Gauss’ Law and Ampere’s Law

1. Consider the spherical charge distribution defined below. Find the electric field everywhere.

\[ \rho = \begin{cases} 
q, & r = 0 \\
0, & 0 < r < a \\
(\rho_0 \sin r)/r^2, & a \leq r \leq b 
\end{cases} \]

2. Consider the cylindrical charge distribution defined below. Find the electric field everywhere.

\[ \rho = \begin{cases} 
\rho_l, & r = 0 \\
0, & 0 < r < a \\
(\rho_0 e^{-\gamma r})/r, & a \leq r < b 
\end{cases} \]

3. Consider a uniform surface charge density, \( \rho_s \), extending to infinity in the horizontal plane \((x - y \text{ plane})\). Use Gauss’ Law to find the electric field above and below this plane.

4. Consider an infinitely long coaxial cable that has the following current density distribution. Find the magnetic field everywhere.

\[ \mathbf{J}(r) = \begin{cases} 
\frac{J_0 \sin(\pi z_0)}{r} \mathbf{k}, & 0 \leq r \leq a \\
0, & r > a 
\end{cases} \]