Electric Field of Charged Rod (3)

Symmetry dictates that the resulting electric field is directed radially.

- $\theta_2 = \pi - \theta_1, \quad \Rightarrow \quad \sin\theta_2 = \sin\theta_1, \quad \cos\theta_2 = -\cos\theta_1.$
- $\cos\theta_1 = \dfrac{L/2}{\sqrt{L^2/4 + R^2}}.$
- $E_R = -\dfrac{k\lambda}{R}\left(\cos\theta_2 - \cos\theta_1\right) = \dfrac{k\lambda}{R}\dfrac{L}{\sqrt{L^2/4 + R^2}}.$
- $E_z = \dfrac{k\lambda}{R}\left(\sin\theta_2 - \sin\theta_1\right) = 0.$
- Large distance $(R \gg L)$: $E_R \simeq \dfrac{kQ}{R^2}.$
- Small distances $(R \ll L)$: $E_R \simeq \dfrac{2k\lambda}{R}$
- Rod of infinite length: $\vec{E} = \dfrac{2k\lambda}{R}\hat{R}.$