

task_dtoqvpvrbdtdcozfk_with_calculation

Student Group

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electrostatic, field lines, exam ee2 SS2022

Exercise E1 Electrostatics I

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

Result: $E_4 = -\$4$. Which value needs E_4 to have to get a resulting force of $\$0$ ~\rm N\$ on $\$q_0$?

Path: \$q_0 = -1 \sim \text{rm nC\$}

- $q_1 = -2 \sim \text{nmC}$

$$\text{path}\$Es_4 = 4310.97 \text{ m}\over{\text{m}}$$

- $\vec{F}_{01} = \left(\begin{array}{ccc} 19.97 & \sim \text{rm } \mu \text{ N} & \parallel 0 \parallel \end{array} \right)$

With the `vecnorm` and `mag` components, we can calculate the resulting magnitude of the

the per-unit volume is $\Delta \rho_{\text{repsol}} = \rho_{\text{repsol}} - \rho_{\text{begin}} = 0.854 \text{ g/cm}^3$ and the resulting magnitude of the

$$\|\vec{F}\| = \sqrt{\left(\sum_i F_{i,x}\right)^2 + \left(\sum_i F_{i,y}\right)^2}$$

In the flow of 0.3 ft³/sec (ft³/sec is a rate of flow, $\frac{\text{ft}^3}{\text{sec}}$) the velocity is $V = \frac{Q}{A} = \frac{0.3}{28.09} = 0.0107$ ft/sec.

Here, this field was to compare for the face \$, vec(F), (01)\$ from 29.4\$ or 59.6\$:

$$\begin{pmatrix} 0 \\ 1 \end{pmatrix} \in E_4 \quad \& \quad \begin{pmatrix} 1 \\ 0 \end{pmatrix} \in E_4 \quad \& \quad \begin{pmatrix} 0 \\ 1 \end{pmatrix} \in E_4 \quad \& \quad \begin{pmatrix} 1 \\ 0 \end{pmatrix} \in E_4$$

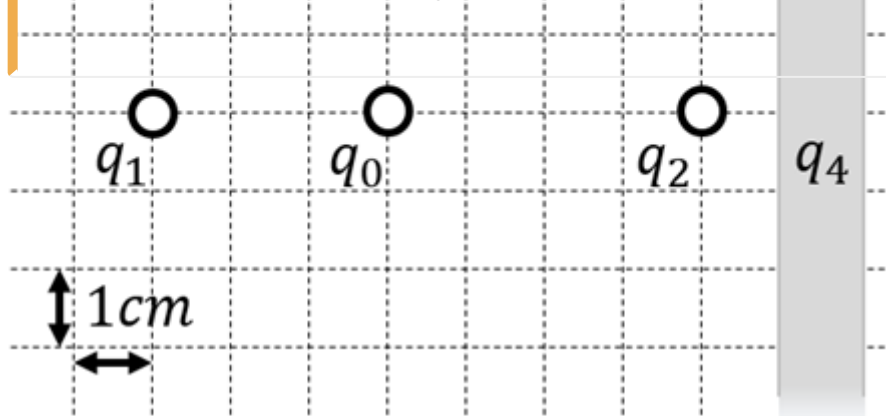
$$\{\{\|\vec{q}\|_1\}^{0.1}\} \over \{q_0\}} \approx \{1.97 \cdot 10^{-6}\} \sim \rm N\} \over \{1$$

$$\frac{\|\text{vec}\{F_{\text{H}}\}_{01}\|}{\|\text{vec}\{q_0\}\|} \approx \left\{ \frac{19.97}{\sqrt{C}} \cdot 10^{-8} \right\} \sim \left(\frac{N}{C} \right) \frac{1}{\sqrt{C}}$$

$$\left(\dot{\rho} \cdot 10^{-9} \right) \sim \left(\rho \cdot C \right) \quad \& \equiv 19.9 / \dots \left(\dot{\rho} \cdot 10^{-3} \right) \left(\rho \cdot N \right) / \left(\rho \cdot C \right) \quad \& \equiv 10.07 \quad \left(\dot{\rho} \cdot 10^{-6} \right) \left(\rho \cdot V \right) / \left(\rho \cdot A \right) \quad \& \equiv 10.07 \quad \left(\dot{\rho} \cdot 10^{-6} \right) \left(\rho \cdot V \right) / \left(\rho \cdot A \right) \quad \& \equiv 10.07$$

$$19.97... \cdot 10^3 \frac{\text{VAs/m}}{\text{As}} \parallel \&= 19.97... \cdot 10^3 \frac{\text{VAs/m}}{\text{As}}$$

$$V_i \over {\rm m} \} \quad \backslash \end{align*}$$



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 $|\vec{F}_1|$.

The force $\vec{F}$ is purely on the x -axis and therefore equal to

$$\vec{F} \{01,x\} = F \{01,x\}$$

$$\frac{\{1\}}{4\pi\epsilon}\cdot\{q_1\cdot q_0\}^{r^2\{0\}} \quad \&=$$

$$\frac{\{1\}}{\{4\pi\}} \cdot 8.854 \cdot 10^{-12} \sim \text{As/Vm} \} \cdot \{1 \cdot 10^{-9}$$

$$\sim \text{m C} \cdot 2 \cdot 10^{-9} \sim \text{m C} \cdot \frac{(3 \cdot 10^2 \sim \text{m})^2}{\dots} \quad \&=$$

$$\frac{19.97 \times 10^{-6} \text{ m} \cdot \text{As}^2 \cdot V_m}{\text{As} \cdot m^2} = 19.97 \times 10^{-6} \text{ m} \cdot \text{As}^2 \cdot V_m$$

$\cdot 10^{-6} \text{ \rm \{VAs\}\over\{m\}} = 19.97... \cdot 10^{-6} \text{ \rm \{Ws\}\over\{m\}} \quad \&= 19.97... \text{ \rm \mu N} \quad \text{\text{(to the right)}} \quad \end{align*}$

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

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:

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

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

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