PY 202 Day 3?

→ clicker: channel 14

Clicker Q

~~A~~ Field only depends on source q

(+1) d (+1)

(+1) d (+2)

same E

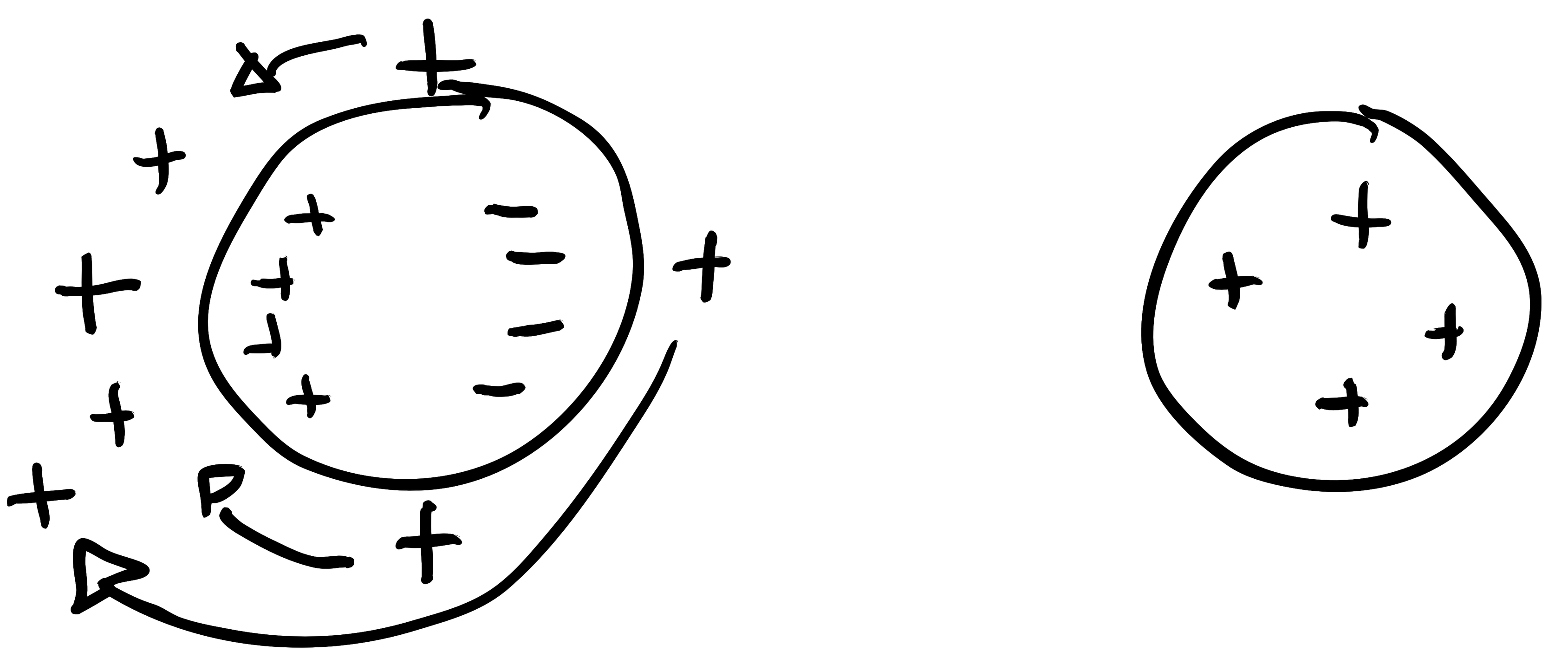
smaller F

larger F

Quiz 1

conductor

metal sphere



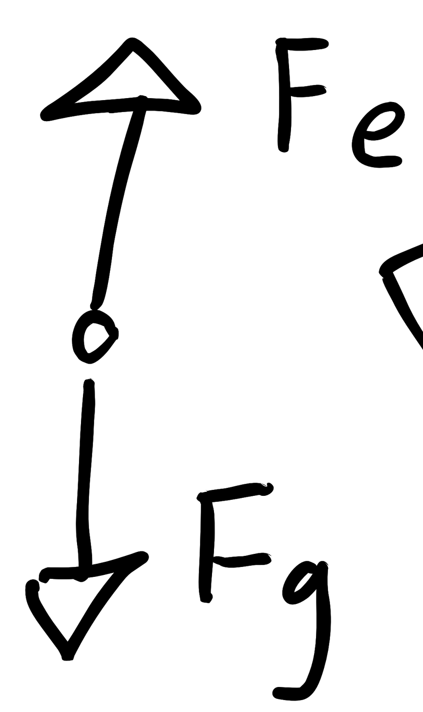
extended obj

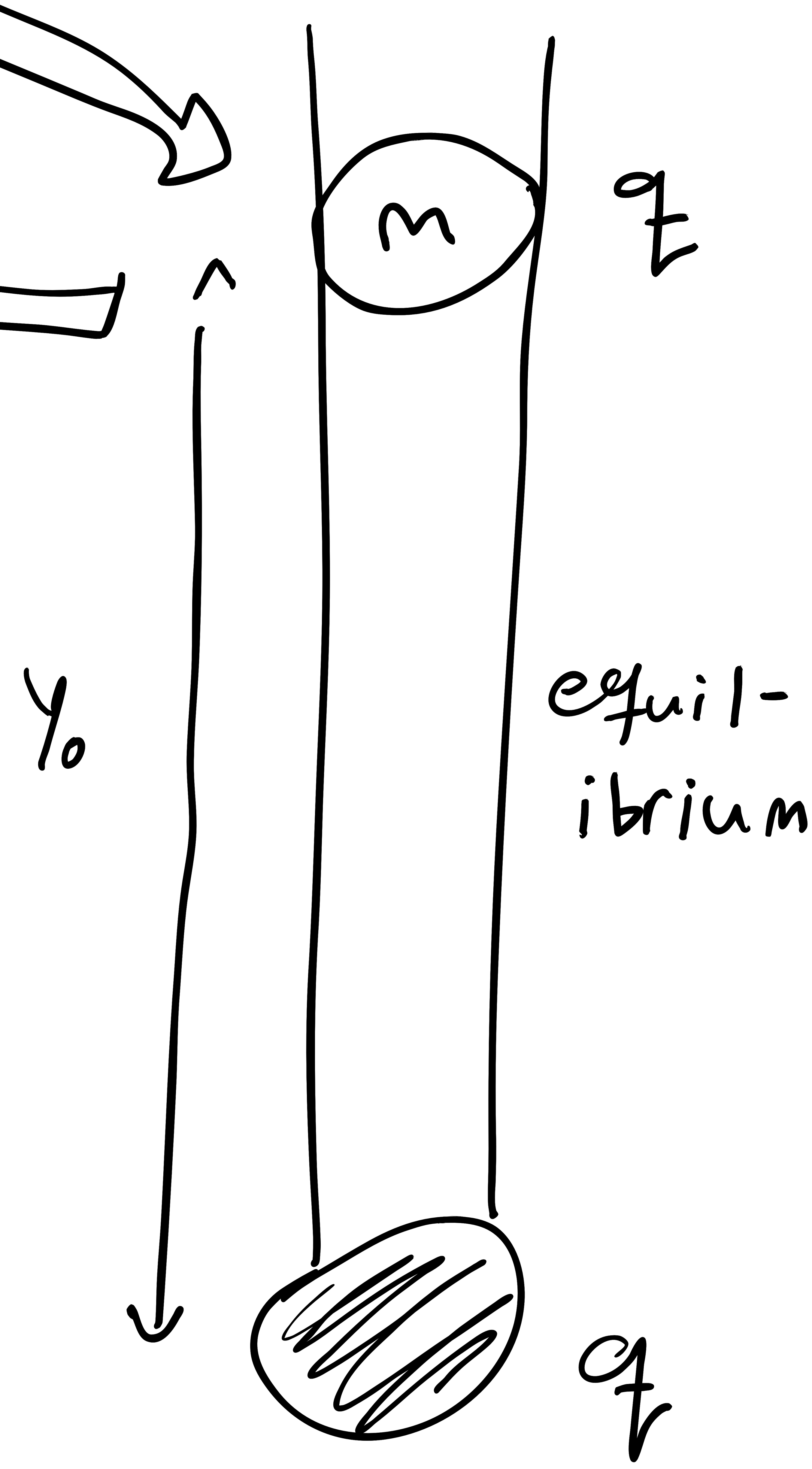
point charges don't have these complications

- behavior of conductor
- diff. ~~of~~ between point q's and extended objects

- Partial Derivatives Intro
- other HW comment:
  - -> DRAW SKETCHES (carefully)

ex)





Show that y_0 is an equilibrium

$$y_0 = \sqrt{\frac{kqQ}{mg}}$$

<u>Strategy</u>:

$$\vec{F}_g + \vec{F}_{el} = 0$$

Use Coulomb's Law to find $\vec{F}_{el}$!

