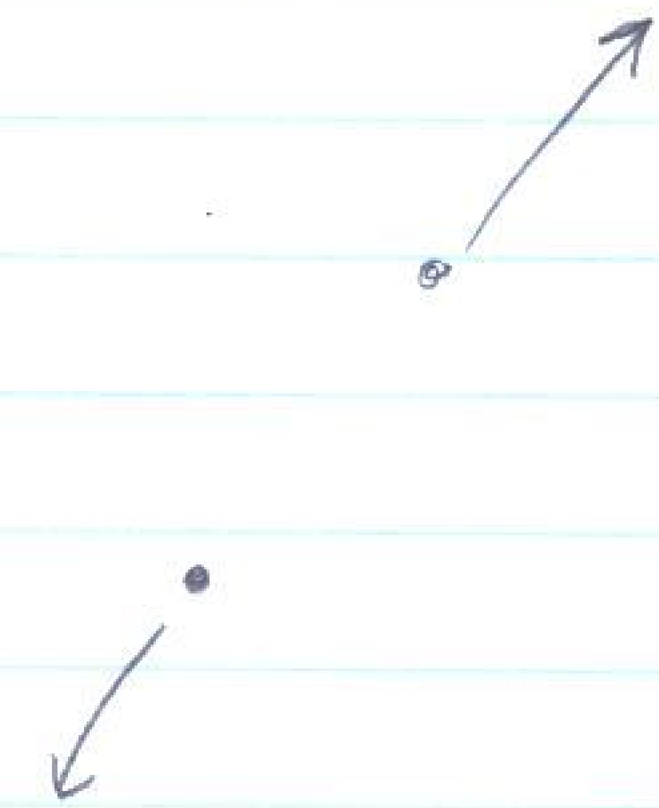
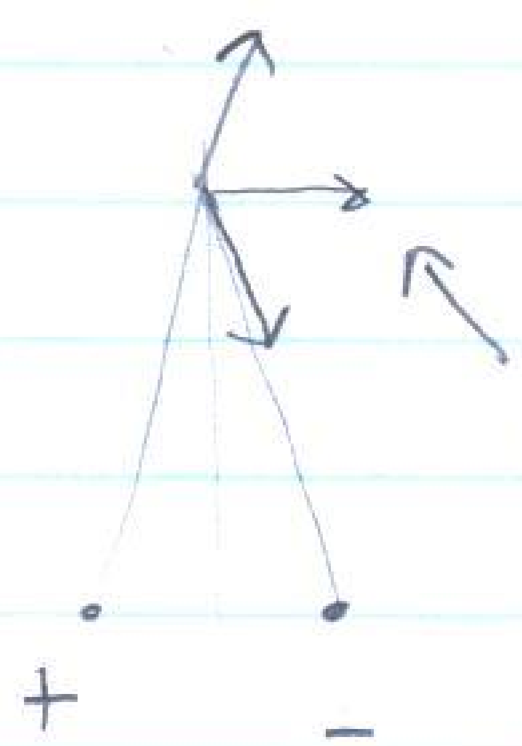
Last time:

$$\vec{F}_{12} = \underbrace{k_e}_{\frac{1}{4\pi\varepsilon_0}} \frac{q_1 q_2}{r^2} \hat{r}_{12}$$



