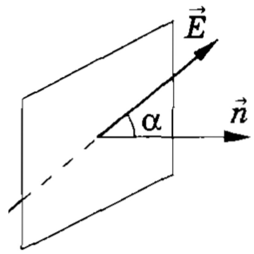
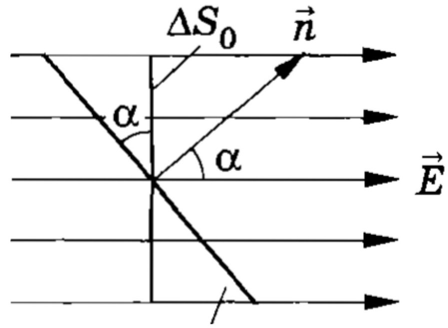
The Flux of the Vector.

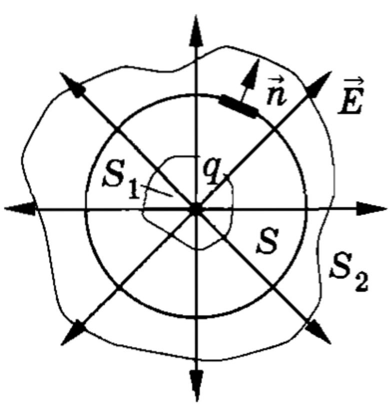


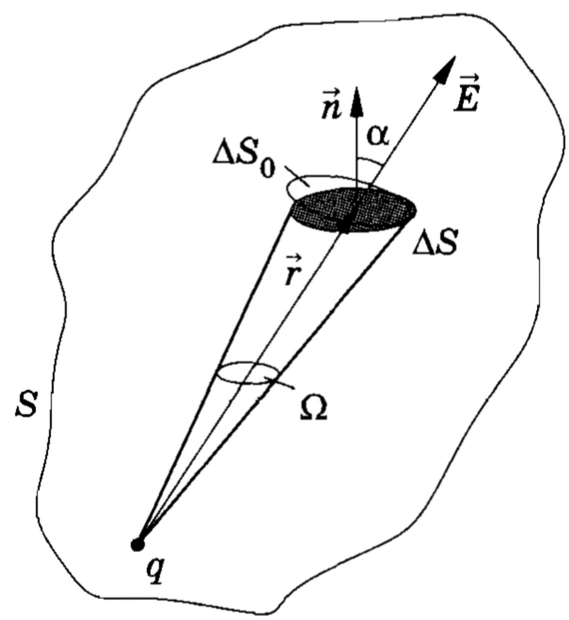


$$\Delta S_0 = \Delta S \cos\alpha.$$

$$\Delta N = E\cos\alpha \cdot \Delta S = E\Delta S_0,$$

Theorem. The flux of the electric field through the closed surface is proportional to the charge enclosed inside this surface.

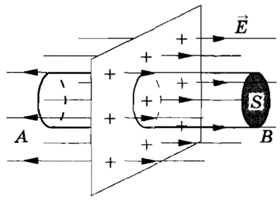




$$E_n = k\frac{q}{\varepsilon r^2}.$$

$$N = \sum_i E_{n_i}\Delta S_i = E_n \sum_i \Delta S_i = E_n \cdot 4\pi r^2 = k\frac{4\pi q}{\varepsilon}.$$

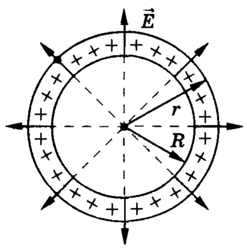
Applications. Charged Plane.

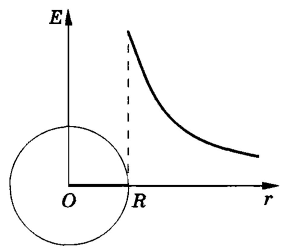


$$2SE_n = k\frac{4\pi}{\varepsilon}\sigma S.$$

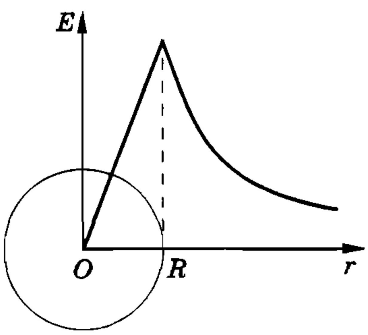
$$E = k\frac{2\pi|\sigma|}{\varepsilon}.$$

Applications. Charged Sphere.





Applications. Charged Ball.



Homework problem 1. *Use Gauss' law to find the electric field of a thin infinite straight wire with a linear density of charge ρ.*

Note: One can of course compute the same result differently: imagine that the wire is made of tiny pieces, so small that each produces field of a single particle. Then one can add-up fields of all these pieces. This harder exercise requires knowledge of integrals but gives the same answer!

Homework problem 2. *Positive charge q is uniformly spread along the length on the thin wire ring with radius R (so it is spread along the perimeter of a circle). Find the field along the axes of the symmetry of the ring as a function of h, the height from the plane of the ring. (Hint: see Note above).*