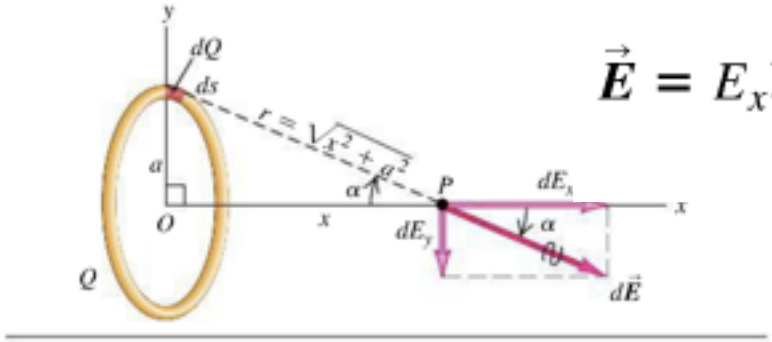
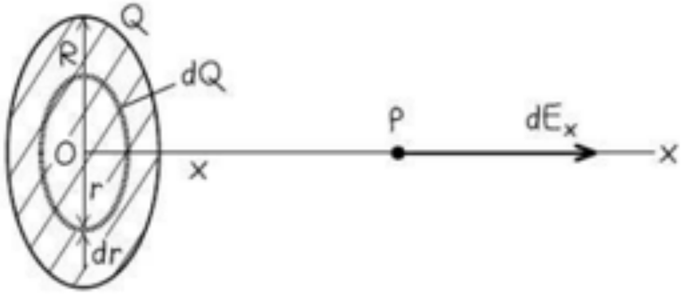
Lecture 12

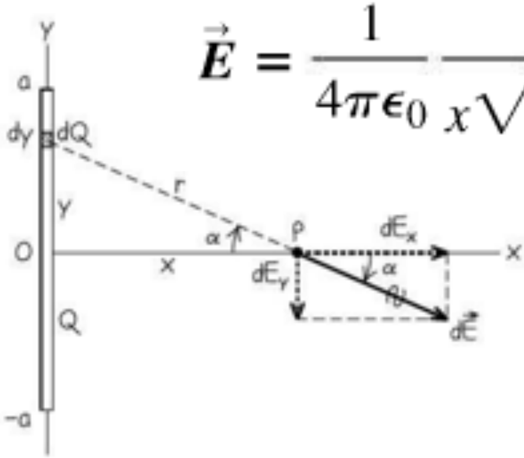
PHYC 161 Fall 2016

Electric Field of Various Charge Distributions



$$\vec{E} = E_x \hat{\imath} = \frac{1}{4\pi\epsilon_0} \frac{Qx}{(x^2 + a^2)^{3/2}} \hat{\imath}$$



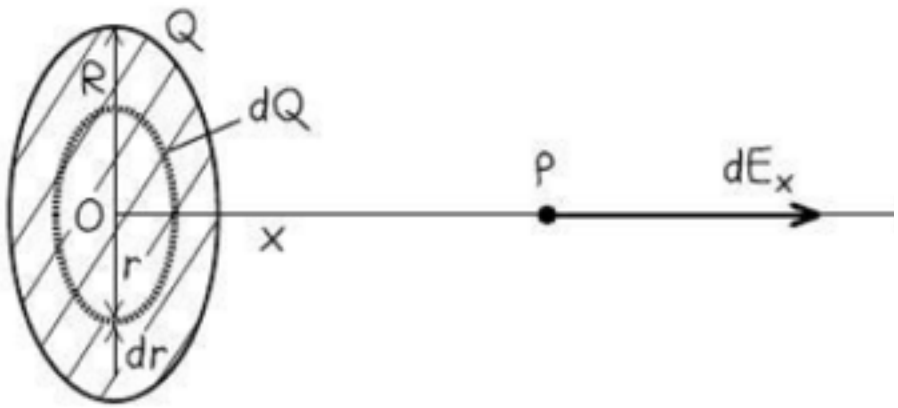


$$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{Q}{x\sqrt{x^2 + a^2}} \hat{\imath}$$

$$E_x = \frac{\sigma x}{2\epsilon_0}\left[-\frac{1}{\sqrt{x^2 + R^2}} + \frac{1}{x}\right]$$

$$= \frac{\sigma}{2\epsilon_0}\left[1 - \frac{1}{\sqrt{(R^2/x^2) + 1}}\right]$$

What is the electric field due to an infinite sheet?