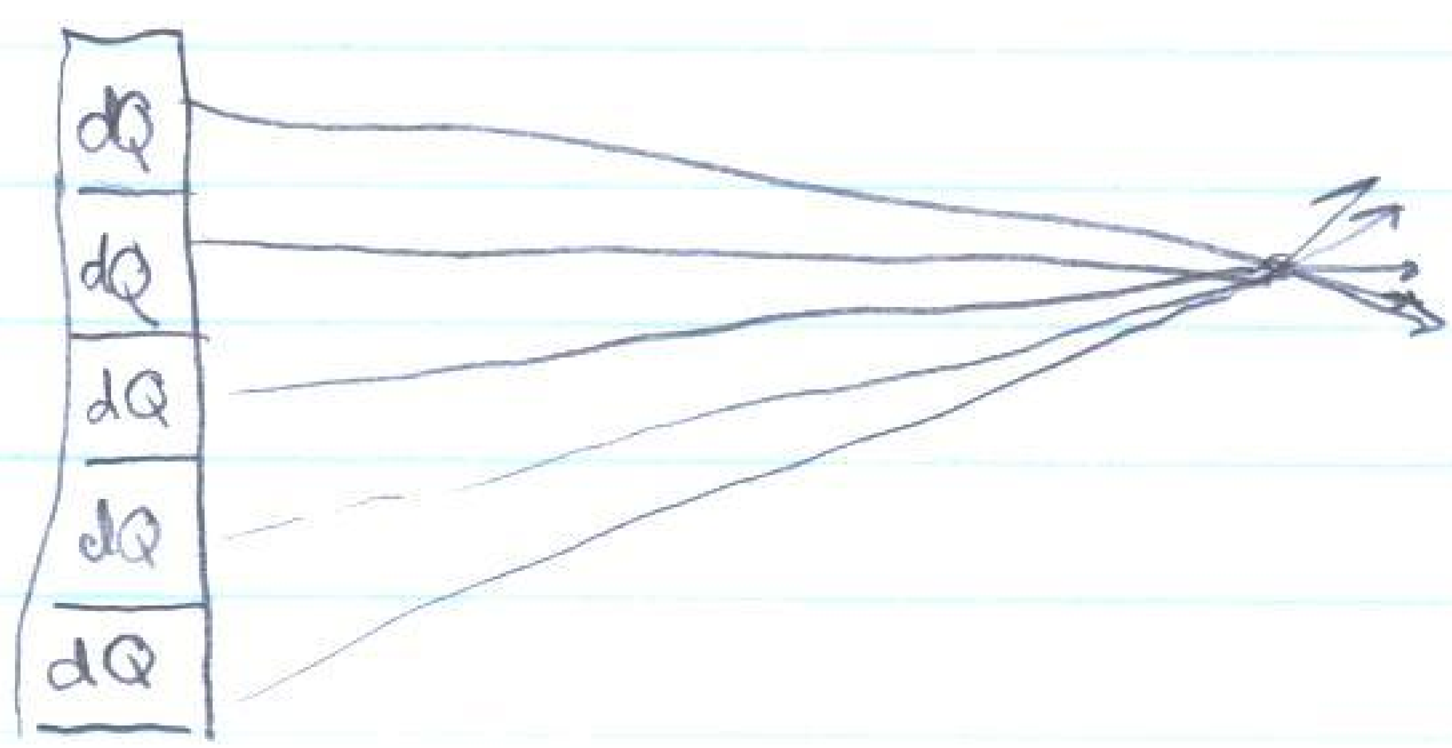
Point Charges $\vec{E} = \frac{\vec{F}}{q_0} \longrightarrow \frac{k_e Q}{r^2} \hat{r}$ (Enlectric Field From a point charge)



$$\vec{E}_{TOT} = \vec{E}_+ + \vec{E}_-$$

Continuous Distribution:

1



$$\vec{E}_{TOT} = \sum_i \vec{E}_i = \sum \frac{dQ\, k_e}{r_i^2} \hat{r}_i$$

Then we had:

$$\lambda = \frac{\text{Charge}}{\text{Lendth}} \qquad dQ = \lambda\, dx$$

$$E_{TOT} = \sum_i k_e \frac{dQ}{r^2} \longrightarrow \int_0^L k_e \frac{\lambda\, dx}{r_x^2}$$

A. Last Time Compute Electric FieldS

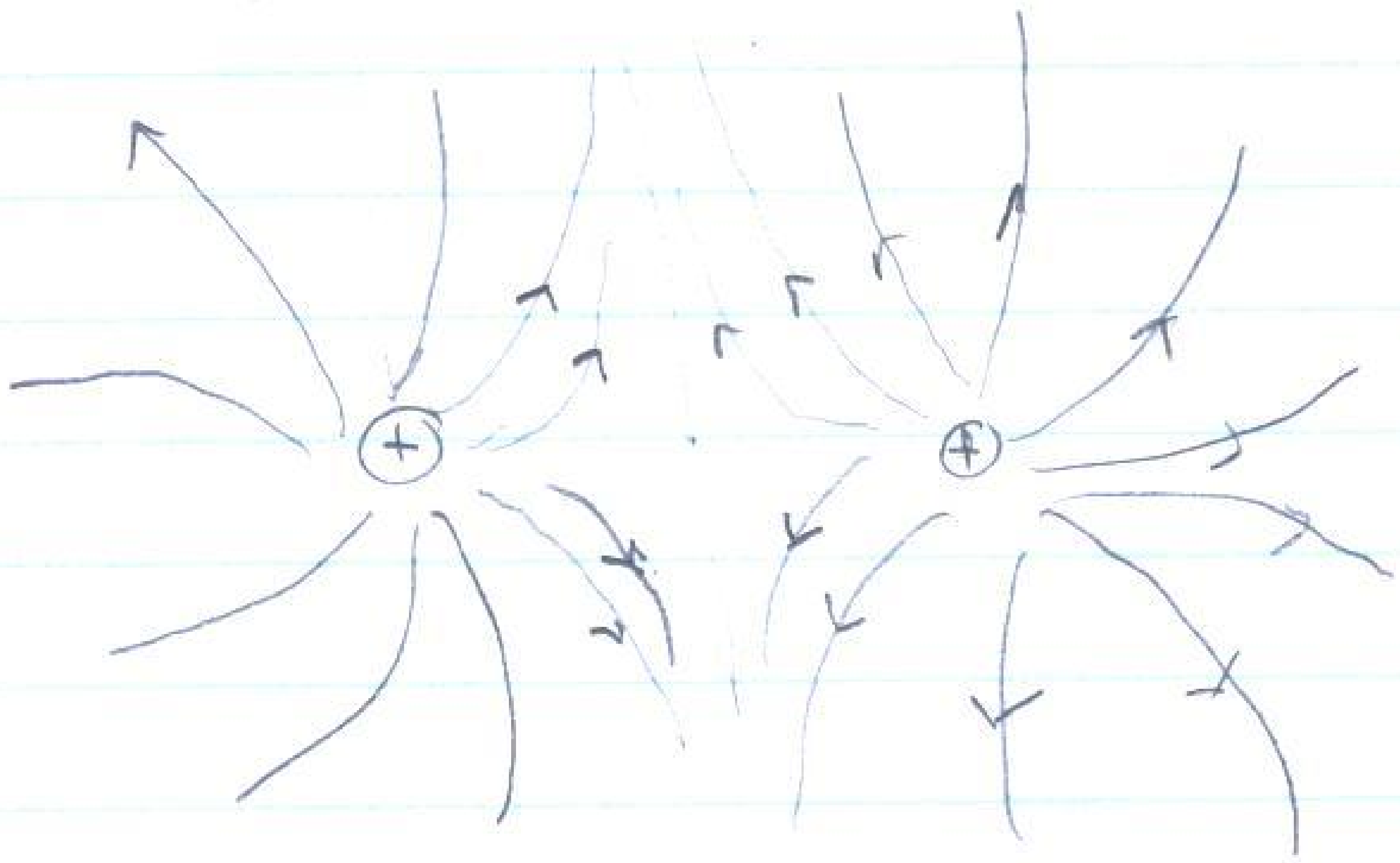
B. Today, What happens when you put a charge in an E-field

