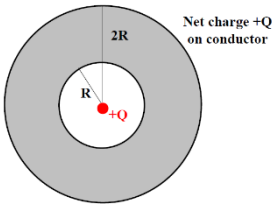
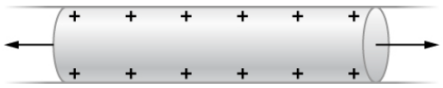
Questions on Gauss Law

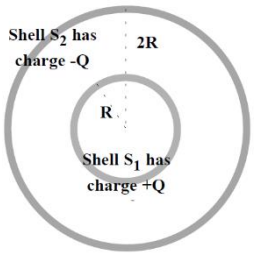
1. A solid insulating sphere of radius R has charge distributed uniformly throughout its volume. (a) What fraction of the sphere's total charge is located within the region $r = R/2$? (b) What is the ratio of the electric field magnitude at $r = R/2$ to that on the surface of the sphere?
2. In a certain region of space the electric field is given by $\vec{E}(r) = (\frac{a}{r})\hat{r}$. It points radially away from the origin and has a magnitude $E(r) = a/r$, where $a = 90 Nm/C$. How much electric charge (in nanoC) is located inside a sphere with radius R = 0.5 meters?
3. A spherical ball of plasma has a radius 0.50 m. The electric field on the surface of the ball is measured to be 8.9×10^3 N/C and points radially inward toward the center. What is the average volume charge density of the plasma?
4. A point charge +Q is located at the center of a solid spherical conducting shell with inner radius of R and outer radius of 2R as shown in the Figure. In addition, the conducting shell has a total net charge of +Q. How much charge is located on the outer surface (r = 2R) of the conducting shell?



5. A solid insulating sphere of radius R has a non-uniform volume charge distribution given by $\rho(r) = \frac{a}{r}$, where a is a constant. What is the total charge Q of the insulating sphere?
6. Discuss whether Gauss's law can be applied to other forces, and if so, which ones.
7. The surface charge density on a long straight metallic pipe is σ. What is the electric field outside and inside the pipe? Assume the pipe has a diameter of $2a$.

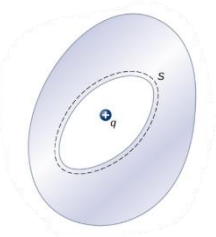


8. Two charged concentric spherical shells have radii 10.0 cm and 15.0 cm. The charge on the inner shell is 4.00×10^{-8} C, and that on the outer shell is 2.00×10^{-8} C. Find the electric field (a) at r = 12.0 cm and (b) at r = 20.0 cm.

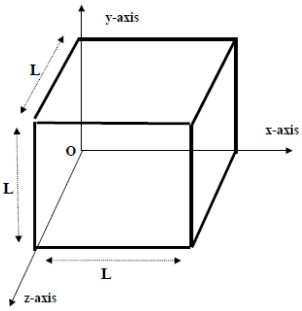


9. Consider a spherical conducting shell S1 of radius R on which charge +Q is placed. Without touching or disturbing it, this shell is now surrounded concentrically by a similar shell S2 of radius 2R on which charge -Q is placed (see Figure). What is the magnitude of the electric field in the region between the two shells (R <r < 2R)? What is the electric field inside shell S1 (r < R)?

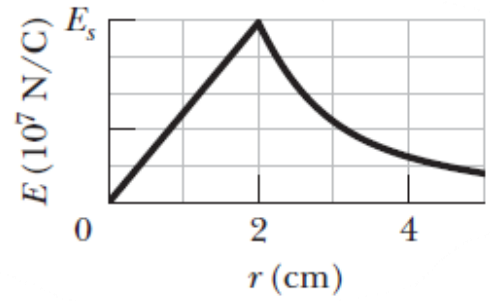
10. A charge q is placed in the cavity of a conductor as shown below. Will a charge outside the conductor experience an electric field due to the presence of q?



11. In a certain region of space within a distribution of charge the electric field is given by $\vec{E}(x) = ax\hat{x}$. It points in the x direction and has a magnitude $Ex(x) = ax$, where $a = 150N/(Cm)$. How much electric charge (in nanoC) is located inside the cube with sides of length L = 2 m shown in the Figure?



1. Figure gives the magnitude of the electric field inside and outside a sphere with a positive charge distributed uniformly throughout its volume. The scale of the vertical axis is set by $E_x = 5.0 \times 10^7\ N/C$.What is the charge on the sphere?



12. The earth (a conductor) has a net electric charge. The resulting electric field near the surface has an average value of about 150 N/C directed toward the center of the earth. (a) What is the corresponding surface charge density? (b) What is the total surface charge of the earth?
13. A solid insulating sphere of radius R has a non-uniform volume charge distribution given by ρ(r) = ar, where a is a constant. What is the total charge Q of the insulating sphere?
14. The electric flux through a square-shaped area of side 5 cm near a large charged sheet is found to be 3×10^{-5} N·m^2 /C when the area is parallel to the plate. Find the charge density on the sheet.