Exercises

1.

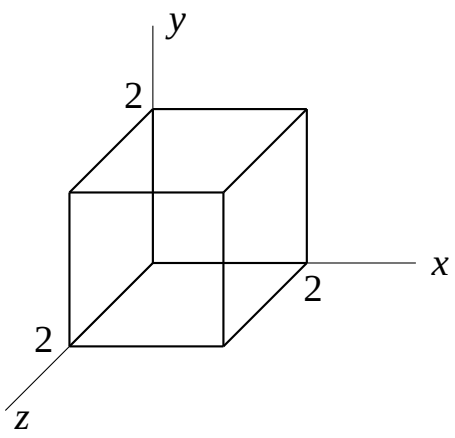
(a) Find the force acting on a small charge q at a distance x along the axis of a circular charged wire ring, of charge density λ_L Cm^{-1} and radius r.

(b) If the distance x is sufficiently large, show that the ring acts as a point charge.

(c) If the ring is extended to a solid disc of radius R and charge density ρ_A Cm^{-2}, determine the new force acting.

2.

The figure shows a cubic volume, with sides of 2 m length.



Find the charge enclosed within the volume if the flux density **D** is:

$$\mathbf{D} = 2x^2\hat{\mathbf{x}} \quad \text{Cm}^{-2}$$

3.

Find the electric flux density **D**, and the electric field intensity **E** (assuming the medium is air), at a distance *r* from:

(a) A point charge *q*.

(b) A line charge of infinite length, with charge density λ_L Cm^{-1} (such as the inner conductor of a coaxial cable).

(c) The axis of an infinitely long, hollow, cylindrical shell of radius *R* and uniform charge density λ_A Cm^{-2}. (Try both $r < R$ and $r > R$).

(d) A uniform large plane surface charge of *q* Coulombs over the two faces of an area *A* of conductor.

(e) Above the same conductor plate as (d) when a second plate is also positioned above it at a height $h > r$.

4.

A static electric charge is distributed in the form of a uniform spherical cloud of radius *a*. Find the electric field intensity at all points. Compare the results with that for a point charge field and explain similarities and differences.

5.

A positive charge *q* is distributed uniformly over a hollow spherical shell of radius *a*. A second shell of surface density ρ_A Cm^{-2} surrounds it at radius $b > a$.

(a) Find the value of ρ_A that produces zero **E** field at points $r > b$.

(b) What is **E** at points $r < b$ with this value of ρ_A?

6.

A spherical charge distribution is given by:

$$K = \begin{cases} K_0\left(1-\dfrac{r^2}{a^2}\right) & r < a \\ 0 & r > a \end{cases} \quad \text{Cm}^{-3}$$

where K_0 and a are constants.

(a) Sketch the distribution, and a few representative field lines.

(b) Determine the total charge.

(c) Determine the electric field **E** at all points. (Justify each step in your calculations).