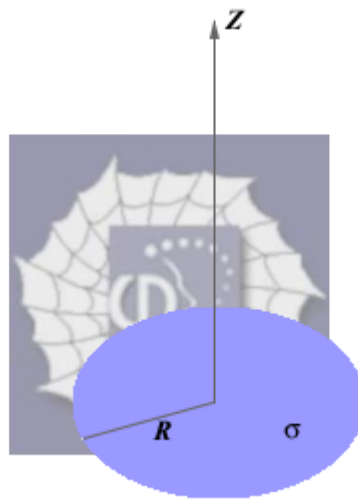


296.

Problem 28.25 (RHK)

We have to find the distance along the charged disk of radius R where the electric field strength is equal to one-half of the value of the field at the surface of the disk at the centre.



Solution:

We recall that the electric field strength at a distance z along the axis from the centre of a charged disk of radius R and surface charge density σ is given by the expression

$$E_z = \frac{\sigma}{2\epsilon_0} \left(1 - \frac{z}{\sqrt{z^2 + R^2}} \right).$$

From this we note that the electric field strength at the centre of the disk is

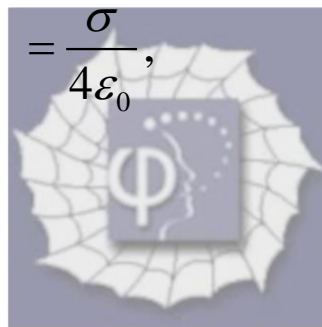
$$E_0 = \frac{\sigma}{2\epsilon_0}.$$

Therefore, the distance z along the axis where the strength of the electric field will be one-half of its value at the centre will be given by the equation

$$\frac{\sigma}{2\epsilon_0} \left(1 - \frac{z}{\sqrt{z^2 + R^2}} \right) = \frac{1}{2} E_0$$

or

$$\frac{z}{\sqrt{z^2 + R^2}} = \frac{1}{2}.$$



We therefore have the condition that

$$3z^2 = R^2,$$

or

$$z = \frac{1}{\sqrt{3}} R.$$