

24. (a) In Eq. 24-12, $\lambda = q/L$ where q is the net charge enclosed by a cylindrical Gaussian surface of radius r . The field is being measured outside the system (the charged rod coaxial with the neutral cylinder) so that the net enclosed charge is only that which is on the rod. Consequently,

$$|\vec{E}| = \frac{\lambda}{2\pi\epsilon_0 r} = \frac{2.0 \times 10^{-9}}{2\pi\epsilon_0 (0.15)} = 240 \text{ N/C} .$$

- (b) and (c) Since the field is zero inside the conductor (in an electrostatic configuration), then there resides on the inner surface charge $-q$, and on the outer surface, charge $+q$ (where q is the charge on the rod at the center). Therefore, with $r_i = 0.05$ m, the surface density of charge is

$$\sigma_{\text{inner}} = \frac{-q}{2\pi r_i L} = -\frac{\lambda}{2\pi r_i} = -6.4 \times 10^{-9} \text{ C/m}^2$$

for the inner surface. And, with $r_o = 0.10$ m, the surface charge density of the outer surface is

$$\sigma_{\text{outer}} = \frac{+q}{2\pi r_o L} = \frac{\lambda}{2\pi r_o} = +3.2 \times 10^{-9} \text{ C/m}^2 .$$