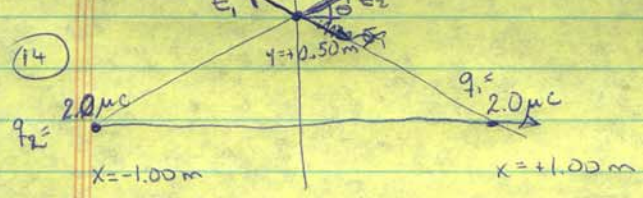
HOMEWORK WEEK 2 PHYSICS ELECTRIC FORCES/ELECTRIC FIELDS

pg 635-637 #4, 14, 15, 27

(4) $F_e = \frac{K|q_1||q_2|}{r^2} = \left(8.99\times10^9 \frac{N m^2}{C^2}\right)\frac{(1.60\times10^{-19} C)(1.60\times10^{-19} C)}{(2\times10^{-15} m)^2}$

$F_e = 57.54 N$

(14)

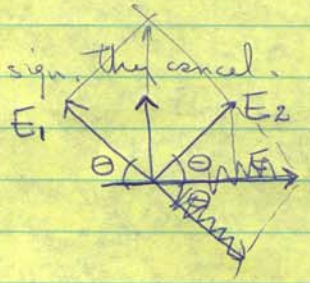


$\vec{E} = \frac{Kq}{r^2}$ $r = \sqrt{(1.00)^2+(0.50)^2}$

$r = 1.118 m$

a) $|E_1| = |E_2| = \frac{Kq}{r^2} = \left(8.99\times10^9 \frac{N m^2}{C^2}\right)\frac{(2\times10^{-6} C)}{(\sqrt{1^2+0.5^2})^2} = 14384 N/C$

The x-components of E_1 and E_2 are opposite in sign, they cancel. In the y-axis, the components add:



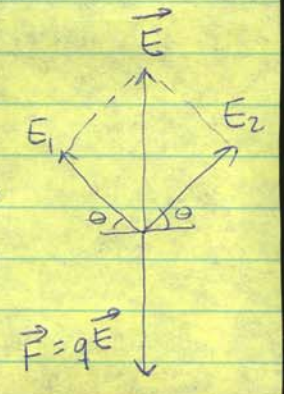
$E = 2E_x = 2(14384 N/C)\sin\theta$

$E_x = 2(14384 N/C)\left(\frac{0.5}{1.118}\right)$

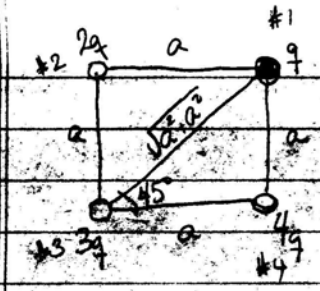
$E = 12865 N/C$ vertical, upwards

b) $\vec{F} = q\vec{E} = (-3\times10^{-6} C)(12865 N/C)$

$F = -0.0386 N$ vertical downwards



(15)



$$\vec{E}_2 = \frac{K(2q)}{a^2}\hat{\imath}$$

$$\vec{E}_3 = \frac{K(3q)}{(\sqrt{2a^2})^2}\cos 45^\circ \hat{\imath} + \frac{K(3q)}{(\sqrt{2a^2})^2}\sin 45^\circ \hat{\jmath}$$

$$\vec{E}_4 = \frac{K(4q)}{a^2}\hat{\jmath}$$

$$\vec{E} = \vec{E}_2 + \vec{E}_3 + \vec{E}_4 = 3.06\frac{Kq}{a^2}\hat{\imath} + 5.06\frac{Kq}{a^2}\hat{\jmath}$$

a) magnitude $E = \sqrt{(3.06)^2 + (5.06)^2} = \boxed{5.91\frac{Kq}{a^2}}$

direction $\theta = \arctan\left(\frac{5.06}{3.06}\right)$ $\boxed{\theta = 58.8^\circ}$

b) $\vec{F} = q\vec{E} = \left(5.91\frac{Kq}{a^2}\right)(q) = \boxed{5.91\frac{Kq^2}{a^2}}$ at 58.8°

(27) a) $a = \frac{F}{m} = \frac{qE}{m} = \frac{(1.60\times10^{-19}\,C)(640\,N/C)}{1.67\times10^{-27}\,Kg} = 6.13\times10^{10}\,m/s^2$

b) $v_f = v_0 + at$ $\quad t = \frac{v_f}{a} = \frac{1.20\times10^6\,m/s}{6.13\times10^{10}\,m/s^2} = 1.96\times10^{-5}$ seconds

c) $x = \frac{1}{2}at^2 + v_0t + x_0 = \frac{1}{2}\left(6.13\times10^{10}\,m/s^2\right)\left(1.96\times10^{-5}\,s\right)^2 = 11.8\,m$

d) $KE = \frac{1}{2}mv^2 = \frac{1}{2}\left(1.67\times10^{-27}\,Kg\right)\left(1.20\times10^6\,m/s\right)^2 = 1.20\times10^{-15}\,J$