

task_5u1zbroaz75w39jk_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E1 Electrostatics I (written test, approx. 8 % of a 120-minute written test, SS2024)

..... 2

electrostatic, field lines, exam ee2 SS2024

Exercise E1 Electrostatics I**(written test, approx. 8 % of a 120-minute written test, SS2024)**

5. Which two charges are placed on the horizontal axis, the other two charges are placed on the vertical axis. The values of the point charges are $q_1 = -1 \text{ nC}$, $q_2 = -5 \text{ nC}$, $q_0 = 1 \text{ nC}$, and $q_4 = 1 \text{ nC}$. Which value needs E_4 to have to get a resulting force of 0 N on q_0 ?

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

- $q_1 = -5 \text{ nC}$

Path: $E_4 = 500 \text{ V/m}$

- $\vec{F}_{01} = \left(\begin{array}{c} 0 \\ 0 \end{array} \right) + 917 \cdot 10^{-6} \text{ N}$

In the beginning, the same calculation is done, we can calculate the resulting magnitude of the force F_{01} by using the formula $F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$ with $\epsilon_0 = 8.854 \cdot 10^{-12} \text{ As/Vm}$

$$F_{01} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12}} \frac{(-1 \cdot 10^{-9}) \cdot (-5 \cdot 10^{-9})}{(0.01)^2} = 1.123 \cdot 10^{-3} \text{ N}$$

In the same way, we can calculate the force F_{02} and F_{03} from q_0 to q_2 and q_0 to q_4 :

$$F_{02} = \frac{1}{4\pi\epsilon_0} \frac{q_0 q_2}{r^2} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12}} \frac{(1 \cdot 10^{-9}) \cdot (-5 \cdot 10^{-9})}{(0.01)^2} = -1.123 \cdot 10^{-3} \text{ N}$$

$$F_{03} = \frac{1}{4\pi\epsilon_0} \frac{q_0 q_4}{r^2} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12}} \frac{(1 \cdot 10^{-9}) \cdot (1 \cdot 10^{-9})}{(0.01)^2} = 1.123 \cdot 10^{-3} \text{ N}$$

$$\vec{F}_{01} = |E_4| \cdot |q_0| \cdot \vec{e}_4 \quad \vec{e}_4 = \frac{\vec{F}_{01}}{|F_{01}|} = \frac{1.123 \cdot 10^{-3} \text{ N}}{1.123 \cdot 10^{-3} \text{ N}} = 1$$

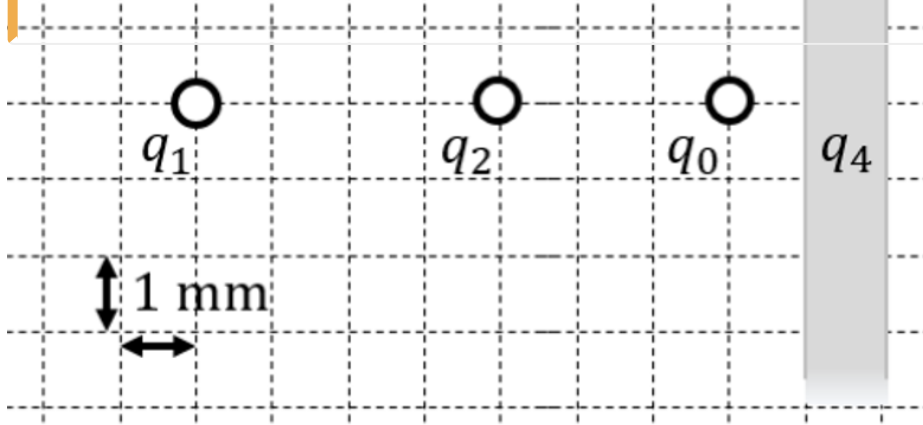
$$\frac{|F_{01}|}{|q_0|} = \frac{1.123 \cdot 10^{-3} \text{ N}}{1 \cdot 10^{-9} \text{ C}} = 1.123 \cdot 10^6 \text{ V/m}$$

$$\frac{1.123 \cdot 10^6 \text{ V/m}}{1 \cdot 10^{-9} \text{ C}} = 1.123 \cdot 10^6 \text{ V/m}$$

$$1.123 \cdot 10^6 \text{ V/m} = 1.123 \cdot 10^6 \text{ V/m}$$

$$1.123 \cdot 10^6 \text{ V/m} = 1.123 \cdot 10^6 \text{ V/m}$$

$$1.123 \cdot 10^6 \text{ V/m} = 1.123 \cdot 10^6 \text{ V/m}$$



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

Path

First, set up a coordinate system. Here, I choose x pointing to the right (positive values to the right) and y pointing upwards (positive values upwards).

Then, calculate the magnitude of the forces, like $\vec{F}_{01}$ (force on q_0 from q_1).

The force $\vec{F}_{01}$ is purely on the x-axis and therefore equal to

$$F_{01,x} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 \cdot q_0}{r_{01}^2} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12} \cdot \frac{1}{\text{As/Vm}}} \cdot \frac{1 \cdot 10^{-9} \cdot 5 \cdot 10^{-9}}{(7 \cdot 10^{-3})^2} = 917. \cdot 10^{-6} \cdot \frac{(As)^2 \cdot Vm}{As \cdot m^2} = 917. \cdot 10^{-6} \cdot \frac{VAs}{m} = 917. \cdot 10^{-6} \cdot \frac{Ws}{m}$$

$$\vec{F}_{01} = +917. \cdot 10^{-6} \cdot \mu N$$
 Since both q_0 and q_1 have the same sign for their charges, they are repelling each other. Therefore, The force $\vec{F}_{01}$ points to the right (positive value).

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

$$\vec{F}_{02} = F_{02,x} = -1997. \cdot 10^{-6} \cdot \mu N$$

$$\vec{F}_{03} = F_{03,y} = -1123. \cdot 10^{-6} \cdot \mu N$$
 Since q_0 and q_2 have the different sign for their charges, they are attract each other. Therefore, The force $\vec{F}_{02}$ points to the left (negative value).
 Since q_0 and q_3 have the different sign for their charges, they are attract each other. Therefore, The force $\vec{F}_{03}$ points downwards (negative value).

From:
<https://first.mexle.te.hs-heilbronn.de/> - MEXLE Wiki

Permanent link:
https://first.mexle.te.hs-heilbronn.de/electrical_engineering_and_electronics/task_5u1zbroaz75w39jk_with_calculation

Last update: 2026/01/20 16:30

