

PHYS 122-Lecture 3:

More Electric Fields

- Review of Charge and Force
- Fields
- Examples

Mass ► Law ► Field

$$F_g = G \frac{|m_1 m_2|}{r^2}$$

Charge ► Law ► Field

$$F_E = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2}$$

$$F_E = k \frac{|q_1 q_2|}{r^2}$$

$$\left[F_E = \frac{1}{4\pi\epsilon} \frac{|q_1 q_2|}{r^2} \right]$$

Mass ► Law ► Field

$$F_g = G \frac{|m_1 m_2|}{r^2}$$

$$F_g = m_1 \left(G \frac{|m_2|}{r^2} \right)$$

$$F_g = m_1 g_2$$

$$\mathbf{F}_g = m_1 \mathbf{g}$$

Charge ► Law ► Field

$$F_E = \frac{1}{4\pi\epsilon_0} \frac{|q_1 q_2|}{r^2}$$

$$F_E = q_1 \left(\frac{1}{4\pi\epsilon_0} \frac{|q_2|}{r^2} \right)$$

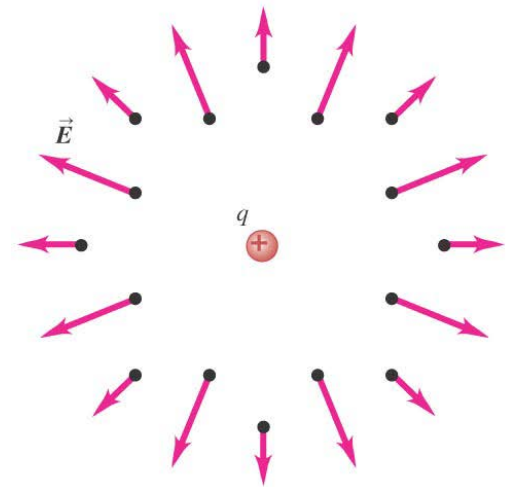
$$F_E = q_1 E_2$$

$$\mathbf{F}_E = q_1 \mathbf{E}$$

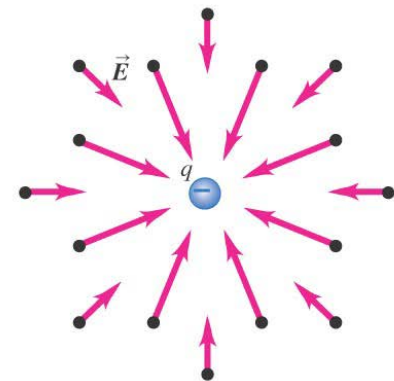
Electric field of a point charge

- Follow the discussion in the text of the electric field of a point charge, using Figure 21.18 at the right.
- Follow Example 21.5 to calculate the magnitude of the electric field of a single point charge.

(a) The field produced by a positive point charge points *away from* the charge.

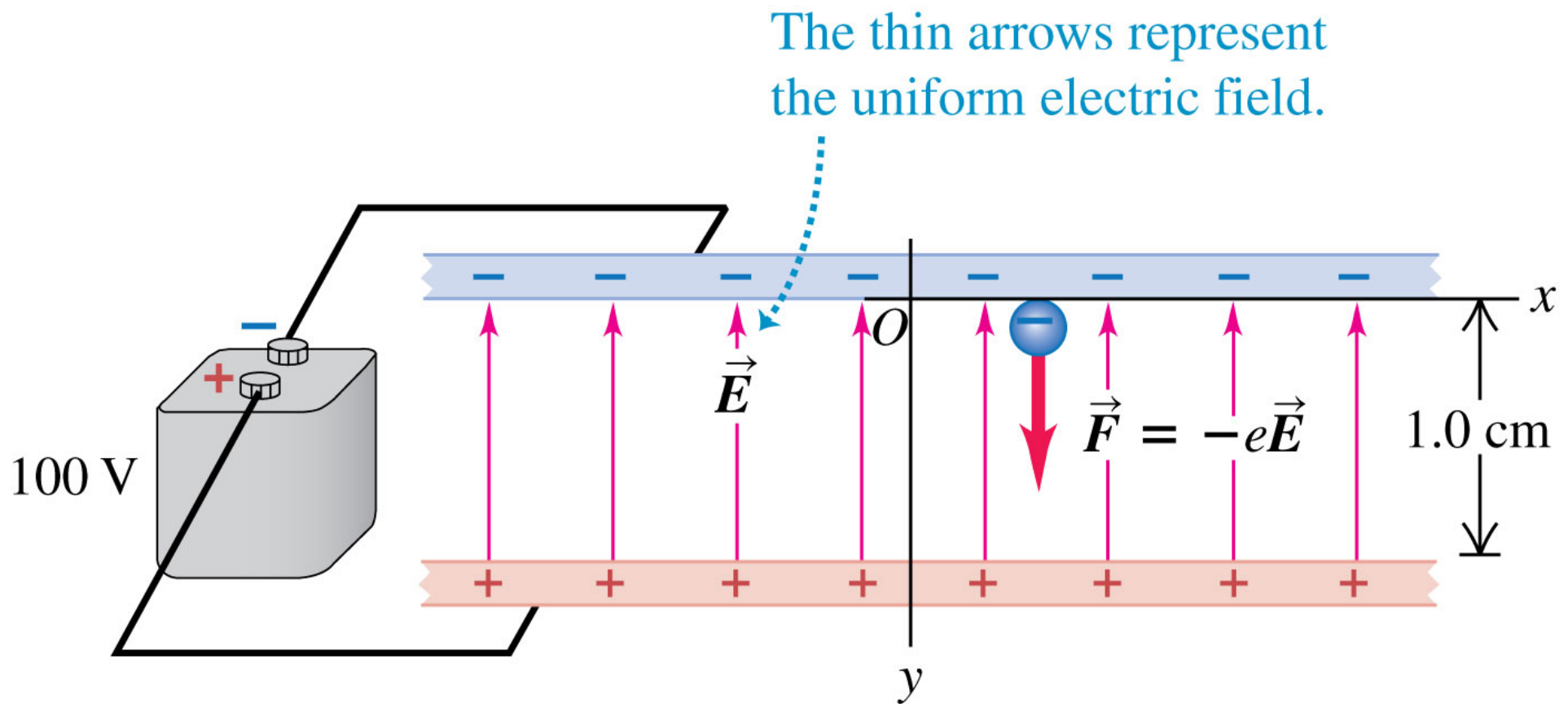


(b) The field produced by a negative point charge points *toward* the charge.



