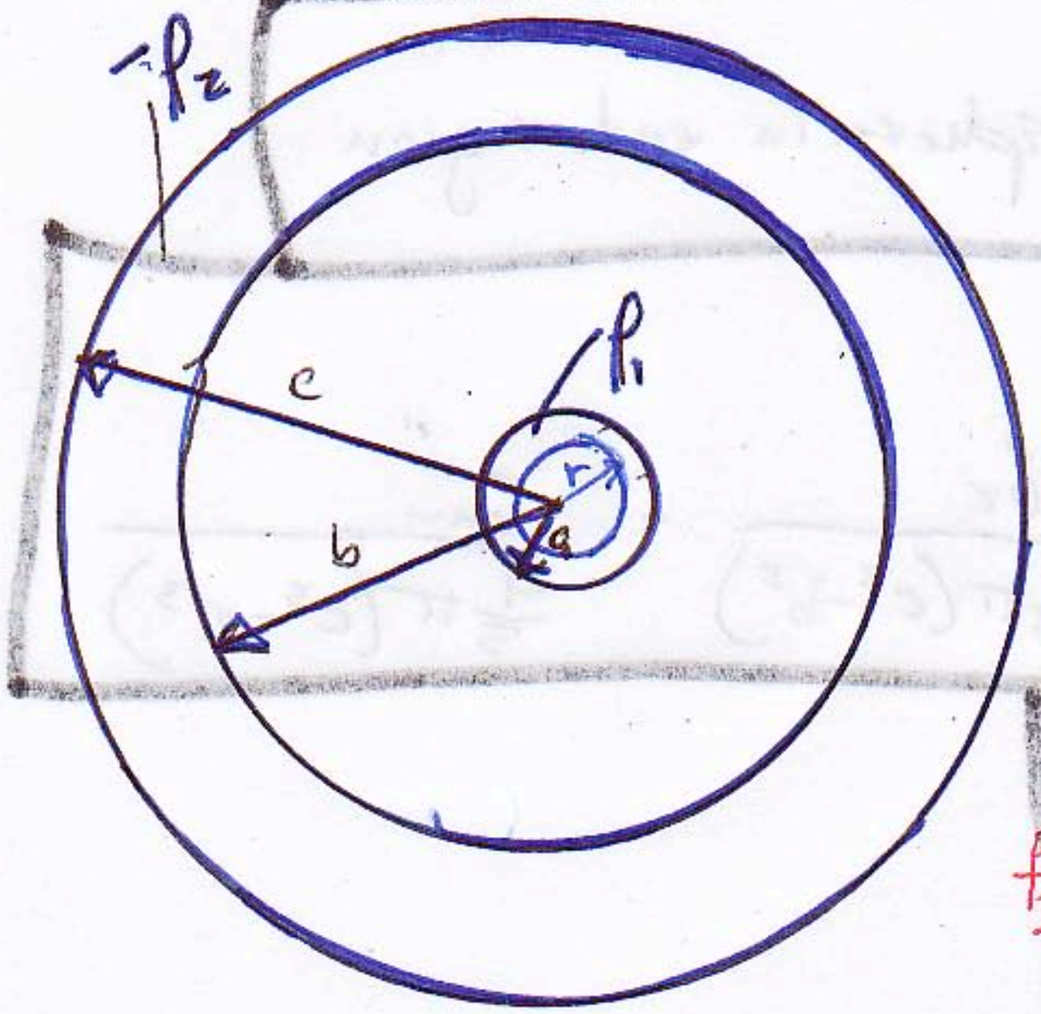
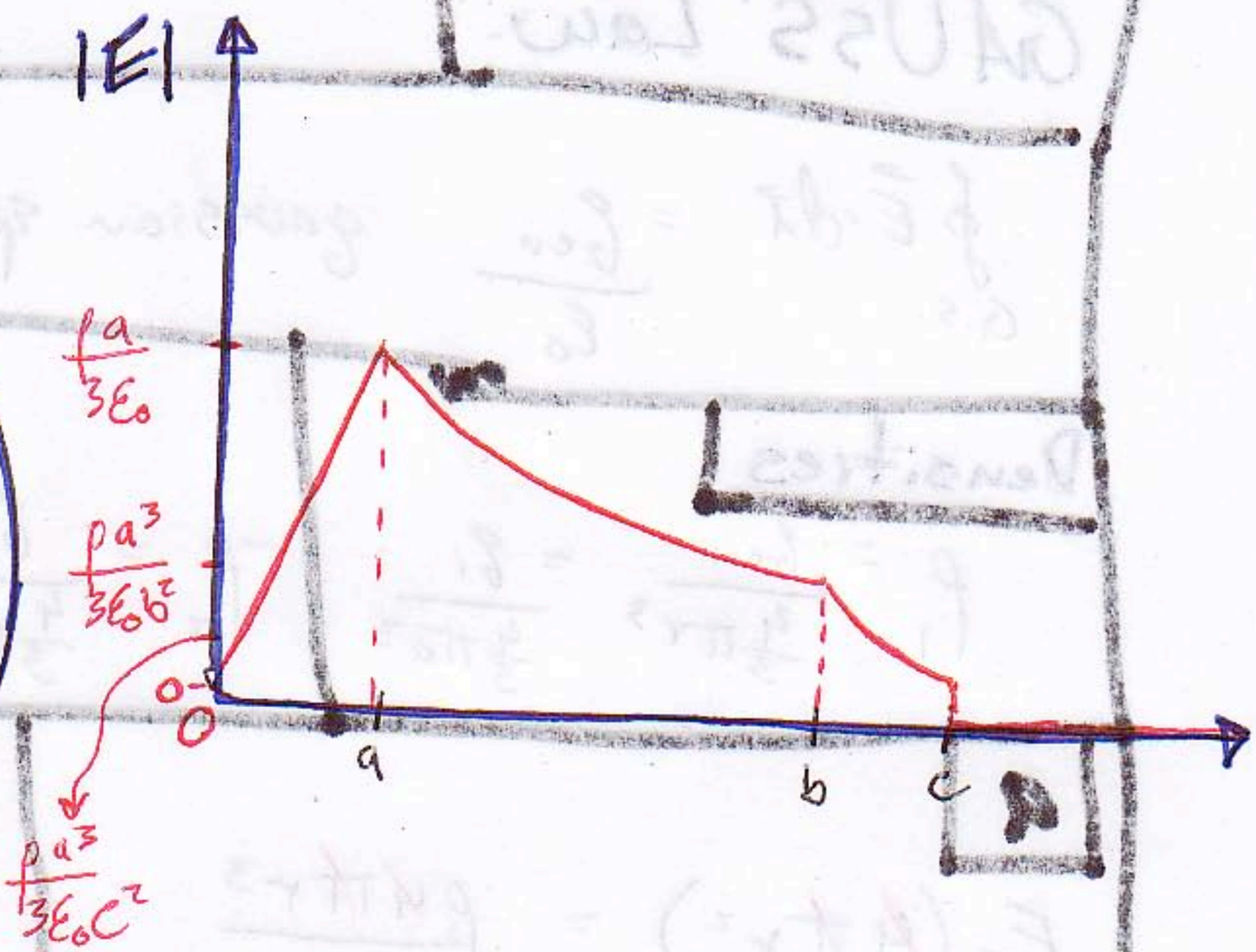
Key Gauss' Law





