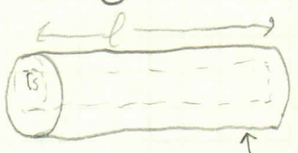
2.16 (i)

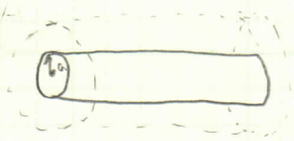


uniform charge density, ρ

$$\oint_S \vec{E}_1 \cdot d\vec{A} = \frac{Q_{enc}}{\varepsilon_0} \qquad Q_{enc} = \rho \pi s^2 l$$

$$|\vec{E}_1| \oint_S dA = |E_1| 2\pi s l = \frac{\rho \pi s^2 l}{\varepsilon_0} \Rightarrow |\vec{E}_1| = \frac{\rho s}{2\varepsilon_0} \Rightarrow E_1 = \frac{\rho}{2\varepsilon_0} s\hat{s}$$

(ii)



$$Q_{enc} = \rho \pi a^2 l$$

$$|\vec{E}_2| 2\pi s l = \frac{\rho \pi a^2 l}{\varepsilon_0} \Rightarrow \vec{E}_2 = \frac{\rho a^2}{2\varepsilon_0} \frac{1}{s} \hat{s}$$

(iii) $E_3 = 0$ bc $q_{enc} = 0$

$$\vec{E} = \begin{cases} \frac{\rho}{2\varepsilon_0} s\hat{s} & \text{for } 0 \le s \le a \\ \frac{\rho a^2}{2\varepsilon_0} \frac{1}{s} \hat{s} & \text{for } a < s < b \\ 0 & \text{for } b \le s \end{cases}$$