Coulomb's Law (PP|638)

5. $q_1 = +6.0\,\mu C$ } ~~+8.0 μC~~ +4.0 μC

$q_2 = -2.0\,\mu C$

$F_Q = 2.0\,N$

$r = d$

$$F_Q = \frac{kq_1q_2}{r^2}$$

$$r^2 = \frac{kq_1q_2}{F_Q}$$

$$d^2 = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)\left(6.0\times10^{-6}C\right)\left(2.0\times10^{-6}C\right)}{2.0N}$$

$d \doteq 0.2324\,m$

$q_1 = +4.0\,\mu C/2 = +2.0\,\mu C$

$q_2 = +2.0\,\mu C$

$r = 2(0.2324m) = 0.4648m$

$F = ?$ (repulsive)

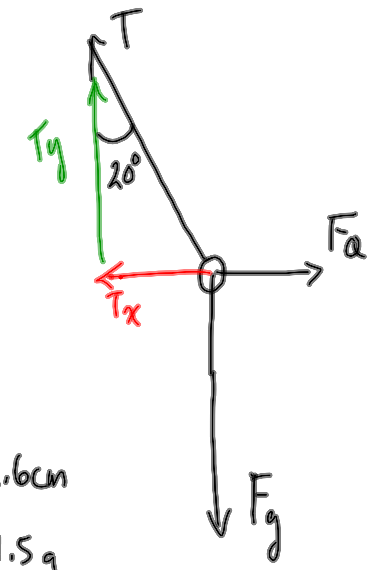
$$F = \frac{kq_1q_2}{r^2}$$

$$F = \frac{k\left(2.0\times10^{-6}C\right)^2}{(0.4648m)^2}$$

$\boxed{F \doteq 0.17\,N}$

Coulomb's Law + Vectors (pp 640-641)

9.



O

$r = 2.6\,cm$

$m = 1.5\,g$

$q_1 = q_2 = q$

Vertically:

$T_y = F_g$

$T_y = mg$

$T_y = (0.0015\,kg)(9.8\,m/s^2)$

$T_y = 0.014715\,N$

$\tan\theta = \dfrac{T_x}{T_y}$

$T_x = T_y \tan\theta$

$T_x = (0.014715\,N)(\tan 20^\circ)$

$T_x = 0.0053558\,N$

Horizontally:

$F_Q = T_x = 0.0053558\,N$

$F_Q = \dfrac{kq_1q_2}{r^2}$

$F_Q = \dfrac{kq^2}{r^2}$

$q^2 = \dfrac{F_Q r^2}{k}$

this is the magnitude

$q^2 = \dfrac{(0.0053558\,\cancel{N})(0.026\,\cancel{m})^2}{\left(9.0\times10^9\,\frac{\cancel{N}\cdot\cancel{m}^2}{C^2}\right)}$

$q = \pm 2.0\times10^{-8}\,C$

$q = 2.0\times10^{-8}\,C$

§ 14.2 Describing Fields

Electric Field Intensity | Strength

All the force vectors make up the field → force per unit mass | charge

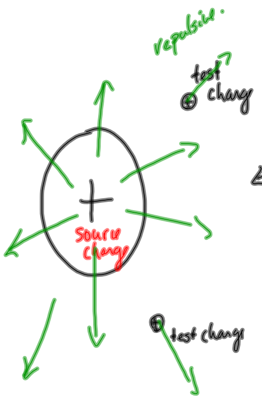
The electric field intensity at a point is the quotient of the electric force on a charge and the magnitude of the charge located at that point.

$$\vec{E} = \frac{\vec{F}_Q}{q}$$ Vector!

where $\vec{E}$ is the electric field intensity $\left(\frac{N}{C}\right)$

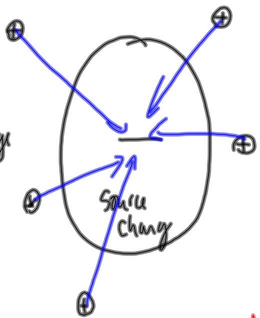
$\vec{F}_Q$ is the force acting on a positive test charge (N)

q is the charge in the field (C)



← The field is radially outward for a positive source charge.

For a negative source charge the field is directed radially inward.



MP | 645

$q_t = +2.0 \times 10^{-9}$ C

$\vec{F}_Q = 4.0 \times 10^{-9}$ N [W]

a) $\vec{E} = ?$

b) if $q = +9.0 \times 10^{-6}$ C, $\vec{F}_Q = ?$

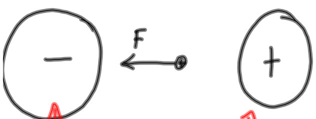
$$\vec{E} = \frac{\vec{F}}{q}$$

$$\vec{E} = \frac{4.0 \times 10^{-9} \text{ N [W]}}{2.0 \times 10^{-9} \text{ C}}$$

direction is ok as long as q is +

$$\vec{E} = 2.0 \frac{N}{C} \text{ [W]}$$

We don't know what is causing the field, we only know that a + charge will experience a force to the West at this location.



this could create the field OR This could create the field.

b) $\vec{E} = \frac{\vec{F}_Q}{q}$

$\vec{F}_Q = q\vec{E}$

$\vec{F}_Q = (9.0 \times 10^{-6} \text{ C})(2.0 \frac{N}{C} \text{ [W]})$

$\vec{F}_Q = 1.8 \times 10^{-5}$ N [W]

if this is +, then the dir is west.

Gravitational Field Intensity:

$$\vec{g} = \frac{\vec{F}_g}{m} \qquad (\vec{F}_g = m\vec{g})$$

* vector (but will always be radially inward)

where $\vec{g}$ is the gravitational field intensity (N/kg)

$\vec{F}_g$ is the force of gravity (N)

m is the mass (kg)

Always attractive

PP/646-647 (electric field intensity)

MP/648 + PP/649 (gravitational field intensity).