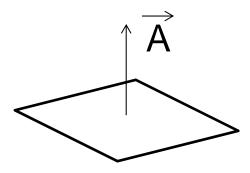
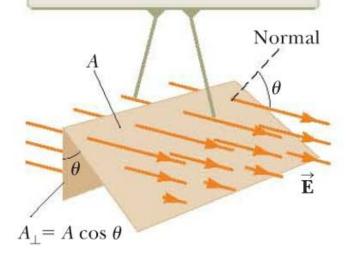
Electric Field Lines and Electric Flux

Area vector and Flux



Area vector is a vector perpendicular to a plane surface with magnitude equals to the area of the plane.

The number of field lines that go through the area A_{\perp} is the same as the number that go through area A.

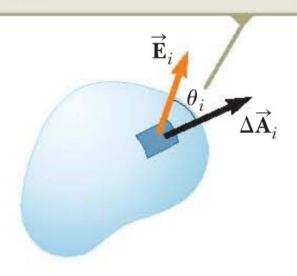


Flux
$$\Phi_E = E A \cos \theta = \vec{E} \cdot \vec{A}$$

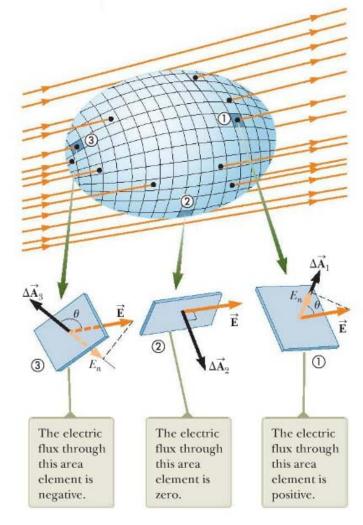
Class 8. Gauss's Law

Flux for curve surface

The electric field makes an angle θ_i with the vector $\Delta \vec{A}_i$, defined as being normal to the surface element.



$$d\Phi_{E} = \vec{E} \cdot d\vec{A} \implies \Phi_{E} = \int \vec{E} \cdot d\vec{A}$$



For closed surface, surface vector is positive when it is pointing outward.

Gauss's Law (Maxwell's first equation)

For any closed surface,

$$\varepsilon_0 \Phi_E = q_{in}$$
 or $\varepsilon_0 \oiint \vec{E} \cdot d\vec{A} = q_{in}$

Two types of problems that involve Gauss's Law:

- 1. Give you left hand side (i.e. flux through a given surface), calculate the right hand side (i.e. charge enclosed by that surface).
- 2. Give you right hand side (i.e. a charge distribution), calculate the left hand side (i.e. flux and the electric field).

Example