Answer: you move

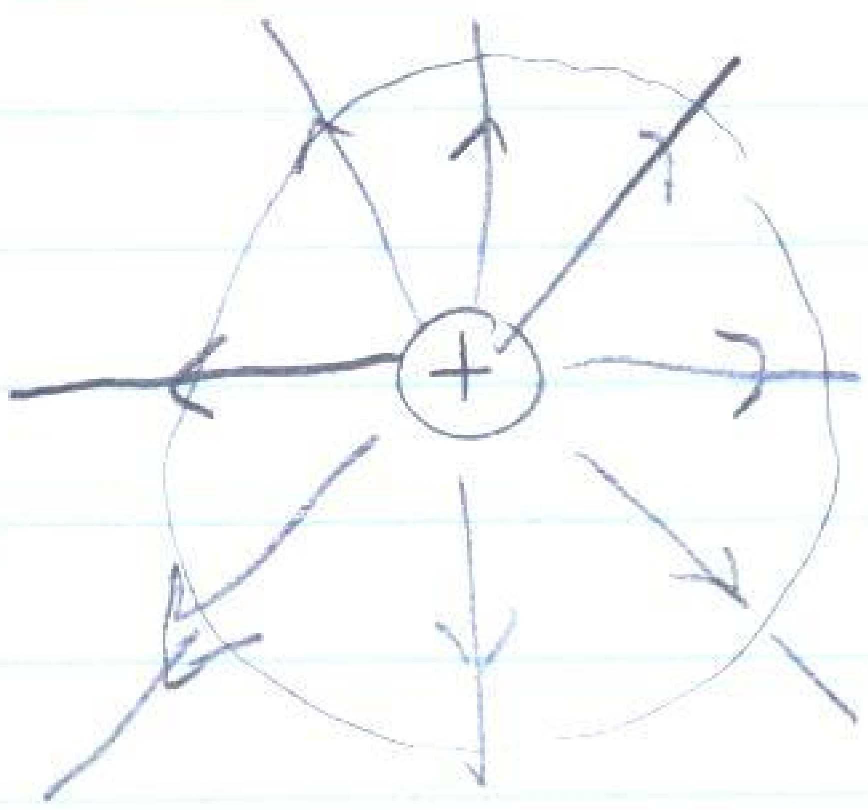
$$\vec{F} = q\, \vec{E}_{(x,t)} = m\vec{a}$$

- Show Elenctric Field Applet:

Example



Coulomb Law:



