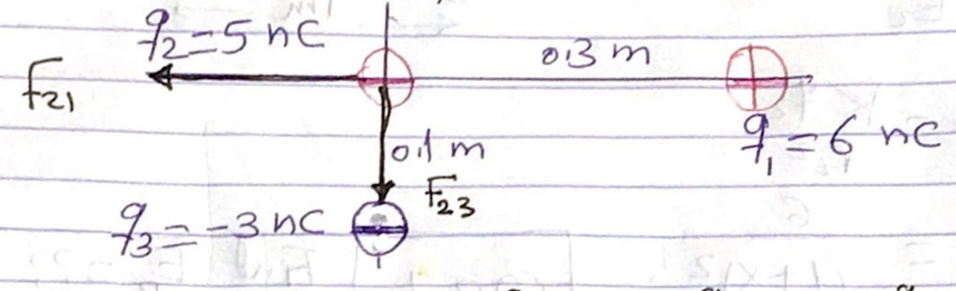
11/717 Three point charges are arranged as shown in Fig.
Find the (a) the magnitude and
(b) the direction of the electric force on the particle at the origin



$$F_{21} = \frac{K q_2 q_1}{r_{21}^2} = \frac{9\times10^{9} \times 6\times10^{-9} \times 5\times10^{-9}}{(0.3)^2}$$

$$\vec{F_{21}} = 3\times10^{-6}\,(-\hat{i})$$

$$F_{23} = \frac{9\times10^{9} \times 5\times10^{-9} \times 3\times10^{-9}}{(0.1)^2}$$

$$= 13.5\times10^{-6}\ N\,(-\hat{j})$$

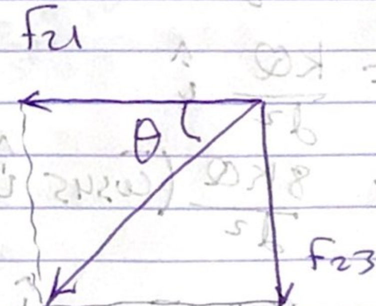
$$\vec{F_2} = \vec{F_{21}} + \vec{F_{23}}$$

$$= (-3\,\hat{i} - 13.5\,\hat{j})\times10^{-6}\ N$$

$$|F_2| = \sqrt{(3)^2 + (13.5)^2}$$

$$= 13.8\times10^{-6}\ N$$

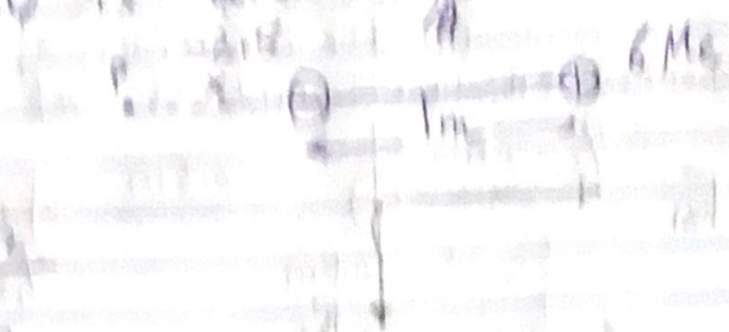
(b) direction $\theta =$



$$\theta = \tan^{-1}\left(\frac{13.5}{3}\right)$$

$$= 77^\circ + 180 = 257.5^\circ$$

Q1 / Fig | determine the point other than infinity at which the electric field is zero.



$E_1 = E_2$

$\frac{Kq_1}{r_1^2} = \frac{Kq_2}{r_2^2}$

$\frac{2.5}{x^2} = \frac{6}{(1+x)^2}$

$6x^2 = 2.5(1+x)^2$

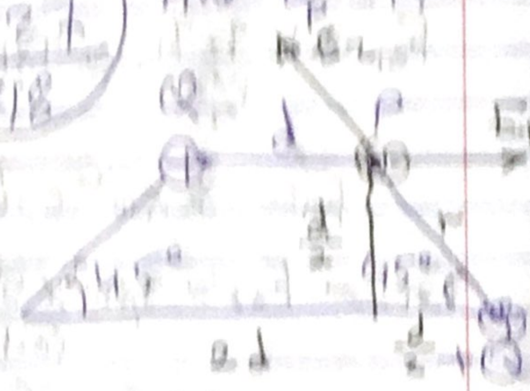
$2.4x^2 = (1+x)^2$

$1.55x = 1+x$

$0.55x = 1$

$x = 1.82\,m$

Q2 / Fig | Find E_p ??



