4.3 \( Q_1 \) and \( Q_2 \) are point charges located at \((0, -4, 3)\) and \((0, 1, 1)\). If \( Q_1 \) is 2 nC, find \( Q_2 \) such that

(a) The force on a test charge at \((0, -3, 4)\) has no z-component.

(b) The E at \((0, -3, 4)\) has no y-component.

4.4 Charges \(+Q\) and \(+3Q\) are separated by a distance 2 m. A third charge is located such that the electrostatic system is in equilibrium. Find the location and the value of the third charge in terms of \( Q \).

4.5 Determine the total charge

(a) On line \( 0 < x < 5 \text{ m} \) if \( \rho_L = 12x^2 \text{ mC/m} \)

(b) On the cylinder \( \rho = 3, 0 < z < 4 \text{ m} \) if \( \rho_S = \rho z^2 \text{ nC/m}^2 \)

(c) Within the sphere \( r = 4 \text{ m} \) if \( \rho_v = \frac{10}{r \sin \theta} \text{ C/m}^3 \)

4.7 A ring placed along \( y^2 + z^2 = 9, x = 0 \) carries a uniform charge of 5 nC/m.

(a) Find E at \( P(4, 0, 0) \).

(b) If two identical point charges \( Q \) are placed at \((0, -4, 0)\) and \((0, 4, 0)\) in addition to the ring, find the value of \( Q \) such that E = 0 at \( P \).

4.9 Find E at \((0, 0, 4)\) due to a charge of 2 nC distributed uniformly on

(a) The line \( 0 \leq x \leq 3 \)

(b) The arc \( \rho = 3, \pi/4 \leq \phi \leq \pi/2, z = 0 \)

4.11 A point charge 100 pC is located at \((4, 1, -3)\) while the x-axis carries charge 2 nC/m. If the plane \( z = 3 \) also carries charge 5 nC/m², find E at \((1, 1, 1)\).

4.15 A line charge with uniform charge \( \rho_L \text{ C/m} \) lies along the x-axis. The electric flux density at \((-3, 6, 8)\) is 3 nC/m².

(a) Find \( \rho_L \).

(b) Determine D at \((0, 0, 4)\).

4.21 Point charges 5 \( \mu \text{C}, -3 \mu \text{C}, 2 \mu \text{C}, \) and 10 \( \mu \text{C} \) are located at \((-12, 0, 5), (0, 3, -4), (2, -6, 3), \) and \((3, 0, 0)\) respectively. Calculate the flux through the spherical surfaces at

(a) \( r = 1 \)

(b) \( r = 10 \)

(c) \( r = 15 \)
4.25 If the electric flux density is \( \mathbf{D} = \frac{10}{r} \mathbf{a}_r \) nC/m², find the total charge within \( 0 \leq r \leq 2 \) m.

4.26 Find the work done in carrying a 5-C charge from \( P(1, 2, -4) \) to \( R(3, -5, 6) \) in an electric field

\[
\mathbf{E} = \mathbf{a}_x + z^2 \mathbf{a}_y + 2yz \mathbf{a}_z \text{ V/m}
\]

4.29 Two point charges \( Q_1 = 3 \) nC and \( Q_2 = -2 \) nC are placed at \( (0, 0, 0) \) and \( (0, 0, -1) \) respectively. Assuming zero potential at infinity, find the potential at

(a) \( (0, 1, 0) \)

(b) \( (1, 1, 1) \)

4.39 A spherical charge distribution is given by

\[
\rho_v = \begin{cases} 
\rho_0 \left(1 - \frac{r^2}{a^2}\right), & r \leq a \\
0, & r > a 
\end{cases}
\]

(a) Find \( \mathbf{E} \) and \( V \) for \( r \geq a \).

(b) Find \( \mathbf{E} \) and \( V \) for \( r \leq a \).

(c) Show that the maximum value of \( \mathbf{E} \) is at \( r = 0.745a \).

(d) Find where \( V \) is maximum and calculate that maximum value.

4.44 A point charge \( Q \) is placed at the origin. Calculate the energy stored in region \( r > a \).