answer in terms of q, Q, m, k, g

$$\left.\begin{aligned} \vec{F}_g &= -mg\,\hat{j} \\ \vec{F}_{el} &= k\,\frac{qQ}{y_0^2}\,\hat{j} \end{aligned}\right\} = \frac{kqQ}{y_0^2} - mg = 0$$

$$\boxed{y_0 = \sqrt{\frac{kqQ}{mg}}}$$

displace mass m by Δy

restoring force: $F = \dfrac{kqQ}{(y_0+\Delta y)^2} - \dfrac{kqQ}{y_0^2}$

$$\frac{kqQ}{y_0^2+2y_0\Delta y} - \frac{kqQ}{y_0^2} \approx$$

$\Delta y \ll y_0$

$$= \frac{-2y_0\Delta y\, kqQ}{y_0^4 + 2y_0^3\Delta y}$$

$$= \frac{-2y_0\Delta y\, kqQ}{y_0^4\left(1+2\frac{\Delta y}{y_0}\right)}$$

$\Delta y \ll y_0$

$$\approx -\frac{2\Delta y\, kqQ}{y_0^3}$$

$$\left(\begin{aligned} &\frac{kqQ}{y_0^2} - mg = 0 \\ &\Rightarrow \frac{kqQ}{y_0^2} = mg \end{aligned} \right)$$

$$\rightarrow \frac{-2\Delta y\, kqQ}{y_0^3} = -\frac{2\Delta y\, mg}{y_0}$$

$$= F_{restoring} = m\frac{d^2\Delta y}{dt^2}$$

$$\frac{d^2\Delta y}{dt^2} + \frac{2g}{y_0}\Delta y = 0$$

$$\text{"}\frac{d^2x}{dt^2} + \omega^2 x = 0\text{"}$$

Continuous Charge Distribution

Linear charge density: λ $[C/m]$

surface charge density σ $[C/m^2]$

volume charge density ρ $[C/m^3]$

electric field: due to an infitessimal

$$d\vec{E} = k \frac{dq}{r^2}$$

charge dq (dq is small, so it acts like a point charge)

