ODM EDUCATIONAL GROUP
Changing your Tomorrow

Electric flux, Statement of Gauss's theorem

CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 01
CHAPTER NAME : ELECTRIC CHARGES AND FIELDS

Website: www.odmegroup.org
Email: info@odmps.org
Toll Free: **1800 120 2316**
Sishu Vihar, Infocity Road, Patia, Bhubaneswar- 751024

LEARNING OUTCOME

- Students can understand electric flux and its application in the open and closed surface.
- Students should understand the physical information contained in Gauss's law and they should be able to apply this law to the calculation of field distributions in systems with specified symmetry.
- Students can explore the definitions:

  (a) vectorially surface area element;

  (b) flux of a vector field (the flux of fields other than E will be involved);

  (c) open and closed surfaces
- Students will be able to explore Gauss' Law and clearly understand how to apply it.

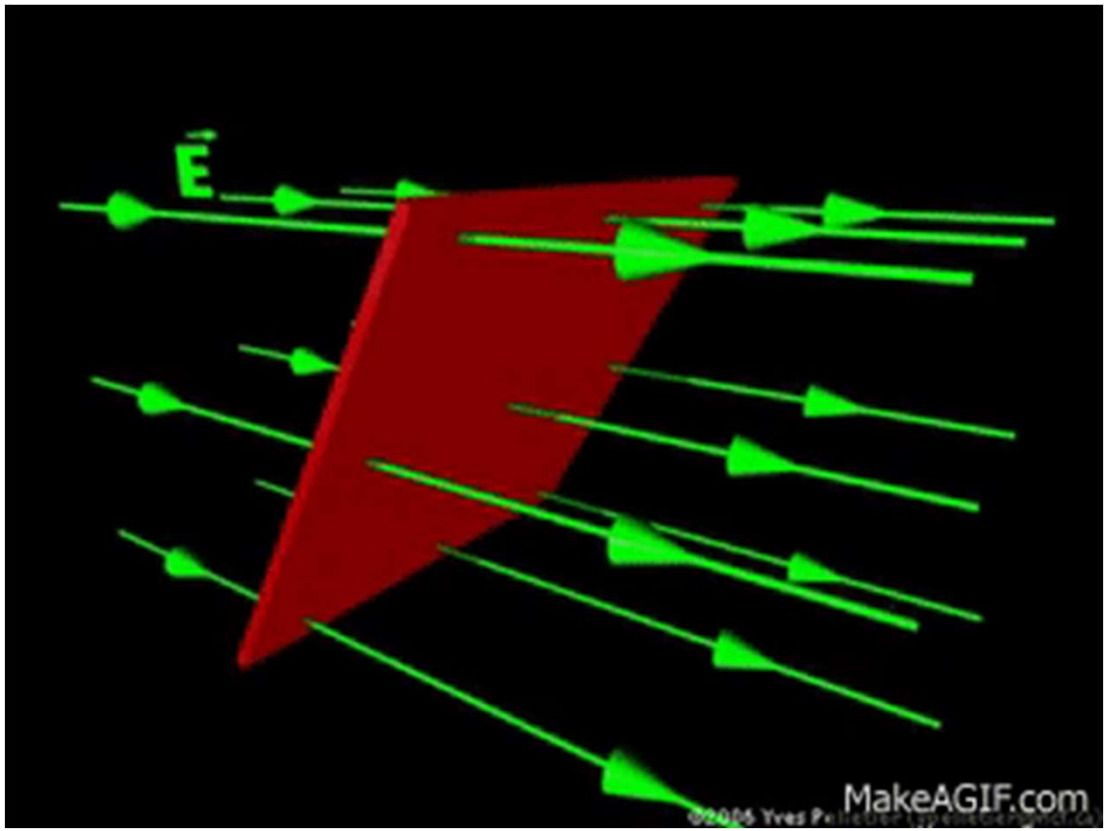
ODM EDUCATIONAL GROUP
Changing your Tomorrow

QUICK REVIEW

1. Define torque?
2. How torque is produced by a dipole in a uniform electric field?
3. What is the net force on the dipole when placed in Uniform?
4. In which case torque by the dipole is maximum and when torque is zero?
5. What is the net force on the dipole when it is placed in a non-uniform electric field?

