CLASSICAL ELECTRODYNAMICS I
Homework Set 7
March 17, 2017

1. Consider a line of identical point charges q located along the z axis at $z = 0$, $\pm a$, $\pm 2a$, $\cdots$. Clearly the potential has azimuthal symmetry so, in cylindrical coordinates, $\Phi = \Phi(\rho, z)$.

   (a) Solve the Laplace equation in the region between the point charges in the form of a series expansion in cylindrical coordinates. (*Hint:* Construct your solution in terms of modified Bessel functions.)

   (b) Determine the expansion coefficients such that the potential is completely determined up to an arbitrary overall additive constant. *Hint:* Consider the region $-a/2 < z < a/2$ and use the fact that the potential must satisfy the Poisson equation in this region. Use techniques similar to those discussed in class for finding the expansion of the Green function in spherical coordinates.

   (c) Take the limit of your result for $\rho \gg a$ and find the corresponding electric field. Give an intrepretation of your result in terms of a well-known charge distribution.