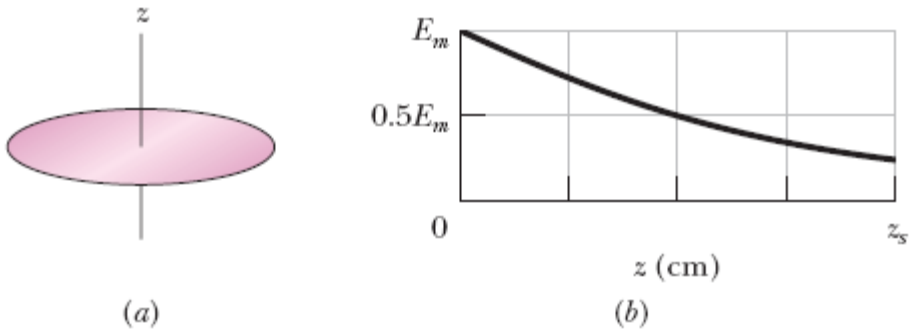
Answer on Question #64911-Physics-Other

Figure (a) shows a circular disk that is uniformly charged. The central z axis is perpendicular to the disk face, with the origin at the disk. Figure (b) gives the magnitude of the electric field along that axis in terms of the maximum magnitude Em at the disk surface. The z axis scale is set by zs = 12.0 cm.

What is the radius of the disk?

Solution



The electric field along z axis is

$$E(z) = \frac{\sigma}{2\varepsilon_0}\left(1 - \frac{z}{\sqrt{z^2 + R^2}}\right).$$

So,

$$E(z) = E_m\left(1 - \frac{z}{\sqrt{z^2 + R^2}}\right).$$

We have

$$E\left(\frac{z_s}{2} = 6\ cm\right) = 0.5E_m = E_m\left(1 - \frac{\frac{z_s}{2}}{\sqrt{\left(\frac{z_s}{2}\right)^2 + R^2}}\right)$$

$$1 - \frac{6}{\sqrt{6^2 + R^2}} = 0.5$$

$$\frac{6}{\sqrt{6^2 + R^2}} = 0.5$$

$$\sqrt{6^2 + R^2} = 12$$

$$36 + R^2 = 144$$

$$R = \sqrt{144 - 36} = 10.4\ cm.$$

Answer: 10.4 cm.