INTRODUCTION

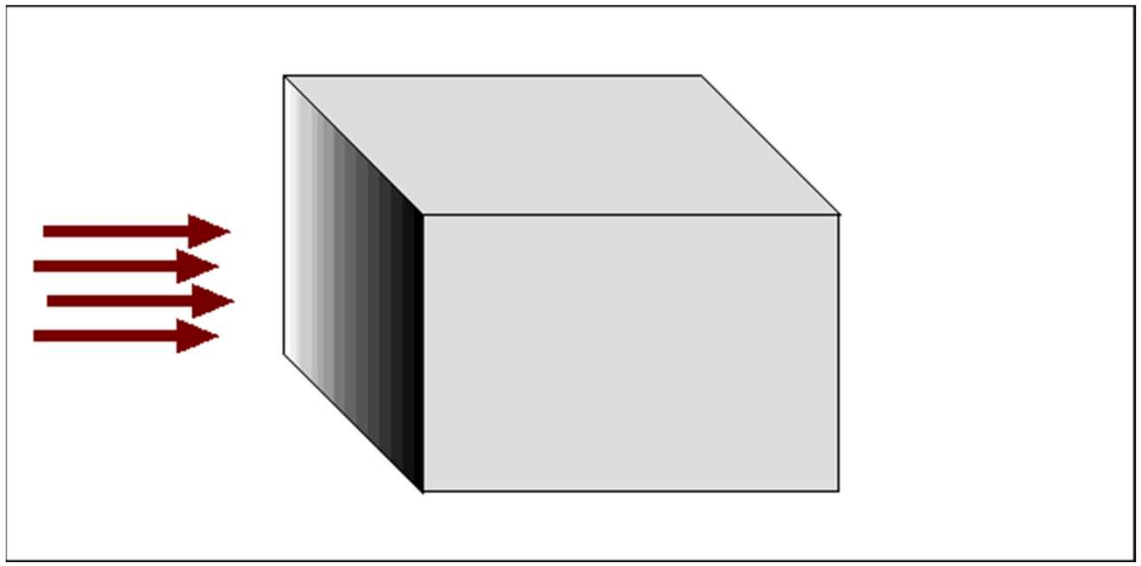
- What is electric field lines?
- What is area vector?

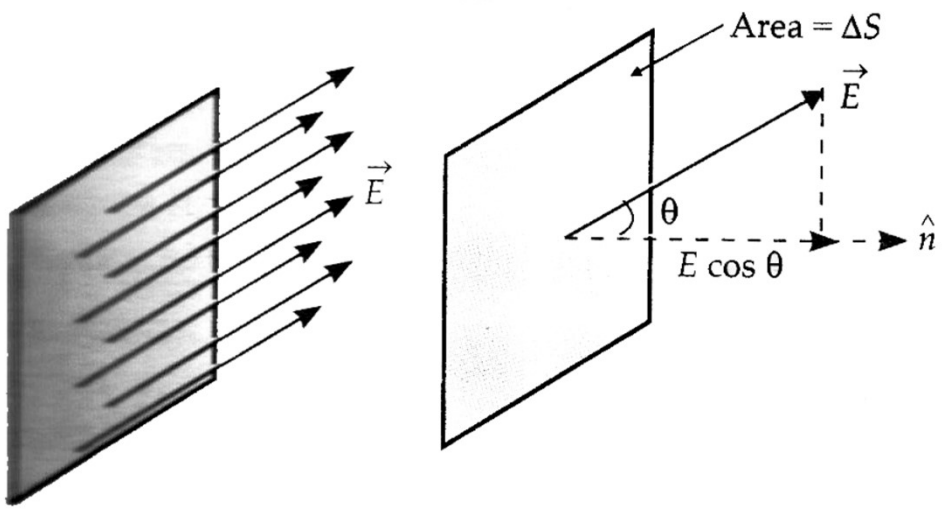


ODM EDUCATIONAL GROUP
Changing your Tomorrow

Electric Flux

- It is the measure of the numbers of electric field lines through a given surface.
- **Definition:** It is defined as the dot product of electric field and area vector.
- Mathematically, $d\phi = \vec{E}.d\vec{s} = Eds\cos\theta$





Flux through an inclined area.

