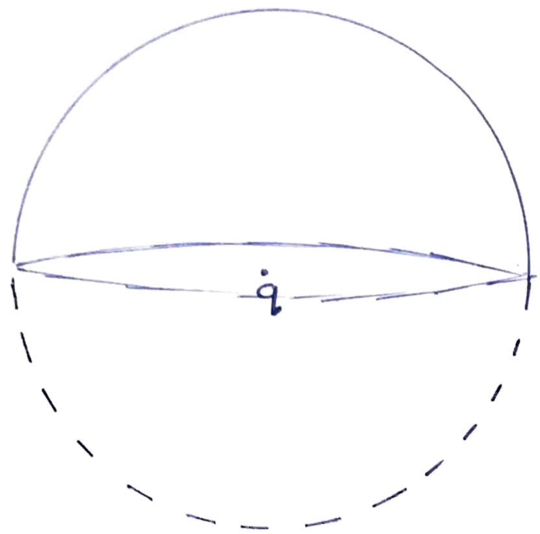
Q) Find the electric flux passing through a hemispherical bowl having a charge q kept at its centre.

Solⁿ:→



$\Sigma q_{in} = q$ —— ⊛

$\because$ flux passing from upper hemisphere = flux passing from lower hemisphere

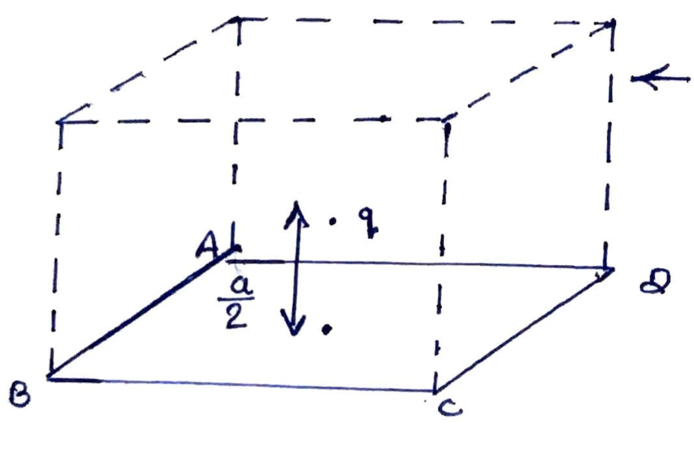
$\Rightarrow \phi_{up} = \phi_{Lower}$ —— ①

$\because \phi_{total} = \phi_{up} + \phi_{Lower}$

$$\frac{\Sigma q_{in}}{\varepsilon_0} = 2 \cdot \phi_{up}$$

$$\Rightarrow \phi_{up} = \frac{q}{2\varepsilon} \quad \frac{N\text{-}m^2}{C}$$

Q) A charge 'q' is kept at a ht. $\frac{a}{2}$ from the center of a square of side length 'a'. Find the electric flux passing from the square.



Solⁿ:→ Electric flux passing from each square face $= \frac{1}{6} \times$ total Electric flux passing from the cube

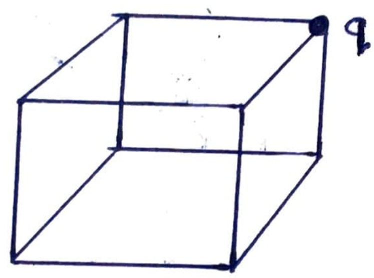
$$\phi_{ABCD} = \frac{\phi_{total}}{6}$$

$$= \frac{\Sigma q_{in}}{6 \cdot \varepsilon_0}$$

$$= \frac{q}{6\varepsilon} \quad \frac{N}{C} \cdot m^2$$

Q) A charge 'q' is placed at the corner of a cube, find the electric flux passing from the cube.

Solⁿ:→



We need 7 more identical cubes like the given cube to surround the charge 'q' symmetrically such that 'q' may come at the center.

so $\phi_{small\ cube} = \frac{1}{8} \times \phi_{Big\ cube}$

$$= \frac{1}{8} \cdot \frac{\Sigma q_{in}}{\varepsilon}$$

$$\Rightarrow \phi_E = \frac{q}{8\varepsilon} \quad \frac{N}{C} \cdot m^2$$

Q) in the above question, what will be the flux passing from each face of the square.

Solⁿ:→ The Bigger cube (containing 8 small cubes), will have 4 square small faces in its each square face.

$\therefore$ total No. of small square faces on the bigger cube $= 6 \times 4 = 24$.

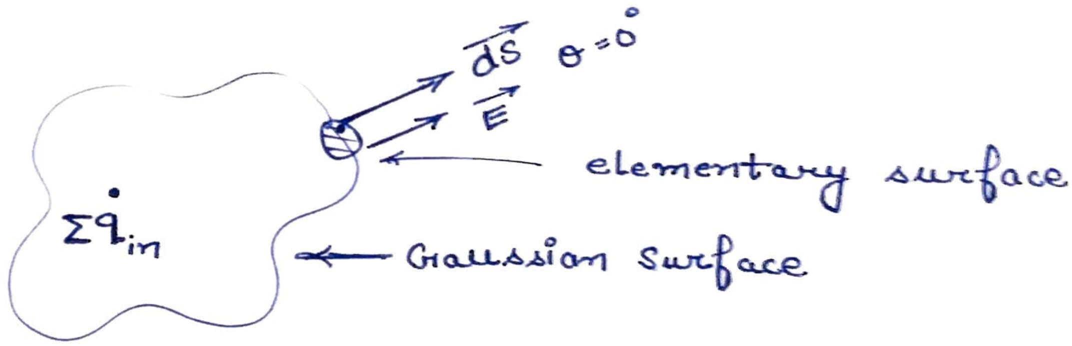
so flux passing from each smaller square face

$$\phi_{small} = \frac{1}{24} \times \phi_{total}$$

$$= \frac{1}{24} \cdot \frac{\Sigma q_{in}}{\varepsilon_0}$$

$$\Rightarrow \phi_{small} = \frac{q}{24\varepsilon_0}$$

Gauss Theorem :→ Gauss theorem is an easy & superior method to calculate the electric field near any charge.



$\because$ flux passing from the elementary surface

$$d\phi_E = \vec{E} \cdot \vec{dA}$$

so total flux passing from the whole surface;

$$\oint d\phi_E = \oint \vec{E} \cdot \vec{dA}$$

$$\Rightarrow \phi_E = \oint \vec{E} \cdot \vec{dA} \quad \text{--- (1)}$$

from Gauss Law :→

$$\phi_E = \frac{\Sigma q_{in}}{\varepsilon_0} \quad \text{--- (2)}$$

from (1) & (2)

Gauss theorem $\Rightarrow$ $$\boxed{\oint \vec{E} \cdot \vec{dA} = \frac{\Sigma q_{in}}{\varepsilon_0}} \quad \text{--- (*)}$$

Imp. points

1) The Gaussian surface must always pass from the point where we calculate the Electric field.

2) The Gaussian surface must be such that ie: its shape must be such that all the points over it must have the same intensity of electric field. ie: $E = \text{const.}$

3) charge enclosed inside the Gaussian surface must be known. ie: $\Sigma q_{in} = \text{known}$

4) total surface area of the Gaussian surface must already known. ie: $\oint ds = \text{known}$

5) Gaussian surface must be a close surface.