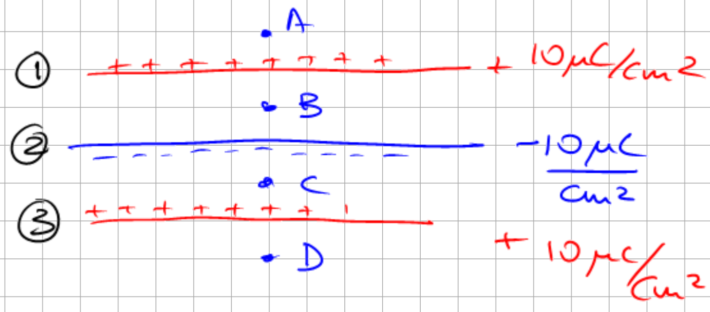
17.63 (2e)



$$|\sigma_1| = |\sigma_2| = |\sigma_3| = \sigma$$

@ A :

$$\vec{E}_1 = \frac{|\sigma_1|}{2\varepsilon_0}\hat{y}$$

$$\vec{E}_2 = -\frac{|\sigma_2|}{2\varepsilon_0}\hat{y}$$

$$\vec{E}_3 = \frac{|\sigma_3|}{2\varepsilon_0}\hat{y}$$

$$\vec{E}^{(A)}_{net} = \sum_{i=1}^{3} \vec{E}_i = \frac{\sigma}{2\varepsilon_0}\hat{y}$$

@ B :

$$\vec{E}_1 = -\frac{\sigma}{2\varepsilon_0}\hat{y} \qquad \underbrace{\vec{E}_2 = -\frac{\sigma}{2\varepsilon_0}\hat{y}\ , \ \vec{E}_3 = \frac{\sigma}{2\varepsilon}\hat{y}}_{\text{as @ A}}$$

$$\vec{E}^{(B)}_{net} = -\frac{\sigma}{2\varepsilon_0}\hat{y}$$

@ C :

$$\vec{E}_1 = -\frac{\sigma}{2\varepsilon_0}\hat{y} \qquad E_2 = \frac{\sigma}{2\varepsilon_0}\hat{y} \qquad E_3 = \frac{\sigma}{2\varepsilon}\hat{y}$$

$$\vec{E}^{(C)}_{net} = +\frac{\sigma}{2\varepsilon_0}\hat{y}$$

@ D:

$$\vec{E}_1 = -\frac{\sigma}{2\varepsilon_0}\hat{y} \qquad \vec{E}_2 = \frac{\sigma}{2\varepsilon_0}\hat{y} \qquad \vec{E}_3 = -\frac{\sigma}{2\varepsilon_0}\hat{y}$$

$$\vec{E}^{(D)}_{net} = -\frac{\sigma}{2\varepsilon_0}\hat{y}$$

$$K = \frac{1}{4\pi\varepsilon_0} \therefore \varepsilon_0 = \frac{1}{4\pi K}$$

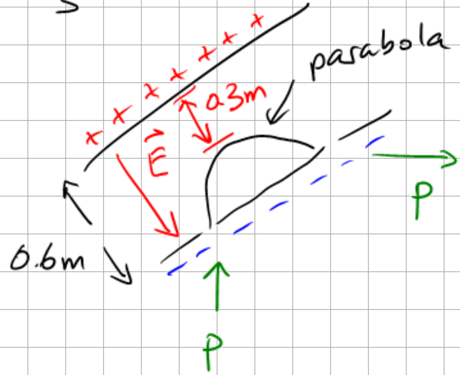
$$\frac{\sigma}{2\varepsilon_0} = 5.65\times 10^9 \ \frac{N}{C}$$

from $\frac{10\,(\mu C)}{10^{-4}(m^2)} \cdot \frac{1}{2} \cdot \underline{4\cdot 3.14\cdot 9\cdot 10^9}$

$$\frac{10^{-5}\ 6.28\cdot 9\cdot 10^9}{10^{-4}}$$

17.93 protons , $q = +e$ $\quad v = 6.0 \times 10^6 \frac{m}{s}$

ignore gravity



projectile motion

$\vartheta_{in} = 45°$ $\qquad \vartheta_{out} = -45°$ (below + x)

x - motion : $v_x = v_{ox} = v_0 \cos 45° = \frac{v_0}{\sqrt{2}} = \text{const.}$; $x = v_{ox} t$

y - motion : $v_y = v_{oy} + a_y t$ $\qquad a_y = ?$

$$v_y = v_0 \sin 45° - \frac{qE}{m} t \qquad m a_y = \underbrace{F_y = -qE}_{\vec{F} = -qE\hat{j}\,!}$$

$$= \frac{v_0}{\sqrt{2}} - \frac{eE}{m_p} t$$

$$y = v_{oy} t + \frac{1}{2} a_y t^2 = \frac{v_0}{\sqrt{2}} t - \frac{1}{2}\frac{eE}{m_p} t^2$$

We should be able to solve this by ignoring the x-motion

$$v_{fin}^2 = v_{in}^2 + 2a\Delta s$$

Δs is given as $d/2 = 0.3\,m$

$v_{fin} = 0$ (apex of parabola)