POINTS TO REMEMBER

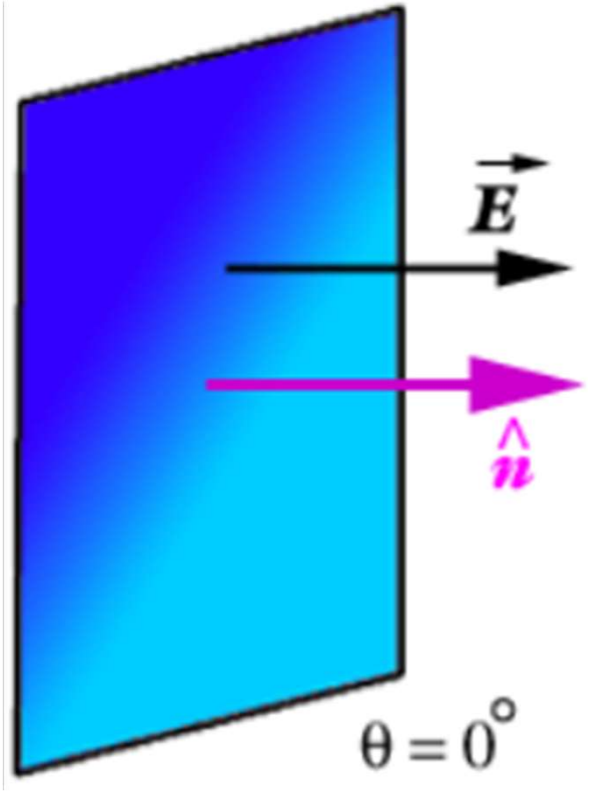
1. It is a scalar quantity
2. S.I unit $\rightarrow \frac{N}{c}m^2 or \left[\frac{V}{m} \times m^2 = V \times m\right]$
3. Dimensional formula $\frac{[MLT^{-2}][L^2]}{[AT]} = [ML^3T^{-3}A^{-1}]$

Electric Flux

Case – I: When $\theta = 0^0$ (i.e surface is normal to the field)

$d\phi = Eds\,cos\,0 = Eds$ (maximum).

It is called emerging flux

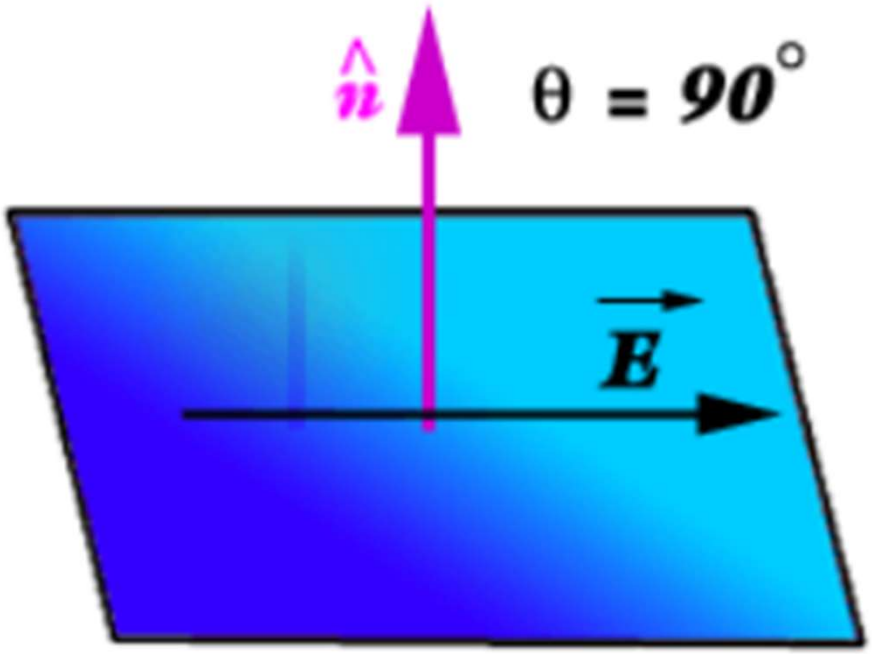


Electric Flux

Case – II

when $\theta = 90^0$ (i.e surface is kept parallel to the field)