Electron in a uniform field

- Example 21.7 requires us to find the force on a charge that is in a known electric field. Follow this example using Figure 21.20 below.



Integral Form

$$E = \frac{1}{4\pi\epsilon_0} \frac{|q|}{r^2}$$

$$E_i = \frac{1}{4\pi\epsilon_0} \frac{|q_i|}{r^2}$$

$$E_T = \sum_i \frac{1}{4\pi\epsilon_0} \frac{|q_i|}{r^2}$$

$$E_T = \int \frac{1}{4\pi\epsilon_0} \frac{1}{r^2} dq$$

A word on dQ...

dQ is interpreted as “a little bit of charge”

Oftentimes, dQ is rewritten as:

$$\delta Q = \rho \cdot \delta V$$

$$\delta Q = \sigma \cdot \delta A$$

$$\delta Q = \lambda \cdot \delta l$$

where

ρ is the volume charge density [charge/m³]

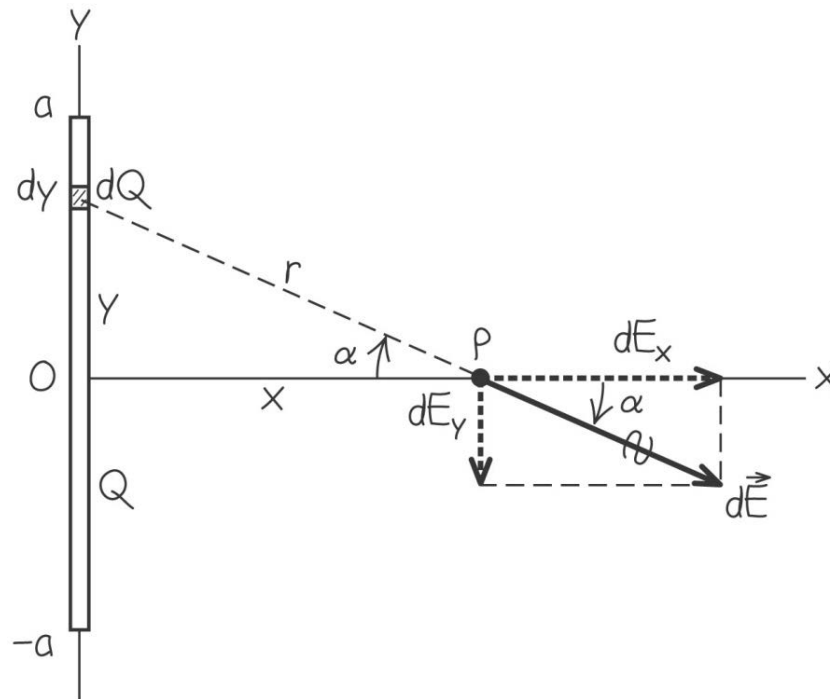
σ is the surface charge density [charge/m²]

λ is the line charge density [charge/m]



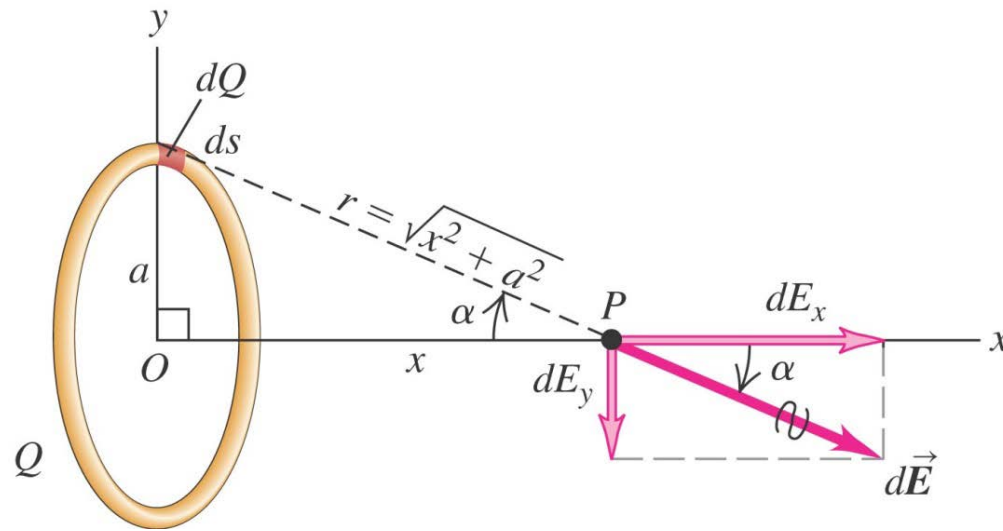
Field of a charged line segment

- Follow Example 21.10 and Figure 21.24 below.



Field of a ring of charge

- Follow Example 21.9 using Figure 21.23 below.



Field of a uniformly charged disk

- Follow Example 21.11 using Figure 21.25 below.

