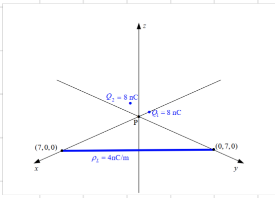
Matlab Analytical (Set 3)



$\rho_L = 4$ nC/m → line charge density

$\rho_L = 4\times10^{-9}$ C/m

$$E = E_1 + E_2 + E_L$$

① $R_1 = (0a_x + 0a_y + 0a_z) - (0a_x + a_y + a_z)$

$= -a_y - a_z$

$$E_1 = \frac{Q_1}{4\pi \varepsilon_0 |R_1|^3} R_1$$

$$= \frac{8\times10^{-9}}{4\pi \times \frac{1}{36\pi}\times10^{-9}\times\left(\sqrt{(-1)^2+(-1)^2}\right)^3} \times (-a_y - a_z)$$

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

$$E_1 = -25.46a_x - 25.46a_z$$

② $R_2 = (0a_x + 0a_y + 0a_z) - (0a_x - a_y + a_z)$

$R_2 = a_y - a_z$

$$E_2 = \frac{Q_2}{4\pi \varepsilon_0 |R_2|^3} R_2$$

$$= \frac{8\times10^{-9}}{4\pi \times \frac{1}{36\pi}\times10^{-9}\times\left(\sqrt{(1)^2+(1)^2}\right)^3} \times (a_y - a_z)$$

$$E_1 = 25.46a_y - 25.46a_z$$

③ $dE_L = \frac{k\,dQ}{|R|^2}$

$\rho = \sqrt{3.5^2 + 3.5^2} = 4.9497$

$a_\rho = \frac{-a_x}{\sqrt{2}} - \frac{a_y}{\sqrt{2}}$

$$E_L = \frac{\rho_L}{4\pi\varepsilon_\rho}(\cos\alpha_1 - \cos\alpha_2)\,a_\rho$$

$$= \frac{(4\times10^{-9})(9\times10^{9})}{4.94974}(\cos 135 - \cos 45)\,a_\rho$$

$$= -7.27a_x + 7.27a_y$$

④ $E = E_1 + E_2 + E_L$

$E = -7.27a_x - 7.27a_y - 50.92a_z$

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