$$\int d\vec{E} = \vec{E}$$

$$E_x = \int dE_x$$

$$E_y = \int dE_y$$

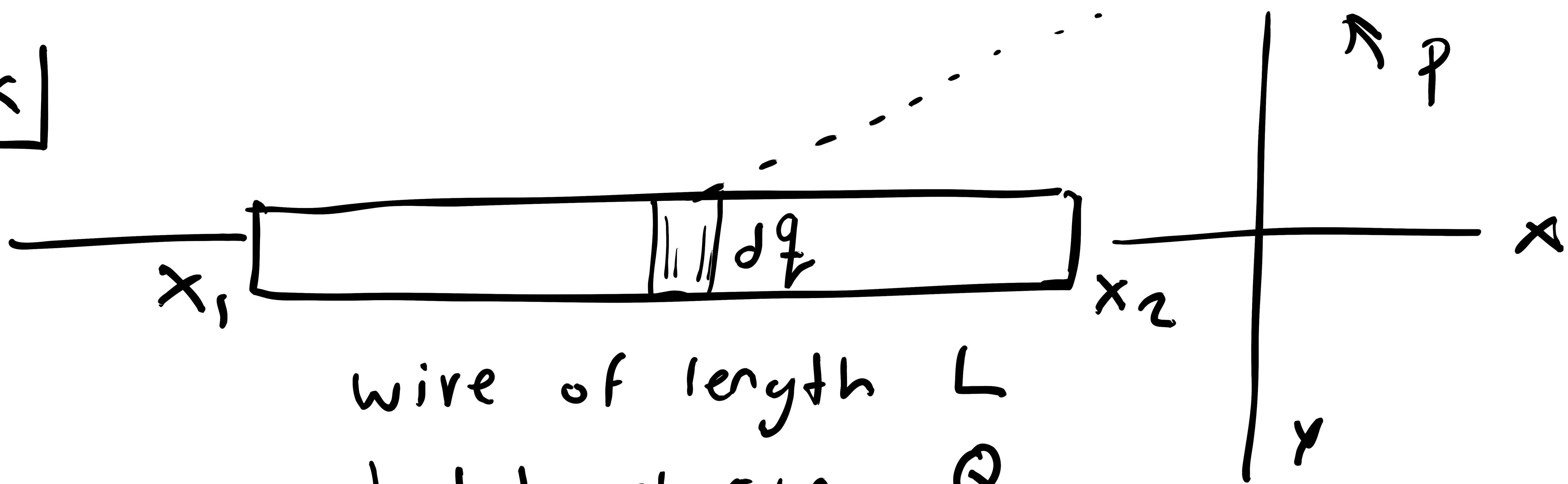
total charge

$$Q = \lambda L$$

$$Q = \sigma A$$

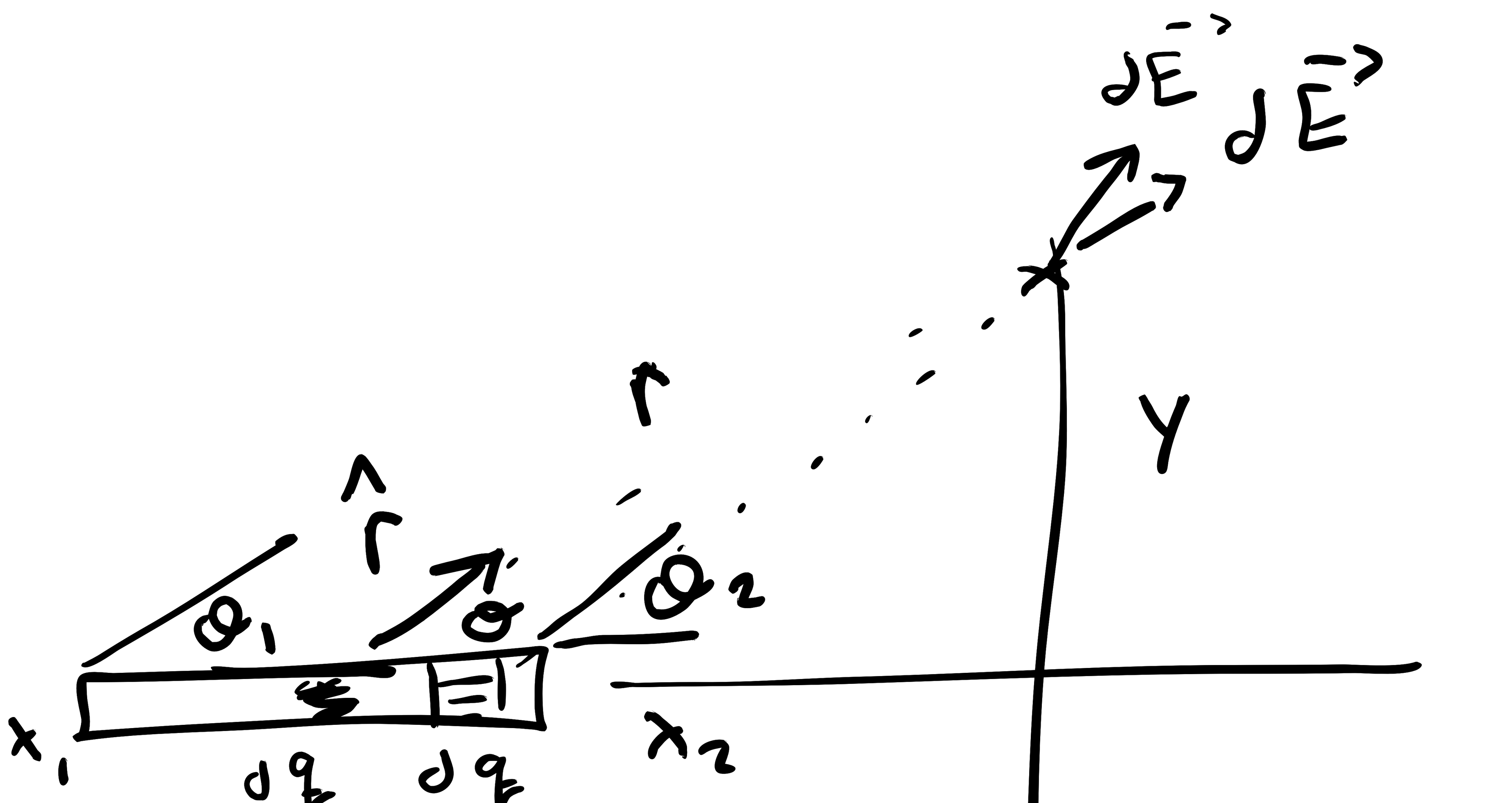
$$Q = \rho V$$

ex



wire of length L
total charge Q

$\vec{E} = ?$ at any point P



Can use integral as function of x or θ

$$d\vec{E} = dE\,\hat{r}$$
$$d\vec{E} = dE_x\,\hat{i} + dE_y\,\hat{j}$$

$$dE = \frac{k\,dq}{r^2}$$

rewrite in terms of θ, Y, Q