Electric Field of Point Charges in Plane (1)

Determine magnitude of $\vec{E}_1$ and $\vec{E}_1$ and identify directions in plane:

$$E_1 = \frac{k|q_1|}{(3m)^2} = 7.99\text{N/C}, \quad E_2 = \frac{k|q_2|}{(5m)^2} = 4.32\text{N/C}.$$  

Determine $x$- and $y$-components of $\vec{E}_1$ and $\vec{E}_2$ and of the resultant field $\vec{E}$:

$$E_{1x}^x = 0, \quad E_{1y}^y = 7.99\text{N/C};$$  
$$E_{2x}^x = -3.46\text{N/C}, \quad E_{2y}^y = 2.59\text{N/C};$$  
$$E_x = -3.46\text{N/C}, \quad E_y = 10.6\text{N/C}.$$  

Determine magnitude and direction of $\vec{E}$:

$$E = \sqrt{E_{x}^2 + E_{y}^2} = 11.2\text{N/C}, \quad \theta = \arctan \left( \frac{E_y}{E_x} \right) = 108^\circ.$$
(a) Find the electric charge $q_2$.

(b) Find the angle $\theta$. 

\[ q_1 = 3 \text{nC} \]
\[ q_2 = 4 \text{nC} \]
Two point charges, one known and the other unknown, produce a horizontal electric field as shown.

What is the value of the unknown charge?

\[ E = \frac{kq_1q_2}{r^2} \]

where:
- \( E \) is the electric field strength
- \( k \) is Coulomb's constant
- \( q_1 \) and \( q_2 \) are the charges
- \( r \) is the distance between the charges

For the given diagram:
- \( q_1 = 1 \text{nC} \)
- \( r = 5 \text{m} \)

Solving for \( q_2 \):

\[ q_2 = \frac{Er^2}{kq_1} \]

Substituting the given values:

\[ q_2 = \frac{(E)(5^2)}{(8.99 \times 10^9)(1 \times 10^{-9})} \]

Calculate the value of \( q_2 \).
Consider four triangles with point charges of equal magnitude at two of the three corners.

(a) Determine the direction of the electric field $\vec{E}_i$ at the third corner of triangle $(i)$.
(b) Rank the fields $E_i$ according to strength.
Find magnitude and direction of the resultant electric field at point $P$.

- $E_1 = \frac{k|q_1|}{8m^2} = 3.38 \text{ N/C}$.
- $E_2 = \frac{k|q_2|}{4m^2} = 6.75 \text{ N/C}$.
- $E_3 = \frac{k|q_3|}{8m^2} = 3.38 \text{ N/C}$.
- $E_x = E_1 \cos 45^\circ + E_3 \cos 45^\circ = 4.78 \text{ N/C}$.
- $E_y = E_2 = 6.75 \text{ N/C}$.
- $E = \sqrt{E_x^2 + E_y^2} = 8.27 \text{ N/C}$.
- $\tan \theta = \frac{E_y}{E_x} = 1.41$.
- $\theta = \arctan 1.41 = 54.7^\circ$. 

$q_1 = +3 \text{nC}$
$q_2 = +3 \text{nC}$
$q_3 = -3 \text{nC}$