

task_dtoqvpvrbdtozfk_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E2 Electrostatics I (written test, approx. 10 % of a 120-minute written test, SS2022)	2
--	---

electrostatic, field lines, exam ee2 SS2022

Exercise E2 Electrostatics I

(written test, approx. 10 % of a 120-minute written test, SS2022)

2. What has been given to you? The charges are $q_1 = 1 \text{ nC}$, $q_2 = 2 \text{ nC}$, $q_0 = 1 \text{ nC}$, $q_4 = 1 \text{ nC}$. The value of the point charge q_0 is 1 nC . Which value needs E_4 to have to get a resulting force of 0 N on q_0 ?

Path: $q_0 = 1 \text{ nC}$

- $q_1 = 2 \text{ nC}$

Path: $E_4 = 2310.97 \text{ (n/mkV)}$

- $\vec{F}_{01} = \left(\begin{array}{c} 19.97 \\ 0 \\ 0 \end{array} \right) \text{ (nN)}$

In the x -direction, the force components are $F_{01,x} = 19.97 \text{ nN}$. The force F_{02} is purely in the y -direction, $F_{02,y} = 8.854 \text{ (nAs/Vm)}$.

$$|\vec{F}_{01}| = \sqrt{F_{01,x}^2 + F_{01,y}^2} = \sqrt{19.97^2 + 0^2} = 19.97 \text{ nN}$$

$$|\vec{F}_{02}| = \sqrt{F_{02,x}^2 + F_{02,y}^2} = \sqrt{0^2 + 8.854^2} = 8.854 \text{ nN}$$

$$|\vec{F}_{03}| = \sqrt{F_{03,x}^2 + F_{03,y}^2} = \sqrt{10.05^2 + 0^2} = 10.05 \text{ nN}$$

$$|\vec{F}_{04}| = \sqrt{F_{04,x}^2 + F_{04,y}^2} = \sqrt{0^2 + 10.05^2} = 10.05 \text{ nN}$$

$$|\vec{F}_{01}| = 19.97 \text{ nN}$$

$$|\vec{F}_{02}| = 8.854 \text{ nN}$$

$$|\vec{F}_{03}| = 10.05 \text{ nN}$$

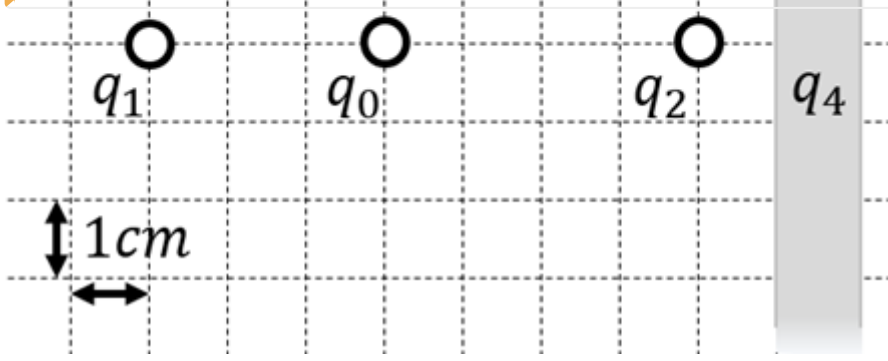
$$|\vec{F}_{04}| = 10.05 \text{ nN}$$

$$|\vec{F}_{01}| = 19.97 \text{ nN}$$

$$|\vec{F}_{02}| = 8.854 \text{ nN}$$

$$|\vec{F}_{03}| = 10.05 \text{ nN}$$

$$|\vec{F}_{04}| = 10.05 \text{ nN}$$



1. Calculate the single forces \vec{F}_{01} , \vec{F}_{02} , \vec{F}_{03} , on the charge q_0 !

Path

First, calculate the magnitude of the forces, like \vec{F}_{01} .
 The force \vec{F}_{01} is purely on the x -axis and therefore equal to $F_{01,x}$.

$$\vec{F}_{01} = F_{01,x} \hat{x} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 \cdot q_0}{r_{01}^2} \hat{x} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12}} \cdot \frac{1 \cdot 1}{(3 \cdot 10^{-2})^2} \hat{x} = 19.97 \dots \cdot 10^{-6} \frac{\text{As}^2 \cdot \text{Vm}}{\text{As} \cdot \text{m}^2} = 19.97 \dots$$

$\cdot 10^{-6} \left\{ \frac{V_A}{m} \right\} = 19.97... \cdot 10^{-6} \left\{ \frac{W}{m} \right\} \quad \&= 19.97... \left\{ \mu N \right\} \quad \text{\texttt{(to the right)}} \end{align*}$

Similarly, we get for \vec{F}_{02} and \vec{F}_{03} $\begin{align*} \vec{F}_{02} = F_{02,x} \quad \&= -28.09... \left\{ \mu N \right\} \quad \text{\texttt{(to the right)}} \quad \backslash \backslash \\ \vec{F}_{03} \quad \&= -22.47... \left\{ \mu N \right\} \quad \text{\texttt{(to the top left)}} \quad \backslash \backslash \end{align*}$

For \vec{F}_{03} , we have to calculate the x - and y -component.

This is possible, by using the angle α between the line through q_0 and q_3 and the positive x -axis (pointing to the right).

So, α has to be between 90° and 180° . It can be calculated by:

$\begin{align*} \alpha = \arctan\left(\frac{-4\text{~cm}}{+2\text{~cm}}\right) = \pi - 1.1071... = \\ 180^\circ - 63.4...^\circ = 116.6...^\circ \end{align*}$

Based on this, the x - and y -component is: $\begin{align*} F_{03,x} \quad \&= \\ |\vec{F}_{03}| \cdot \cos \alpha = 10.05... \left\{ \mu N \right\} \quad \text{\texttt{(to the left)}} \quad \backslash \backslash \\ F_{03,y} \quad \&= |\vec{F}_{03}| \cdot \sin \alpha = 20.10... \left\{ \mu N \right\} \quad \text{\texttt{(to the top)}} \quad \backslash \backslash \end{align*}$

From:

<https://wiki.mexle.org/> - **MEXLE Wiki**

Permanent link:

https://wiki.mexle.org/electrical_engineering_and_electronics/task_dtoqpvrbdtcozfk_with_calculation

Last update: **2024/07/15 15:03**

