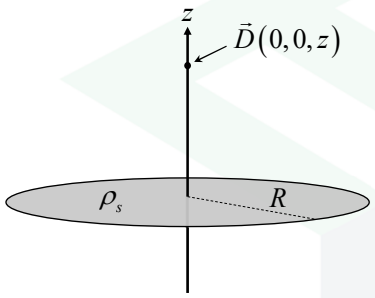
EMPossible

Electromagnetics:
Electromagnetic Field Theory

Example:
Uniform Infinite Plate Charge

1

Result From Uniform Finite Circular Plate



The total charge is

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

The total field is

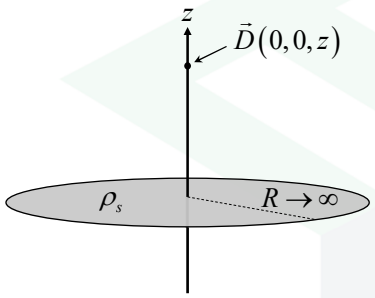
$$\vec{D}_{\text{Total}} = \frac{\rho_s}{2}\left(1 - \frac{z}{\sqrt{R^2 + z^2}}\right)\hat{a}_z$$

EMPossible

Slide 2

2

Total Charge



What is the total charge Q_{Total}?

From the previous example, total charge was

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

The infinite sheet charge has $S = \infty$

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

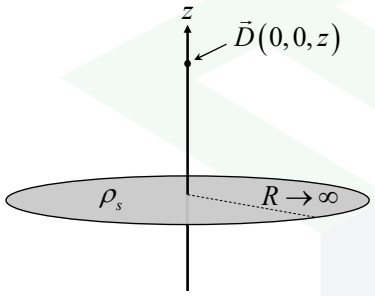
$$\boxed{Q_{\text{Total}} = \infty}$$

EMPossible

Slide 3

3

Total Field



What is the total field $\vec{D}$?

From the previous example, the total field was

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

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

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

$$= \frac{\rho_s}{2}\left(1 - \frac{z}{\infty}\right)\hat{a}_z$$

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

7. Interpret the result.

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

EMPossible

Slide 4

4