

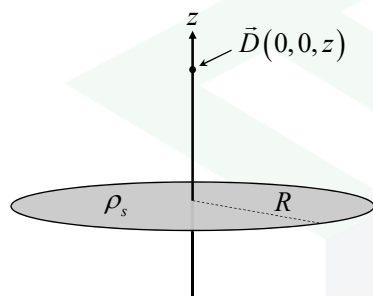


Electromagnetics:
Electromagnetic Field Theory

Example: Uniform Infinite Plate Charge

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Result From Uniform Finite Circular Plate



The total charge is

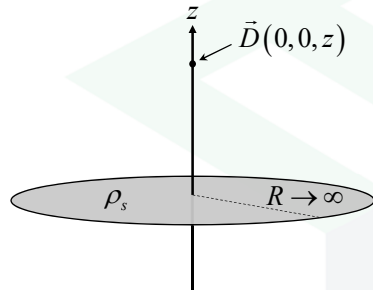
$$Q_{\text{Total}} = \rho_s S$$

The total field is

$$\vec{D}_{\text{Total}} = \frac{\rho_s}{2} \left(1 - \frac{z}{\sqrt{R^2 + z^2}} \right) \hat{a}_z$$

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Total Charge



What is the total charge Q_{Total} ?

From our previous example, we have

$$Q_{\text{Total}} = \rho_s S$$

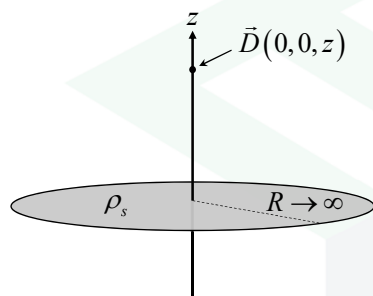
The infinite sheet charge has $S = \infty$

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

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

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Total Field



What is the total field \vec{D} ?

From our previous example, we have

$$\vec{D}_{\text{Total}} = \frac{\rho_s}{2} \left(1 - \frac{z}{\sqrt{R^2 + z^2}} \right) \hat{a}_z$$

For the infinite sheet charge, $R = \infty$

$$\begin{aligned} \vec{D}_{\text{Total}} &= \frac{\rho_s}{2} \left(1 - \frac{z}{\sqrt{\infty^2 + z^2}} \right) \hat{a}_z \\ &= \frac{\rho_s}{2} \left(1 - \frac{z}{\infty} \right) \hat{a}_z \end{aligned}$$

$$\vec{D}_{\text{Total}} = \frac{\rho_s}{2} \hat{a}_z$$

7. Interpret the result.

The electric field does not decrease with distance away from an infinite sheet.

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