D1
A nonuniform electric field is directed along the x-axis at all points in space. This magnitude of the field varies with x, but not with respect to y or z. The axis of a cylindrical surface, 0.80 m long and 0.20 m in diameter, is aligned parallel to the x-axis, as shown in the figure. The electric fields $E_1$ and $E_2$, at the ends of the cylindrical surface, have magnitudes of 8000 N/C and 3000 N/C respectively, and are directed as shown. ($\varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot \text{m}^2$) The charge enclosed by the cylindrical surface is?

![Diagram of cylindrical surface with electric fields $E_1$ and $E_2$.]

D2
A nonuniform, but spherically symmetric, distribution of charge has a charge density $\rho(r)$ given as follows:

$$\rho(r) = \rho_0 \left(1 - \frac{4r}{3R}\right) \text{ for } r \leq R$$

$$\rho(r) = 0 \text{ for } r > R$$

Where $\rho_0$ is a positive constant. (a) Find the total charge contained in the charge distribution. (b) Obtain an expression for the electric field in the region $r > R$. (c) Obtain an expression for the electric field in the region $r \leq R$. (d) Graph the electric-field magnitude $E$ as a function of $r$. (e) Find the value of $r$ at which the electric field is maximum, and find the value of that maximum field.

D3
A small particle has charge $-5.00 \mu\text{C}$ and mass $2.00 \times 10^{-4} \text{kg}$. It moves from point A, where the electric potential is $V_A = +200V$, to point B, where the electric potential is $V_A = +800V$. The electric force is the only force acting on the particle. The particle has speed 5.00 m/s at point A. What is its speed at point B? Is it moving faster or slower at B than at A? Explain.