Physics 513, Autumn Quarter 2018
Electrodynamics: Homework Assignment 2.
Due October 11 either 11:00am in class or 10:45am in the instructor's mailbox.

1. A variant of Jackson problem 1.12. Consider a system of point charges $\{q_i\}$, and potentials $\{\Phi_i\}$ where Φ_i is the potential at the position of q_i taking into account all the other charges except the charge q_i. Derive a form of Green's Reciprocation Theorem:

$$\sum_i \Phi_i q_i' = \sum_i \Phi_i' q_i$$

where the primed notation indicates a different set of charges and its associated potentials at the same points.

2. Recall in class the surface term in Jackson equation 1.44 can be written as

$$\Phi(r) = -\iint \Phi_s \sigma_{1s}\, dA'$$

where σ_{1s} is the surface charge induced by a unit Green's function point charge. Show that this expression may be obtained from the result of problem 1. Perhaps you could show the discrete-charge version of the above expression then simply extend the result to a continuous surface.

3. Consider a plane geometry. (NB., the Green's functions for non-planar geometries are discussed in Jackson chapter 3.)

a. What is the Green's function for this geometry? Use cylindrical coordinates with the plane containing the origin, *z* the distance above the plane, and ρ the cylindrical radial coordinate. Hint: the similar image-charge problem should be reviewed.

b. With this Green's function, what is the corresponding induced charge on the plane?

c. Suppose the plane has potential $\Phi_s = \frac{Q_0}{2\pi\epsilon_0}\frac{\left(\rho^2+z_0^2\right)^{3/2}}{z_0^3}\frac{1}{\rho}e^{-\rho/z_0}$, where q_0 and z_0 are constants. Using the Green's Function from (a), find the potential at position (ρ=0, z=z_0).

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