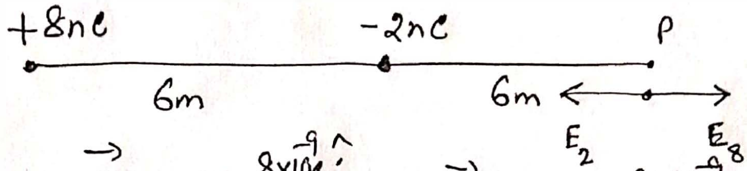
Sample: Electric field: Hints

1. $\vec{F} = q\vec{E}$ $\qquad \vec{E} = 100\ N/C\ \hat{x}$

$\underline{\vec{F} = ?}$ $\qquad q = -2.0\ \mu C$

2. 

$\vec{E}_8 = K \dfrac{8\times10^{-9}}{(12)^2}\hat{i}$, $\quad \vec{E}_2 = K\dfrac{-2\times10^{-9}}{(6)^2}\hat{i}$

$\boxed{\vec{E}_8 - \vec{E}_2}$

3. $\dfrac{q}{m} = 0.1\dfrac{C}{kg}$, $\quad |\vec{E}| = 10\ N/C$, $\quad t = 2$ sec.

$\vec{F}_a = m\vec{a}$ and $\vec{F}_c = q\vec{E}$

$m\vec{a} = q\vec{E} \implies \cancel{\dfrac{q}{m} = \dfrac{\vec{E}}{\vec{a}}}$ $\qquad q/m = a/E$

Thus, $|\vec{a}| = (10\ N/C)\left(\dfrac{1}{0.1}\dfrac{kg}{C}\right)$

Then, $\boxed{x = \frac{1}{2}at^2}$

4. $E_1 = K\dfrac{q}{r_1^2}$ $\quad ; \quad E_2 = K\dfrac{q}{r_2^2}$

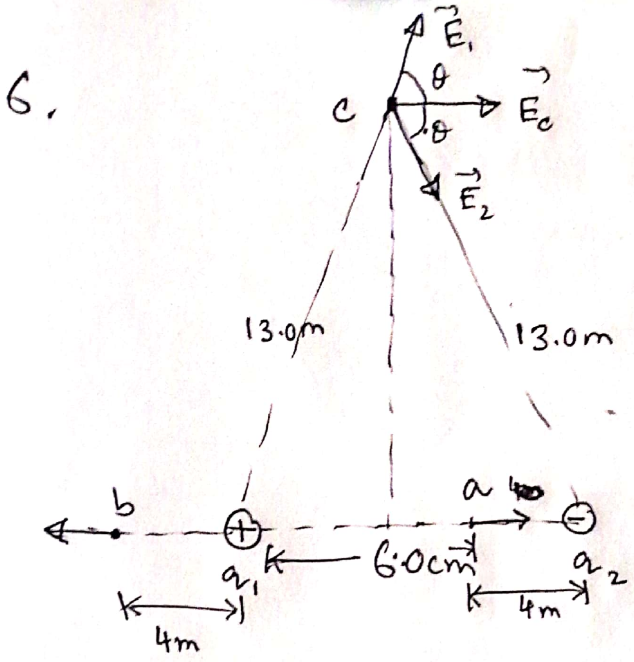
$\underline{r_1 = 1m}$, $\quad \underline{E_1 = 100\ N/C}$. $\qquad \dfrac{E_1}{E_2} = \dfrac{r_2^2}{r_1^2}$ $\qquad \boxed{r_2 = ?}$

5. $\vec{F} = q\vec{E}$ $\qquad \vec{E} = K\dfrac{q}{r^2}\hat{r}$

$r = 300m$, $\quad E = 1000\ N/C$

$\boxed{q = ?}$

6.



