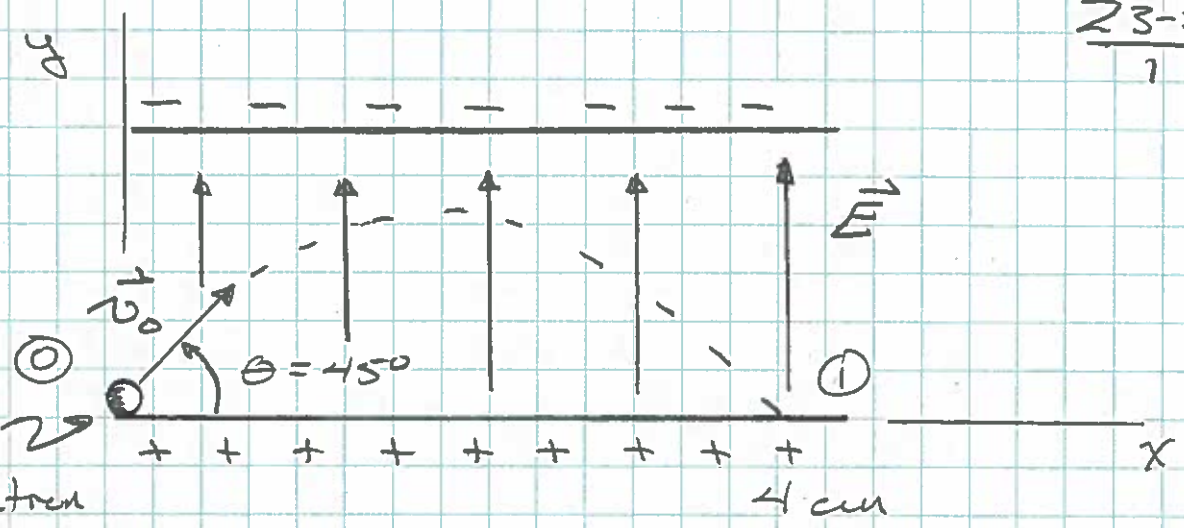


electron

$q = -e$

$m = 9.11 \times 10^{-31}$ kg

$v_0 = 5 \times 10^6$ m/s

a.) for 2D motion 1 → 2: $a_x = 0$, $a_y = ?$

$t_0 = 0$ $\quad x_0 = y_0 = 0$ $\quad v_{x0} = v_0 \cos\theta$ $\quad v_{y0} = v_0 \sin\theta$

$x_1 = 4$ cm $\quad y_1 = 0$ $\quad t_1$

x-motion:

$$x_1 = x_0 + v_{x0}\Delta t + \tfrac{1}{2} a_x \Delta t^2 \qquad \Delta t = t_1 - t_0$$

$$x_1 = v_0 \cos\theta \, t_1$$

$$\text{So, } \quad t_1 = \frac{x_1}{v_0 \cos\theta} = 1.131 \times 10^{-8} \text{ s}$$

y-motion:

$$y_1 = y_0 + v_{y0}\Delta t + \tfrac{1}{2} a_y \Delta t^2$$

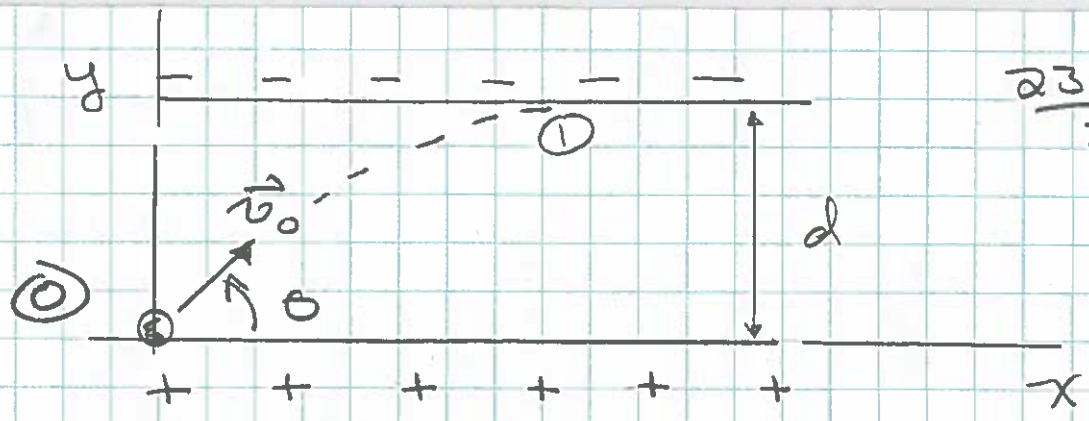
$$0 = v_0 \sin\theta \, t_1 + \tfrac{1}{2} a_y t_1^2$$

$$a_y = -\frac{2 v_0 \sin\theta}{t_1} = -6.252 \times 10^{14} \text{ m/s}^2$$

Now: $\vec{F} = m\vec{a} = q\vec{E} \Rightarrow \vec{E} = -\frac{m}{e}\vec{a} = 3600\,\hat{j}$ N/C

Note: $\vec{a} = a_y \hat{j}$

b.)



For smallest spacing d, $y_1 = d$

with $a_y = -6.252 \times 10^{14}\ m/s^2$ from a.

at ①: $y_1 = d$

$v_{y_1} = 0$

So: y-motion:

$$v_{y_1}^2 = v_{y_0}^2 + 2 a_y \Delta y \qquad \Delta y = y_1 - y_0$$

$$0 = (v_0 \sin\theta)^2 + 2 a_y d$$

So: $$d = -\frac{(v_0 \sin\theta)^2}{2 a_y} = 0.01\ m$$

$$= \underline{1.0\ cm}$$