Question #86382, Physics / Electromagnetism

Electric field inside and outside of uniformly charged solid sphere:

Radius of the charged solid sphere (R= 0.75 m)

Volume charged density of solid sphere (ρ = 0.25 nC/m^3)

Electric charge on sphere (Q)

$Q = \rho V$ Where V is volume of solid sphere i.e. ($\frac{4}{3}\pi R^3$)

Q = Total charge enclosed by the sphere.

(a) Electric flux through the sphere

Flux = $\oint E.ds$

= E*A Where A = electric field passing through the surface

= E*4* π*R^2 E = Electric field on the surface.

(Note: We can find electric field by substituting radius of solid sphere in the formula of electric field inside the solid sphere as given below)

(b) Electric field inside the solid sphere i.e. (radius of Gaussian sphere = 0.5m)

$\oint E.ds = \frac{Q\prime}{\epsilon}$

$\oint E * ds * \cos 90° = \frac{Q\prime}{\epsilon}$ Since E and ds are perpendicular to each other.

$E * 4\pi r^2 = \rho * \frac{4}{3}\pi r^3/\varepsilon$

$E = \frac{\rho r}{3\varepsilon}$

On substituting values

E = $\frac{0.25*0.5*10^{-9}}{3*8.85*10^{-12}}$ N/C

E = 0.0047 * 10^3 N/C

- Electric field outside the solid sphere i.e. (radius of Gaussian sphere = 1.5

$$\oint E.ds = \frac{Q}{\epsilon}$$

$\oint E * ds * \cos 90° = \frac{Q}{\epsilon}$ Since E and ds are perpendicular to each other.

$E * 4\pi r^2 = \rho * \frac{4}{3}\pi R^3/\varepsilon$

$E = \frac{\rho R^3}{3\varepsilon r^2}$

E = 0.0017* 10^3 N/C

(c) If this sphere were made of conducting material then

Electric field inside the conductor will be zero and outside it will be same as the electric field outside the solid sphere.