

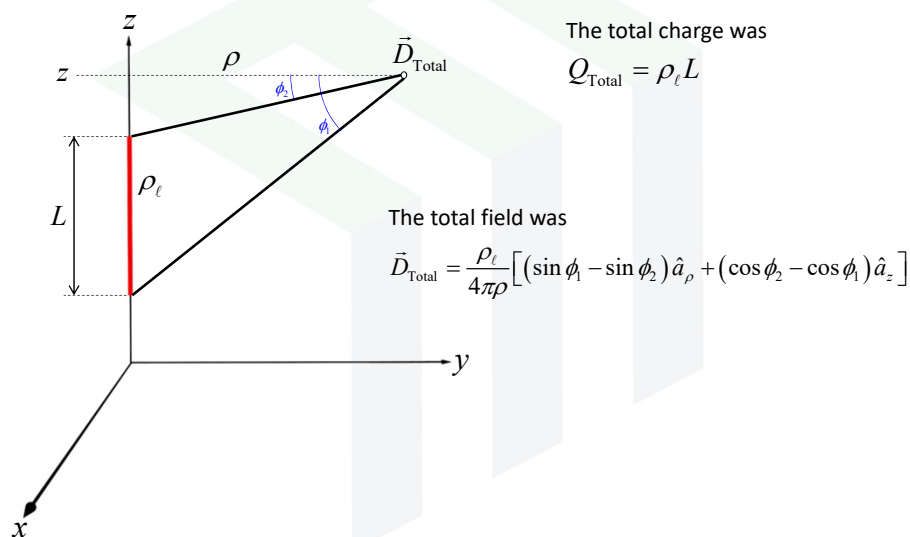


Electromagnetics:
Electromagnetic Field Theory

Example:
Uniform Infinite Line Charge

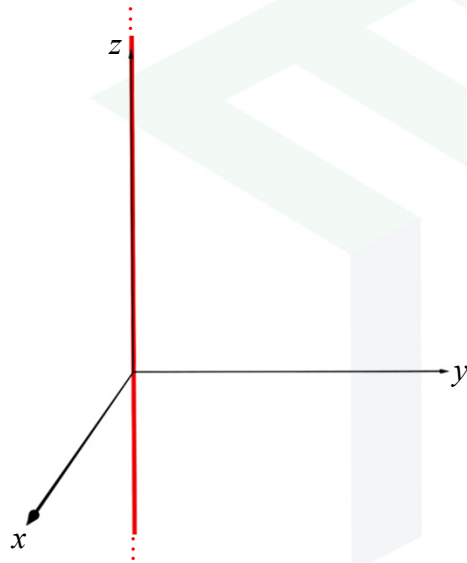
1

Result from Uniform Finite Line Charge Example



2

Total Charge



What is the total charge Q ?

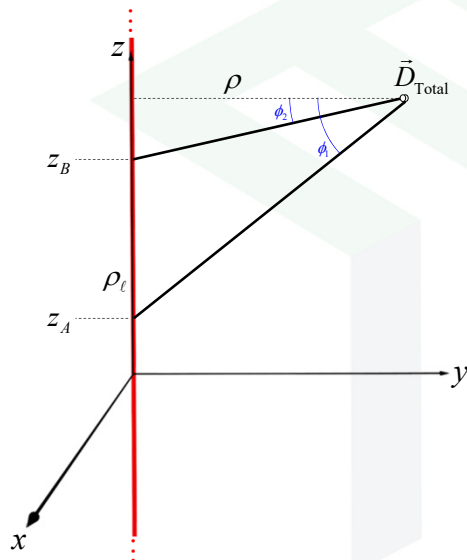
Use the result from the finite line charge to get this answer simply by letting L go to infinity.

$$\begin{aligned} Q_{\text{Total}} &= \rho_l L \\ &= \rho_l \cdot \infty \end{aligned}$$

$$Q_{\text{Total}} = \infty$$

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Total Field



What is the total field \vec{D}

When the length of the line is infinity, the angles ϕ_1 and ϕ_2 become

$$\phi_1 = 90^\circ \quad \phi_2 = -90^\circ$$

The total field is then derived from the expression for the finite length charge.

$$\begin{aligned} \vec{D}_{\text{Total}} &= \frac{\rho_l}{4\pi\rho} \left[(\sin\phi_1 - \sin\phi_2)\hat{a}_\rho + (\cos\phi_2 - \cos\phi_1)\hat{a}_z \right] \\ &= \frac{\rho_l}{4\pi\rho} \left\{ [\sin(90^\circ) - \sin(-90^\circ)]\hat{a}_\rho + [\cos(-90^\circ) - \cos(90^\circ)]\hat{a}_z \right\} \\ &= \frac{\rho_l}{4\pi\rho} \{ [1 - (-1)]\hat{a}_\rho + [0 - 0]\hat{a}_z \} \end{aligned}$$

$$\vec{D}_{\text{Total}} = \frac{\rho_l}{2\pi\rho} \hat{a}_\rho$$

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