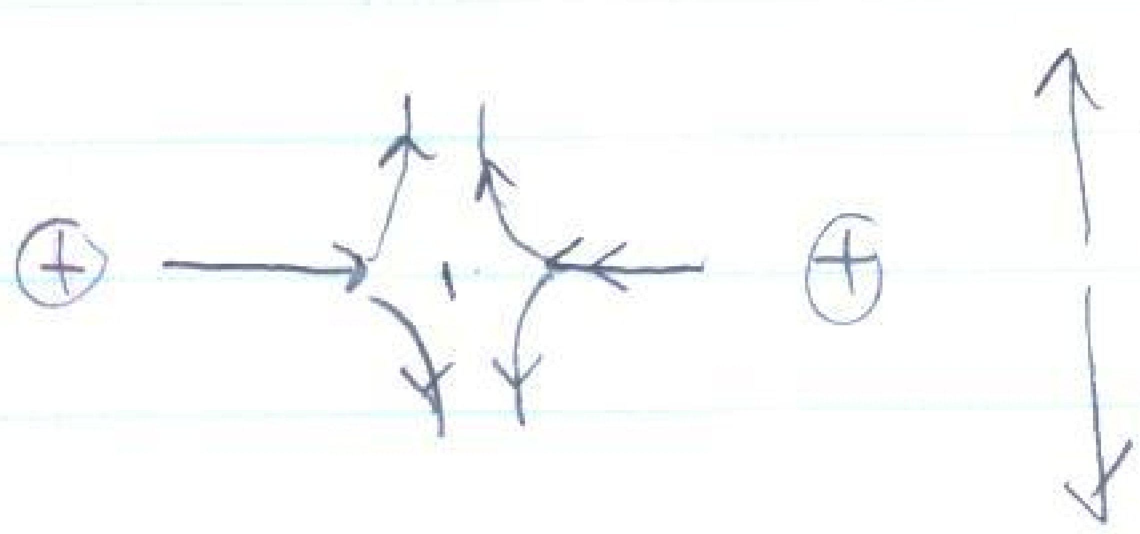
$E \propto$ density of Lines

$$E \propto \frac{N_{lines}}{4\pi r^2}$$

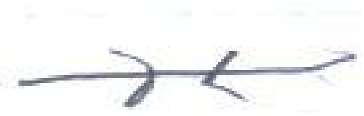
$$E \propto \frac{1}{r^2}$$

There is no stable Equilibrium:

