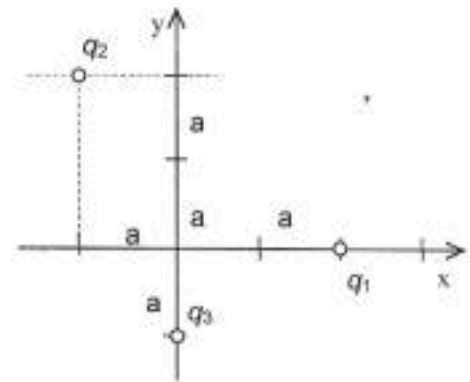
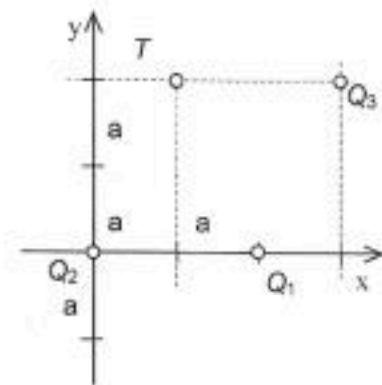


1. KOLOKVIJ — Osnove elektrotehnike I (30. 10. 2012) skupina A

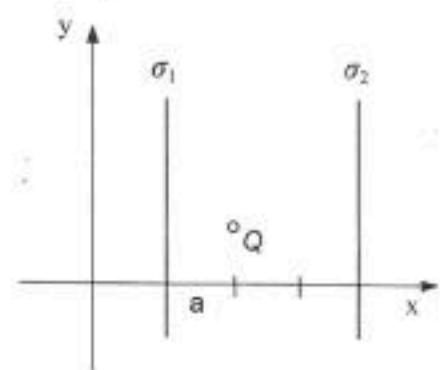
1. Izračunajte silo na premo elektrino $q_3 = 2 \cdot 10^{-6}$ As/m v elektrostat. polju, ki ga povzročata premi elektrini $q_1 = -5 \cdot 10^{-6}$ As/m in $q_2 = 8 \cdot 10^{-6}$ As/m. Elektrine so nameščene v zraku, kot je prikazano na sliki ($a = 20$ cm).



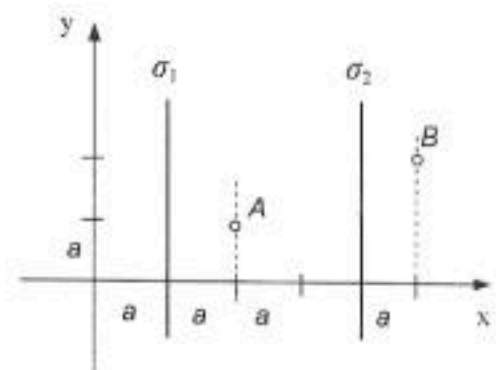
2. Določite Q_3 tako, da bo električna poljska jakost v točki T enaka nič. $Q_1 = 6 \cdot 10^{-9}$ As, $Q_2 = -6 \cdot 10^{-9}$ As in $a = 15$ cm; elektrine so nameščene v zraku tako kot je prikazano na sliki.



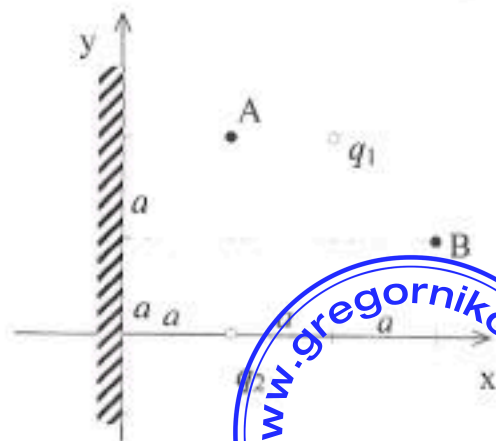
3. Izračunajte silo na točkasto elektrino $Q = 4 \cdot 10^{-6}$ As/ v polju dveh ravninskih elektrinin: $\sigma_1 = 2 \cdot 10^{-9}$ As/m² in $\sigma_2 = 4 \cdot 10^{-9}$ As/m².



