

CLASSICAL ELECTRODYNAMICS I

Homework Set 4

February 15, 2013

1. A hollow (non-grounded) spherical conductor of radius R is located with its center at the origin. The sphere contains a point charge q located on the positive z -axis a distance a from the origin. Use the *method of Green functions* to find the potential $\Phi(z)$ at *all* points on the z axis.
2. Consider a potential problem in the half-space defined by $z \geq 0$, with Dirichlet boundary conditions on the plane $z = 0$ (and at infinity).
 - (a) Determine the appropriate Green function $G(\mathbf{r}, \mathbf{r}')$.
 - (b) If the potential on the plane $z = 0$ is specified to be $\Phi = V$ inside a circle of radius a centered at the origin, and $\Phi = 0$ outside that circle, find an integral expression for the potential at the point P specified in terms of cylindrical coordinates (ρ, ϕ, z) .
 - (c) Show that, along the z -axis ($\rho = 0$), the potential is given by

$$\Phi = V \left(1 - \frac{z}{\sqrt{a^2 + z^2}} \right) .$$