Electric Force & Field Worksheet

(1) (a) $F_1 = \frac{k q_1 q_2}{r^2}$ $\quad F_2 = \frac{k(2q_1)(2q_2)}{r^2}$

$= 4 \frac{k q_1 q_2}{r^2}$

$4(3.0 \times 10^{-6} N) = \underline{1.2 \times 10^{-5} N}$

(b) $F_2 = \frac{k\left(\frac{q}{2}\right) q_2}{r^2}$ $\quad \frac{1}{2} \frac{k q_1 q_2}{r^2}$

$\frac{1}{2}(3.0 \times 10^{-6} N) = \underline{1.5 \times 10^{-6} N}$

(c) $F_2 = \frac{k q_1 q_2}{(3r)^2} = \frac{1}{9} \frac{k q_1 q_2}{r^2}$

$\frac{1}{9}(3.0 \times 10^{-6} N) = \underline{3.3 \times 10^{-7} N}$

(2) $F = \frac{k q_1 q_2}{r^2} = \frac{(9 \times 10^9)(5.0 \times 10^{-8} C)(1.0 \times 10^{-7} C)}{(.02 m)^2}$

$= 0.11 N$

(3) $F = \frac{k q_1 q_2}{r^2}$

$1.2 \times 10^{-9} = \frac{9 \times 10^9 (Q)(2Q)}{(.04)^2}$

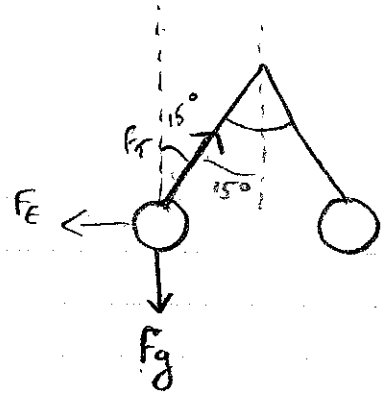
$\underline{Q = 1.0 \times 10^{-9} C}$ second charge $\underline{2Q = 2.0 \times 10^{-9} C}$

(4) $F = \frac{k q_1 q_2}{r^2}$

$4.2 \times 10^{-4} = \frac{9 \times 10^9 (1.1 \times 10^{-7})(1.1 \times 10^{-7})}{r^2}$

$r = 0.51 m$

(5)



equilibrium
$\Sigma F = 0$

x

$-F_E + F_T \sin 15 = 0$

$F_T \sin 15 = F_E$

$F_T = \frac{F_E}{\sin 15}$

y

$F_T \cos 15 - F_g = 0$

$F_T \cos 15 = F_g$

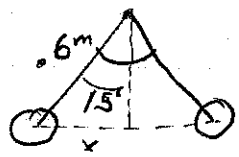
$F_E \frac{\cos 15}{\sin 15} = mg = (.002)(9.8)$

$F_E = 5.25 \times 10^{-3} N$

$F_E = k \frac{q_1 q_2}{r^2}$

$5.25 \times 10^{-3} = \frac{(9 \times 10^9) q^2}{(.310\,m)^2}$

$q = 2.4 \times 10^{-7} C$

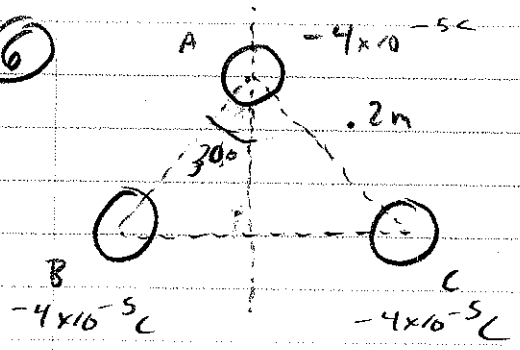


$\sin 15 = \frac{x}{.6}$

$x = .155\,m$

So $r = 2x = 2(.155) = 0.310\,m$

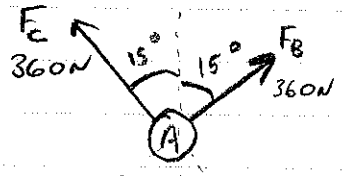
(6)



