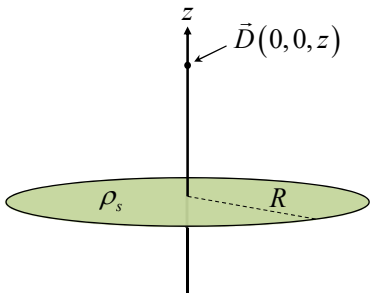
Electrostatics:

Example – Uniform Infinite Plate Charge

EE3321

Electromagnetic Field Theory

Result From Uniform Finite Circular Plate



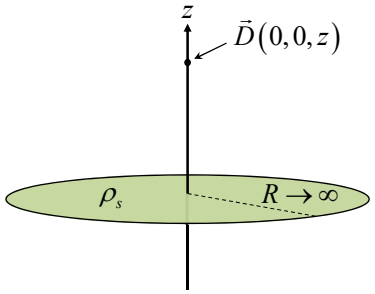
The total charge is

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

The total field is

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

Total Charge



What is the total charge Q_{Total}?

From our previous example, we have

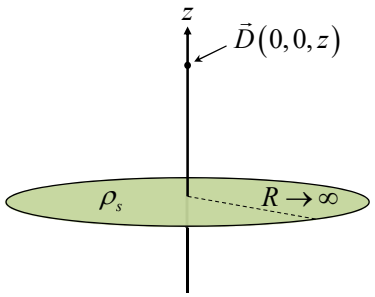
$$Q_{\text{Total}} = \rho_s S$$

The infinite sheet charge has $S = \infty$

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

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

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, $R = \infty$

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

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

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

7. Interpret the result.

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