CLASSICAL ELECTRODYNAMICS I

Homework Set 4

October 13, 2017

1. A conducting sphere of radius R is composed of two hemispheres separated by an insulated ring of negligible thickness. The insulated ring lies in the $z = 0$ plane and the upper and lower hemispheres are kept at potentials $+V$ and $-V$, respectively.

   (a) Use the Green function for the sphere to find an integral expression for the potential anywhere *inside* the sphere.

   (b) Evaluate the integral analytically for points on the z axis.

2. Consider the two-dimensional problem in which we want to find the potential $\Phi(x, y)$ in the slit defined by the $x = 0$ and $x = a$ planes.

   (a) Suppose that on the $x = 0$ plane, $\Phi(0, y) = 0$ and on the $x = a$ plane, $\Phi(a, y) = V \exp(-b^2 y^2)$, where V is a constant. Determine the potential in the slit as a Fourier integral. (Integral tables are permitted for the evaluation of the expansion coefficients.)

   (b) Now suppose that the boundary conditions are the same on *both* planes; that is, supose $\Phi(0, y) = \Phi(a, y) = V \exp(-b^2 y^2)$. Use the results of part (a) to determine the potential $\Phi(x, y)$ in the slit for this case.

3. Find the potential $\Phi(x, y, z)$ in an infinitely deep well, as shown below. The potential is zero on all sides of the well except the bottom side where the potential satisfies $\Phi(x, y, 0) = V$, with V a constant.