$\vec{E}_a = E_{1a}\hat{i} + E_{2a}\hat{i}$

$E_{1a} = K\frac{q_1}{r_{1a}^2}$ $\quad r_{1a} = 0.06m$

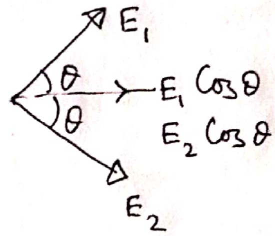
$E_{2a} = K\frac{q_2}{r_{2a}^2}$ $\quad r_{2a} = 0.04m$

$\vec{E}_b = -E_{1b}\hat{i} + E_{2b}\hat{i}$

$E_{1b} = K\frac{q_1}{r_{1b}}$ $\quad r_{1b} = 0.04m$

$E_{2b} = K\frac{q_2}{r_{2b}}$ $\quad r_{2b} = 0.14m$

$\vec{E}_c = \vec{E}_{1c} + \vec{E}_{2c}$



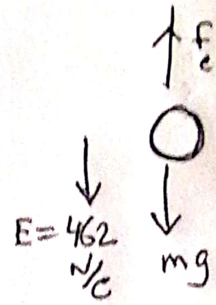
$E_{1c,x} = E_{2c,x} = E_{1c}\cos\theta$

$\cos\theta = \frac{5}{13}$

$E_{1c,y} = -E_{2cy}$ thus no y component.

$E_{1c} = K\frac{q_1}{r_{1c}^2}$ $\quad r_{1c} = 0.13m$; $E_{2c} = K\frac{q_2}{r_{2c}^2}$ $\quad r_{2c} = 0.13m$

7.



(a) $\boxed{\text{weight}, = m\,g}$

$m = 3 \times 10^{-12}$ kg

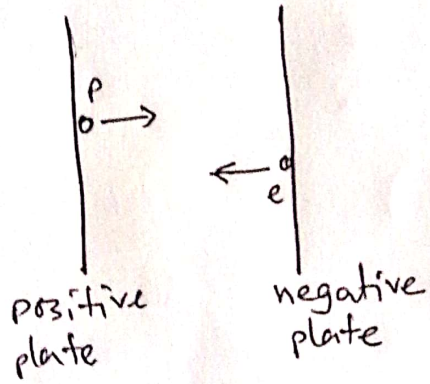
(b) $\vec{F} = q\vec{E}$

$E = 462$ N/C , $\underline{F_e = F_g = \text{weight}}$

$$\boxed{q = \frac{\text{weight}}{E}}$$

(c) $\boxed{N = \frac{q}{e}}$ $\qquad e = 1.6 \times 10^{-19}$ C .

8.



Proton acceleration,

$$a_p = \frac{eE}{m_p}$$

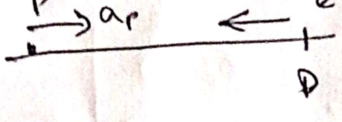
Electron acceleration,

$$a_e = \frac{-eE}{m_e}$$

Position for proton, $x_p = \frac{1}{2} a_p t^2$

" " electron, $x_e = D - \frac{1}{2} a_e t^2$

initial at $x = D$.



means,

some time, $x_p = x_e$

$$\frac{1}{2}\frac{eE}{m_p}t^2 = D - \frac{1}{2}\frac{eE}{m_e}t^2$$

$$\Rightarrow t^2 = \frac{2D}{eE}\left(\frac{1}{m_p} + \frac{1}{m_e}\right)^{-1}$$

At meet point, $x_{meet} = \frac{1}{2}\frac{eE}{m_p} t^2_{meet}$

$$x_{meet} = \frac{1}{2}\frac{eE}{m_p}\frac{2D}{eE}\left(\frac{1}{m_p} + \frac{1}{m_e}\right)^{-1}$$

$$\Rightarrow \boxed{x_{meet} = \frac{D m_e}{m_p + m_e}}$$

$D = 0.05$m ; $m_e = 9.11 \times 10^{-31}$ kg $\quad m_p = 1.67 \times 10^{-27}$ Kg

9.

$W_{net} = \Delta K$ (change in KE)

$\Delta K = K_f - K_i = 0 - (1.67 \times 10^{-17} J)$

$W = -Fd$ $\qquad d = \underline{10 \text{ cm}}$

$= -F(0.10 m)$

$$F = \frac{W}{d} = \frac{1.6 \times 10^{-17} J}{0.1 m}$$

$$\boxed{E = \frac{F}{e}}$$