4. Izračunajte napetost med točkama $A = (2a, a)$ in $B = (5a, 2a)$ v polju dveh ravninskih elektrinin: $\sigma_1 = -5 \cdot 10^{-9}$ As/m² in $\sigma_2 = -10 \cdot 10^{-9}$ As/m². Elektrine so nameščene, kot kaže slika ($a = 25$ cm).



5. Izračunajte napetost U_{AB} med točkama A in B. Napetost povzročata premi elektrini $q_1 = 8 \cdot 10^{-9}$ As/m in $q_2 = 12 \cdot 10^{-9}$ As/m, ki ležita pred ozemljeno prevodno površino kot je prikazano na sliki ($a = 10$ cm).



$$\epsilon_0 = 8,85 \cdot 10^{-12} \text{ As/Vm}$$

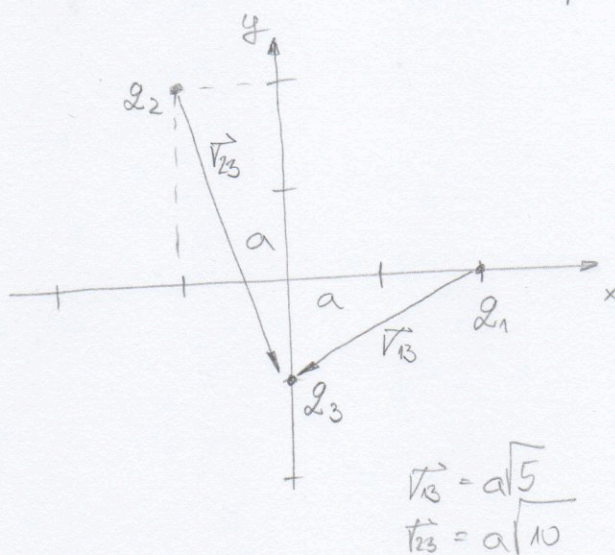
$$q_1 = -5 \cdot 10^{-6} \text{ As/m}$$

$$q_2 = 8 \cdot 10^{-6} \text{ As/m}$$

$$q_3 = 2 \cdot 10^{-6} \text{ As/m}$$

$$a = 20 \text{ cm} = 20 \cdot 10^{-2} \text{ m}$$

$$F_{q_3} = ?$$



$$r_{13} = a\sqrt{5}$$

$$r_{23} = a\sqrt{10}$$

$$F_{q_3} = F_{q_{13}} + F_{q_{23}}$$

$$F_{q_{13}} = \frac{q_1 q_3}{2\pi \cdot \epsilon_0 \cdot r_{13}} \vec{r}_{13} = \frac{-5 \cdot 10^{-6} \cdot 2 \cdot 10^{-6}}{2\pi \cdot 8,85 \cdot 10^{-12} \cdot 20 \cdot 10^{-2} \cdot \sqrt{5}} \left(-\frac{2}{\sqrt{5}} \vec{t}_x - \frac{1}{\sqrt{5}} \vec{t}_y \right) =$$

$$= \frac{-0,1019}{-0,1019} = \boxed{(0,3595 \vec{t}_x + 0,1798 \vec{t}_y) \text{ N/m}}$$

$$\frac{\frac{\text{As}}{\text{m}} \cdot \frac{\text{As}}{\text{m}}}{\frac{\text{As}}{\text{Vm}} \cdot \text{m}} = \frac{\text{As}^2}{\text{m}^2} = \frac{\text{AsNm}}{\text{As}} = \boxed{\text{N/m}}$$

$$F_{q_{23}} = \frac{q_2 q_3}{2\pi \epsilon_0 r_{23}} \vec{r}_{23} = \frac{8 \cdot 10^{-6} \cdot 2 \cdot 10^{-6}}{2\pi \cdot 8,85 \cdot 10^{-12} \cdot 20 \cdot 10^{-2} \cdot \sqrt{10}} \left(\frac{1}{\sqrt{10}} \vec{t}_x - \frac{3}{\sqrt{10}} \vec{t}_y \right)$$

