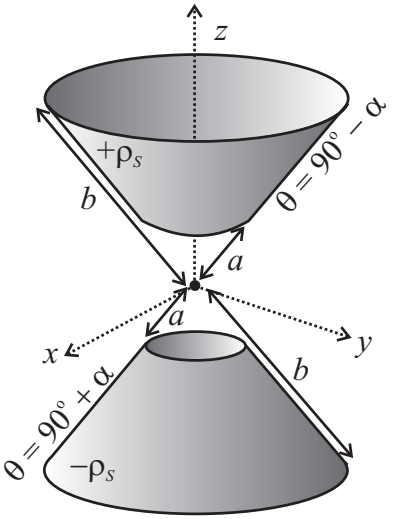
ECE 3025 Homework 8: Voltage Problems

1. **Integral Set-up:** For the cases in this problem, set-up and simplify (but do not evaluate) the corresponding voltage or E-field integrals. (10 points)

   (a) Volume charge is placed uniformly within a cube of width L (on all edges), centered at the origin. If the charge density is ρ_V, what is the voltage at the point (x, y, z)?

   (b) Two square plates of charge (sides of length L) lie parallel to the xy plane, centered on the z-axis. One plate rests at $z = 0$ and has a uniform surface charge of ρ_S, while the other plate rests at $z = d$ and has a uniform surface charge of $-\rho_S$. What is the voltage at the point (x, y, z)?

   (c) A biconical surface of charge is defined by the regions $\theta = 90° - \alpha$, $\theta = 90° + \alpha$, and $a \leq r \leq b$. The upper cone has a positive, uniform surface charge density of $+\rho_S$ and the lower cone has a negative, uniform surface charge density of $-\rho_S$. Derive an expression for calculating the electrostatic field $\vec{E}$ for point on the xy plane due to this charge distribution. *Simplify as much as possible* without evaluating the final integral(s).



2. **Sphere Charge:** Using Gauss's law, calculate the $\vec{D}$ field for *all* points inside and around a sphere of radius R that contains a uniform volume charge ρ_v. When your calculation is finished, compute $\nabla \cdot \vec{D}$ to demonstrate the recovery of the true $\rho_v(\vec{r})$ in space. (5 points)