PHYS 301 – Assignment #3

Due Wednesday, Nov. 6 at 14:00

1. Solve Laplace's equation by separation of variables in *cylindrical* coordinates. Assume that the potential is independent of the z-coordinate such that $V = V(s, \phi)$. Like we had for Cartesian coordinates, you should find solutions that depend on a sum over k. You will need to consider the $k = 0$ case separately. Your solution for the potential should also satisfy $V(s, \phi + 2\pi) = V(s, \phi)$.

2. Consider an infinitely-long cylinder of radius R. The surface of the cylinder carries a charge per unit area $\sigma(\phi) = a \sin(5\phi)$, where a is a constant. Find the potential inside ($s < R$) and outside ($r > R$) the cylinder. Use your results from the first problem.

Hints:

- Make use of the boundary condition $E^{\perp}_{\text{outside}} - E^{\perp}_{\text{inside}} = \sigma/\varepsilon_0$.
- Ensure that the potential is continuous at $s = R$.