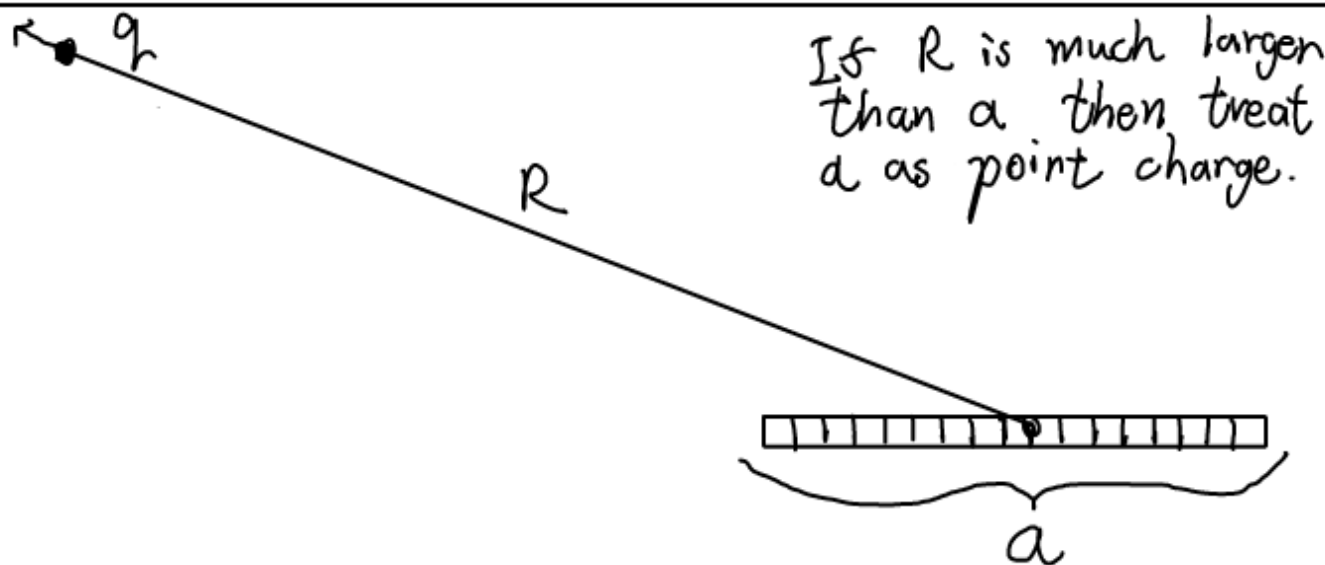


# Electrostatic Field

Charge Distribution

point  
line  
surface  
volume



If  $R$  is much larger than  $a$  then treat  $a$  as point charge.

Find  $E$  at Point P

$Q_1 = |Q|$

$Q_2 = -|Q|$

$\vec{E} = \frac{\vec{F}}{q} = k \frac{Qq}{R^2} \left( \frac{1}{q} \right) = \frac{kQ}{R^2}$

$\vec{E}_{Q_1} = \frac{k|Q|}{R^2} (\cos\theta \hat{x} - \sin\theta \hat{y})$

$= \frac{k|Q|}{R^2} \left( \frac{x}{R} \hat{x} - \frac{a}{R} \hat{y} \right)$

$E = \frac{kQ}{R^2}$

$Q$

A diagram showing two charges  $Q_1 = |Q|$  and  $Q_2 = -|Q|$  on the  $y$ -axis, separated by a distance  $2a$ . A point  $P$  is located in the  $x$ - $y$  plane at a distance  $R$  from the origin. The distance from  $Q_1$  to  $P$  is  $r$ , and the angle between the  $x$ -axis and the line  $Q_1P$  is  $\theta$ . The distance from  $Q_2$  to  $P$  is also  $r$ , and the angle between the  $y$ -axis and the line  $Q_2P$  is  $\theta$ . The coordinates of  $P$  are  $(x, a)$ .

A diagram showing a point charge  $Q$  at a distance  $R$  from a point  $P$ . The distance  $R$  is labeled, and the charge  $Q$  is labeled.

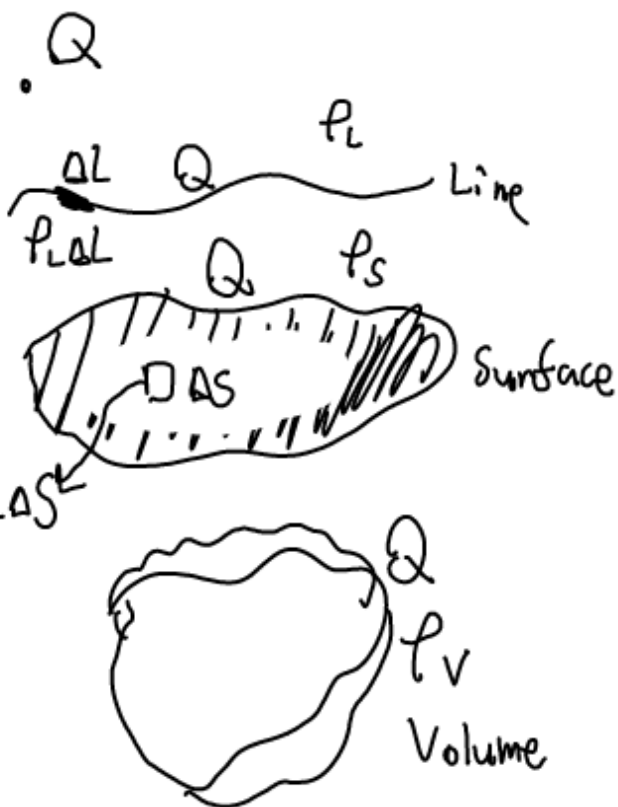
$$\vec{E}_{Q_2} = \frac{k|Q|}{R^2} \left( -\frac{x}{R} \hat{x} - \frac{a}{R} \hat{y} \right)$$

$$\vec{E} = \vec{E}_{Q_1} + \vec{E}_{Q_2} = \frac{k|Q|}{R^2} \left( -\frac{2a}{R} \right) \hat{y} = \frac{2k|Q|a}{R^3} (-\hat{y})$$

if  $x$  is much greater than  $a$ .

$$\vec{E} \rightarrow \frac{2ak|Q|}{x^3} (-\hat{y})$$

$$= \frac{2k|Q|a}{(\sqrt{x^2+a^2})^3} (-\hat{y})$$



$$\rho_L = \frac{C}{m}$$

$$\rho_S = \frac{C}{m^2}$$

$$\rho_V = \frac{C}{m^3}$$