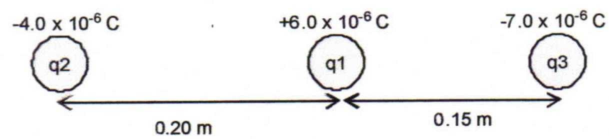
Name: Key

Review Worksheet

Electric Forces and Fields

1. The figure below shows three point charges that lie along the x axis.



   a. Determine the magnitude and direction of the net electrostatic force on charge q_1:

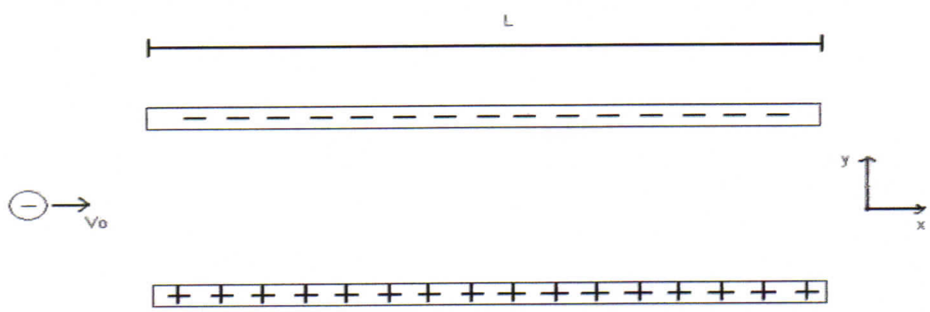
$F_{Eq2} = \frac{K(-4\mu C)(6\mu C)}{(0.2m)^2} = -5.4N$ (left) $F_{Eq3} = \frac{K(6\mu C)(-7\mu C)}{(0.15m)^2} = -16.8N$ – Right

$16.8 - 5.4 = $ **11.4 N to the right**

   b. Determine the magnitude and direction of the electric field at the point where q1 lies:

$E = \frac{kQ_2}{r^2} = 900{,}000\ N/C$ ($r = 0.2m$) $E = \frac{kQ_3}{r^2} = 2800000$ ($r = 0.15m$) $E_{total} = 1{,}900{,}000\ N/C$ to the right

2. An electron enters the region of a uniform electric field as shown below. Assume the initial velocity of the particle to be 3.0×10^6 m/s and the Electric Field strength to be 200 N/C. The horizontal length of the plates is also known to be 10.0 cm.



   a. Find the acceleration of the electron while in the field:

$ma = F_e$ $ma = QE$ $a = \frac{QE}{m}$ $a = -3.51 \times 10^{13}\ m/s^2$

   b. Find the time at which it leaves the field if it enters at t = 0s:

Constant velocity in x-direction $.1m = (3 \times 10^6\ m/s)(t)$ $t = 3.3 \times 10^{-8}\ s$

   c. What is its vertical position when it leaves the field if it enters at y_o = 0m?

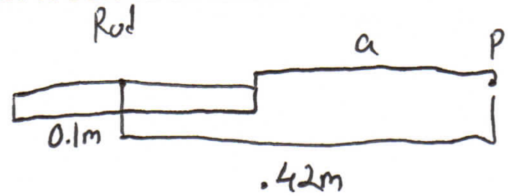
$\Delta y = \frac{1}{2}at^2 + V_0 t$

$\Delta y = \frac{1}{2}(-3.51 \times 10^{13})(3.7 \times 10^{-8})^2$

$\Delta y = -0.02m$ or 2cm

3. A rod 10.0 cm long is uniformly charged and has a total charge of -25.0 μC. Determine the magnitude and direction of the electric field along the axis of the rod at a point 42.0 cm from its center. Make sure to state its direction.

[ ] N/C



$L = .1m$

$a = .42 - .05 = 0.37m$

$E = \frac{kQ}{a(L+a)} = 1.29 \times 10^6$ N/C towards rod

we proved this earlier

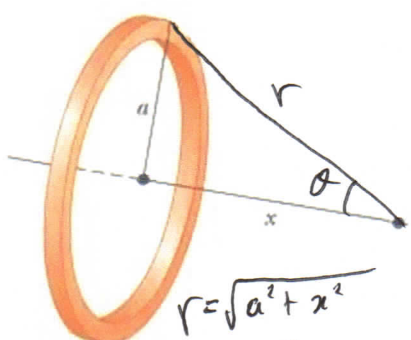
4. Below is a uniformly charged ring of total charge Q and radius a. Determine an expression for the electric field strength along the axis of the ring at a distance x from the center of the ring.