$$d\phi = Eds\ cos\ 9\ 0^o \Rightarrow d\phi = 0$$

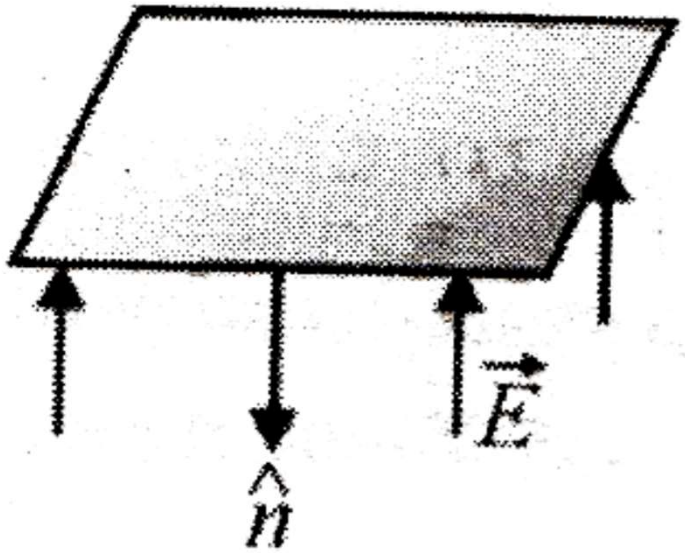


Electric Flux

Case – III

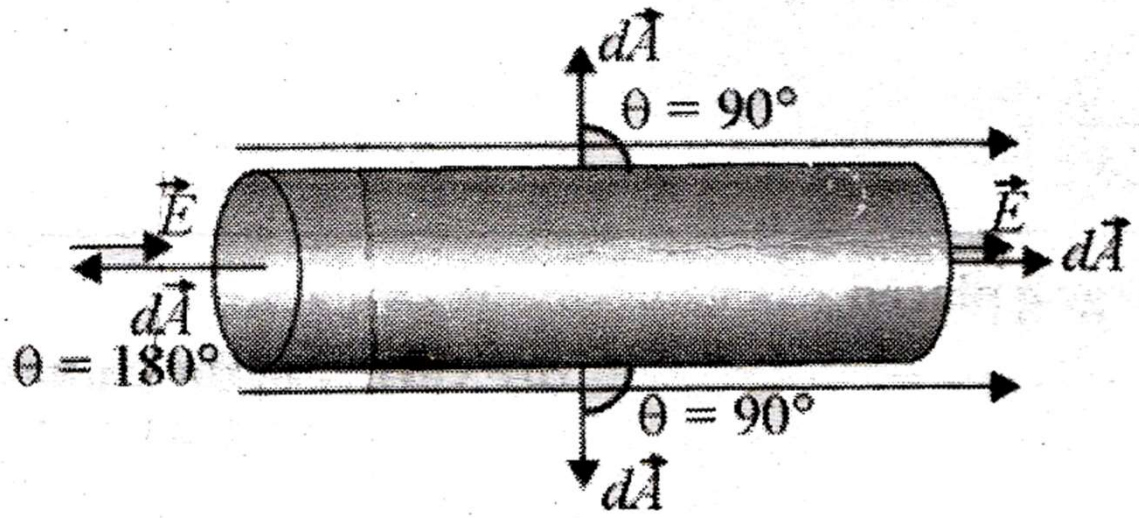
When $\theta = 180^o, d\phi = Eds\,cos\,1\,80^0 = -Eds$

This negative flux is called entering flux.



