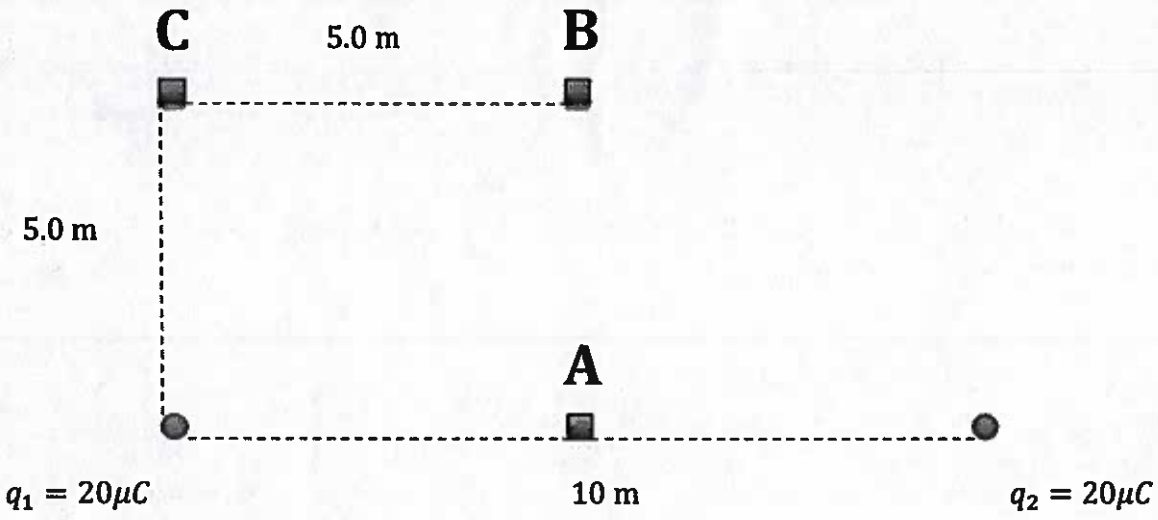
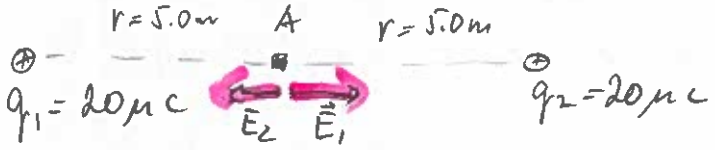
Answers

P12 **ELECTRIC FIELD**

- **Two identical point charges are separated by distance of 10.0 m.**



1. **Given that point A is the midpoint of the separation distance between two identical point charges, calculate the strength of the electric field at point A.**



$\vec{E}_A = \vec{E}_1 + \vec{E}_2$

$\|\vec{E}_1\| = \|\vec{E}_2\|$

$\therefore \vec{E}_A = 0$ N/C [R]

2. Determine the strength and direction of the electric field at point B.

$q_1 = 20\,\mu C$ $\quad q_2 = 20\,\mu C$

$\Rightarrow r = \sqrt{5^2 + 5^2}$

$r = \sqrt{50}$

$\Rightarrow r^2 = 50$

$\vec{E}_B = \vec{E}_1 + \vec{E}_2$

$E_1 = \dfrac{kq_1}{r^2}$

$\vec{E}_B = [0, 5091.1688]\ N/C$

$= \dfrac{(9.0\times10^9)(20\times10^{-6})}{50}$

$= 3600\ N/C$

$\vec{E}_1 = 3600[\cos 45°, \sin 45°]$

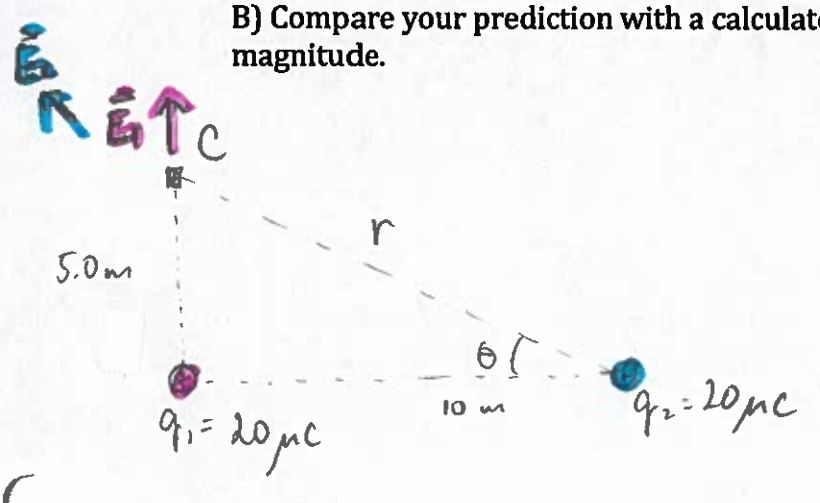
$\vec{E}_1 = [2545.5844, 2545.5244]\ N/C$

By Symmetry: $\vec{E}_2 = [-2545.5844, 2545.5244]\ N/C$

∴ The electric field at pont B is $5.1\times10^3\ N/C$ [up].

3. A) Predict the strength of the electric field at point C relative to the strength of the electric field at point B.

B) Compare your prediction with a calculated value of the electric field's magnitude.



$\theta = \tan^{-1}\left(\frac{5}{10}\right)$

$\theta = 26.5651 = 27°$

$r = \sqrt{5^2 + 10^2}$

$r = \sqrt{125} \Rightarrow r^2 = 125$

$E_1 = \frac{(9.0\times10^9)(20\times10^{-6})}{5.0^2}$

$E_1 = 7200\ N/C$

$\therefore \vec{E}_1 = [0, 7200]\ N/C$

$E_2 = \frac{(9.0\times10^9)(20\times10^{-6})}{125}$

$E_2 = 1440\ N/C$

$\vec{E}_2 = 1440\,[-\cos 27°, \sin 27°]$

$\vec{E}_2 = [-1283.0494, 653.7463]\ N/C$

$\vec{E}_c = \vec{E}_1 + \vec{E}_2 = [-1283.0494, 7853.7463]\ N/C$

$\|\vec{E}_c\| = 7957.8607\ N/C$

$= 8.0\times10^3\ N/C$

C) What is the direction of the electric field at point C?

$\theta = \tan^{-1}\left(\frac{7853.7463}{1283.0494}\right)$

$\theta = 81°$

$\therefore$ the direction of $\vec{E}_c$ is [L 81° U]