Sheet 6

1 A 2 mC positive charge is located in vacuum at $P_1(3,-2,-4)$ and a $5\mu C$ negative charge is at $P_2(1,-4,2)$:

a) Find the vector force on the negative charge.

b) What is the magnitude of the force on the charge at P_1?

$$\left[\begin{array}{c}\bar{F}_{12} = 0.616\,\bar{a}_x + 0.616\,\bar{a}_y - 1.848\,\bar{a}_z \\ |\bar{F}| = 2.04\ N\end{array}\right]$$

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2 Find the force on a $100\ \mu C$ charge at $(0,0,3)m$ if four like charges of $20\mu C$ are located on the x and y axes at $\pm 4m$.

$$[\bar{F}_T = 1.73\ \bar{a}_z]$$

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3 Find $\bar{E}$ at $P(1,1,1)$ caused by four identical $3nC$ point charges located at $P_1(1,1,0)$, $P_2(-1,1,0)$, $P_3(-1,-1,0)$, $P_4(1,-1,0)$

$$\left[\bar{E} = 6.82\,\bar{a}_x + 6.82\,\bar{a}_y + 23.8\,\bar{a}_z\right]$$

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4 Charge is distributed uniformly along an infinite straight line with constant densityρ_l . Develop the expression of electric field intensity $\bar{E}$ at general point P.

$$\left[\bar{E} = \frac{\rho_l}{2\pi\epsilon\, r}\,\bar{a}_r\right]$$

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5 Develop an expression for $\bar{E}$ due to charge uniformly distributed over an infinite plane with densityρ_s.

$$\left[\bar{E} = \frac{\rho_S}{2\epsilon}\,\bar{a}_n\right]$$

6 A plane $y = 3$m contains a uniform charge distribution of a density $\rho_s = \left(\frac{10^{-8}}{6\pi}\right)$ C/m^2

Determine $\bar{E}$ at all points

$$\left[\bar{\boldsymbol{E}} = \begin{cases} \mathbf{30}\,\bar{\boldsymbol{a}}_{\boldsymbol{y}} & \boldsymbol{y > 3} \\ -\mathbf{30}\,\bar{\boldsymbol{a}}_{\boldsymbol{y}} & \boldsymbol{y < 3} \end{cases}\right]$$

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7 Determine $\bar{E}$ at $(x, -1, 0)$ m due to a uniform sheet charge with $\rho_s = \left(\frac{1}{3\pi}\right)$ nC/m^2

is located at $z = 5$ m and a uniform line charge with $\rho_l = \left(\frac{-25}{9}\right)$ nC/m $at\ z = -3, y = 3\ m.$

$$\left[\bar{\boldsymbol{E}} = -\mathbf{8}\bar{\boldsymbol{a}}_{\boldsymbol{y}} - \mathbf{12}\bar{\boldsymbol{a}}_{\boldsymbol{z}}\right]$$

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8 Find the Cartesian components of the electric field due to finite line charge $\rho_l = 15$ μC/m along x-axis from $x = 2$ to 4 m at point $P\ (0,3,0)\ m.$

$$\left[\bar{\boldsymbol{E}} = \mathbf{45} \times \mathbf{10^3}\left(-\mathbf{0.232}\bar{\boldsymbol{a}}_{\boldsymbol{x}} + \mathbf{0.2453}\ \bar{\boldsymbol{a}}_{\boldsymbol{y}}\right)\right]$$