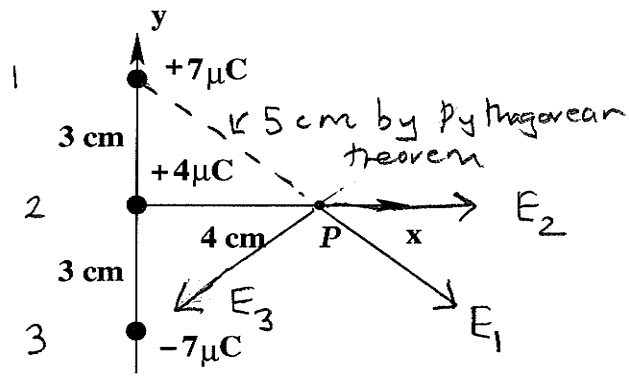
NAME: KEY

Quiz 1, Physics 9C, Winter 2016

General Instructions: This quiz is closed book. Only a calculator is allowed. Please show all your work, and give units for all answers and on all graphs. Credit will only be given for complete solutions. The constant k in Coulomb's law is $k = 9 \cdot 10^9$.

Three point charges lie along a vertical line as shown in the Figure. Find the magnitude and direction of the electric field this combination of charges produces at the point P on the x axis. Pay attention to the signs of the charges! If you prefer, you may give your answer in terms of $\hat{i}$ and $\hat{j}$ rather than magnitude + direction.



The directions of the 3 electric fields are shown sketched in the figure. Because $Q_1 = Q_3$ and the distances of Q_1 and Q_3 from P are equal $|\vec{E}_1| = |\vec{E}_3|$ and it is clear $\vec{E}_1 + \vec{E}_3$ will point in the $-y$ direction. Meanwhile, $\vec{E}_2$ is in the $+\hat{x}$ direction.

$$\vec{E}_1 + \vec{E}_3 = -9\cdot10^9 (7\cdot10^{-6})/(.05)^2 \; {}^{3}/_{5} \; 2\hat{j} = -3.02\cdot10^7 \hat{j} \; \frac{N}{C}$$

(2 equal contributions; $^{3}/_{5}$ to get y component; $(.05)^2$ see figure comment)

$$\vec{E}_2 = 9\cdot10^9 (4\cdot10^{-6})/(.04)^2 = +2.25\cdot10^7 \hat{i} \; \frac{N}{C}$$

$$\rightarrow \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = (+2.25\cdot10^7 \hat{i} - 3.02\cdot10^7 \hat{j}) \frac{N}{C}$$

This answer is sufficient.

$$|\vec{E}_1 + \vec{E}_2 + \vec{E}_3| = 3.77\cdot10^7 \; N/C$$

direction is 0.93 rad = 53° below $\hat{x}$ axis

($\tan^{-1}\left(\frac{3.02}{2.25}\right)$)