SHOW ALL WORK!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

Given a spherically symmetric charge distribution, where the charge density is given by:

\[ \rho(R) = B(1 - \alpha R^3) \]

(a) At \( R = 0 \), the charge density is \( \rho(0) = 0 \). Calculate \( \alpha \).

(b) If the total charge is \( Q_0 \), calculate \( B \).

(c) Calculate the electric field at an arbitrary value of \( R \), for \( R < R_o \) (inside the sphere).

(d) Calculate the magnitude of the potential difference between the center and the outer surface of the sphere.

(e) If \( V = 0 \) at \( R = R_o \), and the sphere is negatively charged, what is the potential at \( R = 0 \)?

\[ \frac{d}{dR} \left( \int_0^R \rho dV \right) = \frac{d}{dR} \left( \int_0^R \rho(1 - \alpha R^3) \right) = \alpha \rho(R) \]

\[ E = \frac{\rho}{\varepsilon_0} \left( \frac{R}{3} - \frac{R^2}{2} \right) \]

\[ 1 \text{V} = \left| \int E \cdot dl \right| = \int_0^{R_o} \frac{\rho}{\varepsilon_0} \left( \frac{R}{3} - \frac{R^2}{2} \right) dR = \frac{3Q_0}{4\pi \varepsilon_0 R_o} \]

\[ \Delta V_{\text{outside}} = \frac{Q_0}{4\pi \varepsilon_0 R_o} \]

\[ \Delta V_{\text{inside}} = \frac{Q_0}{4\pi \varepsilon_0 R_o} - \frac{3Q_0}{16\pi \varepsilon_0 R_o} \]

\[ \Delta V_{\text{total}} = \frac{3Q_0}{16\pi \varepsilon_0 R_o} \]