Problem 3.10. In Ex. 3.2 we assumed that the conducting sphere was grounded ($V = 0$). But with the addition of a second image charge, the same basic model will handle the case of a sphere at *any* potential V_0 (relative, of course, to infinity). What charge should you use, and where should you put it? Find the force of attraction between a point charge q and a *neutral* conducting sphere.

Problem 3.11. Find the force between a point charge q and a nearby spherical conductor which *also* carries (total) charge q (use the method of Prob. 3.10). Show that this force is actually *attractive* (!) if the separation distance a is less than a critical value a_c. What *is* that critical value? [*Answer:* $R(1+\sqrt{5})/2$.]

! Problem 3.12. A uniform line charge λ is placed on an infinite straight wire, a distance d above a grounded conducting plane. (Let's say the wire runs parallel to the x-axis and directly above it, and the conducting plane is the xy plane.)

(a) Find the potential in the region above the plane. [*Hint:* Refer to Prob. 2.53.]

(b) Find the charge density σ induced on the conducting plane.

Problem 3.16. For the infinite slot (Ex. 3.3), determine the charge density $\sigma(y)$ on the strip at $x = 0$, assuming it is a conductor at constant potential V_0.

Problem 3.18. A cubical box (side length a) consists of five metal plates, which are welded together and grounded (Fig. 3.23). The top is made of a separate sheet of metal, insulated from the others, and held at a constant potential V_0. Find the potential inside the box. [What should the potential at the center $(a/2, a/2, a/2)$ be? Check numerically that your formula is consistent with this value.][13]

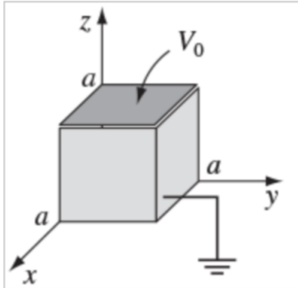

Fig. 3.23

Fig. 3.23