Answer on Question #73632 Physics / Electric Circuits

The line density of charge in a wire is $\lambda = 0.2$ Cm^{-1}. If this wire is symmetrically enclosed, along its length, by a cylindrical surface of radius $r = 1$ m and length $h = 1.5$ m, calculate

i) the electric flux through the cylindrical surface
ii) the electric field at the curved surface of the cylinder

Solution:

The Gauss law states that electric flux Φ through a closed surface is given by

$$\Phi = \oint \mathbf{E} d\mathbf{A} = \frac{q_{\text{net}}}{\varepsilon_0}$$

where q_{net} is a net charge that enclosed inside closed surface.

i)

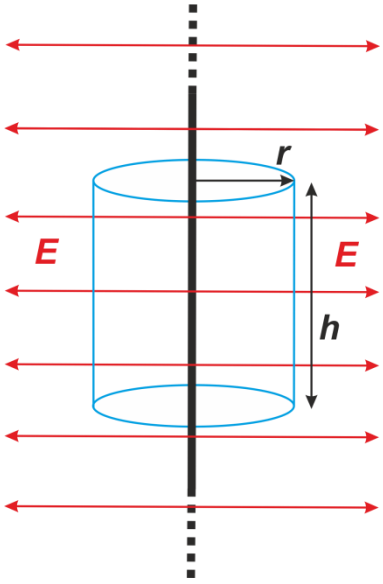
$$\Phi = \frac{q_{\text{net}}}{\varepsilon_0} = \frac{\lambda h}{\varepsilon_0} = \frac{0.2 \times 1.5}{8.85 \times 10^{-12}} = 3.39 \times 10^{10} \text{ V} \cdot \text{m}$$

ii)

$$\Phi = \oint \mathbf{E} d\mathbf{A} = \int_{\text{side}} E dA = E \int_{\text{side}} dA = E \times 2\pi r h$$

$$E = \frac{\Phi}{2\pi r h}$$

$$E = \frac{3.39 \times 10^{10}}{2 \times 3.14 \times 1 \times 1.5} = 3.60 \times 10^{9} \frac{\text{N}}{\text{C}}$$



Answers:

i) 3.39×10^{10} V · m
ii) 3.60×10^{9} N/C