$E_1 = \frac{KQ}{d^2}$

$E_2 = \frac{KQ}{\frac{d^2}{8}} = \frac{8KQ}{d^2}$

$r = \sqrt{\left(\frac{d}{?}\right)^2 + \left(\frac{d}{?}\right)^2}$

$r = \sqrt{\frac{d^2}{8}} = \frac{d}{2\sqrt{2}}$

$r^2 = \frac{d^2}{8}$

$\vec{E}_1 = \frac{KQ}{d^2}\hat{i}$

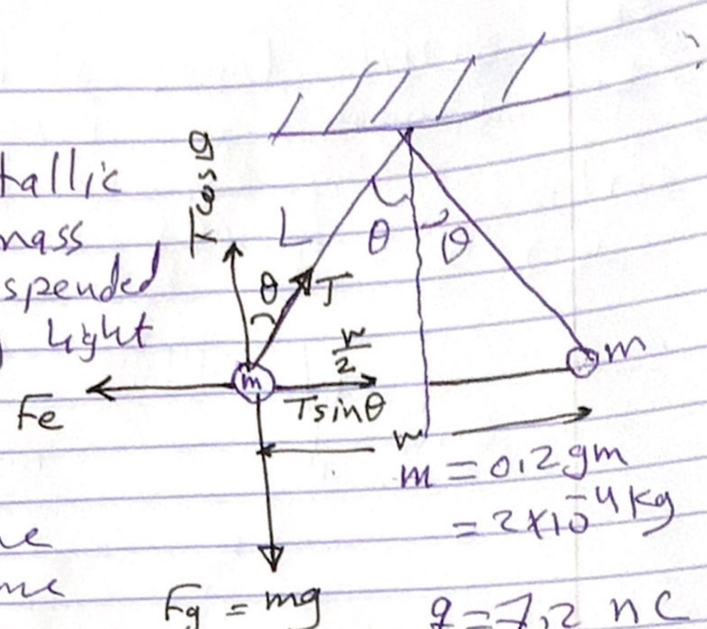
$\vec{E}_2 = \frac{8KQ}{d^2}(\cos 45\,\hat{i} + \sin 45\,\hat{j})$

$\vec{E}_2 = \frac{KQ}{d^2}(5.66\,\hat{i} + 5.66\,\hat{j})$

$\vec{E}_p = \vec{E}_1 + \vec{E}_2 = (6.66\,\hat{i} + 5.66\,\hat{j})\frac{KQ}{d^2}$

16/7/7

Two small metallic spheres each of mass 0.2 gm are suspended as pendulums by light strings of length L as shown in Fig. The spheres are given the same electric charge of 7.2 nC and come to equilibrium when $\theta = 5°$. How long is the string. $L = ?$



$m = 0.2\,gm$
$= 2\times10^{-4}\,kg$

$q = 7.2\,nC$
$= 7.2\times10^{-9}\,C$
$\theta = 5°$

$\Sigma F_x = 0$

$F_e = T\sin\theta$ — ①

$\Sigma F_y = 0$

$F_g = T\cos\theta$ — ②

$\frac{①}{②} \rightarrow \frac{F_e}{F_g} = \frac{T\sin\theta}{T\cos\theta}$

$\frac{F_e}{F_g} = \tan\theta$

$F_e = mg\tan\theta$

$\frac{Kq^2}{r^2} = mg\tan\theta$

$Kq^2 = r^2 mg\tan\theta$

but $\sin\theta = \frac{0.5r}{L}$

$L = \frac{0.5r}{\sin\theta} = \frac{0.5(0.0516)}{\sin 5}$

$L = 0.3\,m$

$9\times10^9 \times (7.2\times10^{-9})^2 = r^2 \times 2\times10^{-4} \times 10 \times \tan 5$

$r^2 = 2.666\times10^{-3}$

$r = 0.0516\,m$