Use gauss' Law to find an expression for the magnitude of electric field.

a) E_I in region $r < a$

b) E_{II} in region $a < r < b$

c) E_{III} in region $b < r < c$

d) for $r > c$ $E_{IV} = 0$, find $\frac{\rho_1}{\rho_2}$

e) plot the magnitude of E.
lable magnitude at $r = 0, a, b, c$

GAUSS' Law

$$\oint_{G.S.} \vec{E} \cdot d\vec{A} = \frac{q_{en}}{\varepsilon_0}$$ Gaussian sphere in each region

Densities

$$\rho_1 = \frac{q_{en}}{\frac{4}{3}\pi r^3} = \frac{q_1}{\frac{4}{3}\pi a^3}$$

$$\rho_2 = \frac{q_2}{\frac{4}{3}\pi(c^3-b^3)} = \frac{q_{en}}{\frac{4}{3}\pi(c^3-r^3)}$$

a

$$E_I(4\pi r^2) = \frac{\rho_1 \frac{4}{3}\pi r^3}{\varepsilon_0}$$

$$E_I = \frac{\rho_1 r}{3\varepsilon_0}$$ Ans

b

$$E_{II}(4\pi r^2) = \frac{\rho_1 \frac{4}{3}\pi a^3}{\varepsilon_0}$$

$$E_{II} = \frac{\rho_1 a^3}{3\varepsilon_0 r^2}$$ Ans

c

$$E_{III}(4\pi r^2) = \rho_1 \frac{4}{3}\pi a^3 - \rho_2 \frac{4}{3}\pi(c^3-r^3)$$

$$E_{III} = \frac{\rho_1 a^3 - \rho_2(c^3-r^3)}{3\varepsilon_0 r^2}\ \varepsilon_0$$ Ans

d

$$E_{IV}(4\pi r^2) = \rho_1 \frac{4}{3}\pi a^3 - \rho_2 \frac{4}{3}\pi(c^3-b^3)$$

$$E_{IV} = 0 = \frac{\rho_1 a^3 - \rho_2(c^3-b^3)}{3\varepsilon_0}\ \varepsilon_0$$

$$\rho_1 a^3 = \rho_2(c^3-b^3)$$

$$\frac{\rho_1}{\rho_2} = \frac{c^3-b^3}{a^3}$$ Ans