PHY 712 – Problem Set #2

1. Consider a one-dimensional charge distribution of the form:

\[ \rho(x) = \begin{cases} 
0 & \text{for } x \leq -a/2 \\
\rho_0 x / a & \text{for } -a/2 \leq x \leq a/2 \\
0 & \text{for } x \geq a/2, 
\end{cases} \]

where \( \rho_0 \) and \( a \) are constants.

(a) Solve the Poisson equation for the electrostatic potential \( \Phi(x) \) with the boundary condition \( \Phi(x \to -\infty) = 0 \).

(b) Find the corresponding electrostatic field \( E(x) \).

(c) Plot \( \Phi(x) \) and \( E(x) \).

(d) Discuss your results in terms of elementary Gauss’s Law arguments.