magnitude.
* Gaussian should not pass through any DISCRETE CHARGE. However the Gaussian surface can pass through a CONTINOUS CHARGE distribution.