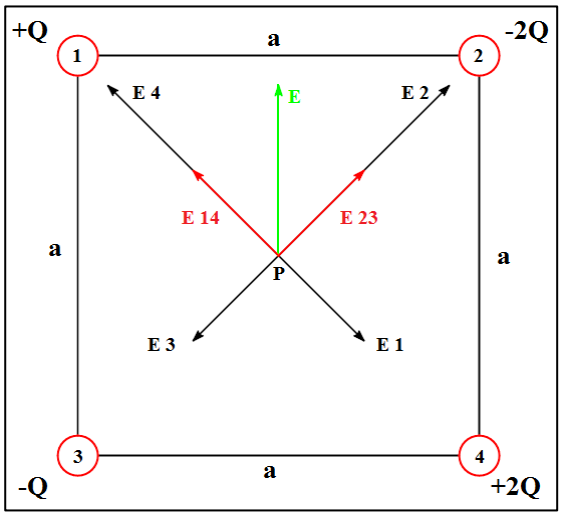
Fyzika LS 2014/2015 – 4. 10-minútovka – riešenia úloh

Nabitý štvorec –*Q*

$Q = 1{,}0 \cdot 10^{-8}$ C, a = 5 cm = 0,05 m, E = ? N/C



$E = F / Q = k \,.\, Q / r^2$, $k = 9 \cdot 10^9$ N · m^2 · C^{-2}

$E = E_1 + E_2 + E_3 + E_4 = E_{14} + E_{23}$

$|E_{14}| = |E_{23}| = E'$

$$E' = k \cdot \frac{|2Q - Q|}{r^2}\,,\ r^2 + r^2 = a^2 \ \Rightarrow\ r = a/\sqrt{2}$$

$$E' = k \cdot \frac{Q}{0{,}5 \cdot a^2} = 2k \cdot \frac{Q}{a^2}$$

$$E = E' + E' \ \Rightarrow\ E^2 = E'^2 + E'^2 = 2 \cdot E'^2 \ \Rightarrow\ E = \sqrt{2} \cdot E'$$

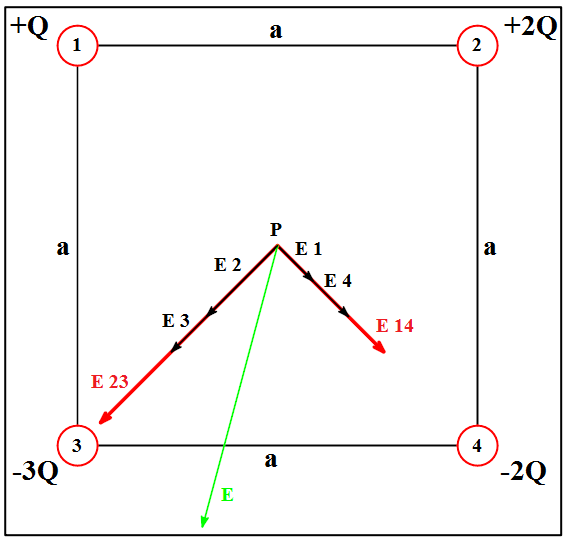
$$E = \sqrt{2} \cdot 2 \cdot k \cdot \frac{Q}{a^2} = \sqrt{8} \cdot k \cdot \frac{Q}{a^2}$$

$$E = \left(\sqrt{8} \cdot 9 \cdot 10^9 \cdot \frac{1{,}0 \cdot 10^{-8}}{0{,}05^2}\right) \text{N/C} = \left(\frac{\sqrt{8} \cdot 9 \cdot 10}{0{,}05^2}\right) \text{N/C}$$

$E \approx 101823$ N/C

Nabitý štvorec –3*Q*

$Q = 1{,}0 \cdot 10^{-8}$ C, a = 5 cm = 0,05 m, E = ? N/C



$E = F / Q = k \,.\, Q / r^2$, $k = 9 \cdot 10^9$ N · m^2 · C^{-2}

$E = E_1 + E_2 + E_3 + E_4 = E_{23} + E_{14}$

$r^2 + r^2 = a^2 \ \Rightarrow\ r = a/\sqrt{2}$

$$E_{23} = k \cdot \frac{|2Q + 3Q|}{r^2} = k \cdot \frac{5Q}{0{,}5 \cdot a^2} = 2k \cdot \frac{5Q}{a^2}$$

$$E_{14} = k \cdot \frac{|Q + 2Q|}{r^2} = k \cdot \frac{3Q}{0{,}5 \cdot a^2} = 2k \cdot \frac{3Q}{a^2}$$

