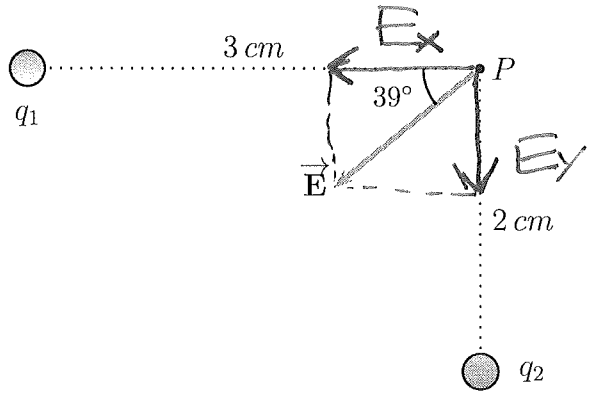
Physics 161

Test 1

Two point charges, q_1, and q_2, are placed such that they are to the left of and below a point P as shown.

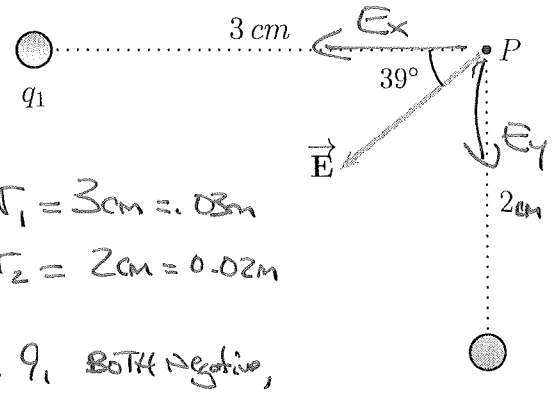


(a) If the net electric field created by the two charges at point P, $\vec{\mathbf{E}}$, is at the 39° shown, are q_1 and q_2 positive or negative? For full points your answer must include an *explanation* of your reasoning. *(2pts)*

When split into Component Ex points left and Ey is down. Since q_1 is left of P and q_2 is Below (And Given the way attraction/Repulsion Works) q_1 must be creating Ex and q_2 creating Ey. Since Ex towards q_1, q_1 must be negative

Since Ey towards q_2, q_2 must also be negative

(b) What is the ratio of the of value of the two charges, q_2/q_1? *(4pts)*



From previous part $E_x = \frac{k|q_1|}{r_1^2}$, $E_y = \frac{k|q_2|}{r_2^2}$, $r_1 = 3cm = .03m$, $r_2 = 2cm = 0.02m$

$\tan 39^\circ = \frac{E_y}{E_x} = \frac{\frac{k|q_2|}{r_2^2}}{\frac{k|q_1|}{r_1^2}} = \frac{|q_2|}{|q_1|}\frac{r_1^2}{r_2^2}$. Since q_2 & q_1 BOTH negative,

$\frac{|q_2|}{|q_1|} = \frac{q_2}{q_1} \Rightarrow \frac{q_2}{q_1} = \frac{r_2^2}{r_1^2}\tan 39^\circ = \frac{(.02m)^2}{(.03m)^2}\tan 39^\circ = \left(\frac{2}{3}\right)^2 \tan 39^\circ = \frac{4}{9}\tan 39^\circ$

$\Rightarrow \boxed{\frac{q_2}{q_1} = 0.3599 = 0.36}$

(c) If $|q_1| = 10\,\mu C$, what is the magnitude of the net electric field at P? *(4pts)*

$q_2 = 0.36\, q_1 = 0.36(-10\mu C) = -3.6\mu C$

$\therefore E_x = \frac{k|q_1|}{r_1^2} = \frac{(9\times10^9\, N\cdot m^2/C^2)(10\times10^{-6}\, C)}{(0.03m)^2} = 1\times10^8\, N/C$

$E_y = \frac{k|q_2|}{r_2^2} = \frac{(9\times10^9\, N\cdot m^2/C^2)(3.6\times10^{-6}\, C)}{(.02m)^2} = 8.1\times10^7\, N/C$

$E = \sqrt{E_x^2 + E_y^2} = 1.29\times10^8\, N/C$