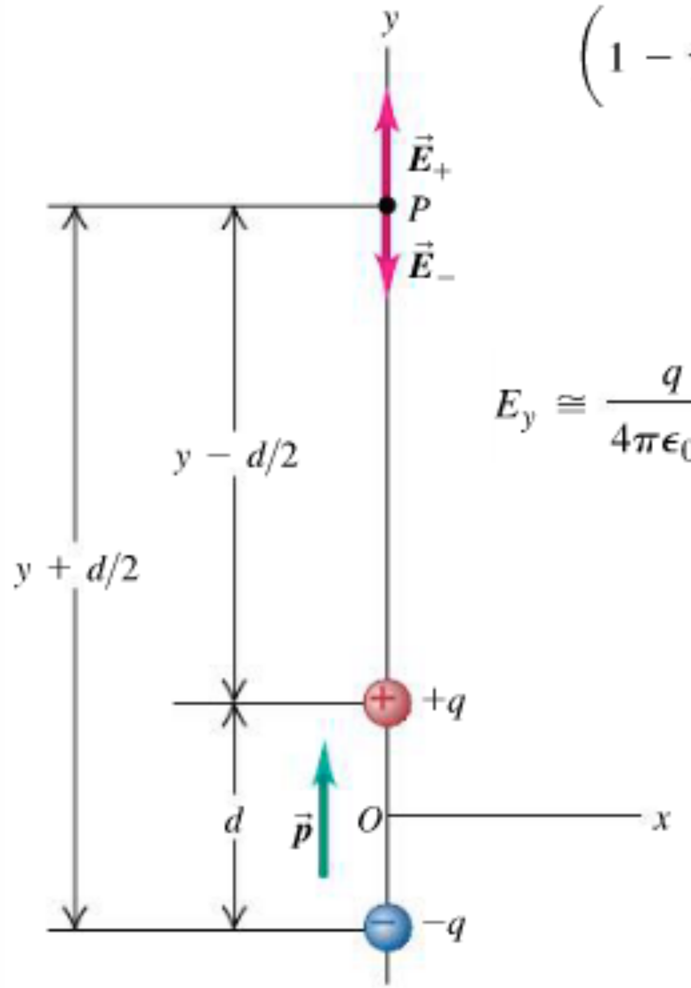
$$E_x = \frac{\sigma x}{2\epsilon_0}\left[-\frac{1}{\sqrt{x^2 + R^2}} + \frac{1}{x}\right]$$

$$= \frac{\sigma}{2\epsilon_0}\left[1 - \frac{1}{\sqrt{(R^2/x^2) + 1}}\right]$$

Given the expression above for a disk of charge, what is the field of an infinite sheet of charge?

HW related…

21.33 Finding the electric field of an electric dipole at a point on its axis.



$$\left(1 - \frac{d}{2y}\right)^{-2} \cong 1 + \frac{d}{y} \quad \text{and} \quad \left(1 + \frac{d}{2y}\right)^{-2} \cong 1 - \frac{d}{y}$$

$$E_y \cong \frac{q}{4\pi\epsilon_0 y^2}\left[1 + \frac{d}{y} - \left(1 - \frac{d}{y}\right)\right] = \frac{qd}{2\pi\epsilon_0 y^3} = \frac{p}{2\pi\epsilon_0 y^3}$$

Gauss's law

- Carl Friedrich Gauss helped develop several branches of mathematics, including differential geometry, real analysis, and number theory.
- The "bell curve" of statistics is one of his inventions.
- Gauss also made state-of-the-art investigations of the earth's magnetism and calculated the orbit of the first asteroid to be discovered.
- While completely equivalent to Coulomb's law, **Gauss's law** provides a different way to express the relationship between electric charge and electric field.