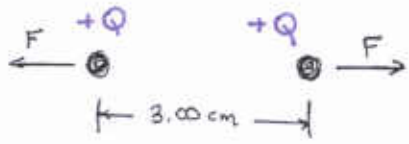
Name_____ Units? Units?

Phys 2120, Section 3
Quiz #1 – Spring 2003

1. Two identical positive charges ar separated by a distance of 3.00 cm. They experience a force of repulsion of magnitude 0.550 N. What is the value of each charge?



$F = 0.550\ N$

Magnitude of repulsive force is $F = k\frac{Q^2}{r^2}$.

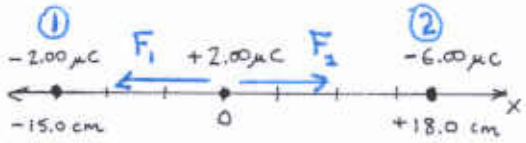
Solve for Q^2:

$$Q^2 = \frac{Fr^2}{k} = \frac{(0.550N)(0.0300m)^2}{(8.99\times10^9\ Nm^2/C^2)} = 5.51\times10^{-14}C^2$$

$$Q = 2.35\times10^{-7}C$$

2. Two charges are located on the x axis; a $-2.00\,\mu$C charge is located at $x = -15.0$ cm and a $-6.00\,\mu$C charge is located at $x = +18.0$ cm. A $+2.00\mu$C charge is placed at the origin.

Find the magnitude and direction of the (net) force on the charge at the origin.



Charge at origin is attracted to both of the other charges, as shown.

Find magnitudes of the forces from charges ① and ②:

$$F_1 = k\frac{|q_1 q_0|}{r^2} = \left(8.99\times10^9\frac{Nm^2}{C^2}\right)\frac{(2.00\times10^{-6}C)(2.00\times10^{-6}C)}{(0.15m)^2} = 1.60\ N$$

$$F_2 = k\frac{|q_2 q_0|}{r^2} = \left(8.99\times10^9\frac{Nm^2}{C^2}\right)\frac{(6.00\times10^{-6}C)(2.00\times10^{-6}C)}{(0.18m)^2} = 3.33\ N$$

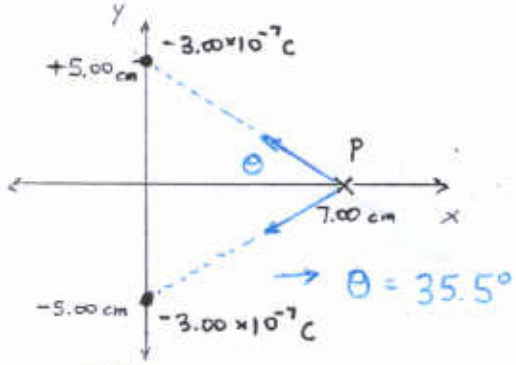
Including the directions, the net x-force on the charge at the origin is

$$F_{x,net} = +3.33N - 1.60N = +1.73\ N$$

(Force has magnitude 1.73 N, points in +x dir.)

3. Two -3.00×10^{-7} C charges are located on the y axis at $y = +5.00$ cm and $y = -5.00$ cm.

What is the magnitude and direction of the electric field at a point P on the x axis, at $x = 7.00$ cm?



The fields due to the charges point as shown and have equal magnitudes. Then the total field at P must point in the $-x$ direction.

Distance of P from each charge is $r = \sqrt{(5.0\,\text{cm})^2 + (7.0\,\text{cm})^2} = 8.60$ cm.

Magnitude of field due to each charge is $E = k\frac{|q|}{r^2} = (8.99\times10^9 \frac{N\cdot m^2}{C^2})\frac{(3.0\times10^{-7}C)}{(8.60\times10^{-2}m)^2} = 3.6\times10^5$ N/C

x-comp of field from each:

$E_x = -E\cos\theta = -3.00\times10^5 \frac{N}{C}$ $\quad E_{x,\text{Total}} = 2E_x = \boxed{-5.93\times10^5 \frac{N}{C}}$

b) If a -2.00×10^{-7} C charge is placed at point P, what is the magnitude and direction of the force on the charge?

(Mag of field is $5.93\times10^5 \frac{N}{C}$, points along $-x$ axis)

From $\vec{F} = q\vec{E}$ the force on the charge placed at P has only an x component, which is:

$F_x = qE_x = (-2.00\times10^{-7}C)(-5.93\times10^5 \frac{N}{C})$

$= \boxed{+1.2\times10^{-1}\,N}$

Ie. force has magnitude $\boxed{0.12\ N}$ and points in the $\boxed{+x}$ direction.

You must show all your work and include the right units with your answers!

$k = \frac{1}{4\pi\epsilon_0} = 8.99\times10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}$ $\quad \epsilon_0 = 8.85\times10^{-12} \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}$ $\quad F = k\frac{|q_1q_2|}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{|q_1q_2|}{r^2}$

$\mathbf{F} = m\mathbf{a}$ $\quad g = 9.80\frac{\text{m}}{\text{s}^2}$ $\quad m_{\text{elec}} = 9.1094\times10^{-31}$ kg $\quad e = 1.602\times10^{-19}$ C

$\mathbf{F} = q\mathbf{E}$ $\quad E_{\text{pt ch}} = k\frac{|q|}{r^2}$ $\quad E_{\text{plane}} = \frac{\sigma}{2\epsilon_0}$