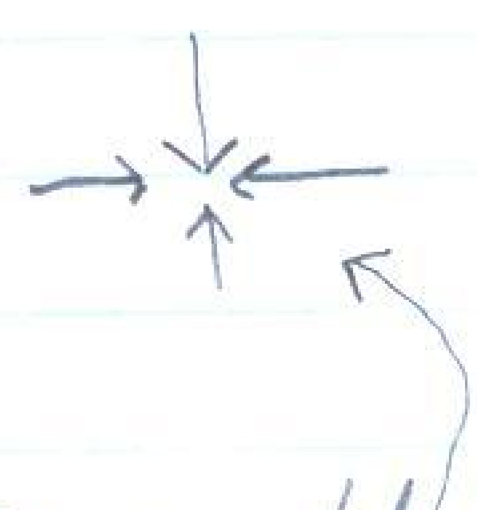
In order to make stable



unstable this way

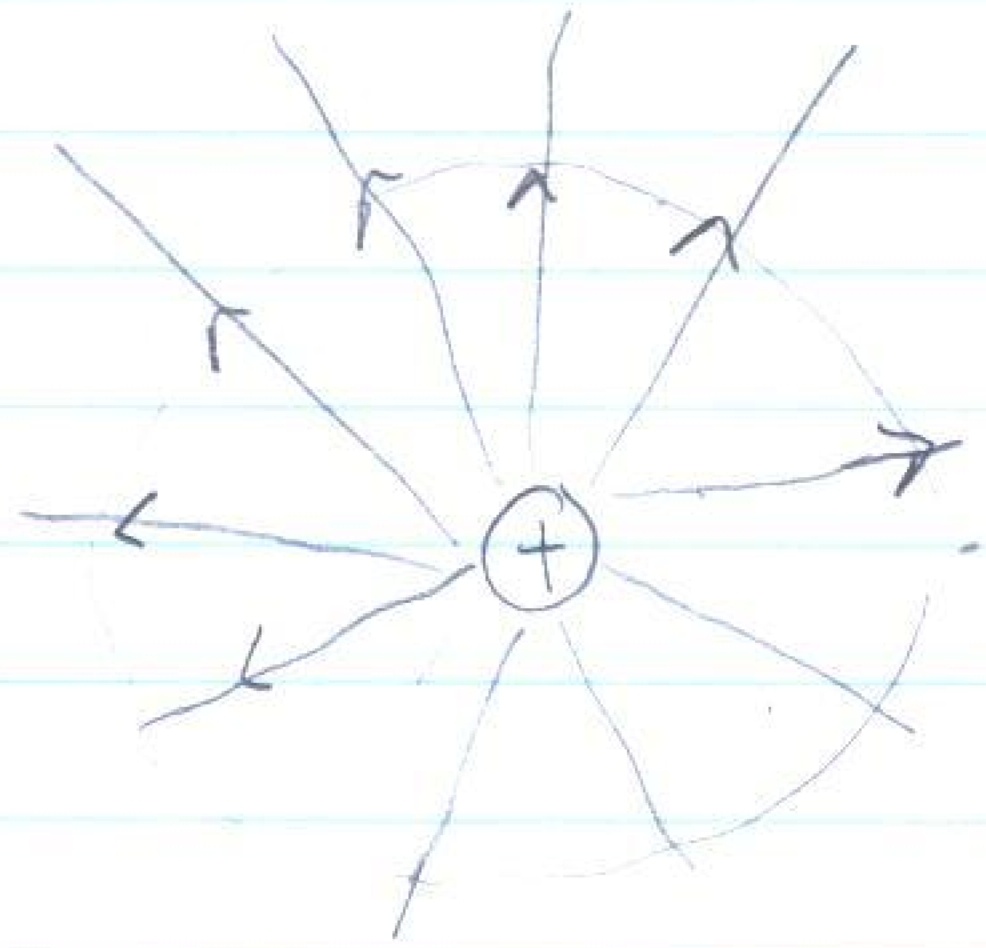


stable this way



lines would have to cross

Electric Field Lines

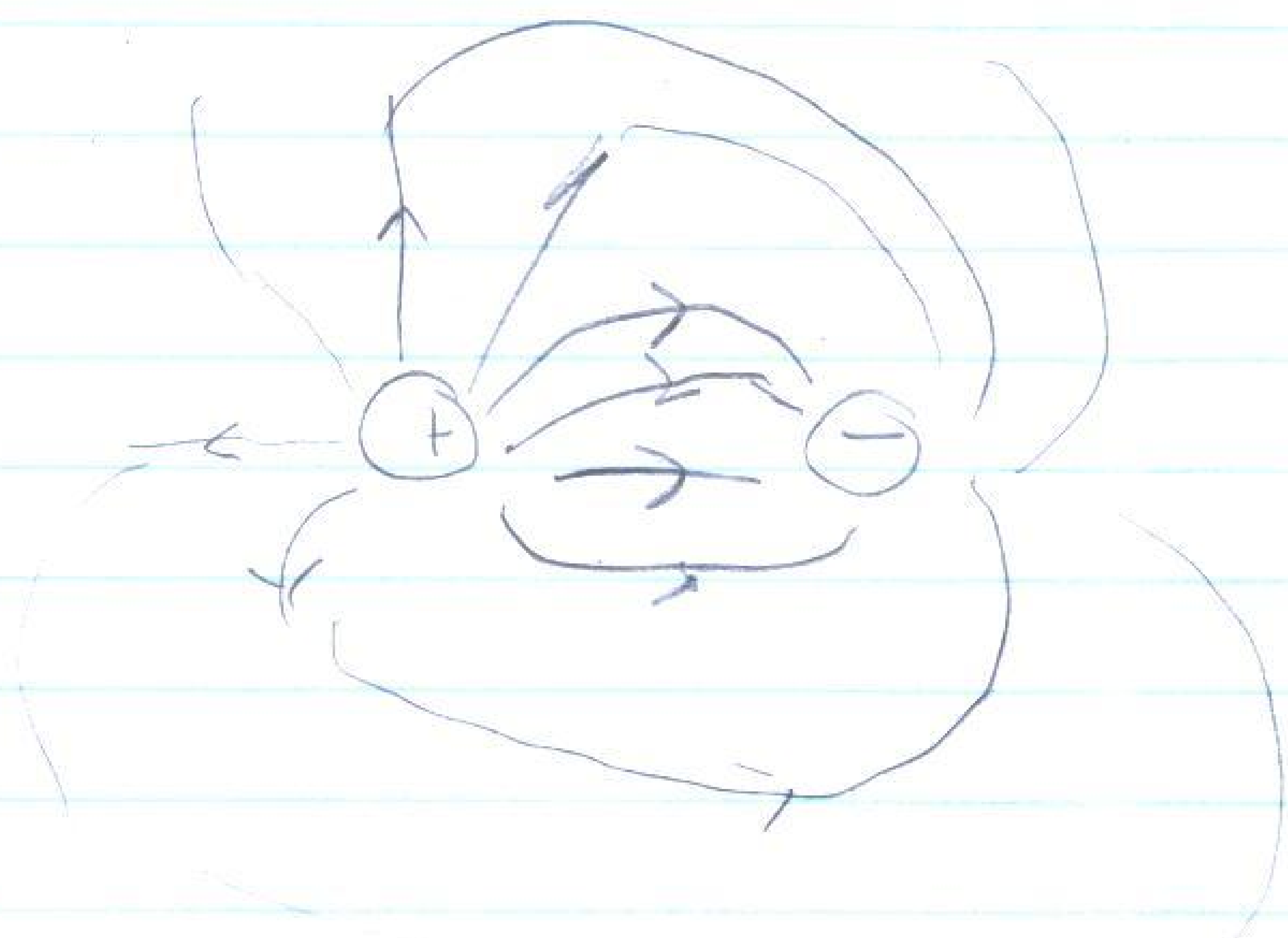


- Arrows Show The direction of the [illegible] Field

- Density = # of Lines crossing / Area = stre[illegible] of efield

- The number of field lines leaving a charge is $\propto$ to charge

