PHYS 621 – HOMEWORK # 7 – DUE FRIDAY, 10/23/2009

Problem 1. An infinite thin flat sheet of conducting material has a circular thin cut of radius $a$. The part of the conducting sheet inside the cut is kept at constant potential $V$, while the conducting sheet outside the cut is kept at zero potential.

a) Show that the potential at any point above the sheet is

$$\phi(\rho, \varphi, z) = \int_0^\infty dke^{-kz}\left\{\frac{1}{2}B_0J_0(k\rho) + \sum_{n=1}^\infty J_n(k\rho)[A_n(k)\sin(n\varphi) + B_n\cos(n\varphi)]\right\},$$

where

$$\begin{align*}
A_n(k) &= \frac{kV}{\pi} \int_0^a d\rho \rho \int_0^{2\pi} d\varphi J_n(k\rho) \sin(n\varphi), \\
B_n(k) &= \frac{kV}{\pi} \int_0^a d\rho \rho \int_0^{2\pi} d\varphi J_n(k\rho) \cos(n\varphi).
\end{align*}$$

b) Using the limit $\rho \to 0$ of the previous equation, find the potential above the center of the inner part of the conducting sheet.

c) Show that the potential above the cut is

$$\phi(\varphi, z) = Va \int_0^\infty dke^{-kz}J_0(ka)J_1(ka).$$

Problem 2. Jackson problem 4.1

Problem 3. Jackson problem 4.2