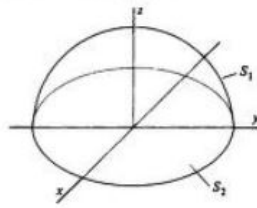


Collaborators:

Schey II-8 An electrostatic force field is given by $\vec{E} = \lambda(\vec{i}yz + \vec{j}xz + \vec{k}xy)$, where λ is a constant. Use Gauss' law to find the total charge enclosed by the surface shown in the figure consisting of S_1 , the hemisphere $z = (R^2 - x^2 - y^2)^{\frac{1}{2}}$, and S_2 , its circular base in the xy -plane.



■

Schey II-10 It sometimes happens that surface integrals can be evaluated without using the long-winded procedures outlined in the text. Try evaluating $\iint_S \vec{F} \cdot \hat{n} dA$ for each of the following; think a bit and avoid a lot of work!

(a) $\vec{F} = \vec{i}x + \vec{j}y + \vec{k}z$.

A , the three squares each of side b as shown in the figure.

(b) $\vec{F} = (\vec{i}x + \vec{j}y) \ln(x^2 + y^2)$.

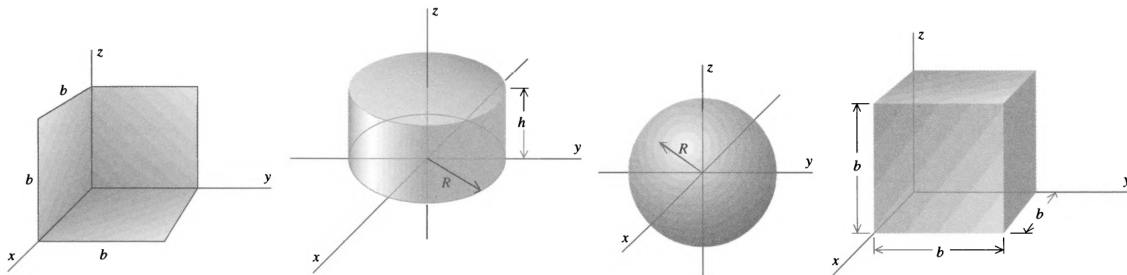
A , the cylinder (including the top and bottom) of radius R and height h shown in the figure.

(c) $\vec{F} = (\vec{i}x + \vec{j}y + \vec{k}z)e^{-(x^2+y^2+z^2)}$.

A , the surface of the sphere of radius R centered at the origin as shown in the figure.

(d) $\vec{F} = \vec{i}E(x)$, where $E(x)$ is an arbitrary scalar function of x .

A , the surface of the cube of side b shown in the figure.



Figures (a), (b), (c), and (d)

■

HRK E27.11 A point charge q is placed at one corner of a cube of edge a . What is the flux through each of the cube faces? (Hint: Use Gauss' law and symmetry arguments.)

■

HRK E26.40 Figure 26-36 shows a Thomson atom model of helium ($Z = 2$). Two electrons, at rest, are embedded inside a uniform sphere of positive charge $2e$. Find the distance d between the electrons so that the configuration is in static equilibrium.

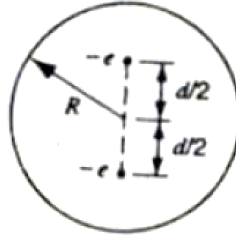


FIGURE 26-36. Exercise 40.

■

HRK P27.17 A solid nonconducting sphere of radius R carries a nonuniform charge distribution, with charge density $\rho = \rho_s r / R$, where ρ_s is a constant and r is the distance from the center of the sphere. Show that

- (a) the total charge on the sphere is $Q = \pi \rho_s R^3$
- (b) the electric field inside the sphere is given by $E = \frac{1}{4\pi\epsilon_0} \frac{Q}{R^4} r^2$
- (c) Write down the electric field outside the sphere, $r > R$. You do not need to derive your result, just explain how you know what it is.

■

HRK E27.25

Charge is distributed uniformly throughout an infinitely long cylinder of radius R .

- (a) Show that E at a distance r from the cylinder axis ($r < R$) is given by $E = \frac{\rho r}{2\epsilon_0}$, where ρ is the volume charge density.
- (b) What result do you obtain for $r > R$?

■