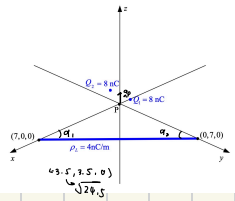
Exercise: A finite uniform linear charge $\rho_L = 4$ nC/m lies on the xy plane as shown in Figure 3.4, while point charges of 8 nC each are located at (0, 1, 1) and (0, -1, 1). Find **E** at (0, 0 ,0). Write a MATLAB program to verify your answer.



(3.5, 3.5, 0)

$\sqrt{24.5}$

$$\vec{E}_p = \frac{Q}{4\pi\varepsilon_0 |\vec{R}_{p1}|^3}\vec{R}_{p1}$$

$\vec{R}_{p1} = (0,0,0) - (0,1,1) = (0,-1,-1)$

$\hat{a}_{p1} = -a_y - a_z$

$$\vec{E}_1 = \frac{Q_1}{4\pi\varepsilon_0(\sqrt{2})^3}(0,-1,-1) \qquad |R_{p1}| = \sqrt{2}$$

$= -25.46\,a_y - 25.46\,a_z$

$\vec{R}_{p2} = (0,0,0) - (0,-1,1) = (0,1,-1)$

$\hat{a}_{p2} = a_y - a_z$

$$\vec{E}_2 = \frac{Q_2}{4\pi\varepsilon_0(\sqrt{2})^3}(0,1,-1) \qquad |R_{p2}| = \sqrt{2}$$

$= 25.46\,a_y - 25.46\,a_z$

line:

$$\vec{E}_p = \frac{\rho_L}{4\pi\varepsilon_0}\cdot\frac{1}{\rho}(\cos\alpha_2 - \cos\alpha_1)$$

$$= \frac{4\times10^{-9}}{4\pi\times\frac{10^{-9}}{36\pi}}\cdot\frac{1}{\sqrt{24.5}}\cdot\frac{2}{\sqrt{2}}\,a_\rho$$

$= -7.273\,a_x - 7.273\,a_y$

$\vec{R}_{cp} = (0,0,0) - (3.5, 3.5, 0)$

$= -3.5\,a_x - 3.5\,a_y$

$$\hat{a}_\rho = \frac{\vec{R}_{cp}}{|R_{cp}|} = \frac{1}{\sqrt{24.5}}\vec{R}_{cp} = \frac{(-3.5,-3.5,0)}{\sqrt{24.5}}$$

$\rho = \sqrt{24.5}$

$\vec{E}_T = \vec{E}_1 + \vec{E}_2 + \vec{E}_p$

$\vec{E}_T = -7.273\,a_x - 7.273\,a_y - 50.84\,a_z$