January 22, 2002

PHY 712 – Problem Set #2

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

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

where ρ_0 and a are constants.

   (a) Solve the Poisson equation for the electrostatic potential $\Phi(x)$ with the boundary conditions $\Phi(x \to -\infty) = 0$ and $d\Phi(x \to \infty)/dx = 0$.

   (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.