CLASSICAL ELECTRODYNAMICS I

Homework Set 6

March 10, 2017

1. Two concentric spheres are each divided into two hemispheres by the same horizontal plane. The inner sphere has radius a and the outer sphere has radius b. The upper hemisphere of the inner sphere and the lower hemisphere of the outer sphere are maintained at constant potential V. The other hemispheres are at zero potential.

   (a) Determine the potential in the region $a < r < b$ as a series in Legendre polynomials. Include terms at least up to $\ell = 4$.

   (b) Give the potential for your result in part (a) in the limit $b \to \infty$.

   (c) Give the potential for your result in part (a) in the limit $a \to 0$.

2. The surface of a hollow conducting sphere of radius a is divided into an *even number* of equal segments by a set of planes whose common line of intersection is the z axis and which are distributed uniformly in the angle ϕ. (The segments are like the skin on wedges of an apple, or the earth's surface between successive meridians of longitude.) The segments are kept at fixed potentials $\pm V$, alternately.

   (a) Set up a series representation for the potential inside the sphere for the general case of $2n$ segments, and determine exactly which coefficients are nonzero. (Either calculate directly or use symmetry arguments.) For the nonzero terms, give the coeffients as integrals over $x = \cos\theta$.

   (b) For the special case of $n = 1$ (two hemispheres), determine the potential in explicitly real form up to and including all terms with $\ell = 3$.