$$= \frac{0,14547}{0,14547} = \boxed{(0,1438 \vec{t}_x - 0,4314 \vec{t}_y) \text{ N/m}}$$

$$F_{q_3} = \boxed{(0,5033 \vec{t}_x - 0,2516 \vec{t}_y) \text{ N/m}}$$



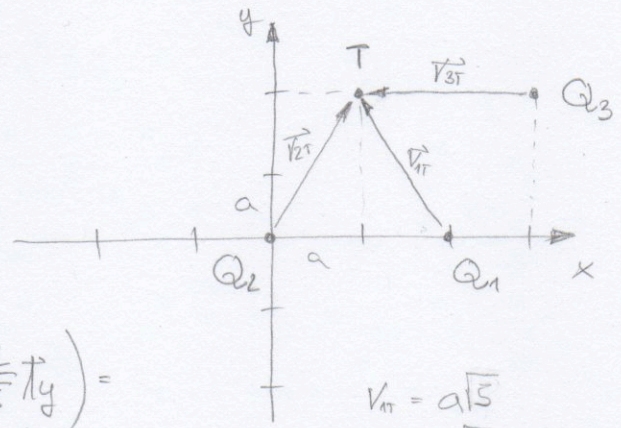
$$Q_1 = 6 \cdot 10^{-9} \text{ As}$$

$$Q_2 = -6 \cdot 10^{-9} \text{ As}$$

$$a = 15 \text{ cm} = 15 \cdot 10^{-2} \text{ m}$$

$$\vec{E} = \frac{Q}{A} = \frac{Q}{4\pi\epsilon_0 r^2}$$

$Q_3 = ?$ da bo $\vec{E}_T = \emptyset$



$$\vec{E}_1 = \frac{Q_1}{4\pi\epsilon_0 r_{1T}^2} \cdot \vec{r}_{1T} = \frac{6 \cdot 10^{-9}}{4\pi \cdot 8,85 \cdot 10^{-12} \cdot (15 \cdot 10^{-2} \cdot \sqrt{5})^2} \left(-\frac{1}{\sqrt{5}} \vec{r}_x + \frac{2}{\sqrt{5}} \vec{r}_y \right) = (-214,366 \vec{r}_x + 428,731 \vec{r}_y) \text{ V/m}$$

$$r_{1T} = a\sqrt{5}$$

$$r_{2T} = a\sqrt{5}$$

$$r_{3T} = 2a$$

$$\frac{\text{As}}{\text{m}^2} = \frac{\text{V}}{\text{m}}$$

$$\vec{E}_2 = \frac{-6 \cdot 10^{-9} \text{ As}}{4\pi\epsilon_0 \cdot (15 \cdot 10^{-2} \cdot \sqrt{5})^2} \left(\frac{1}{\sqrt{5}} \vec{r}_x + \frac{2}{\sqrt{5}} \vec{r}_y \right) = (-214,366 \vec{r}_x - 428,731 \vec{r}_y) \text{ V/m}$$

$$\vec{E}_T = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = \emptyset$$

$$\vec{E}_3 = -\vec{E}_1 - \vec{E}_2$$



$$\frac{-Q_3}{4\pi\epsilon_0 (r_{3T})^2} \cdot \vec{r}_x = -428,732 \vec{r}_x \Rightarrow Q_3 = \frac{428,732 \vec{r}_x \cdot 4\pi \cdot \epsilon_0 \cdot (2 \cdot 15 \cdot 10^{-2})^2}{-1 \vec{r}_x}$$

$$Q_3 = -4,29 \cdot 10^{-9} \text{ As}$$

$$\frac{\vec{r}_x}{2a} \cdot \frac{\text{As}}{\text{m}^2} \cdot \text{m}^2 = \text{As}$$