$v_{in} = \frac{v_0}{\sqrt{2}}$

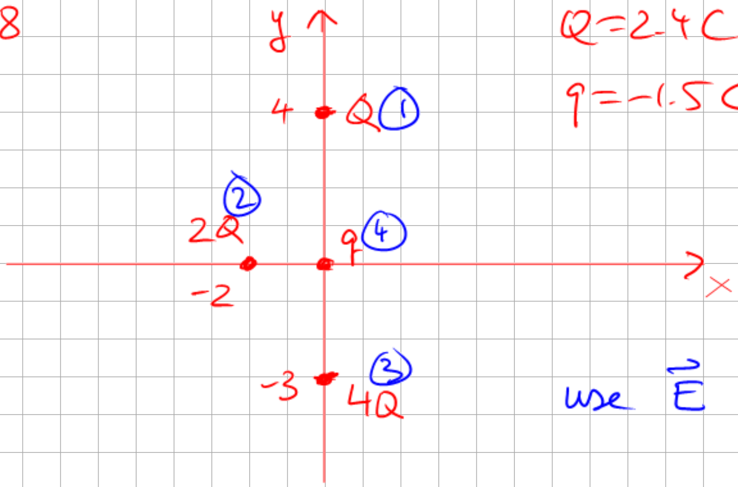
$$\therefore\ 0 = \frac{v_0^2}{2} - \frac{\cancel{2} eE}{m_p} \frac{d}{\cancel{2}}$$

$$\therefore\ E = \frac{v_0^2}{2} \cdot \frac{m_p}{ed} = 0.5 \cdot 36 \cdot \times 10^{12} \cdot \frac{1.67 \times 10^{-27}}{1.60 \times 10^{-19} \cdot 0.6}$$

$$= \frac{18 \cdot 1.67}{0.6 \quad 1.60} \times 10^4 = 3.13 \times 10^5 \frac{N}{C}$$

$$= 3.1 \times 10^5 \frac{N}{C}$$

17.98



$Q = 2.4\,C$

$q = -1.5\,C$

use $\vec{E}$

a) $\vec{F}_{on\,q} = ?$ component form

b) $\vec{F}_{on\,4Q} = ?$ "

a) @ $(0,0)$ $\quad \vec{F}_{on\,q} = q\,\vec{E}_{\text{net from } Q,2Q,4Q}(0,0) = q\sum_{i=1}^{3}\vec{E}^{(i)}$

$\vec{E}_1(0,0) = \frac{KQ}{16}(-\hat{j}) \qquad \vec{E}_2(0,0) = \frac{K\,2Q}{4}\,\hat{i}$

$\vec{E}_3(0,0) = \frac{K\,4Q}{9}\,\hat{j} \qquad \therefore\ \vec{E}^{net}(0,0) = KQ\left(0.5\hat{i} + \left(\frac{4}{9} - \frac{1}{16}\right)\hat{j}\right)$

$= KQ\left(0.5\hat{i} + 0.382\,\hat{j}\right)$

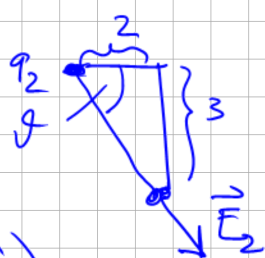
$\vec{F}_{on\,q} = q\,\vec{E}^{net}(0,0) \quad = -K\,(2.4 \cdot 1.5)(0.5\hat{i} + 0.382\hat{j})$

$= -(\underbrace{9.0 \cdot 2.4 \cdot 1.5}_{32.4}) \cdot 10^9\,(0.5\hat{i} + .382\hat{j})$

$= (-16.2\,\hat{i} - 12.4\,\hat{j})\ \underbrace{GN}_{10^9\,N}$

b) $\vec{F}_{on\,4Q}$: need $\vec{E}^{net}(0,-3)$

@ $(0,-3)$: $\vec{E}_4 = \frac{K|q|}{9}\,\hat{j} = .111\,K|q|\,\hat{j}$, $\quad \vec{E}_2 = ?$



$E_2 = \frac{K \cdot 2Q}{2^2 + 3^2} = \frac{2KQ}{13}$

$\vec{E}_2(0,-3) = E_2\left(\cos\vartheta\,\hat{i} - \sin\vartheta\,\hat{j}\right)$ ~ ϑ = geometry angle

$\frac{2}{\sqrt{13}} \qquad \frac{3}{\sqrt{13}}$

$\vec{E}_2(0,-3) = KQ\,\frac{2}{13}\left(\underbrace{\frac{2}{\sqrt{13}}}_{.555}\hat{i} - \underbrace{\frac{3}{\sqrt{13}}}_{.832}\hat{j}\right) = KQ\left(.0854\,\hat{i} - .128\,\hat{j}\right)$

$GN = 10^9\,N$

$\vec{E}_1 = -\underbrace{\frac{KQ}{49}\hat{j}}_{-.0204\,KQ\hat{j}} \quad \therefore \quad \vec{F}_{on\,3} = K\,4Q\left[.0854\,Q\,\hat{i} + (0.111|q| - .128\,Q - .0204\,Q)\,\hat{j}\right]$

$= 36 \times 10^9 \cdot 2.4\,(2.05\,\hat{i} - .190\,\hat{j}) = \boxed{(180\,\hat{i} - 16.4\,\hat{j})\ GN}$