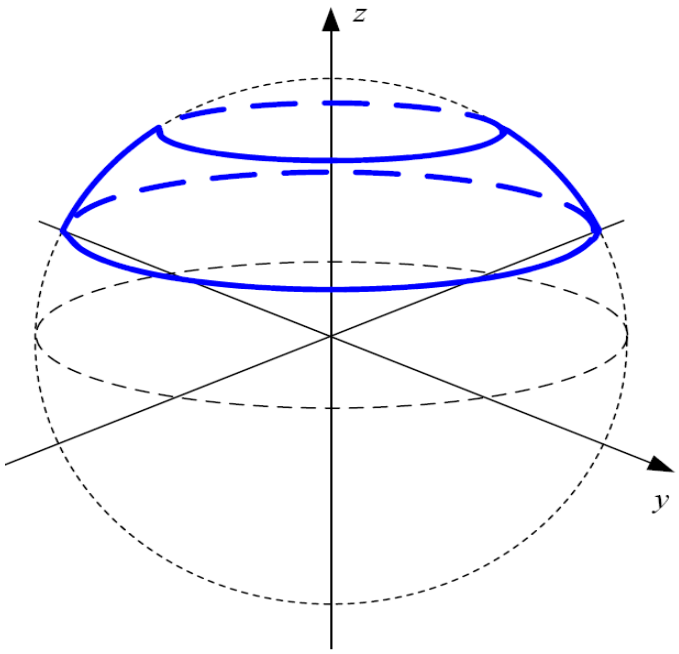
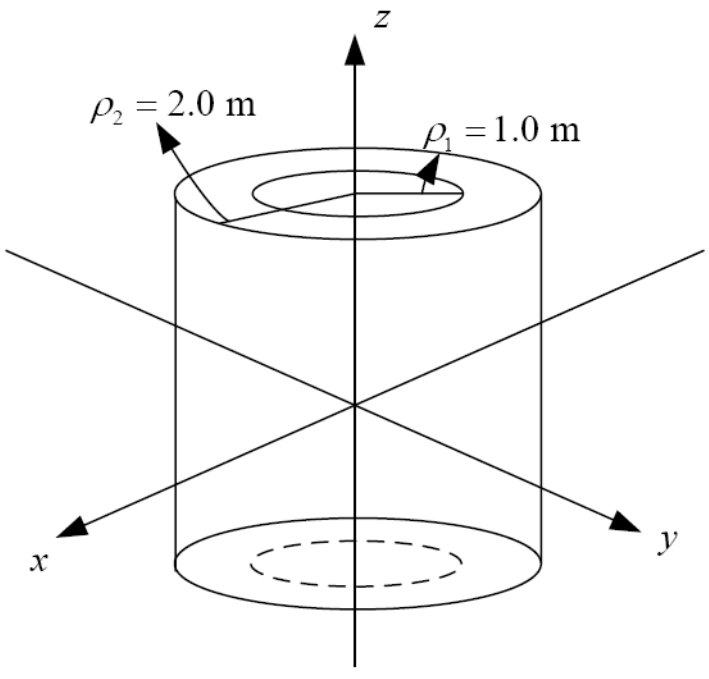
Home Assignment – 5

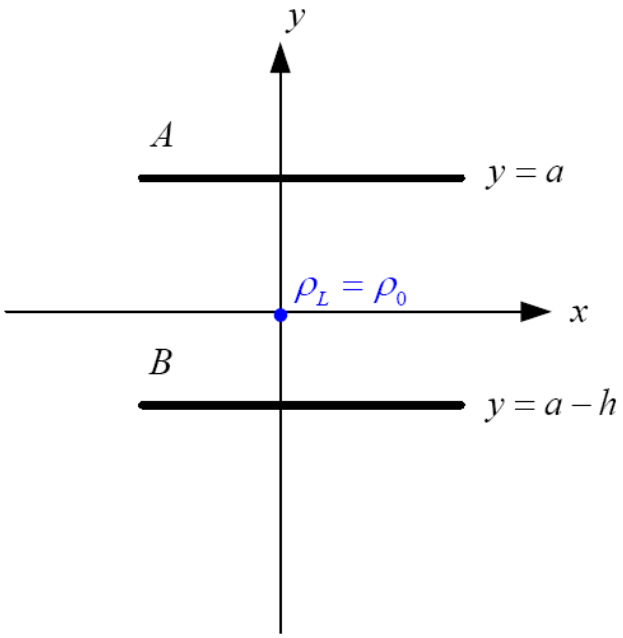
1. Let $\vec{J} = \frac{400sin\theta}{r^2+4}\ \hat{a}_r\ A/m^2$. Write a MATLAB program to find the total current flowing through that portion of the spherical surface $r =$ 0.8, bounded by $0.1\pi < \theta < 0.3\pi$, and $0 < \varphi < 2\pi$.



2. An electric field $\vec{E} = \frac{5\times10^4}{\rho}\hat{a}_\rho$ V/m exists in cylindrical coordinates. Find analytically the electric energy stored in the region bounded by $1.0m < \rho < 2.0m$, $-2.0m < z < 2.0m$ and $0 < \varphi < 2\pi$ as shown in following Figure. Verify your answer using a MATLAB program.



3. An infinite line charge with charge density $\rho_L = \rho_0$ lies on the z axis. Two infinite conducting planes are located at $y = a$ and $y = a - h$ and both have zero potential. Find the voltage at any given point (x, y). If, $\rho_0 = 1.0 \times 10^{-7}\ C/m$, $a = 1.0m$ and $h = 2.0m$, plot the contours of the voltage.



4. Two perfect dielectrics have relative permittivities $\varepsilon_{r1} = 3$ and $\varepsilon_{r2} = 6$. The planar interface between them is the surface $x + y + 2z = 1$. The origin lies in region 1. If $\vec{E}_1 = 24.0\hat{a}_x + 36.0\hat{a}_y + 42.0\hat{a}_z\ V/m$, find $\vec{E}_2$. Write a MATLAB program to determine the field $\vec{E}_2$ for arbitrary values of the permittivities ε_{r1} and ε_{r2}.