- Electric Field lines start on + charges and end on negative Charges



- Electric Field lines don't cross

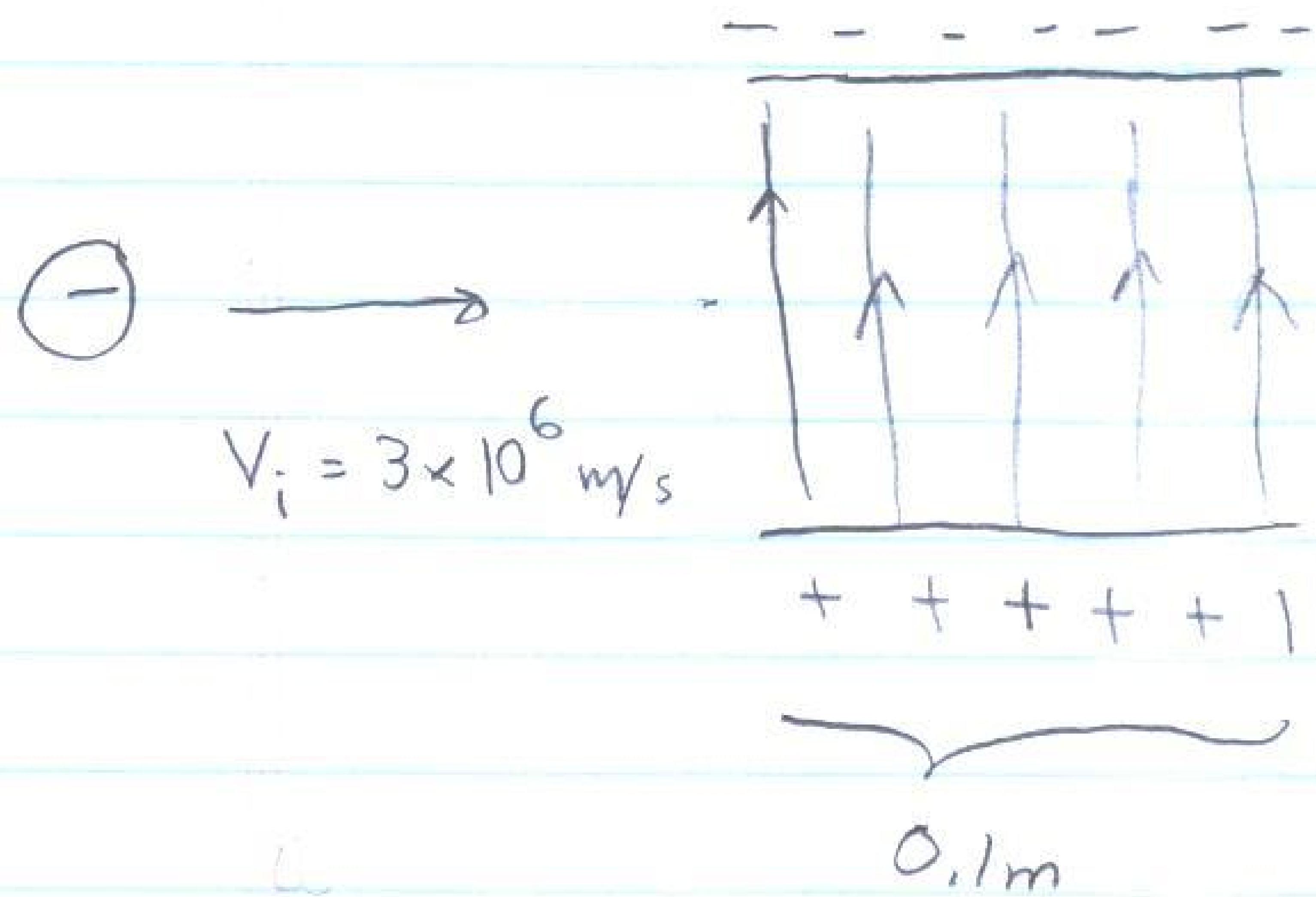
E_{TOT} is a sum

Motion In a constant Field

$$\vec{F} = q\vec{E} = m\vec{a}$$

$$\frac{q}{m}\vec{E} = \vec{a} \qquad \text{(A is constant}$$

Example:



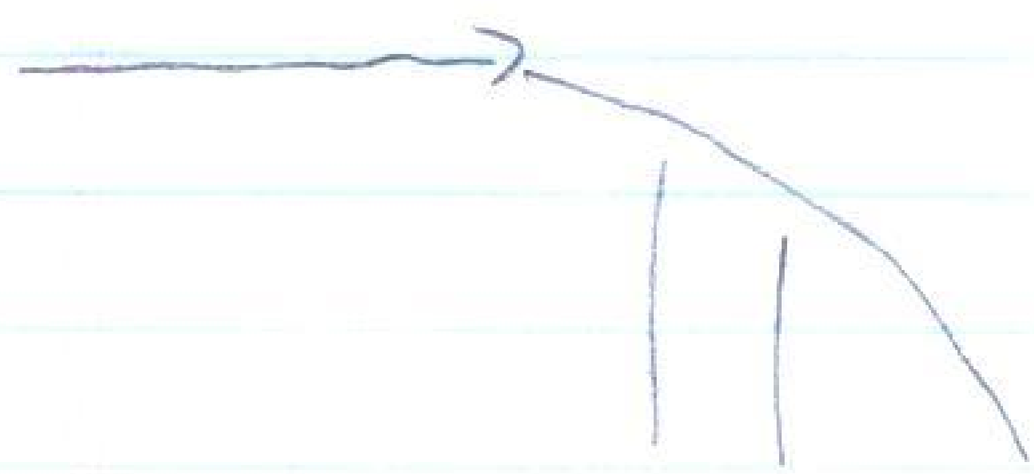
$$E = 200\,\frac{N}{C} = 200\,\frac{V}{m}$$

$$E = \frac{2\cancel{0}\cancel{0}\,V}{1\cancel{0}\cancel{0}\,cm} = 2\,\frac{V}{cm}$$

