P3323 Separation of variables - Spherical coordinates September 16, 2016

A spherical conducting shell of radius R is immersed in an otherwize uniform electric field  $\mathbf{E} = E_0 \hat{\mathbf{z}}$ .



1. Let's use the center of the sphere as the reference point where V = 0. Write an expression for the potential corresponding to the uniform E-field.

2. What are the boundary conditions on the potential at r = 0, r = R, and  $r \to \infty$ ?

3. Write a general expression for the potential outside the sphere.

4. Write a general expression for the potential inside the sphere.

5. Use the boundary condition at the surface of the sphere to relate  $A_l$  and  $B_l$ .

6. Use the boundary condition at  $r \to \infty$  to determine  $A_l$ .

7. Write an expression for  $V(r, \theta)$  outside the sphere