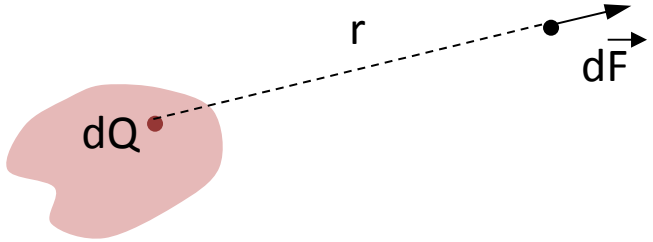
Class 2: Calculation with Coulomb's Law

Calculating Integration to Calculate the Electric Force Between an Extensive Charge Distribution and a Point Charge q

Step 1. Write down the infinitesimal force dF in terms of an infinitesimal element dQ in the extensive charge distribution.

$$d\vec{F} = \frac{1}{4\pi\varepsilon_0}\frac{qdQ}{r^2}\hat{r}$$

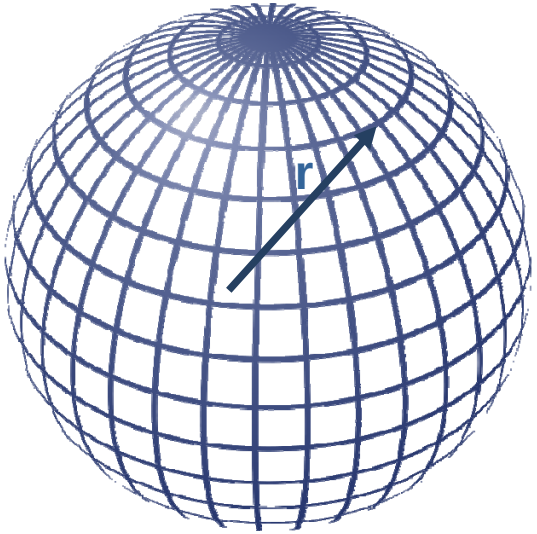


Step 2. Resolve dF in components.

Step 3. Write the integrand terms of a common set of variables.

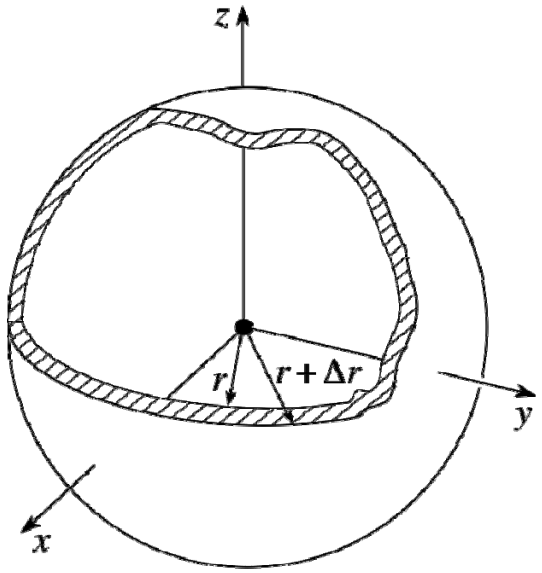
Step 4. Do an integration for each component

Some Important Geometric Formulae of a Sphere



$$\text{Surface area of a sphere} = 4\pi\, r^2$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi\, r^3$$

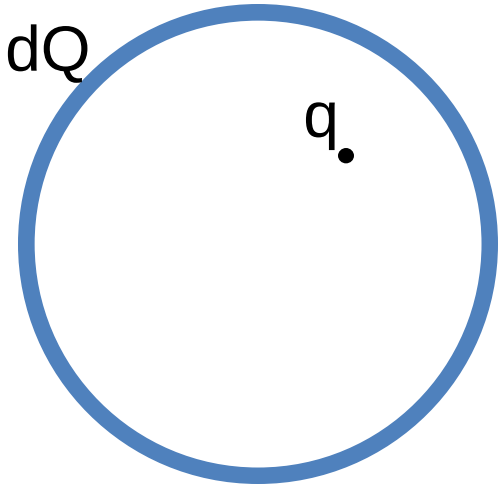


Volume of a spherical thin shell of thickness dr

$$= dV$$

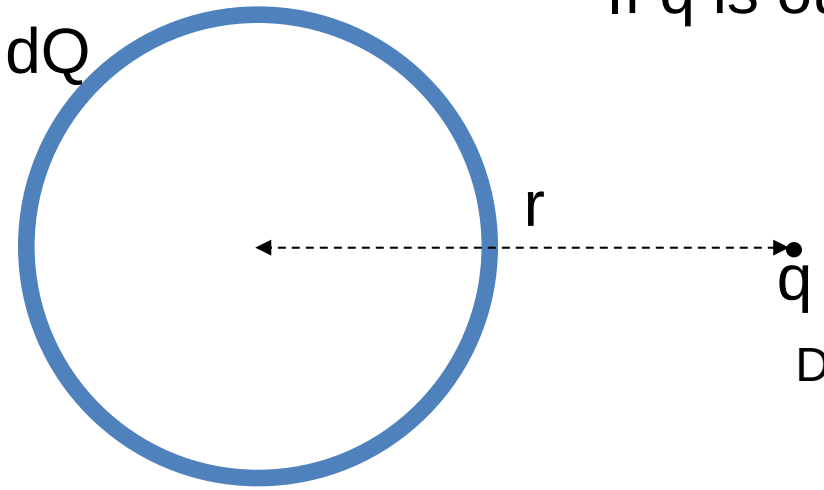
$$= 4\,\pi\, r^2\, dr$$

Some Important Results for a Sphere



F=0 if q is inside the spherical shell

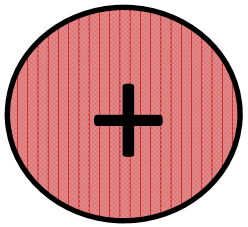
If q is outside the spherical shell:



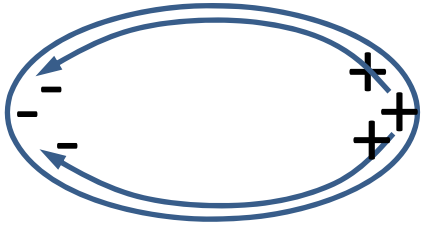
$$|\vec{F}| = \frac{1}{4\pi\varepsilon_0}\frac{q\,dQ}{r^2}$$

Direction: towards or away from the center of the spherical shell.

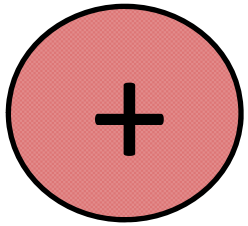
Polarization of a neutral object by another charged object



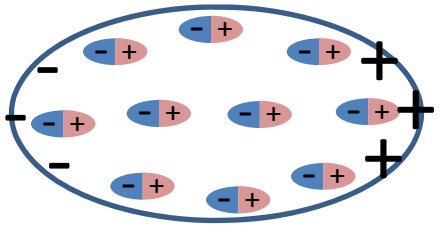
Charged object



Conductor. Total charge =0



Charged object



Insulator. Total charge =0

Different mechanisms, but same effect for both cases. The effect is more significant for conductor.

Because of polarization, the neutral object is attracted to the charged object (no matter whether the charged object is positively or negatively charged).