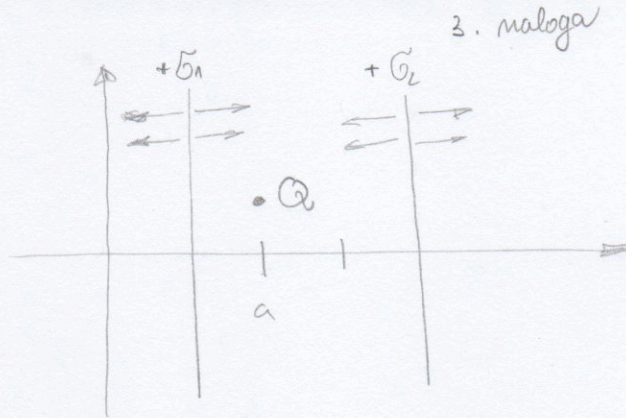


$$Q = 4 \cdot 10^{-6} \text{ As}$$

$$\sigma_1 = 2 \cdot 10^{-9} \text{ As/m}^2$$

$$\sigma_2 = 4 \cdot 10^{-9} \text{ As/m}^2$$

$$F_Q = ?$$



$$F = Q \cdot E$$

$$F_{1Q} = \frac{\sigma_1}{2\epsilon_0} \cdot \vec{r}_x = \frac{2 \cdot 10^{-9}}{2 \cdot \epsilon_0} \cdot \vec{r}_x = \boxed{69,314 \text{ Tx V/m}}$$

$$\frac{\frac{\text{As}}{\text{m}^2}}{\frac{\text{Vs}}{\text{Vm}}} = \frac{\text{Vs}}{\text{Vm}}$$

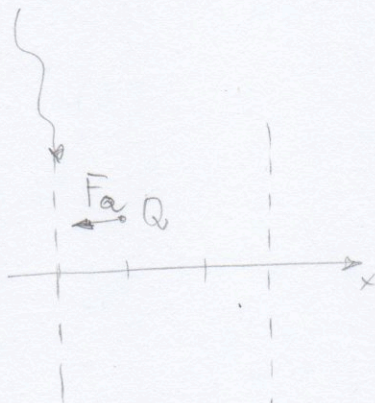
$$E = \boxed{-69,314 \text{ Tx V/m}}$$

$$F_{2Q} = \frac{\sigma_2}{2\epsilon_0} \cdot \vec{r}_x = \frac{4 \cdot 10^{-9}}{2 \cdot \epsilon_0} \cdot \vec{r}_x = \boxed{-138,628 \text{ Tx V/m}}$$

$$F = E \cdot Q = -69,314 \text{ V/m Tx} \cdot 4 \cdot 10^{-6} \text{ As} =$$

$$= \boxed{-27,73 \cdot 10^{-3} \text{ Tx N}}$$

$$\frac{\text{Vs}}{\text{m}} = \frac{\frac{\text{Nm}}{\text{As}} \cdot \text{As}}{\frac{\text{m}}{\text{s}}} = \text{N}$$



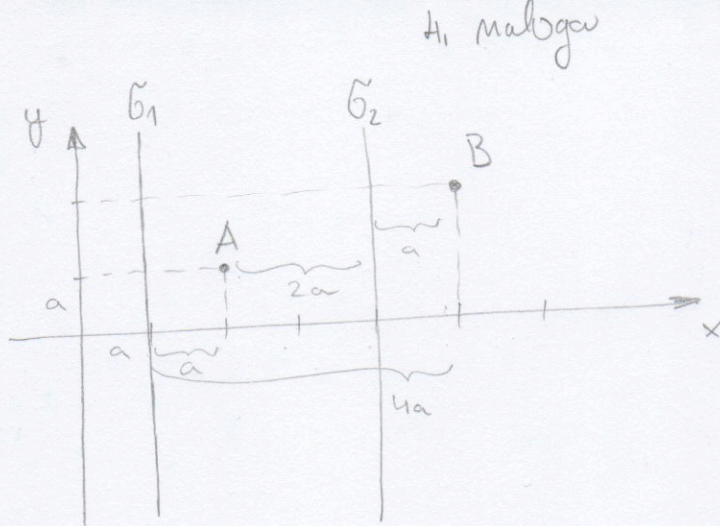
$$\sigma_1 = -5 \cdot 10^{-9} \text{ As/m}^2$$

