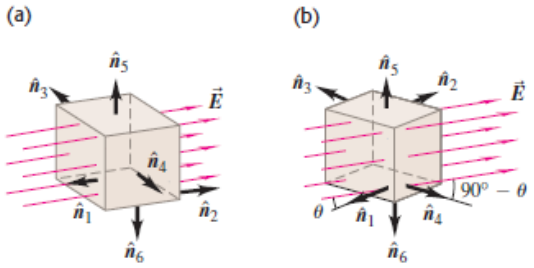
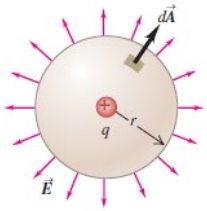
Gauss law

1. Electric Fields in an Atom. The nuclei of large atoms, such as uranium, with 92 protons, can be modeled as spherically symmetric spheres of charge. The radius of the uranium nucleus is 7.4 $\times 10^{-15}$m approximately (a) What is the electric field this nucleus produces just outside its surface? (b) What magnitude of electric field does it produce at the distance of the electrons, which is about 1.0 $\times 10^{-10}$m (c) The electrons can be modeled as forming a uniform shell of negative charge. What net electric field do they produce at the location of the nucleus?

2. An imaginary cubical surface of side L is in a region of uniform electric field $\vec{E}$. Find the electric flux through each face of the cube and the total flux through the cube when (a) it is oriented with two of its faces perpendicular to $\vec{E}$ (Fig a) and (b) the cube is turned by an angle θ about a vertical axis (Fig b).



3. A point charge $q = +3.00\mu C$ is surrounded by an imaginary sphere of radius $r = 0.20m$ centered on the charge (Fig). Find the resulting electric flux through the sphere.



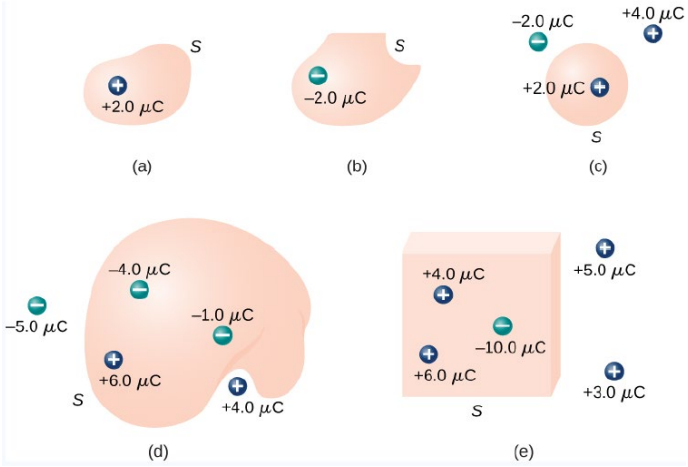
4. A thin-walled, hollow sphere of radius 0.250 m has an unknown charge distributed uniformly over its surface. At a distance of 0.300 m from the center of the sphere, the electric field points radially inward and has magnitude 180 N/C. How much charge is on the sphere?

5. Find the flux through a spherical Gaussian surface of radius a = 1 m surrounding a charge of 8.85 pC.

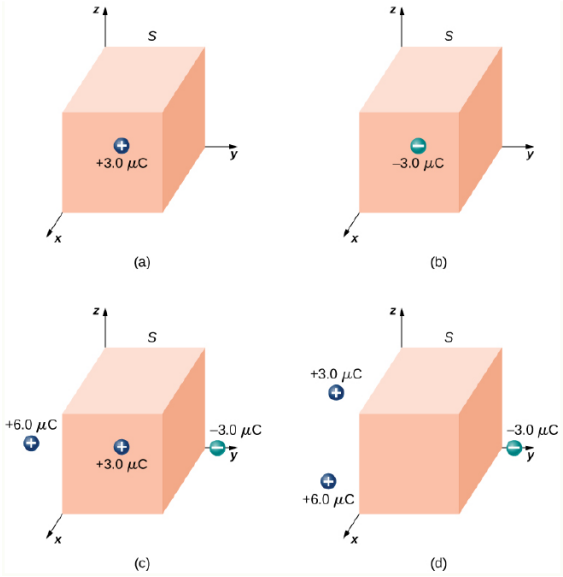
6. A thundercloud produces a vertical electric field of magnitude 28.0 kN/C at ground level. You hold a 22.0 cm × 28.0 cm sheet of paper horizontally below the cloud. (a) What is the electric flux through the sheet? (b) What would the flux be if you tilt the sheet of paper by 30°? (c) What would the flux be if you hold the sheet of paper vertically?

7. A 6-nC point charge is located at the center of a cube of side length 2.0 m. What is the electric flux through each of the faces of the cube?

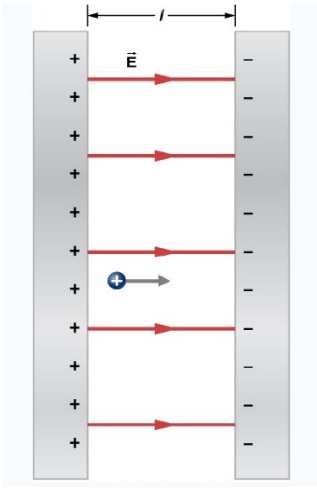
8. Calculate the electric flux through each Gaussian surface shown in Figure



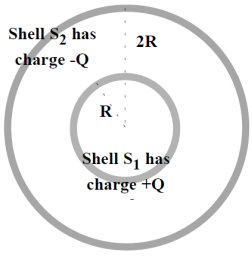
9. Calculate the electric flux through the closed cubical surface for each charge distribution shown in Figure



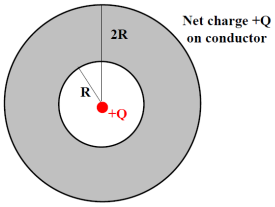
10. Two large conducting plates carry equal and opposite charges, with a surface charge density σ of magnitude $6.81 \times 10^{-7} C/m^2$, as shown in Figure. The separation between the plates is $l = 6.50$ mm. What is the electric field between the plates?



11. 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)?



12. 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?



13. A solid insulating sphere of radius R has charge distributed uniformly throughout its volume. What fraction of the sphere's total charge is located within the region r < R/2?

14. A solid insulating sphere of radius R has a non-uniform volume charge distribution given by $\rho(r) = ar$, where a is a constant. What is the total charge Q of the insulating sphere?

15. 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?