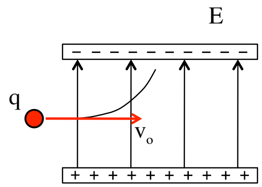
Problem 23.49

One way to generate a constant electric field is between oppositely charged parallel plates (at least away from the edges), so that is the situation I've set up. In this case, we will ignoring edge effects.



a.) This is, sadly, another kinematics problem with electrical overtones. Specifically, for time of flight to go .0500 meters:

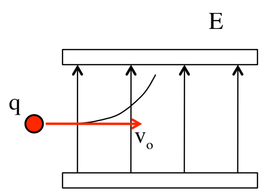
$$x_2 = \cancelto{0}{x_1} + v_{o,x}\Delta t + \frac{1}{2}\cancelto{0}{a_x}(\Delta t)^2$$

$$\Rightarrow \quad \Delta t = \frac{x_2}{v_{o,x}}$$

$$\Rightarrow \quad \Delta t = \frac{(5\text{x}10^{-2}\ \text{m})}{(4.5\text{x}10^{5}\ \text{m/s})}$$

$$= 1.11\text{x}10^{-7}\ \text{sec}$$

b.) It's vertical displacement during that time interval?



From N.S.L.:

$$F = ma$$

$$\Rightarrow \quad qE = ma$$

$$\Rightarrow \quad a = \frac{qE}{m}$$

So:

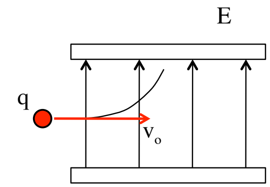
$$y_2 = \cancelto{0}{y_1} + \cancelto{0}{v_{o,y}}\Delta t + \frac{1}{2}a_y(\Delta t)^2$$

$$\Rightarrow \quad y_2 = \frac{1}{2}\left(\frac{qE}{m}\right)(\Delta t)^2$$

$$= \frac{1}{2}\left(\frac{(1.60\text{x}10^{-19}\ \text{C})(9.60\text{x}10^{3}\ \text{N/C})}{(1.67\text{x}10^{-27}\ \text{kg})}\right)(1.11\text{x}10^{-7}\ \text{sec})^2$$

$$= 5.67\text{x}10^{-3}\ \text{m}$$

c.) It's velocity at the end of that time interval?



The velocity in the "x" direction won't have changed as there is no force in that direction, so:

$$v_{2,x} = 4.50\text{x}10^{5}\ \text{m/s}$$

In the "y" direction:

$$v_{2,y} = \cancelto{0}{v_{o,y}} + a_y\Delta t$$

$$\Rightarrow \quad v_{2,y} = a_y\Delta t$$

$$= \left(\frac{(1.60\text{x}10^{-19}\ \text{C})(9.60\text{x}10^{3}\ \text{N/C})}{(1.67\text{x}10^{-27}\ \text{kg})}\right)(1.11\text{x}10^{-7}\ \text{sec})$$

$$= 1.02\text{x}10^{5}\ \text{m/s}$$

So:

$$\vec{v} = (4.50\text{x}10^{5}\ \text{m/s})\hat{i} + (1.02\text{x}10^{5}\ \text{m/s})\hat{j}$$