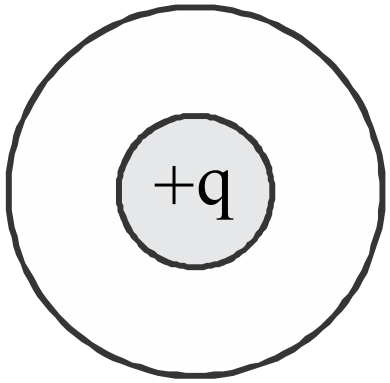
Numerical

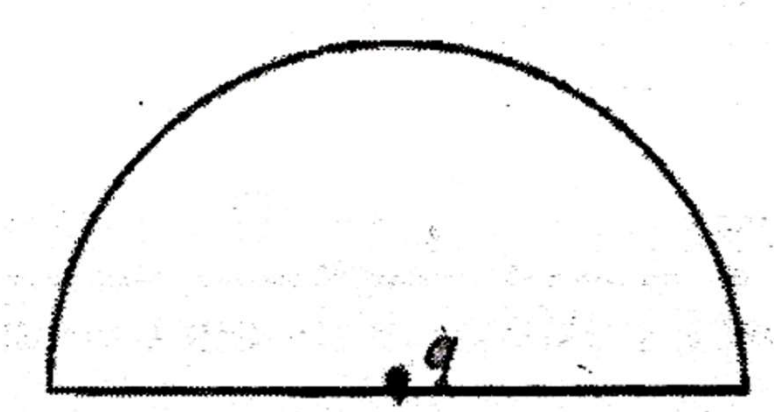
Question: A uniform electric field exists in space. Find the electric flux through a cylindrical surface with the axis parallel to the field.



Numerical

Question: Find the electric flux due to the electric field through the surface as given in the following figure.





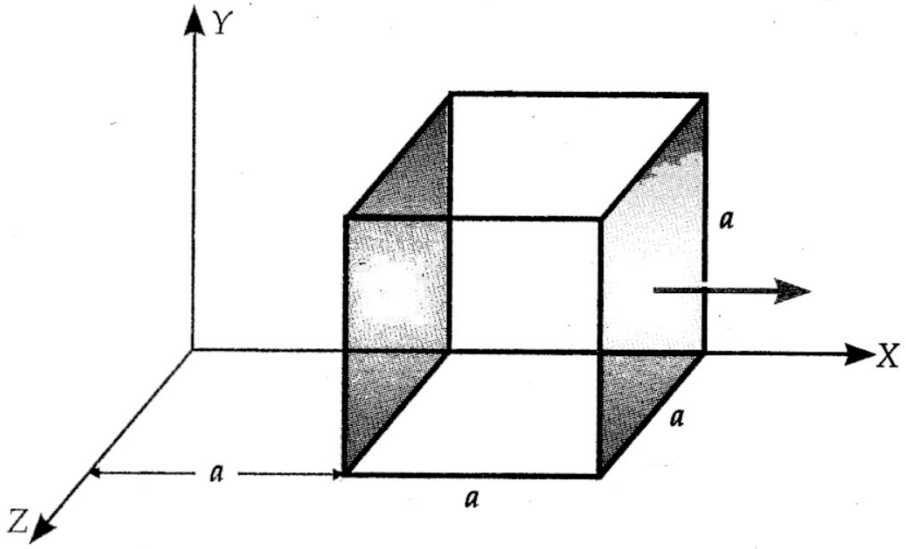
NCERT Numerical

Question: The electric field components in the figure are $E_x = \alpha x^{1/2}, E_y = E_z = 0$ in which $\alpha = 800 N/cm^{1/2}$

Calculate:

a) Flux through the cube of side 0.1 m

b) Also find the charge within the cube (NCERT)



