

task_dtoqvpvrbdtdcozfk_with_calculation

Student Group

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electrostatic, field lines, exam ee2 SS2022

Exercise E2 Electrostatics I

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

6. With the same charge q_1 of 4 nC and charge q_2 the required charge q_3 of 4 nC generalizes the previous results E_4 . Which value needs E_4 to have to get a resulting force of 0 N on q_3 ?

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

- $q_1 = -2 \sim nC$

path\$E\$4-2310-97-115\rm m\over{\rm m}}\$

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

With all the Δx and Δy components, we can calculate the resulting magnitude of the

[illegible]

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

in the power of 0.5 (i.e. left for beginning and right for end of the array) $\lfloor \frac{N}{2} \rfloor$ and $\lfloor \frac{N}{2} \rfloor + 1$.

Here, this money was to be paid away for the face \$, rec'd from [redacted] on [redacted]:

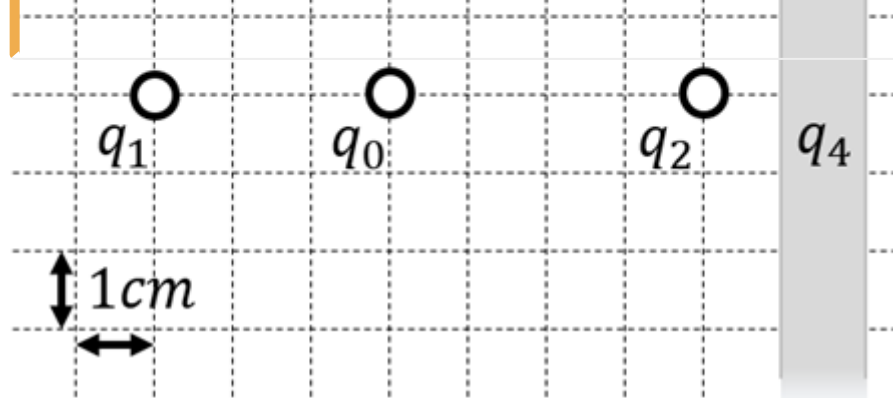
$$\begin{aligned} & \text{begin}{aligned} & \text{vec}{f} = \begin{pmatrix} 0 \\ 1 \end{pmatrix} \quad \&= \begin{pmatrix} 1 & 4 \end{pmatrix} \cdot \begin{pmatrix} 0 \\ 1 \end{pmatrix} \quad \rightsquigarrow \begin{pmatrix} 4 \\ 1 \end{pmatrix} \end{aligned}$$

$$\{\|\vec{E}\|_{01}\|\over{q_0}\|\} \approx \{19.97... \cdot 10^{-6}\} \sim N \over{1}$$

$$\frac{\sqrt{10} \cdot 10^{\{-9\}} \sim \rm C}{\sqrt{10} \cdot 10^{\{-9\}} \sim \rm C} \parallel \&= 19.97... \frac{\sqrt{10} \cdot 10^{\{3\}} \{\rm N\}}{\sqrt{10} \cdot 10^{\{3\}} \{\rm N\}} \parallel \&=$$

$$19.97... \cdot 10^{\{3\}} \{ \{ \rm VAs/m \} \over \{ \rm As \} \} \ \&= \ 19.97... \cdot 10^{\{3\}} \{ \{ \rm VAs/m \} \over \{ \rm As \} \}$$

$$V\over\rm m\}$$



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

$$F_{\{01,x\}} \cdot \begin{pmatrix} F_{\{01\}} \\ F_{\{01,x\}} \end{pmatrix} = F_{\{01,x\}} \cdot \begin{pmatrix} F_{\{01\}} \\ F_{\{01,x\}} \end{pmatrix} =$$

$$\frac{\{1\}}{4\pi i \epsilon} \cdot \{q_1 \cdot q_0\} \over r^2 \{01\} \} \quad \&=$$

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

$$\sim \mathrm{C} \cdot 2 \cdot 10^{-9} \sim \mathrm{C} \cdot \frac{1}{(3 \cdot 10^{-2} \cdot \mathrm{m})^2} \quad \&=$$

$$19.97... \cdot 10^{-6} \text{ } \{ \{ (As)^2 \cdot Vm \} \over {As \cdot m^2} \} \} = 19.97...$$

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

Similarly, we get for $\vec{F}_{02}$ and $\vec{F}_{03}$

$$\vec{F}_{02} = F_{02,x} \quad \&= -28.09... \text{ } \mu\text{N} \quad \text{(to the right)}$$

$$\vec{F}_{03} \quad \&= -22.47... \text{ } \mu\text{N} \quad \text{(to the top left)}$$

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:

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

Based on this, the x - and y -component is:

$$F_{03,x} \quad \&= |\vec{F}_{03}| \cdot \cos \alpha = 10.05... \text{ } \mu\text{N} \quad \text{(to the left)}$$

$$F_{03,y} \quad \&= |\vec{F}_{03}| \cdot \sin \alpha = 20.10... \text{ } \mu\text{N} \quad \text{(to the top)}$$

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