$$\sigma_2 = -10 \cdot 10^{-9} \text{ As/m}^2$$

$$a = 25 \text{ cm} = 25 \cdot 10^{-2} \text{ m}$$

$$U_{AB} = ?$$

$$U_{AB} = \frac{\sigma}{2\epsilon_0} (x_2 - x_1)$$



$$U_{AB} = U_{AB1} + U_{AB2}$$

$$U_{AB1} = \frac{\sigma_1}{2\epsilon_0} (x_B - x_A) = \frac{-5 \cdot 10^{-9}}{2 \cdot \epsilon_0} \cdot 3a = \underline{\underline{-129,964 \text{ V}}}$$

$$U_{AB2} = \frac{\sigma_2}{2\epsilon_0} (x_B - x_A) = \frac{-10 \cdot 10^{-9}}{2\epsilon_0} \cdot (-a) = \underline{\underline{86,64 \text{ V}}}$$

$$U_{AB} = \underline{\underline{-43,32 \text{ V}}}$$

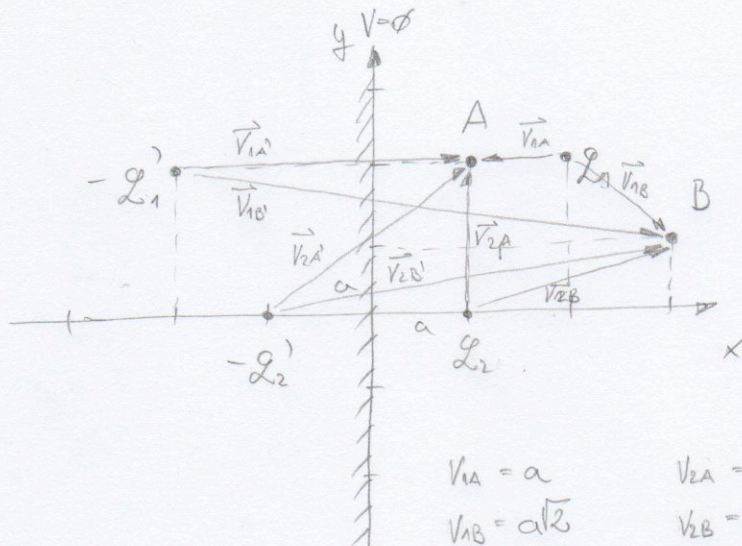
5. malogen

$$Q_1 = 8 \cdot 10^{-9} \text{ As/m}$$

$$Q_2 = 12 \cdot 10^{-9} \text{ As/m}$$

$$a = 10 \text{ cm} = 10 \cdot 10^{-2} \text{ m}$$

$$U_{AB} = ?$$



$$v_{1A} = a \quad v_{2A} = 2a$$

$$v_{1B} = a\sqrt{2} \quad v_{2B} = a\sqrt{5}$$

$$v_{1A}' = 4a \quad v_{2A}' = a\sqrt{8}$$

$$v_{1B}' = a\sqrt{26} \quad v_{2B}' = a\sqrt{17}$$

$$U = \frac{Q}{2\pi\epsilon_0} \ln \frac{r_{0B}}{r_{1A}}$$

$$U_{AB} = \frac{Q_1}{2\pi\epsilon_0} \ln \frac{v_{1B}}{v_{1A}} + \frac{Q_2}{2\pi\epsilon_0} \ln \frac{v_{2B}}{v_{2A}} - \frac{Q_1'}{2\pi\epsilon_0} \ln \frac{v_{1B}'}{v_{1A}'} - \frac{Q_2'}{2\pi\epsilon_0} \ln \frac{v_{2B}'}{v_{2A}'}$$

$$= \frac{8 \cdot 10^{-9}}{2\pi\epsilon_0} \ln \sqrt{2} + \frac{12 \cdot 10^{-9}}{2\pi\epsilon_0} \ln \frac{\sqrt{5}}{2} - \frac{8 \cdot 10^{-9}}{2\pi\epsilon_0} \ln \frac{\sqrt{26}}{4} - \frac{12 \cdot 10^{-9}}{2\pi\epsilon_0} \ln \frac{\sqrt{17}}{18}$$

$$= \boxed{-42,299 \text{ V}}$$

$\frac{As}{cm}$
 $\frac{As}{V \cdot m}$