$dE_x = \frac{k\,dq}{r^2} \cos\theta$ - only want x direction. y cancels out.

$= \frac{k\,dq}{a^2+x^2} \cdot \frac{x}{\sqrt{x^2+a^2}}$

$= \frac{kx\,dq}{(a^2+x^2)^{3/2}}$

$= \frac{kx}{(a^2+x^2)^{3/2}} \int dq$



$r = \sqrt{a^2+x^2}$

$\cos\theta = \frac{x}{\sqrt{x^2+a^2}}$

$$E = \frac{kxQ}{(a^2+x^2)^{3/2}}$$

5. Find the electric field on the axis of the ring from #4 at the following distances from the center of the ring. Assume that a = 10.0 cm and the ring has a total charge of 93.0 μC.

Use equation from problem #4

a. 1.00 cm

[8.24] i MN/C

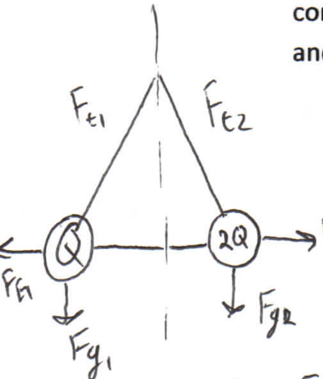
b. 5.00 cm

[29.9] i MN/C

c. 30.00 cm

[7.93] i MN/C

6. Two small spheres of mass *m* are suspended from string of length *l* that are connected at a common point. One sphere has charge *Q* and the other charge *2Q*. The strings make angles Θ_1 and Θ_2 with the vertical.
   a. Explain how Θ_1 and Θ_2 are related - they are the same bc θ is very small
   b. Assume Θ_1 and Θ_2 are small. Show that the distance between the spheres is approximately



$$r \approx \left(\frac{4k_eQ^2l}{mg}\right)^{1/3}$$

x- $F_{E_1} = F_{t_1}\sin\theta$ $\quad F_{E_2} = F_{t_2}\sin\theta$

y- $F_t\cos\theta = F_g$ $\quad F_{t2}\cos\theta = F_{g2}$

For small θ H and l are almost the same. so we know that

$\sin\theta = \tan\theta = \theta$

$F_{E_1} = F_{tx}$

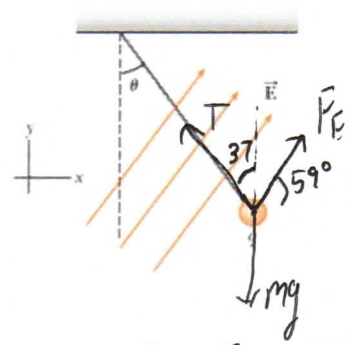
$F_{E_1} = F_t \sin\theta$

$F_{E_1} = \frac{mg}{\cos\theta} = mg\tan\theta$

$\frac{2kQ^2}{r^2} = mg\frac{r}{2L}$

$r = \left(\frac{4kQ^2l}{mg}\right)^{1/3}$

7. A charged cork ball of mass 1.00g is suspended on a light string in the presence of a uniform electric field. When E = (3.00i + 5.00j) x 10^5N/C, the ball is in equilibrium at Θ = 37°. Find:
   a. The charge on the ball
   b. The tension in the string



$T_x = F_{E_x} = Eq = (3\times10^5)(Q)$

$T\sin\theta = (3\times10^5)(Q)$

$T = 4.98\times10^5 Q$

$(.001\,kg)(9.8) = T\cos(37) + (5\times10^5)(Q)$

$Q = 1.09\times10^{-8}\,C$

$T = (4.98\times10^5)(1.09\times10^{-8})$

$T = 0.0054N$

$T_x = F_{E_x}$

$mg = T_y + F_{E_y}$