Home Work Set # 6, Physics 217, Due: October 24, 2001

Problem 1

A uniform line charge λ is placed on an infinite straight wire, a distance d above a grounded conducting plane. 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.

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

Problem 2

In Example 3.2 of Griffiths we assumed that the conducting sphere was grounded ($V = 0$). But with the addition of a second image charge, the same model will handle the case of a sphere at *any* given potential V_0 (relative, of course, to zero at infinity).

a) What charge should you use, and where should you put it?

b) Find the force between a point charge q and a conducting sphere at potential V_0.

Problem 3

Two infinite parallel grounded conducting planes are held a distance a apart. A point charge q is placed in the region between them, a distance x from one plate.

a) Find the force on q.

b) Check that your answer is correct for the special case in which $a \to \infty$. Check that your answer is correct for the special case in which $x = a/2$.

Problem 4

A long rectangular pipe, running parallel to the z axis, has three grounded metal sides, at $y = 0$, $y = \pi$, and $x = 0$. The fourth side, at $x = a$, is maintained at a specified potential $V_0(y)$.

a) Develop a general formula for the potential within the pipe.

b) Find the potential explicitly, for the case $V_0(y) = V_0 = \text{constant}$.

Problem 5

A cubical box consists of five metal sides (length of each side is π) which are welded together and grounded (see Figure 1). The top is made of a separate sheet of metal, insulated from the rest, and held at a constant potential V_0 by a battery. Find the potential inside the box.

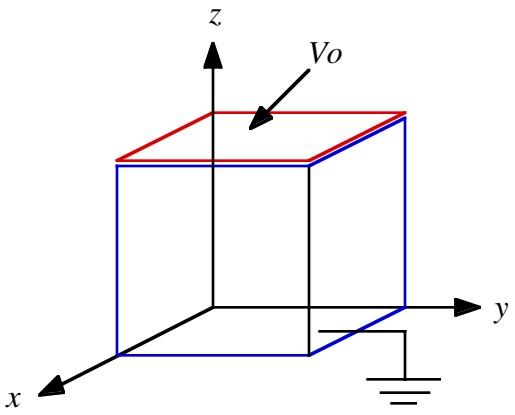

Figure 1. Problem 5.