(Break Down Air $\sim 10\,\frac{kV}{cm}$)

- Constant acceleration down:

$$\vec{a} = \frac{q\vec{E}}{m} = -\frac{|q|\,|E|}{m}\,\hat{j}$$



just like a rock thrown from a cliff

x and y are independent

$$x = x_0 + v_{0x} t + \frac{1}{2} \overset{0}{\cancel{a_x}} t^2$$

$$y = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$\vec{x}$ vs. t

Const accelerat

$$v_x(t) = v_{0x} + \overset{0}{\cancel{a_x t}}$$

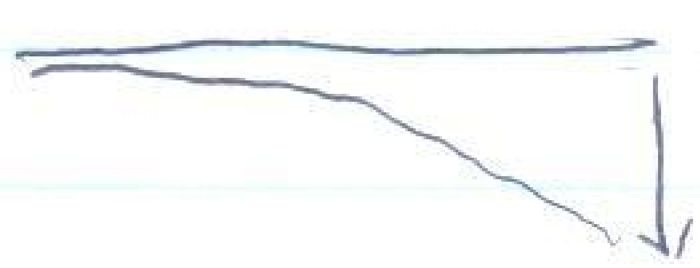
$$v_y(t) = v_{0y} + a_y t$$

$\vec{v}$ vs. t

Questions when does it reach the end

$$t_f = \frac{L}{v_x} = \frac{0.1\,m}{3 \times 10^6\,m/s} = .033 \times 10^{-6}\,s = 33\,ns$$

What is the displacemen Δy



$\Delta y = ?$

$$y(t) = \overset{0}{\cancel{y_0}} + \overset{0}{\cancel{v_{0y}}}\, t + \frac{1}{2} a_y t_f^2$$

$$y = \frac{1}{2} \frac{-|q||E|}{m} t_f^2$$

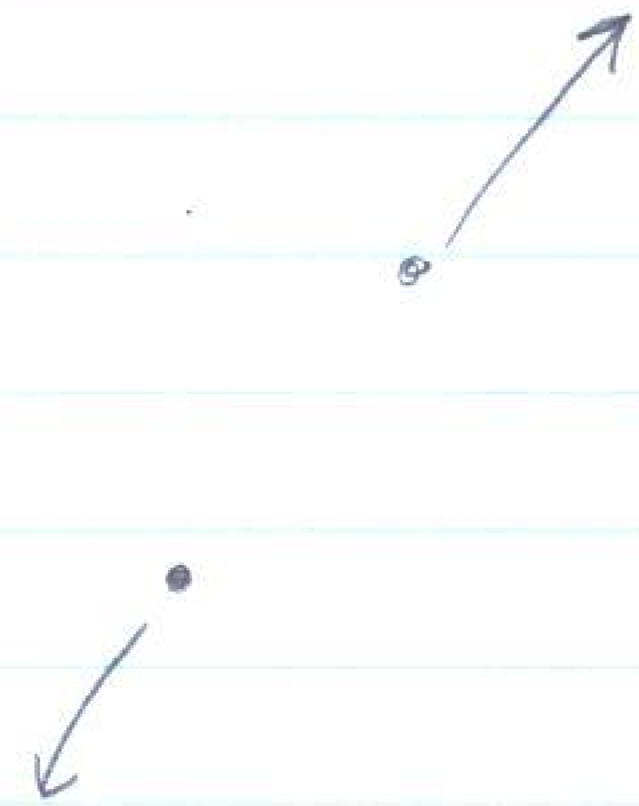
$q = 1 \times 6 \times 10^{-9}\,C$, $E = 200 \frac{N}{C}$, $m = 9.11 \times 10^{-31}\,kg$

