Classical Electrodynamics Quiz Ch 2 2012/04/02

I. A hollow box has conducting walls defined by 6 planes: $y = 0,\ y = b$ and $z = 0,\ z = c$ are held at zero potential, whereas $x = -a$ is at the constant potential $-V$ and $x = +a$ is at the potential $+V$. Please find the potential at any point inside the box.

II. Consider a 2-dimensional plane polar electrostatic potential, i.e., there is no dependance on the coordinate z. It satisfies the Laplace equation $\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\rho\frac{\partial\Phi}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2\Phi}{\partial\phi^2}=0$. The separation of variables technique considers solutions of the special form $\Phi = R(\rho)\Psi(\phi)$, which depend on a separation constant ν.

(i) Please give the general form for the solutions $R(\rho)$ and $\Psi(\phi)$.

(ii) What restrictions are imposed on ν if the solution is to be continuous for the full 2π range of the angle ϕ and nonsingular as $\rho \to 0$?

(iii) Consider the region between two conducting planes held at *zero* potential which intersect at a corner with a finite opening angle β. Please determine the radial behavior of the surface charge density near the corner.