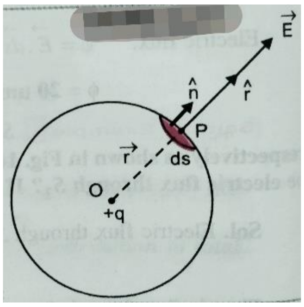
Gauss's law in electrostatics –

According to Gauss for a closed surface total flux in the free surface is $\mathbf{1/\epsilon_0}$ times the total charge inside the closed surface.

Proof of Gauss's law -



.

Suppose a charge q is placed at the centre of the spherical shell of radius r ,

Then electric flux linked with the sphere is $\phi = \oint E\, ds$ (here E and ds is parallel to each other as shown in figure)

But here , $E = q/4\prod\epsilon_0 r^2$

So, $\phi = \oint E\, ds = \oint(\frac{q}{4\prod\epsilon 0r2})\ ds =$ $(q/4\prod\epsilon_0^2) \oint ds =(q/4\prod\epsilon_0 r^2)\ 4\prod r^2 = q/\epsilon_0$

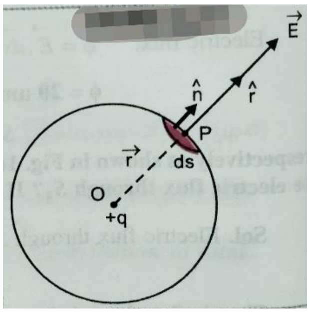
i.e. $\phi= \oint E\, ds = q/\epsilon_0$ Hence prove .

If the medium surrounding the charge has a dielectric constant 'K' then the flux

$\phi= q/K\epsilon_0$

Deduction of Coulomb's law on the basis of Gauss's law –

Suppose a positive point charge is at O . We imagine a sphere of radius r with centre O . The magnitude of electric field intensity at that any point the surface of the sphere is E ,and it directed radially outward . The direction of the small area ds at the point p is along the direction of electric field E . i.e. electric field and area vector are parallel to each other



According to Gauss's theorem ,

$\phi= \oint E\, ds = q/\epsilon_0$

or , $\oint E\, ds\ \cos 0^0 = q/\epsilon_0$, or, $E \oint ds = q/\epsilon_0$ or, $E (4\pi r^2) = q/\epsilon_0$

or, $E= q/4\pi r^2 \epsilon_0 = q/4\pi\epsilon_0 r^2$; This is the electric field intensity due to charge q at distance r , if we put a charge q_0 at point p then the force $F = q\, q_0 /4\pi\epsilon_0 r^2$ which is coulomb's law .