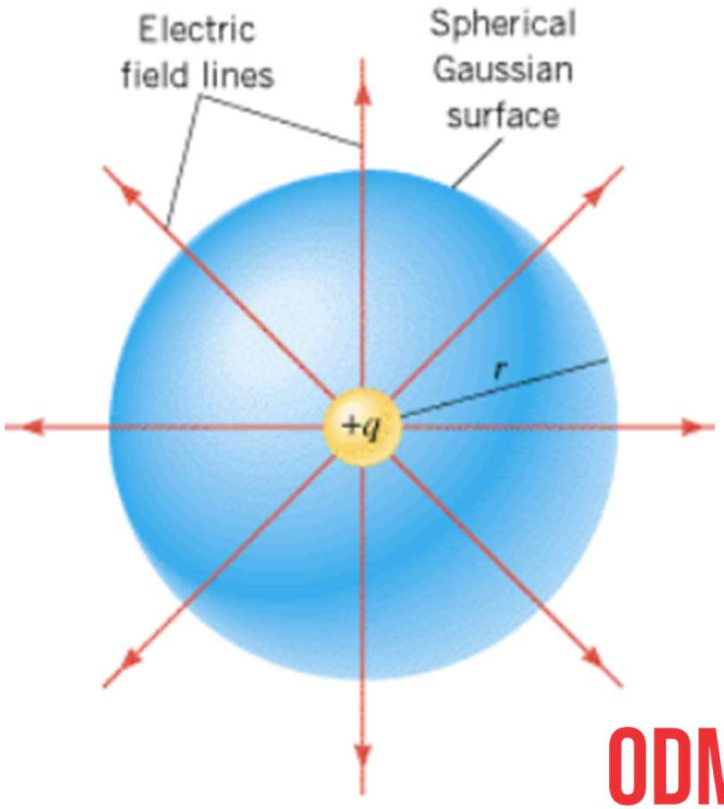
ODM EDUCATIONAL GROUP
Changing your Tomorrow

GAUSS LAW

The net electric flux through any hypothetical close surface in free space is equal to $\frac{1}{\varepsilon_0}$ times of the net charge enclosed within the surface.

Mathematically

$$\phi = \frac{\sum q_{in}}{\varepsilon_0}$$



ODM EDUCATIONAL GROUP
Changing your Tomorrow

POINTS TO REMEMBER

1. It is regarded as the fundamental law in electrostatics

2. It gives the relation between electric field at a point on the close surface and net charge enclosed

3. The hypothetical surface on which Gauss law is obeyed is called Gaussian surfaces.

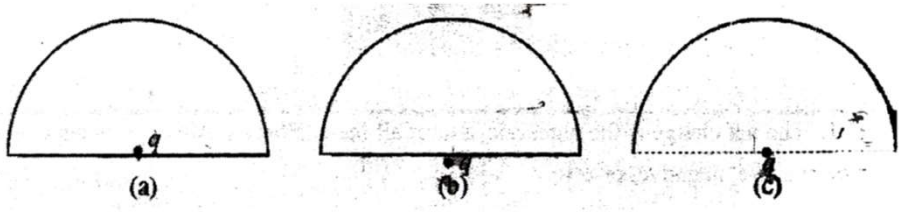
4. If some charges are placed in a medium other than vacuum then the law takes the form as $\varphi = \frac{q_1+q_2+q_3}{\varepsilon_0}$

   - All the charges shown in the figure contribute to the electric field on the surface but only the charges within the surface contribute to the flux.

NUMERICAL

QUESTION:

Find the electric flux due to charge q placed as shown in the following given figures.



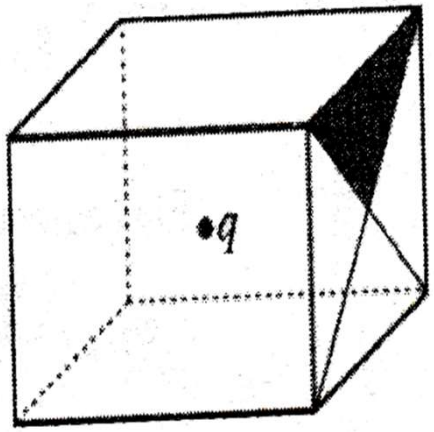
NUMERICAL

A point charge q is placed at the center of a cubical box. Find

(a) Total flux associated with the box

(b) Flux emerging through each face of the box

(c) Flux through a shaded area of the surface



HOME ASSIGNMENT

NCERT exercise 1.15, NCERT example 1. 11 and 1.12.

THANKING YOU

ODM EDUCATIONAL GROUP

ODM EDUCATIONAL GROUP
Changing your Tomorrow