task_1.1.5

Student Group

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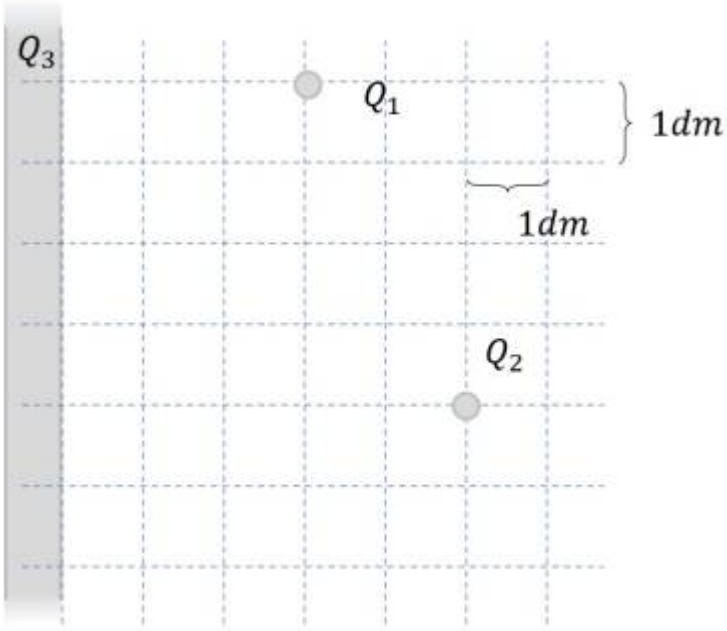
Task 1.1.5 Variation: Forces on Charges (exam task, ca 8% of a 60 minute exam, WS2020)



Given is an arrangement of electric charges located in a vacuum (see picture on the right).
The charges have the following values:
$Q_1=2 ~\mu C$ (point charge)
$Q_2=-4 ~\mu C$ (point charge)
$Q_3=0 ~C$ (infinitely extended surface charge)

$\varepsilon_0=8.854\cdot 10^{-12} ~F/m$, $\varepsilon_r=1$

1. calculate the magnitude of the force of Q_2 on Q_1, without the force effect of Q_3.

Result

\begin{align*} |\vec{F}_C| = 0.3595 ~N \rightarrow 0.36 ~N \end{align*}

2. is this force attractive or repulsive?

Solution

The force is attractive because the charges have different signs.

Now let $Q_2=0$ and the surface charge Q_3 be designed in such a way that a homogeneous electric field with $E_3=100 ~kV/m$ results.
What force (magnitude) now results on Q_1?

Result

\begin{align*} |\vec{F}_C| = 0.4 ~N \end{align*}