$F = k \frac{q_1 q_2}{r^2}$

$\frac{(9 \times 10^9)(4 \times 10^{-5})(4 \times 10^{-5})}{(.2)^2} = 360N$

all forces are the same since all charges and distances are the same

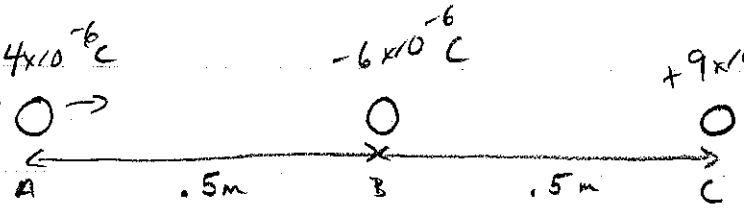


x: $+360 \sin 30 + 360 \sin 30 = 0$

y: $360 \cos 30 + 360 \cos 30 = 624N$

∴ Force is 624 N straight out from each sphere.

(7)



$F = \frac{k q_1 q_2}{r^2}$

(A) $F_{net} = -F_A + F_C = -\frac{(9\times10^9)(4\times10^{-6})(6\times10^{-6})}{(.5)^2} + \frac{(9\times10^9)(4\times10^{-6})(9\times10^{-6})}{(1)^2}$

$= 0.54\ N$ left

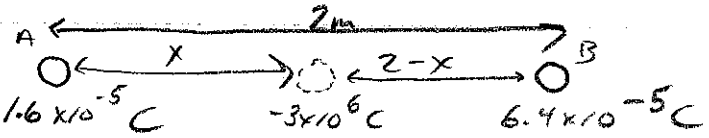
(B) $F_{net} = F_A + F_C = \frac{(9\times10^9)(4\times10^{-6})(6\times10^{-6})}{(.5)^2} + \frac{(9\times10^9)(6\times10^{-6})(9\times10^{-6})}{(.5)^2}$

$= 2.8\ N$ right

(C) $F_{net} = -F_A - F_B = -\frac{(9\times10^9)(4\times10^{-6})(9\times10^{-6})}{(1)^2} + -\frac{(9\times10^9)(6\times10^{-6})(9\times10^{-6})}{(.5)^2}$

$= 2.3\ N$ left

(8)



The charge must be placed between the spheres so that the forces on both sides could add to zero.

$F_A = F_B$

$\frac{k q_A q_2}{x^2} = \frac{k q_B q_2}{(2-x)^2}$

$\frac{1.6\times10^{-5}(2-x)^2}{\sqrt{1.6\times10^{-5}(2-x)^2}} = \frac{6.4\times10^{-5}(x^2)}{\sqrt{6.4\times10^{-5}(x^2)}}$

$.004(2-x) = \frac{.008x}{.004}$

$2 - x = 2x$

$2 = 3x$

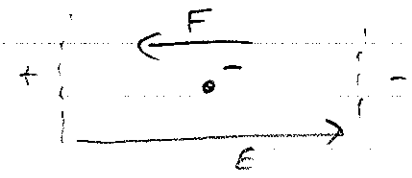
$x = 2/3 = 0.67$

∴ The charge should be 0.67 m from the 1.6×10^{-5}C charge.

(9) $F = qE$

$3.2 = 2.4 \times 10^{-5} E$

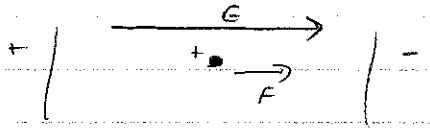
$E = 1.3 \times 10^{6}$ N/C to the right.



(10) $F = qE$

$= (2.05 \times 10^{-7})(12)$

$= 2.46 \times 10^{-6}$ N to the right.



(11) $E = \frac{kQ}{r^2}$ (to the right = +)

$$E = \frac{(9 \times 10^9)(50 \times 10^{-6})}{(.45 + .3)^2} - \frac{(9.0 \times 10^9)(10 \times 10^{-6})}{(.3)^2}$$

$= -2 \times 10^{-5}$

$= 2 \times 10^{-5}$ N/C left.

(12) $E = \frac{V}{d} = \frac{30}{1.0 \times 10^{-6}} = 3.0 \times 10^{7}$ N/C