

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 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: $E_4 = 917 \text{ V/m}$

- $\vec{F}_{01} = \left(\begin{array}{c} 917 \\ 0 \end{array} \right) \text{ nN}$

In the beginning, the same calculation as we can do. We can calculate the resulting magnitude of the force F_{01} by using the formula $F = k \cdot \frac{q_1 \cdot q_0}{r^2}$ with $k = 8.99 \cdot 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2$.

$$F_{01} = k \cdot \frac{q_1 \cdot q_0}{r^2} = 8.99 \cdot 10^9 \cdot \frac{(-5 \cdot 10^{-9}) \cdot (-1 \cdot 10^{-9})}{(1 \cdot 10^{-3})^2} = 4.495 \cdot 10^{-8} \text{ N}$$

In the same way, we can calculate the force F_{02} and F_{03} .

$$F_{02} = k \cdot \frac{q_2 \cdot q_0}{r^2} = 8.99 \cdot 10^9 \cdot \frac{(-5 \cdot 10^{-9}) \cdot (-1 \cdot 10^{-9})}{(1 \cdot 10^{-3})^2} = 4.495 \cdot 10^{-8} \text{ N}$$

Here, the field lines are pointing to the right, so the force $\vec{F}_{01}$ is pointing to the right.

$$\vec{F}_{01} = F_{01} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{02} = F_{02} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{03} = F_{03} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{04} = F_{04} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{05} = F_{05} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{06} = F_{06} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{07} = F_{07} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{08} = F_{08} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{09} = F_{09} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{10} = F_{10} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{11} = F_{11} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{12} = F_{12} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{13} = F_{13} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{14} = F_{14} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{15} = F_{15} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{16} = F_{16} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{17} = F_{17} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{18} = F_{18} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{19} = F_{19} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{20} = F_{20} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{21} = F_{21} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{22} = F_{22} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{23} = F_{23} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{24} = F_{24} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{25} = F_{25} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{26} = F_{26} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{27} = F_{27} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{28} = F_{28} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{29} = F_{29} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{30} = F_{30} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{31} = F_{31} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{32} = F_{32} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{33} = F_{33} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{34} = F_{34} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{35} = F_{35} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{36} = F_{36} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{37} = F_{37} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{38} = F_{38} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{39} = F_{39} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

$$\vec{F}_{40} = F_{40} \cdot \vec{e}_x = 4.495 \cdot 10^{-8} \text{ N} \cdot \vec{e}_x$$

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

$$F_{01,x} = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 \cdot q_0}{r_{01}^2} = \frac{1}{4\pi \cdot 8.854 \cdot 10^{-12} \cdot \frac{1}{\text{As/Vm}}} \cdot \frac{1 \cdot 10^{-9} \cdot 5 \cdot 10^{-9}}{(7 \cdot 10^{-3})^2} = 917. \frac{\text{N}}{\text{m}} \cdot \frac{((\text{As})^2 \cdot \text{Vm})}{\text{As} \cdot \text{m}^2} = 917. \frac{\text{N}}{\text{m}} \cdot \frac{\{\text{VAs}\}}{\text{m}} = 917. \frac{\text{N}}{\text{m}} \cdot \frac{\{\text{Ws}\}}{\text{m}} = +917. \frac{\text{N}}{\text{m}} \cdot \mu\text{N}$$
 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 $\vec{F}_{03}$

$$\vec{F}_{02} = F_{02,x} = -1997. \frac{\text{N}}{\text{m}} \cdot \mu\text{N} \quad \vec{F}_{03} = F_{03,y} = -1123. \frac{\text{N}}{\text{m}} \cdot \mu\text{N}$$
 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?rev=1768922970

Last update: 2026/01/20 16:29

