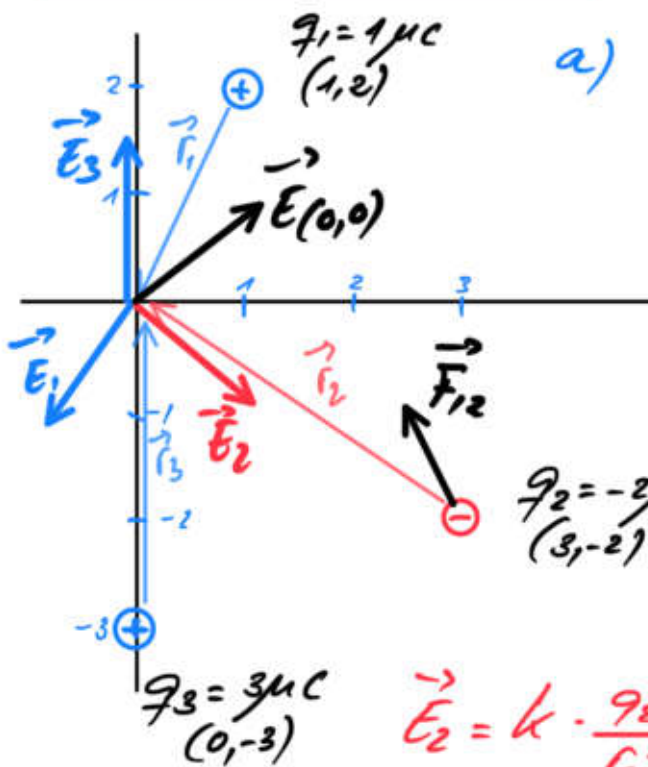


EXERCÍCIO F2BE2727:



a) $\vec{E}_{(0,0)} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3$

$\vec{E}_1 = k \cdot \frac{q_1}{r_1^2} \frac{\vec{r}_1}{r_1}$

$\vec{r}_1 = -2\vec{i} - 2\vec{j}; |\vec{r}_1| = \sqrt{5} \text{ m}$

$\vec{E}_1 = 9 \cdot 10^9 \cdot \frac{+1 \cdot 10^{-6}}{5} \cdot \frac{-2\vec{i} - 2\vec{j}}{\sqrt{5}}$

$\vec{E}_1 = -804,982\vec{i} - 1609,974\vec{j} \left(\frac{\text{N}}{\text{C}}\right)$

$\vec{E}_2 = k \cdot \frac{q_2}{r_2^2} \frac{\vec{r}_2}{r_2} = \dots$

$\vec{r}_2 = -3\vec{i} + 2\vec{j}; |\vec{r}_2| = \sqrt{13} \text{ m}$

$\dots = \vec{E}_2 = 9 \cdot 10^9 \cdot \frac{(-2 \cdot 10^{-6})}{13} \cdot \frac{(-3\vec{i} + 2\vec{j})}{\sqrt{13}} = 1152,072\vec{i} - 768,057\vec{j} \left(\frac{\text{N}}{\text{C}}\right)$

$\vec{E}_3 = k \cdot \frac{q_3}{r_3^2} \frac{\vec{r}_3}{r_3} = 9 \cdot 10^9 \cdot \frac{3 \cdot 10^{-6}}{3^2} \frac{3\vec{j}}{3} = 0\vec{i} + 3000\vec{j} \left(\frac{\text{N}}{\text{C}}\right)$

$\vec{r}_3 = 3\vec{j}$

$\vec{E}_{(0,0)} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 = 347,092\vec{i} + 621,98 \left(\frac{\text{N}}{\text{C}}\right)$

$|\vec{E}_{(0,0)}| = 712,27 \frac{\text{N}}{\text{C}}$

b) $\vec{F}_{12} = ?$ $\vec{F}_{12} = k \cdot \frac{q_1 \cdot q_2}{r_{12}^2} \frac{\vec{r}_{12}}{r_{12}} = \dots$

$\vec{r}_{12} = 2\vec{i} - 4\vec{j} \Rightarrow |\vec{r}_{12}| = \sqrt{20}$

$\dots = \vec{F}_{12} = 9 \cdot 10^9 \cdot \frac{(+1 \cdot 10^{-6})(-2 \cdot 10^{-6})}{20} \frac{2\vec{i} - 4\vec{j}}{\sqrt{20}} =$

$\vec{F}_{12} = -4,02 \cdot 10^{-4} \vec{i} + 8,05 \cdot 10^{-4} \vec{j} \text{ (N)}$

$$|\vec{F}_{12}| = 9 \cdot 10^{-4} \text{ N}$$

c) $V_{(0,0)} = ?$ $V_{(0,0)} = V_1 + V_2 + V_3$

$$\begin{aligned} V_{(0,0)} &= k \frac{q_1}{r_1} + k \frac{q_2}{r_2} + k \frac{q_3}{r_3} = \\ &= 9 \cdot 10^9 \frac{1 \cdot 10^{-6}}{\sqrt{5}} + 9 \cdot 10^9 \frac{(-2 \cdot 10^{-6})}{\sqrt{13}} + 9 \cdot 10^9 \frac{3 \cdot 10^{-6}}{3} = \\ &= 4024,92 - 4992,3 + 9000 \end{aligned}$$

$$V_{(0,0)} = 8032,62 \text{ V}$$

d) $W_{\text{ext}} (q_4 = -4 \mu\text{C})$ desde el origen al ∞ :

$$W_{\text{ext}} = \Delta E_p = q \cdot \Delta V = q_4 \cdot (V_{\infty} - V_{(0,0)})$$

$$W_{\text{ext}} = -4 \cdot 10^{-6} (0 - 8032,62)$$

$$W = 0,032 \text{ J}$$

e) E_p (distribució) = $E_{p21} + E_{p31} + E_{p32}$

$$E_{p21} = k \frac{q_1 q_2}{r_{12}} = 9 \cdot 10^9 \frac{1 \cdot 10^{-6} \cdot (-2 \cdot 10^{-6})}{\sqrt{20}} = -4,02 \cdot 10^{-3} \text{ J}$$

$$E_{p31} = k \frac{q_3 q_1}{r_{31}} = 9 \cdot 10^9 \frac{3 \cdot 10^{-6} \cdot 1 \cdot 10^{-6}}{\sqrt{5^2 + 1^2}} = 5,3 \cdot 10^{-3} \text{ J}$$

$$E_{p32} = k \frac{q_3 q_2}{r_{32}} = 9 \cdot 10^9 \frac{3 \cdot 10^{-6} \cdot (-2 \cdot 10^{-6})}{\sqrt{3^2 + 1^2}} = -17,08 \cdot 10^{-3} \text{ J}$$

$$E_p = -0,0158 \text{ J}$$