

◆ TERMS & DEFINITIONS

Term	Definition
Gauss's Law	The total electric flux through a closed surface equals the net charge enclosed divided by ϵ_0 .
Electric Flux (Φ)	A measure of the total electric field passing through a surface.
Gaussian Surface	A closed surface chosen to apply Gauss's Law to simplify electric field calculations.
Symmetry	A property (spherical, cylindrical, planar) used to simplify electric field problems using Gauss's Law.
Permittivity (ϵ_0)	A constant that characterizes the electric permeability of free space.

◆ SYMBOLS

Symbol	Meaning
Φ_E	Electric flux
\vec{E}	Electric field vector
\vec{dS}	Vector area element on a surface
q_{in}	Net charge enclosed by a surface
ϵ_0	Vacuum permittivity

◆ CONSTANTS

Constant	Symbol	Value	Unit
Vacuum permittivity	ϵ_0	8.854×10^{-12}	$C^2/N \cdot m^2$
$\frac{1}{4\pi\epsilon_0}$	k	9×10^9	$N \cdot m^2/C^2$

◆ FORMULAS

1. Gauss's Law (Integral Form)

$$\Phi_E = \oint \vec{E} \cdot \vec{dS} = \frac{q_{in}}{\epsilon_0}$$

2. Electric Flux

$$\Phi_E = \vec{E} \cdot \vec{A} = EA \cos \theta$$

- θ : Angle between electric field \vec{E} and area vector \vec{A}
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3. Applications of Gauss's Law

(i) Infinite Line of Charge (Linear charge density λ):

$$E = \frac{\lambda}{2\pi\epsilon_0 r}$$

- r : Radial distance from the line
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(ii) Infinite Plane Sheet (Surface charge density σ):

$$E = \frac{\sigma}{2\epsilon_0}$$

(iii) Thin Spherical Shell of Radius R and Total Charge q :

- Outside the Shell ($r > R$):

$$E = \frac{1}{4\pi\epsilon_0} \cdot \frac{q}{r^2}$$

- Inside the Shell ($r < R$):

$$E = 0$$
