A metal rod is placed inside a metal cylinder shown in the cross section. Both are very long. The inner rod is given a charge of \( +39.2 \times 10^{-6} \text{ C/m} \). The outer cylinder is given a charge of \( -67.2 \times 10^{-6} \text{ C/m} \). The inner rod has a radius of 0.327 cm, and the outer cylinder, which is thin, has a radius of 3.75 cm.

(a) Calculate the electric field, magnitude and direction at \( r_1 = 0.625 \text{ cm} \).

(b) Calculate the electric field, magnitude and direction at \( r_2 = 4.25 \text{ cm} \).

\[
E \cdot da = \frac{Q}{\varepsilon_0} \Rightarrow E_{\text{at } r} = \frac{Q_{\text{enc}}}{\varepsilon_0}
\]

\[
E_1 = \frac{\frac{1}{2} \lambda_1}{\varepsilon_0} \Rightarrow E_1 = \frac{\lambda_1}{2 \pi r_1 \varepsilon_0}
\]

\[
E_1 = \frac{+39.2 \times 10^{-6} \text{ C/m}}{8 \pi \left[6.25 \times 10^{-3} \text{ m}^3\right] \left[8.85 \times 10^{-12} \text{ F/m}\right]} = 1.13 \times 10^8 \text{ V/m}
\]

Radially outward

\[
E_2 = \frac{\lambda_1 + \lambda_2}{2 \pi r_2 \varepsilon_0}
\]

\[
E_2 = \frac{39.2 \times 10^{-6} - 67.2 \times 10^{-6}}{2 \pi (4.25 \times 10^{-3}) \left[8.85 \times 10^{-12}\right]} = -1.18 \times 10^7 \text{ V/m}
\]

i.e. Radially inward