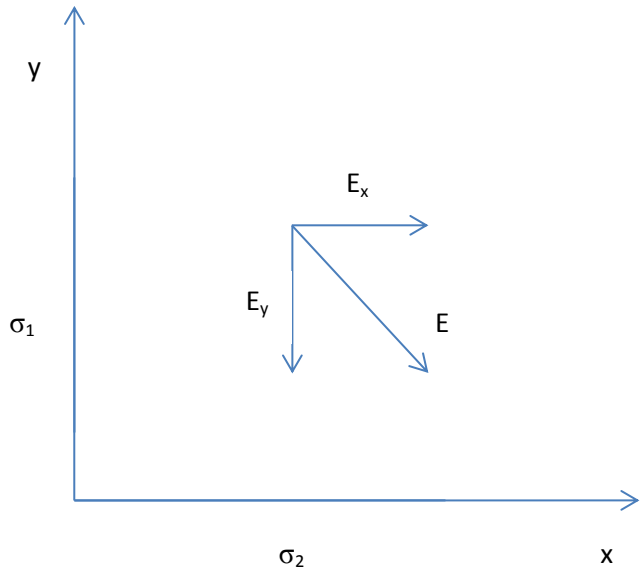
Two infinite, uniformly charged, flat surfaces are mutually perpendicular. One of the sheets has a charge density of + 20.0 pC/m2, and the other carries a charge density of -50.0 pC/m2. What is the magnitude of the electric field at any point not on either surface?

Solution



We have the configuration of problem's system shows in picture, where σ_1=+ 20.0 pC/m2, σ_2=- 50.0 pC/m2.

At point not on either surface with coordinates (x,y) the surfaces with a charge density σ_1 creates the electric field $\mathrm{E_x} = \frac{\sigma_1}{x}$, the surfaces with a charge density σ_2 creates the electric field $\mathrm{E_y} = \frac{\sigma_1}{y}$.

The electric field at point (x,y) is

$$\vec{\mathrm{E}} = \vec{\mathrm{E}}_\mathrm{y} + \vec{\mathrm{E}}_\mathrm{x} = \frac{\sigma_1}{y}\vec{e}_y + \frac{\sigma_2}{x}\vec{e}_x$$

Where $\vec{e}_y, \vec{e}_x$ are basis vectors of coordinate system.

From hence

$$\mathrm{E} = \sqrt{\mathrm{E}^2{}_\mathrm{y} + \mathrm{E}^2{}_\mathrm{x}} = \sqrt{\left(\frac{\sigma_1}{y}\right)^2 + \left(\frac{\sigma_{2^2}}{x}\right)^2}$$

Answer

$$\mathrm{E} = \sqrt{\mathrm{E}^2{}_\mathrm{y} + \mathrm{E}^2{}_\mathrm{x}} = \sqrt{\left(\frac{\sigma_1}{y}\right)^2 + \left(\frac{\sigma_{2^2}}{x}\right)^2}$$

$$\vec{\mathrm{E}} = \vec{\mathrm{E}}_{\mathrm{y}} + \vec{\mathrm{E}}_{\mathrm{x}} = \frac{\sigma_1}{y}\vec{e}_y + \frac{\sigma_2}{x}\vec{e}_x ,$$

Where σ_1=+ 20.0 pC/m2, σ_2=-50.0 pC/m2.