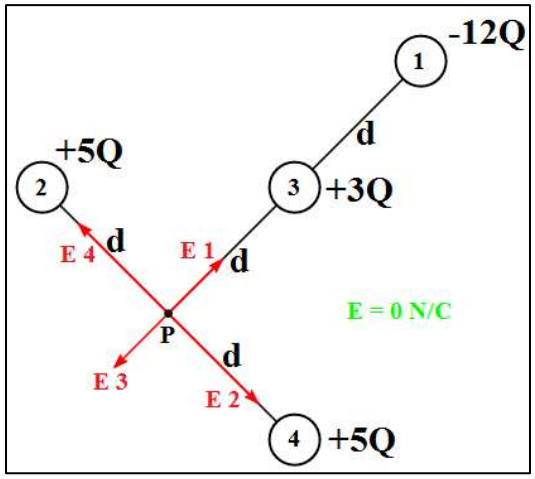
$$E^2 = {E_{23}}^2 + {E_{14}}^2 \ \Rightarrow\ E = \sqrt{E_{23}^2 + E_{14}^2}$$

$$E = \sqrt{\left(2k \cdot \frac{5Q}{a^2}\right)^2 + \left(2k \cdot \frac{3Q}{a^2}\right)^2} = 2k \cdot \frac{Q}{a^2} \cdot \sqrt{34}$$

$$E = \left(2 \cdot 9 \cdot 10^9 \cdot \frac{1{,}0 \cdot 10^{-8}}{0{,}05^2} \cdot \sqrt{34}\right) \text{N/C} = \left(\frac{9 \cdot 10 \cdot 2}{0{,}05^2} \cdot \sqrt{34}\right) \text{N/C}$$

$E \approx 419829$ N/C

Nabité téčko 5*Q*



$E = F / Q = k \,.\, Q / r^2$, $k = 9 \cdot 10^9$ N · m^2 · C^{-2}

$E = E_1 + E_2 + E_3 + E_4$

$|E_{14}| = |E_{23}|$ a majú presne opačné smery, preto $E_2 + E_4 = 0$

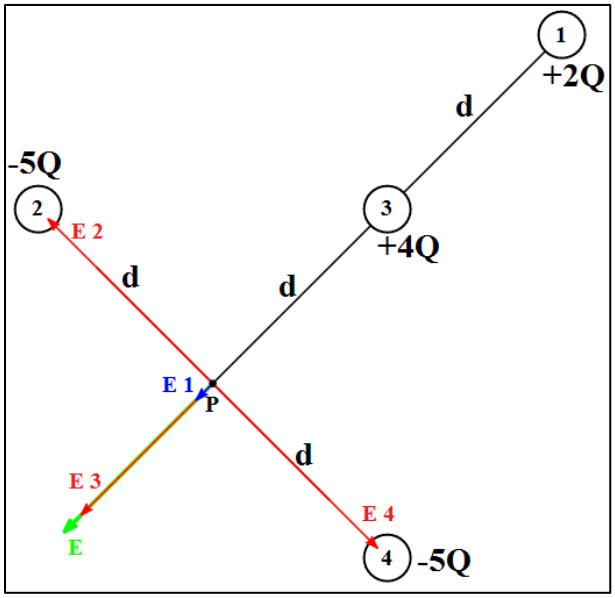
$E = E_1 + E_3 = E_1 + E_3$

$$E_1 = k \cdot \frac{-12Q}{(2d)^2} = k \cdot \frac{-12Q}{4d^2} = k \cdot \frac{-3Q}{d^2}$$

$$E_3 = k \cdot \frac{3Q}{d^2} \qquad E = k \cdot \frac{-3Q}{d^2} + k \cdot \frac{3Q}{d^2} = 0$$

$E = 0 \cdot Q$

Nabité téčko –5*Q*



$E = F / Q = k \,.\, Q / r^2$, $k = 9 \cdot 10^9$ N · m^2 · C^{-2}
$E = E_1 + E_2 + E_3 + E_4$

$|E_{14}| = |E_{23}|$ a majú presne opačné smery => $E_2 + E_4 = 0$
$E = E_1 + E_3 = E_1 + E_3$

$$E_1 = k \cdot \frac{2Q}{(2d)^2} = k \cdot \frac{2Q}{4d^2} = k \cdot \frac{Q}{2d^2}$$

$$E_3 = k \cdot \frac{4Q}{d^2} \qquad E = k \cdot \frac{Q}{2d^2} + k \cdot \frac{4Q}{d^2} = \frac{k \cdot Q}{d^2} \cdot \left(\frac{1}{2} + 4\right)$$

$$E = \frac{9}{2} \cdot \frac{k \cdot Q}{d^2} \cdot = 4{,}5 \cdot \frac{k \cdot Q}{d^2}$$

$$E = 4{,}5 \cdot \frac{9 \cdot 10^9}{d^2} \cdot Q = \frac{2 \cdot 4{,}5^2 \cdot 10^9}{d^2} \cdot Q$$

pozn.: vo všetkých obrázkoch majú vektory intenzity (*E*) pôsobisko v bode P