the closest possible distance of approach, of any proton, to a silver nucleus? What will be the strength of the electric field acting on the proton at that position? What will be the proton's acceleration?

2.40 *Gold potential* **

As a distribution of electric charge, the gold nucleus can be described as a sphere of radius $6 \cdot 10^{-15}$ m with a charge $Q = 79e$ distributed fairly uniformly through its interior. What is the potential ϕ_0 at the center of the nucleus, expressed in megavolts? (First derive a general formula for ϕ_0 for a sphere of charge Q and radius a. Do this by using Gauss's law to find the internal and external electric field and then integrating to find the potential. You should redo this here, even though it was done in an example in the text.)

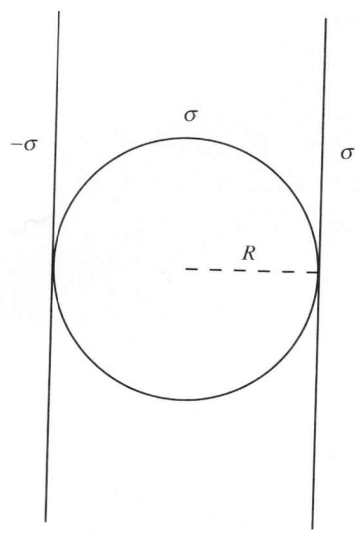

Figure 2.46.

2.41 *A sphere between planes* **

A spherical shell with radius R and surface charge density σ is sandwiched between two infinite sheets with surface charge densities $-\sigma$ and σ, as shown in Fig. 2.46. If the potential far to the right at $x = +\infty$ is taken to be zero, what is the potential at the center of the sphere? At $x = -\infty$?

2.42 *E and ϕ for a cylinder* **

For the cylinder of uniform charge density in Fig. 2.26:

(a) show that the expression there given for the field inside the cylinder follows from Gauss's law;
(b) find the potential ϕ as a function of r, both inside and outside the cylinder, taking $\phi = 0$ at $r = 0$.

2.43 *Potential from a rod* **

A thin rod extends along the z axis from $z = -d$ to $z = d$. The rod carries a charge uniformly distributed along its length with linear charge density λ. By integrating over this charge distribution, calculate the potential at a point P_1 on the z axis with coordinates $(0, 0, 2d)$. By another integration find the potential at a general point P_2 on the x axis and locate this point to make the potential equal to the potential at P_1.

2.44 *Ellipse potentials* ***

The points P_1 and P_2 in Exercise 2.43 happen to lie on an ellipse that has the ends of the rod as its foci, as you can readily verify by comparing the sums of the distances from P_1 and from P_2 to the ends of the rod. This suggests that the whole ellipse might be an equipotential. Test that conjecture by calculating the potential at the point $(3d/2, 0, d)$, which lies on the same ellipse. Indeed it is true, though there is no obvious reason why it should be, that the equipotential surfaces of this system are a family of confocal prolate spheroids. See if you can prove that. You will have to derive