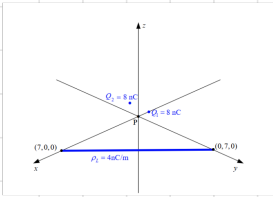


Matlab Analytical (Set 3)



$$\rho_L = 4 \text{ nC/m} \rightarrow \text{line charge density}$$

$$\rho_L = 4 \times 10^{-9} \text{ C/m}$$

$$\mathbf{E} = \mathbf{E}_1 + \mathbf{E}_2 + \mathbf{E}_L$$

$$\begin{aligned} \textcircled{1} \quad \mathbf{R}_1 &= (0a_x + 0a_y + 0a_z) - (0a_x + a_y + a_z) \\ &= -a_y - a_z \end{aligned}$$

$$\begin{aligned} \mathbf{E}_1 &= \frac{Q_1}{4\pi\epsilon_0 |\mathbf{R}_1|^3} \mathbf{R}_1 \\ &= \frac{8 \times 10^{-9}}{4\pi \times \frac{1}{36\pi} \times 10^{-9} \times (\sqrt{(-1)^2 + (-1)^2})^3} \times (-a_y - a_z) \\ &= 25.46 (-a_y - a_z) \end{aligned}$$

$$\mathbf{E}_1 = -25.46a_x - 25.46a_z$$

$$\begin{aligned} \textcircled{3} \quad d\mathbf{E}_L &= \frac{\rho_L da}{|\mathbf{R}|^2} \\ \rho &= \sqrt{3.5^2 + 2.5^2} = 4.3097 \\ a_p &= \frac{a_x}{r_1} - \frac{a_y}{r_2} \end{aligned}$$

$$\begin{aligned} \mathbf{E}_L &= \frac{\rho_L}{4\pi\epsilon_0} (\cos\alpha_1 - \cos\alpha_2) a_p \\ &= \frac{(4 \times 10^{-9})(9 \times 10^9)}{4.3097} (\cos 135^\circ - \cos 45^\circ) a_p \\ &= -7.27a_x + 7.27a_y \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad \mathbf{R}_2 &= (0a_x + 0a_y + 0a_z) - (0a_x - a_y + a_z) \\ \mathbf{R}_2 &= a_y - a_z \end{aligned}$$

$$\begin{aligned} \mathbf{E}_2 &= \frac{Q_2}{4\pi\epsilon_0 |\mathbf{R}_2|^3} \mathbf{R}_2 \\ &= \frac{8 \times 10^{-9}}{4\pi \times \frac{1}{36\pi} \times 10^{-9} \times (\sqrt{(1)^2 + (-1)^2})^3} \times (a_y - a_z) \\ \mathbf{E}_2 &= 25.46a_y - 25.46a_z \end{aligned}$$

$$\begin{aligned} \textcircled{4} \quad \mathbf{E} &= \mathbf{E}_1 + \mathbf{E}_2 + \mathbf{E}_L \\ \mathbf{E} &= -7.27a_x - 7.27a_y - 50.92a_z \end{aligned}$$

∴ \mathbf{E} at $(0,0,0)$ is $-7.27a_x - 7.27a_y - 50.92a_z$.