$t_f = 3.33 \times 10^{8}\,s$

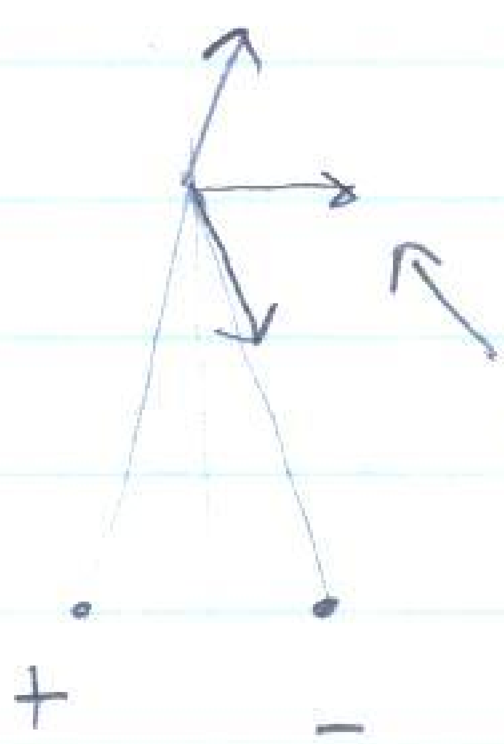
$$\boxed{y = -1.95\,cm}$$

Last time:

$$\vec{F}_{12} = \underbrace{k_e}_{\frac{1}{4\pi\varepsilon_0}} \frac{q_1 q_2}{r^2} \hat{r}_{12}$$



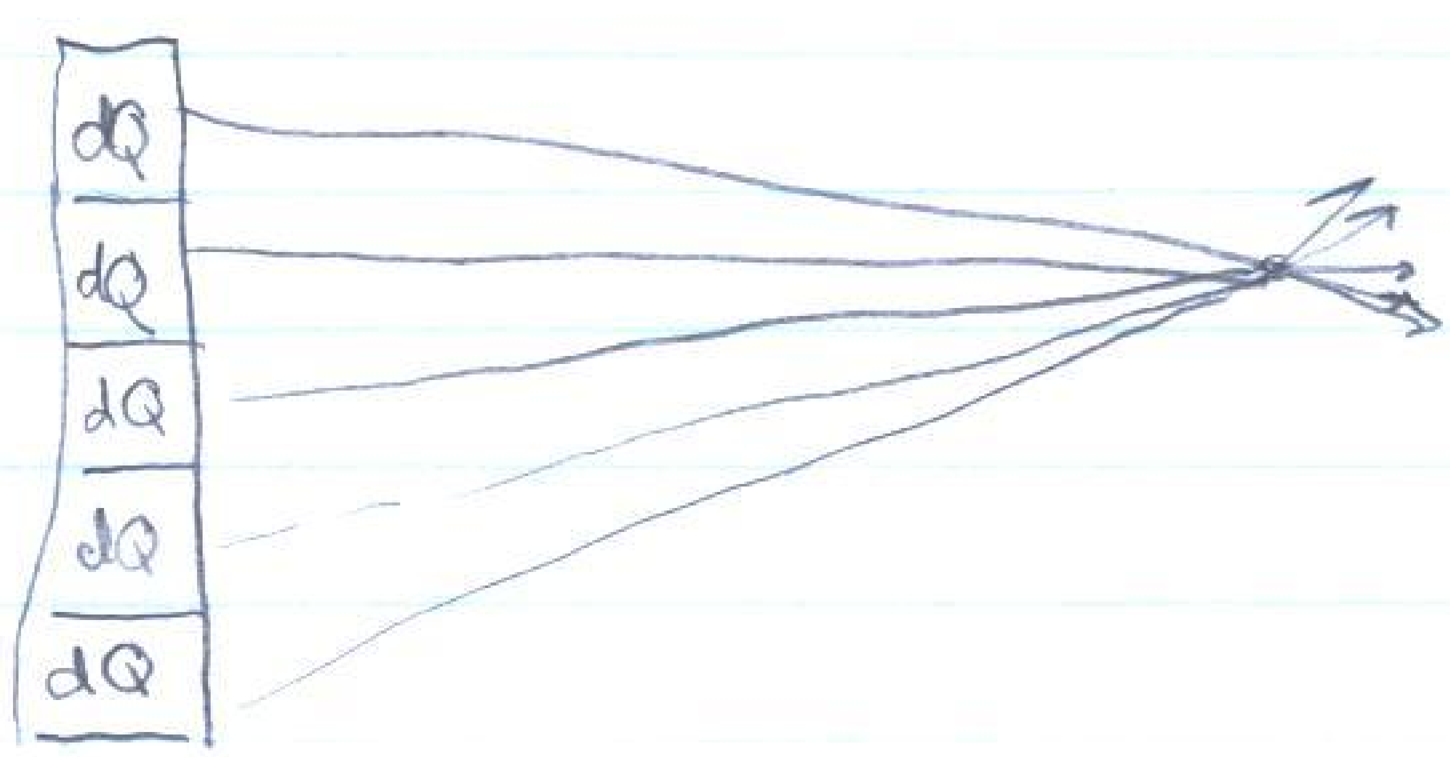
Point Charges $\vec{E} = \dfrac{\vec{F}}{q_0} \longrightarrow \dfrac{k_e Q}{r^2} \hat{r}$ (Enlectric Field From a point charge)



net electric fied

$$\vec{E}_{TOT} = \vec{E}_+ + \vec{E}_-$$

Continuous Distribution:



$$\vec{E}_{TOT} = \sum_i \vec{E}_i = \sum \frac{dQ\, k_e}{r_i^2} \hat{r}_i$$